Issues in Third World Development

edited by
Kenneth C. Nobe
and Rajan K. Sampath

Westview Special Studies in Social, Political, and Economic Development

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Eminent economists and development experts focus on a number of concerns that are currently the major preoccupation of development economists, policymakers, and practitioners. The issues addressed in this collection center on strategies to eradicate poverty, reduce inequality, and deal effectively with problems of management and the utilization of land and water resources. The contributors analyze the issues in the context of past experience, the present international setting, and possible alternative strategies for the future, and consider, as well, theoretical and methodological concerns.

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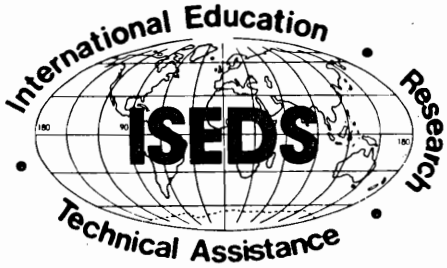

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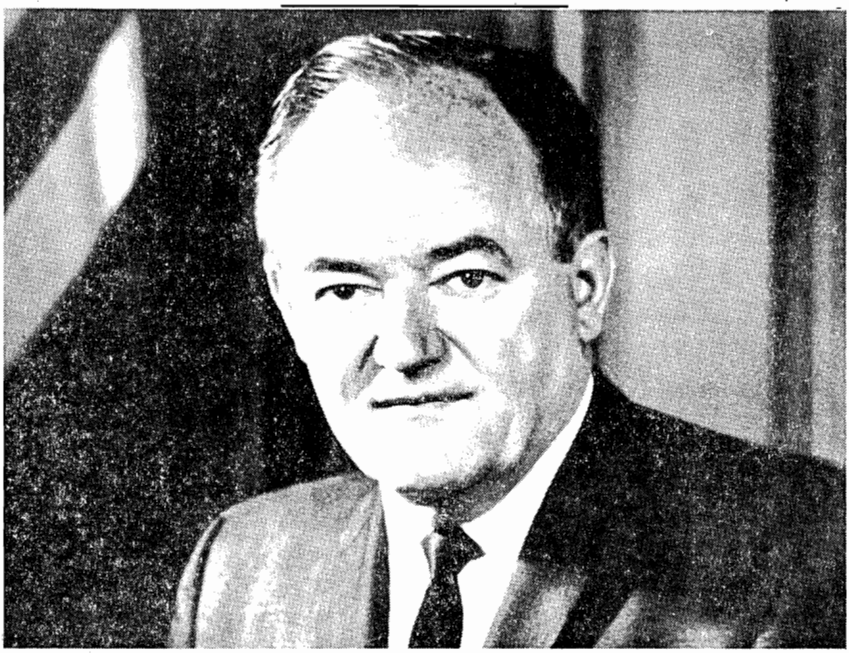
To Hubert H. Humphrey



"There can be no peace in a world plagued by poverty, hunger, disease and illiteracy...We have the chance—we have the obligation—to create the New World our forefathers talked of and sought...[A] world not new in its principalities and kingdoms, but a world new in this final achievable reality: that each child...might enter human society with the right to health, with the right to education, with the right to hope, the right to free expression and the right to human opportunity, because we of this generation willed that it be so."

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Introduction

This book is a collection of 21 papers presented by eminent economists and development experts in an invited seminar series, "Issues in International Development," organized by the International School for Economic Development Studies at Colorado State University during the academic year 1982/1983. These essays focus on a number of leading issues and concerns that are currently the major preoccupation of development economists, policy makers and practitioners. Issues addressed in these essays are centered on methodology and strategies to eradicate poverty, to reduce income inequality and for dealing with problems of management and utilization of agricultural and water resources in the developing countries. These essays are presented in the context of the authors' past experience and selected development problems are analyzed in the light of the present international setting and future prospects for dealing with them.

The International School for Economic Development Studies (ISEDS), which sponsored the seminar series in which the papers printed in this volume were presented, is housed in the Department of Agricultural and Natural Resource Economics but is administratively responsible to the Office of International Programs at Colorado State Univeristy. It was established in 1981 with initial financial support provided by the university's USAID-funded Title XII Program. ISEDS' personnel engage in educational, research and technical assistance activities in areas relating to economic and agricultural development in developing nations, with primary emphasis on policy analysis, development strategies, and program management aspects.

The educational programs of this school are basically designed to serve nondegree professional training needs of a variety of lesser developed countries. Therefore, its student body consists largely of middle- and upper-management level government officials such as agricultural and irrigation engineers, agricultural scientists and economists who serve as administrators, project managers and other government agency scientists directly responsible for designing, implementing, monitoring and evaluating developmental programs. These ISEDS participants are sponsored by a variety of agencies such as Hubert H. Humphrey Fellowship Program, the U.S. Agency for International Development, the Ford Foundation, the

Institute of International Education, AMID-EAST, internationally oriented consulting firms and developing country government agencies. The educational objectives of these participants range from obtaining specialized training in new techniques and skills for program evaluation and management on the one hand to upgrading their basic professional knowledge and techniques within their various discipline specialities on the other extreme. Programs of study are individually designed for each participant but the seminar series was used as an integrating mechanism for the student body and its faculty advisors.

Under the auspices of the International School and with financial support from Title XII, USAID and the Hubert H. Humphrey Fellowship Program we organized a special seminar series on "Issues on International Development". This collection of essays that were presented in the seminar series are categorized into four parts: namely, part one deals with the methodological aspects, part two outlines some new agriculture and rural development strategies, part three focuses on land and water resources management, and part four sets forth a number of selected global issues.

In part one, the methodological aspects, are five papers. In his paper, "Macroeconomic Policy in the Third World —A Structuralist Perspective," Lance Taylor reviews the major conclusions of the new structuralist economists. He argues that short term stabilization tools of the type routinely applied by administrators of the International Monetary Fund and other orthodox practitioners can easily have undesirable effects in poor countries, because there are important structural features of these economies that their models do not address. He initially outlines the essential features of the standard approach and then points out its weaknesses and possible remedies that could be adopted. Finally, he suggests lines along which structuralist analysis can be strengthened to make it truly useful as a basis for policy formation.

Alain de-Janvry in his paper on "Growth and Equity: A Strategy for Reconciliation" argues that the key structural feature that determines the equity impact of growth is the geographical and social location of the market for the final consumption goods produced by the key sectors of developing economies. The key growth sectors, according to him are those privileged by investment in that they have the highest sectoral gross rates of capital formation. When the market for final consumption goods produced by these sectors is located either abroad or in consumption expenditures that originate in profits and rents, "social disarticulation" prevails and growth leads to more inequality. By contrast, he argues, when it is located in consumption expenditures originating in wages and peasant/informal sector incomes (implicit wages), "social articulation" exists and growth tends to be more equitable. In this context, he evaluates the key difference between classical and neoclassical models in terms of the structural specifications of social disarticulation and articulation and concludes that neither model has much to offer for improving development strategies. He feels that the first model is an apology for disarticulated accumulation and that the second assumes the answer to the problem by postulating that the structural conditions of social articulation already hold.

Jerry Eckert, in his paper, "Income Distribution and Development: A Critique of Current Methodology," provides a historical review of the evolution of incorporating distributional concerns into the theory and practice of development. He then looks at the range of distribution theories that are available currently and examines a selection of models which attempt to capture certain distribution concepts to operationalize them as planning tools. In conclusion he suggests some needed further modifications in economic development models so as to more effectively address income distribution issues.

Willis Shaner authored a paper on "Farming Systems Research: An Applied Agricultural Research Methodology for Farmers With Limited Resources in the LDCs". He begins his paper with some ideas as to why agricultural experiment station based research in developing countries is not effective in motivating small farmers. He follows with a description of the farming systems approach and why he thinks it is a more desirable approach to agricultural research and its dissemination among farmers. Some of the earlier farming system research activities as applied in several developing countries are reviewed. He then presents some unresolved issues in the farming systems approach and a few thoughts on the future of farming systems research in the developing countries.

Robert Basmann and his associates in their paper, "Some New Methods of Predicting Changes in Economic Inequality Associated with Trends in Growth and Development", describe some recently developed methods of measuring comprehensive economic inequality. They relate intertemporal changes in economic inequality to basic trends and potential determinants of economic growth and development, to growth in levels in per capita income and expenditure, and to inflationary and deflationary movements of commodity prices, wage rates and to other selected economic variables. Their paper described a quantitative model that is designed for analysis and prediction of directions and rates of intertemporal change in inequality in the personal joint distribution of household expenditures on commodities and on securities, tax payments, and the separate components of household income and wealth. The authors emphasize dependence of the GINI measure of inequality on prices, total expenditure and selected economic development trend variables. Finally, they demonstrated the use of their multivariate personal distribution model to assess the importance of cultural differences in accounting for contemporaneous differences of economic inequality between countries at either different or same levels of economic development.

Part two of this book includes papers concerned with agricultural and rural development strategies. It begins with Robert Evenson's paper, "Economics of Agricultural Growth: The Case of Northern India". In this paper, he reexamines Indian agricultural production and supply data and attempts to interpret its growth performance in an economic as opposed to an agronomic framework. The paper presents an analysis of the foundation of economic growth based on the Indian experience. He analyzes the "determinants of the determinants" of growth at least in a partial sense. Finally, Professor Evenson discusses the effects of alternative growth investment, not just on the supply of agricultural products, but on

their prices as well.

Earl O. Heady in his paper on "Agricultural Development Planning: The Thailand Case" describes the Iowa State University experience in building anlaytical planning models for the Division of Agricultural Economics staff in Thailand's Ministry of Agriculture. He demonstrates how effective application of these models has helped to elevate the Division from providing merely a statistical analysis function to serving as the central policy analysis cell of the Ministry.

Ronald Tinnermeier in his paper on "Agricultural Finance and Rural Development" reviews some major policy issues and experiences relating to rural financial markets and agricultural credit in developing countries and proposes some needed changes in agricultural credit policies. He suggests needed changes in: 1) the organizational framework within which credit programs operate; 2) in the institutional form or mechanisms for mobilizing savings and delivering credit to the end user; and 3) in the operational procedures so as to reduce high operating costs.

Michael Haviland in his paper on "Midcareer Training: A Development Investment--Is It Worth the Cost?" evaluates the role of human capital in development, using the ongoing Humphrey international level midcareer training program which he directs as a case study. His paper describes the origins of the Humphrey Program, outlines its objectives, the way it is being implemented and the early program results.

Uma Lele in her paper on "Problems of Rural Development: Some Contrasts Between Asia and Africa" draws some lessons from the comparative rural development experiences of new nations in Asia and Africa during their postindependence periods. She argues that unlike Asia, landlessness per se is far less an explanation of rural poverty in Africa. Rather, she feels, the problem to date lies with the inability of the new governments in Africa to use available resources effectively to bring about increases in agricultural production and, particularly, productivity in the small land holder sector.

Bruce Johnston in his paper on "The Design of Rural Development: A Policy Perspective" emphasizes the importance of adopting a long term strategic perspective. He argues that rural development is inherently a time consuming process, broadly based and sustainable progress will be measured in decades, not years. Furthermore, he argues, development is essentially a learning process: the growth of organizational competence and of personal knowledge and skills are just as essential as capital formation in the conventional sense. Based on his past experiences, and a detailed study of alternative patterns of agricultural development comparing Japan, Taiwan and the United States, he outlines a three pronged strategy for rural development. The first prong relates to the need for a broadly based employment oriented pattern of agricultural development. The second prong is related to the need to strengthen a very limited set of social services. The third prong concerns organization programs designed to strengthen the institutional infrastructure and managerial skills needed for rural development.

Part three of this book deals with land and water resources

management. The lead paper by David Seckler and Kenneth Nobe on "The Management Factor in Developing Economies" sets forth the proposition that management is the most important factor in economic development. In this paper the authors argue that differences in the economic performance of people from different cultures is determined by the kinds of organizations in which they work, rather than by culturally determined traits of their personalities. Three types of governmental organizations — patronistic, administrative and managerial -- are compared vis-a-vis their impact on economic development efforts. Their second proposition is that organizations persist or change as a transitive act of individual choice and will, not as a result of an intransitive system. Thirdly, they argue that the issues raised by the first two propositions must be settled before a viable theory of economic development can be adapted and implemented. According to the authors, sophisticated management systems are especially necessary to operate the large scale, integrated processes of a modern economy which lesser developed countries are trying to implement. They maintain that reorganization of government agencies to facilitate a "management by results" approach, rather than administering programs that merely monitor inputs, will be necessary before sustainable long term economic growth is possible in developing countries. It is the failure to master these new management systems, which are an adaptation of Peter Drucker's principle of "management by objectives" that is the principle cause of the low economic performance of most developing nations since World War II. They argue further that unless this process of organizational and managerial reform is implemented in the developing countries as a prior condition, very little can be expected from simple capital resource and technology transfers from the developed to the underdeveloped nations.

Daniel Bromley in his paper, "Land and Water Resources: A New Perspective on Economic Development", argues that historically economic development programs have paid too little attention to natural resources and the critical role they play in economic processes in the developing countries. He lays stress on the crucial institutional and technical components of the local economy -- especially as institutions and technique influence control over — and access to — natural resources. He introduces some important concepts such as growth and development and the difference between them. He also discusses institutions and techniques -- the two aspects of a social system that give meaning to the term: "resource". The author concludes that economic development activities concerned with natural resources are misguided in two general aspects. First we tend to deal with technical innovation — new technique -- to solve institutional problems. Second, when institutional change is employed, it is often for the wrong reasons directed towards the wrong problem and carried out at the wrong level, due to incorrect definition of the problem. He argues for institutional reformation rather than for investment in huge physical capital stocks as the correct approach for solving both the problem of efficiency in the use of resources as well as achieving acceptable rates of growth in output.

Everett Richardson in his paper on "Water Use Management and

Development" argues for the need for improvement in water use management in developing countries to improve agricultural production. Drawing on the long-term Colorado State University experience with on-farm water management projects in Pakistan and Egypt, he outlines a strategy for improving irrigation water use efficiency in other developing countries that have a heavy dependence on irrigation in their agricultural sectors.

Max Lowdermilk and Mark Svendsen in their paper, "Improved Irrigation Water Management: A Major Agricultural Development Emphasis" outline the magnitude of the challenge facing irrigated agriculture in the developing world, describing some of the problems confronting irrigation development and suggesting some key criteria and concepts for planning and implementing public irrigation water management programs. Their focus is on a systems approach in which major concern is given to the farm level of the irrigation system which requires an interdisciplinary team approach to problem solving. Lastly, they plead for longer-term commitments from donor agencies and abandonment of their "project-by-project" approach to development.

Peter Rogers in his paper on "Irrigation and Economic Development: Some Lessons from India" sets forth some of the evidence obtainable from India with regard to its interdependence between irrigaton and economic development. His paper reviews the history of irrigation development in India including the planned development during each of the five year planning periods since India's independence. Based on this analysis, the author concludes that despite India's massive investments in irrigation works, the variance of production in food grains production is increasing over time. Thus, contrary to the conventional view, he argues that there is some ambiguity about the importance of irrigation in the post independence era as a major determinant of national agricultural production in India, but notes also that large increases in irrigation efficiency are both possible and necessary in the future.

Part four deals with global issues. The first paper, "The Global Food Situation and the Choice of Development Strategy", is by John Mellor who argues that, given the likelihood of vast population numbers moving into the high growth, medium income stage in many developing countries in the near future, increased food production represents an important, although insufficient, condition for continued economic growth and poverty alleviation throughout the developing world. Therefore, widespread dissemination of technological change elements in agriculture will be needed. He argues that the more mature economies of the world have a critical role to play in the success of such an agriculture-led strategy of economic growth in the developing world. He notes that the developed countries possess the funds and the technical expertise to assist developing countries in undertaking the types of infrastructural improvements needed to increase agricultural production and outlines some approaches for implementing the required transfer of capital and technology.

Vernon Ruttan in his paper on "Reforming the Global Agricultural Research Support System" deals with the structure of international donor assistance for agricultural development. He first

describes the changing structure of international support for agricultural development. He then goes on to discuss some of the specific problems associated with these efforts, with a particular focus on financial and technical assistance for strengthening national agricultural research capacity within targeted developing countries. Finally, he suggests some of the reforms needed in the support for agricultural research. He feels the needed reforms are so substantial that, until they are made, increases in the transfer of resources to poor countries as advocated in the reports such as the Brent Commission and the Presidential Commission on World Hunger would be largely counterproductive. According to him, development of national agricultural research capacity is one of the most effective ways to remove the most serious constraints on the ability of poor countries to meet their basic needs and to sustain other related agricultural and general development activities. As to strategy for reform, he advocates greater support for agriculture -- and he argues that the present project system should be largely replaced by a "formula funding" or "revenue sharing" approach. Under the "formula" approach, he advocates that the size of donor contribution be tied to the level of domestic support, on a nation by nation basis.

Edward Schuh in his paper on "Towards Reform of our International Monetary and Trade Institutions" focuses his attention on the growing importance of international economic relationships and on the growing deficiencies of international economic and policy institutions. He addresses these issues from the perspective of agricultural trade though the principles and issues involved are in general much broader than agriculture. The main argument presented in his paper is that solution to many of the problems in today's world will not be found in domestic policies or in what we do with the domestic institutions. Instead, solutions will be found only in the reform of our international institutions, and in some cases in the creation of new international institutions. He briefly reviews some of the important changes in the structure of the international economic system during the past 20 years and then discusses the recent breakdown and growing irrelevance of these international institutions. Finally, he provides some suggestions for changes needed.

Philip Raup in his paper on "Some Domestic Consequences of the Expanded Role of the United States in Meeting World Food Needs" discusses some of the economic consequences of U.S. involvement in world trade in food grains. He discusses these impacts in terms of increases in U.S. farm land values and their geographical distribution across the United States, higher rates of interest for both short and long-term capital, rapid relocation of major grain usage and the consequent migration of cattle feeding to the Southern Plains. He points out the risk and uncertainty associated with these changes in the U.S. because of the climatic variability in the grain producing belt in Europe and the Soviet Union.

Theodore Schultz in his paper on "A Critique of the Economics of U.S. Foreign Aid" provides a critical account of the U.S. foreign aid policy since World War II. He argues that in providing U.S. foreign aid, insufficient attention has been given to the importance of health, education and the entrepreneurial ability in

developing countries and to the critical role of women in most of their agricultural sectors. He maintains that not enough critical study has been done of the impact of foreign aid activities on the developing countries. Nor have the results of limited serious study significantly impacted U.S. foreign aid policy, with U.S. investment in the International Agricultural Research Centers as a notable exception. He advocates that any donor aid that is based on anti-market biases results in inefficient use of resources. He argues that a strong and persistent anti-market bias conceals the choice between trade and aid. For most low income countries, the opportunities to trade are much more important than foreign aid. He feels that the economic efficiency of foreign aid as a source of subsidized capital for the purpose of building structures, equipment and inventories is, in general, unduly wasteful. Rather, he advocates allocating more funds for institution building and human capital formation. He laments that foreign aid has for too long served the recipients' governments national political and social objectives and in so doing has in large measure failed to reach their farm populations. In his view, an "Old Boys Club" collusion among the international donor fraternity has been perpetuating this undesirable situation. Finally, he advocates a shift in emphasis to dealing more effectively with income and quality of life problems of the farm sector in the developing countries.

In concluding our brief introduction to this book on Issues in Third World Development, we would note that prospective readers will not find it to be a comprehensive treatment of this important topic. What may be lost in comprehensiveness, however, we hope will have been largely offset by gaining early access to what these selected authors consider to be, from their perspectives, some of the crucial issues facing practitioners and policy makers attempting to achieve sustainable economic development processes in the lesser developed countries at the present time. Few readers would likely benefit from reading all of the papers presented; but, hopefully, all would find some of them particularly useful. Certainly, we found this to be the case among the participants of the ISEDS seminar series on "Issues in International Development", in which these papers were originally presented and discussed.

We would like to take this opportunity to thank the Hubert H. Humphrey Fellowship Program and CSU's USAID-funded Title XII Program for the financial support they extended to us in conducting this seminar series. We also want to thank our colleagues and ISEDS faculty advisors and staff, who are too many to mention by name, for all the enthusiastic support they gave in this effort. We are very grateful to Terry C. Kelly and Vaughn L. Brown for their timely help in proofreading and editing this manuscript. Finally, we especially would like to thank Kathy Fiddler but for whose hard work, perseverance and dedication, this work could not have been completed in time.

Kenneth C. Nobe and Rajan K. Sampath
The Editors

Part 1

Methodological Aspects

1
Macroeconomic Policy in the Third World—A Structuralist Perspective

Lance Taylor

Macro issues have been curiously neglected by academic development economists — long-run theories have swamped the practical Finance Minister's question of how to get from one day's crisis to the next. In recent years, there have been attempts to fill this gap from various angles, ranging from the free-market fundamentalism preached and partially practiced by the "Chicago Boys" in Latin America to quite radical approaches. In particular, there has been substantial effort devoted to "structuralist" theory, with the name harking back to a school that flourished around the Economic Commission for Latin America in the 1950s and 1960s.[1] This paper reviews the major conclusions of the new structuralist economists.[2]

The starting point is the observation that short-run stabilization tools of the type routinely applied by the International Monetary Fund (IMF) and other orthodox practitioners can easily have undesirable effects in poor countries, because there are important structural features of their economies that the usual models leave out. To see why, one must first set out the standard approach, as in section 1 here. Sections 2 through 8 point out its weaknesses, and possible remedies. Section 9 summarizes, and suggests lines along which structuralist analysis must be strengthened, if it is to be truly useful as a basis for policy formation.

1. Orthodox Stabilization Ploys

Imagine a country facing balance of payments difficulties, accelerating inflation, and blatant mismanagement in key sectors of the economy. The latter problems may include huge purchases of military equipment by the generals and admirals who happen to be running the political show, insatiable greed and speculative binges on the part of their military and civilian counterparts in charge of the public enterprises, or the destabilizing impact of rapidly growing demands for money wage increases on the part of workers pushing for immediate and massive income redistribution. Compound all this with sudden reluctance on the part of foreign commerical bankers to increase their lending and possible political pressures from the superpowers. What is the economic policy team supposed to do?

In most capitalist or mixed economies (and increasingly even

in socialist ones) there is a standard set of remedies that tends to be applied, often through the intermediation of the International Monetary Fund. One can distinguish at least seven distinct policies that go into orthodox packages. The first three in the following list are almost always recommended, and the other four show up frequently as well:

1. Monetary contraction, usually via the imposition of separate ceilings on credit from the banking system to the private sector and the central government.
2. Devaluation, either explicit or in disguised fashion through cuts in quotas, higher prior deposits for imports and subsidies for exports and general tightening of trade restrictions. In-country economists may prefer the latter package of indirect measures, while the IMF typically presses for a devaluation upfront.
3. Abolition or reduction of government intervention in the price system, e.g. consumer food subsidies.
4. Internal financial reform and liberalization, in particular attempts to raise interest rates.
5. External liberalization in the form of reduction of barriers to trade and capital flows. Again, there may be strong differences of opinion as to whether these will be useful policies, but the consensus among the staffs of the Fund and the World Bank and many academic consultants is that liberalization is a good thing.
6. With or without discrete devaluation, there may be advice to slow the rate at which the local currency is devalued over time in a crawling peg. The slower crawl is supposed to dampen expectations and be an anti-inflationary force.
7. Freezing of wage demands is often recommended, to cut inflationary pressure and perhaps shift the income distribution toward high-saving profit recipients and upper middle class.

How is a specific package fashioned from these elements likely to work? The whole will certainly differ from the sum of the parts, a point taken up in section 9 below. But first we have to look at the components, specifically monetary contraction in sections 2 and 3, devaluation in 4, effects of intervention in food and other markets in 5, interest rate reform in 6, foreign capital markets and the crawling peg in 7, and attempts at income redistribution in 8.

2. Monetary Contraction

There are two justifications for monetary contraction, which get muddled in minds of practitioners of applied orthodoxy who jet out to the Third World. The first is based on the hoary equation of exchange from the quantity theory of money, which states that the value (price times quantity) of transactions in the economy is proportional to the money supply. If the quantity of transactions or output stays constant, then a smaller money stock ought to be associated with a lower price level. On this rationale cutting the

money supply or at least its growth is a key anti-inflationary move.

Open economy monetarism retains the hypotheses of the equation of exchange and stable output (or effectively, full employment) but adds the notion that the price level is determined in the short to medium run either from competition of imported goods or from labor and intermediate imports costs, i.e. the levels of the wage and exchange rate. The IMF couples these assumptions with the balance sheet identity for the banking system -- any rise in the money supply (the banks' main liability item) must be balanced by increases in loans to the government or private firms, or else by higher foreign exchange reserves (banks' loans and foreign exchange holdings are their principal assets). Monetary restriction takes the form of ceilings on credit to the government and private sector; the main benefits are supposed to come in the form of higher foreign reserves, not lower prices.

To apply the open economy monetarist model in detail, first make projections of output and the price level; then you have money demand. Put limits on government and private borrowing from the banking system. From the banks' balance sheets, the change in foreign reserves "must" be determined as a residual item. Or, in other words, if domestic borrowing from the banking system is restricted, then the balance of payments will improve.

This reasoning persuades many, and is certainly neat — causality runs crisply from monetary restraint to lower prices and better external balance.[3] Doubts can be raised, but center on inelegant details such as the likely effects of monetary contraction in practice.

One objection — put forth as often by conservative businessmen as progressive economists — is that tight money drives up interest rates on loans to firms for working capital and investment, and thus increases costs. The normal business response would be a cutback in activity, and attempts to pass increased costs through to higher prices. Even if aggregate demand falls under monetary constraint, aggregate supply may fall by more so that excess demand for commodities (demand minus supply) goes up. Further inflationary pressure would be the result.

The implication is that monetary restraint may be stagflationary in the short-run, increasing prices and causing output contraction if interest rate cost-push is strong enough. The first monetarist model — less money means lower prices — becomes insecure. The second model — less money improves the foreign balance -- goes through because output contraction reduces intermediate imports. Can trade improvement be made less burdensome? In the orthodox script, devaluation's role is to save the balance of payments. But before asking whether it can do so, we should briefly take up the longer run effects of monetary restriction in an inflationary environment.

3. Inflation, Class Struggle, and Growth

Inflation as a macroeconomic phenomenon is poorly understood — one need only contemplate the profusion of theories to recognize the point. Structuralist models are not complete, but at least provide a consistent framework for understanding the

phenomenon. Three mechanisms are important. First, in many economic systems conflicting claims between classes to the available product get translated into steadily rising prices. The classic example is the attempt by workers to maintain living standards when there is lagging agricultural supply. Food prices go up, and they bid up money wages in consequence. The higher wages are passed along into higher output prices, and a cumulative inflationary process is set up. Were workers willing to accept a lower standard of living, the inflation would not occur. But the same can be said of capitalists — the people who mark up rising money wages into higher prices. Inflation is a sign that a capitalist economy is trying to sweep class conflict over distribution of product under the rug.

The second mechanism hinges on the observation that class power to enforce claims depends on the economic situation — workers may well be more powerful when inflation is fast or employment high. The result in the medium run is the business cycle, and in the longer run a fair stability in the functional income distribution. The cyclical story is as follows: an investment boom in the first instance shifts the income distribution toward capital through forced saving. But as employment rises and/or inflation speeds up, labor gains, strength, and can force an increase in the real wage. Profit rates fall, investment stagnates, and output growth declines. Wage claims then erode, the distribution shifts towards profits, and the stage is set for another upswing.

Third, conflicting claims are worked out subject to given institutional rules. One common case is lagged wage adjustment to inflation, say a wage increase in response to past inflation rates every second quarter or every year. Under this type of wage indexation, an acceleration in inflation will reduce the real wage averaged over the indexing period. In inflationary economy practice, rules are bent according to the macro situation, as in the profit squeeze mechanism just described. The main point is that the rules impose a real income loss on workers when inflation accelerates from their built-in lags.

To explore the implications of these inflation responses, we have to bring in the financial side of the economy. Two possibilities present themselves, as described in section 2. Short-run monetary expansion (for example) may reduce prices by moderating interest rate cost-push, or it may not. In the longer run, these outcomes can be assessed when there is an increased growth rate of money supply. To do theory tractably, we start from a postulated initial steady state. Across different steady states, can increasing the money supply growth rate reduce the rate of inflation?

Surprisingly, the answer to this question is "yes". The story goes as follows: An initial acceleration in money supply growth will lend under rapidly adjusting (or "rational") expectations to an initially faster rate of inflation. Given lagged adjustment of the money wage, the real wage consistent with indexing goes down. Workers respond by being more aggressive in wage demands, and ultimately the actual real wage (or wage-price ratio) begins to rise. Saving supply is squeezed, and investment stagnates; the result is reduced demand pressure on commodity markets and incipient decline in the rate of inflation. The ratio of money supply

to value of output rises and as a consequence interest rates fall as well. Working capital cost-push is reduced, making room for higher real wages and a lower steady-state inflation rate consistent with the indexing rules.

For this process it occur stably, investors have to be threatened enough by increased wage demands to cut back aggregate demand and reduce inflationary pressure; a profit-squeeze theory is involved in this sense. Second, the interest rate decline in response to a higher money/output ratio must be strong enough to permit a higher steady state real wage. If not, then the second phase of the adjustment won't go through and faster money growth will lead to more rapid inflation, as usually postulated.

This scenario shows clear long-run "non-neutrality" in the economy. Different money supply growth rates are uniquely linked to different rates of price inflation and output growth -- the signs of the linkages depending on the strength of working capital cost-push. The mechanisms are structural, and plausible in a Third World institutional setting. Orthodox models that leave them out may be a poor basis for formulation of long-term monetary and growth policy.[4]

4. Devaluation — Real Effects

Even when it works correctly, the monetarist approach leaves scant room for currency adjustment — the exchange rate may enter into import costs and the price level, but otherwise is singularly absent from the accounting. To give devaluation a macro role two additional relationships have to be considered: internal balance or the saving gap, and external balance or the trade gap.

Internal balance says that investment demand must be met by saving from the government, private citizens, and foreigners. Foreign saving is equivalent to a current account deficit, with the corresponding capital account surplus representing an increase in foreigners' saving in the form of claims on "our" national wealth. External balance says that the current account deficit is equal to imports of intermediate, capital and consumer goods plus interest payments less exports and net foreign remittances. These balances represent two restrictions on the macro system -- there have to be two corresponding endogenous variables. Candidates on the side of real magnitudes include investment demand (or output growth), the level of economic activity as a determinant of intermediate imports and national saving, and the current account deficit itself. Possible endogenous prices are the exchange rate and the aggregate price level (and implicitly the distribution of income if the money wage is fixed). Different models follow from different hypotheses regarding which variables are exogenous and which are endogenous. In analyzing short run stabilization, it is reasonable to take the exchange rate as a policy variable and investment as fixed. The level of output, the current account deficit and the internal price level become endogenous if the latter is determined by producers' mark-ups over intermediate import and wage costs.

Devaluation or an increase in the local currency to dollar exchange rate has several effects. Prices will rise within the economy as intermediate input costs are driven up, even if the money wage stays fixed. The real wage will fall, and the income

distribution may shift from low-saving workers to high-saving capitalists or mark-up income recipients.

A second increase in potential saving is from the trade deficit if (as usual) devaluation is the last resort when there is an unfavorable foreign balance. The rise in local currency prices of traded goods gives an income gain to exporters with one hand but extracts a loss from importers with the other. The loss exceeds the gain when there is a trade deficit, and real demand for national products falls. Equivalently, foreign saving goes up.

The outcome from higher potential saving is bound to be economic contraction coupled with a worsening income distribution unless export volume responds smartly to the higher exchange rate. There is trade balance improvement through reduced intermediate imports, but it comes at high social cost.

Despite these ill effects, orthodox stabilizers see devaluation as unambiguously a useful thing. The reason is that the rise in domestic value of exports is supposed to stimulate their production and sale abroad, and offset the contraction (though not the price increase nor the real wage decline). Is this a likely event? Results differ from model to model, but in realistic specifications it can be shown that devaluation will be expansionary when the elasticity of export volume with respect to the exchange rate exceeds the ratio of exports to intermediate imports. Note from the external balance relationship that Intermediate imports + Capital goods imports = Exports + Deficit if minor items are omitted from the accounting. The stylized fact is that the trade deficit or financial capital flow toward a developing country is likely to be <u>less</u> than its capital goods imports. Hence exports must exceed intermediate imports, and the export elasticity that guarantees expansionary devaluation can be less than one.

An export elasticity near one with respect to the exchange rate is reasonable in most countries, but only in a "medium" run of more than a few quarters. Before then the export response will be weak, and devaluation stagflationary. If monetary restraint is also stagflationary, there is ample possibility of excessive contraction or what has been called "overkill" by the standard package. We return to this point in section 9 below.[5]

5. Intersectoral Complications

The effects of any macro policy are complicated by the fact that in many developing countries distributional and price interactions between sectors are complex. The paradigm case is an agricultural (or food) sector for which the market is cleared by a varying price coupled with a non-agricultural sector in which output responds to demand. We can begin to understand this system by looking at how income effects influence consumer decisions.

In the market for food, an increase in non-agricultural output and income will raise demand. If supply is fixed or not very price elastic, the incipient demand increase will have to be cut back by a higher price. Since demand for food consumption is not elastic, the increase may be sharp.

In the market for non-agricultural products, things are harder to figure out. A rise in the agricultrual price — on the one hand — will increase farmers' incomes and their demand for

industrial products. By hypothesis for a generally oligopolistic industrial/service sector, the demand increase will be met by increased supply.

On the other hand, an increase in food prices will reduce real income elsewhere in the economy (bread or rice becomes more expensive and your overall purchasing power falls), leading to less buying of non-agricultural products by non-agriculturalists. Hence demand for non-food products can either rise or fall with the food price. Consider the two possibilities in an economy where policy is suddenly redirected toward an increase in agricultural exports.

Farmers' income would rise with the policy change — it cuts internal supply and drives up agricultural prices. If demand for non-agricultural products is dominated by rural income, there would be an export-induced boom. By contrast, if the initial real income loss in the non-agricultural sector is the dominant effect, demand for industrial products would fall and recession result. In the first case, the food price increase is likely to be large, since demand is price-inelastic; in the second case, the real non-agricultural output loss could be serious. Agricultural exporters are perched on a knife-edge. Devaluation or other stimuli to exports do not ease their balancing act.

The same line of reasoning applies to cutting food subsidies, another orthodox policy move. Demand for food products will fall, leading to a decline in either imports or the internal producer's price (or both). There may be a spillover into demand for non-agricultural goods, leading to overall output contraction. Once again, a foreign balance improvement is obtained at the cost of reduced economic activity and a price-induced shift in the income distribution against the poor who devote a large share of their spending to food.

These two examples show that the terms of trade between the agricultural and non-agricultural sectors are in principle highly sensitive to attempted policy changes. Given that food products make up a large share of total production and consumption activity in poor countries, the consequent shifts in income distribution and resource allocation could be expected to be large. In practice, violent responses are not frequently observed. The reason is that governments almost always intervene in food markets, separating and stabilizing consumer, producer, and import prices to try to maintain or at most marginally alter the status quo among the interest groups involved.[6]

This policy stance responds to the structure of a poor economy in which price formation and output responses vary significantly across sectors — this sort of problem is less serious in a more homogenous developed country. Simple attempts to alter the terms of trade via shifting food subsidy rates or agricultural export promotion schemes are bound to have general equilibrium effects which will call forth reaction on the part of groups that get hurt. In some circumstances, such policy changes might be sensible; they are just extremely difficult to apply.

6. Mongering Financial Reform

Monetary contraction, devaluation, and tinkering with the commodity price system represent the first line of orthodox

stabilization policy. Now we turn to more subtle moves, for example a recent thrust toward financial reform, both internally and with respect to the foreign capital account. The internal package is taken up in this section.

In practice, financial improvement boils down to an attempt to raise interest rates. Rates in "official" money markets (especially on bank deposits) are often controlled in developing countries, as a natural counterpart to Central Bank regulation of the banking system through credit restrictions as opposed to rediscounting and open market operations. These latter, market-based interventions are infeasible when the local financial system is not highly articulated as in much of the Third World.

The fixed interest rates are often negative in real terms, i.e. the nominal rate less the observed rate of inflation is less than zero. Negative real rates are common in advanced economies, but have been pointed to as a "distortion" ripe for liquidation in the Third World. The current rate of inflation provides a convenient benchmark against which to measure what the nominal interest rate "should" be.

What are higher interest rates supposed to achieve? One benefit, long term at best, would be increasing use of the banking system and greater financial intermediation. More financial depth would permit open market operations and other flexible regulation policies and undoubtedly is a goal to be pursued, but is not relevant in a stabilization context. What is relevant is the notion that interest rate increases will raise saving rates and available deposits in the banking system. If, as in neoclassical growth theory, the extra saving gets translated automatically into higher investment, the economy can be boosted painlessly onto a faster growth path.

Common sense suggests that the world does not operate neoclassically --an *ex ante* increase in saving is more likely to lead to economic contraction than a sudden investment spurt. Nonetheless, let us assume for discussion that saving does rise with increases in bank interest rates, but that investment demand is interest-sensitive as well. The question becomes: sensitive to *what* interest rates? In many countries, the relevant rates would appear to be the ones ruling in informal financial markets. Except for the largest, both industrial and agricultural firms have recourse to informal lenders instead of the banking system for their finance. Curb and village credit markets are often efficient and well-tailored to the needs of small borrowers. Not surprisingly, the interest they charge is also quite high.

Now assume that bank deposit rates are increased, and in fact more deposits come in. What is their origin? One possibility is reduction in informal lending and a second is drawing-down of hoards of gold and idle balances and sales of real estate and similar goods. If the latter occurs, there will be a transfer from productively useless to useful assets. Bank lending can increase, investment demand be stimulated and working capital costs fall -- all in all a favorable outcome.

The other story is more grim. If higher deposit rates induce moneylenders or their backers to pull resources out of informal markets and put them in banks, there can easily be an overall

credit contraction because reserve requirements or credit ceilings in official institutions are bound to be more strict than those along the curb. The outcome could be working capital cost-push and a decline in investment demand and the level of economic activity--stagflation once again. Under the circumstances, the increase in ex ante saving would only make things worse.

Which outcome is more likely can only be judged by informed observers in a specific country; broad generalizations are beside the point. The important conclusion is that the existing financial structure can frustrate simplistic attempts at reform by "getting the interest rate right". A second observation is that even if the policy is successful it will work only by getting the financial system tail to wag the capital formation dog. Directly stimulating investment and technical progress would be a straighter route to sustained economic growth.

7. Crawling Pegs and External Financial Reform

Besides revising interest rates, recent orthodoxy has focused its attention on the market in foreign assets and the role of the exchange rate in influencing portfolio choice. To set the stage, consider an economy where the authorities have been steadly devaluing the nominal exchange rate in a "crawling peg" at a rate more or less equal to the difference between the domestic and foreign rates of inflation.

Such policies were first introduced in Latin America in the 1960s. Their initial goals were to keep the real return to export activities stable, and to preclude speculation against a maxi-devaluation such as occurs in a fixed-rate exchange regime.[8]

More recently, a third justification for a crawling peg has been proposed. If the crawl is slower than the actual rate of inflation, it can dampen expectations and gradually direct the economy toward an equilibrium with stabler prices.

When crawling pegs were slowed in practice during the 1970s, the shift came as part of a package involving reduction of restrictions on both foreign trade and international capital flows. The results were unexpected.

First, foreign-held capital came streaming toward the domestic banking system, which at any time had to trade national currency for dollars at the ruling exchange rate. Slowing the speed at which the local exchange rate was raised in periodic mini-devaluations reduced the short-term return to holding assets abroad, which can be written as foreign interest rate + expected depreciation of national currency - expected foreign inflation rate. So long as asset-holders continued to believe that the slower crawl would be followed, they had strong incentives to repatriate wealth held in dollars.

Second, the capital inflow led to substantial credit expansion by the banking system, as new deposits were lent out. The jump in money and credit in the system led to a burst of inflation, and instant appreciation or a fall in value of the real exchange rate (defined as the nominal rate divided by the national price level).

Third, there was an investment boom, easily explicable by euphoria in the capitalist system and the increase in the profit rate entailed by lower real import costs.

Now come the difficulties. After the initial exchange appreciation, there was supposed to be a period during which the real exchange rate gradually rose (or depreciated) toward a long-term level consistent with equilibrium in the balance of payments. The rate of change of the real rate is the speed at which the nominal rate is rising minus price inflation. If the real rate is to rise, inflation must run slower than the crawling peg. The whole system was expected to proceed to a low inflation, steady state equilibrium.

Of course, this intricate minuet never was properly danced. The initial investment boom was followed by wage pressure, a profit squeeze and cyclical downturn in standard market economy fashion.[9] More seriously, the lagging real exchange rate held down exports and led to unrest on the part of businessmen in the export sector. Not willing to wait for slow real depreciation and return to external balance, they put their money abroad in speculation against the nominal exchange rate. Meanwhile, export stagnation worsened the internal recession. All signs pointed toward a maxi-devaluation with consequent inflationary burst, output shock and balance of trade improvement, and that finally occurred. An elegantly contrived long-term stabilization scheme ran afoul of the short-run facts of life.

What one learns from these failures is that it is perilous to trust in things working without hitches in the medium to long. Trying to wave down inflation with a stable exchange rate presupposes that people with access to wealth will behave the way you want (or hope, or trust) them to do. Such an assumption is dangerous, doubly so when financial liberalization removes most obstacles to capital flows. Too much was attempted with the slower crawling pegs, because the models underlying the policy were too simple and their architects paid scant heed to the historical failure of such policies before. The fiasco of stabilization based on a slower crawl strongly suggests that the model results be taken with a grain of salt, especially in the long run.

8. Income Redistribution and the Export Push

Usually, income distribution against labor and the poor is implicit in stabilization attempts. Wages may be frozen, food subsidies cut and exports stimulated, all with benefit to landlords and renters.

Justifications for these policies are diverse — to increase saving and "therefore" investment and growth (the neoclassical growth model again); to contract "excessive" aggregate demand; to impose greater discipline on the system, and so on.[10]

Progressive economists have not been much more coherent in their judgments about possible effects of redistribution. One strand -- ranging from the Franco - Italian Sismondi early last century through the Russian narodniki to modern Indian scholars -- argue that an income distribution toward the poor will stimulate aggregate demand, lead to an investment increase through accelerator effects, and raise the economy to higher growth. Alternatively the Latin American structuralist school in the 1950s and 1960s explicitly stated that income concentration might be necessary to stimulate demand for "luxuries" such as consumer durables

which would be the basis for economic expansion after an "easy" phase of import-substituting industrialization had passed.[11]

In the context of stabilization policy, these long-run models suggest that the income concentration associated with most stabilization efforts may dampen aggregate demand overall and at best stimulate certain sectors of the economy. The stimulation may or may not feed back into higher investment and more economic animation after the stabilization episode is over.

One particular issue that comes up repeatedly in both short-and-medium-run contexts is the possible effect of an export push. A number of factors have to be considered:

First, is the economy at full employment of available capacity? If so, an export effort will divert resources from either investment or consumption. If growth is maintained, there would have to be income concentration to lower the aggregate propensity to consume and permit greater sales abroad. If the economy is not at full capacity, then exports add to aggregate demand and permit higher output and growth. The discussion of devaluation in section 4 presupposes excess capacity, but recall from there that the beneficial output effects may take some time to appear.

Second, intersectoral redistribution may be important. Do saving and/or consumption propensities differ across income flows generated by export and non-export sectors? One example in which demand-composition effects matter is in mineral-exporting economies. The export revenues usually accrue to the government, which preferentially demands non-traded goods. The outcome is a higher home goods price, lower real exchange rate, and lack of stimulation for production of non-mineral tradable goods at home. Other less extreme models can also be produced, suggesting that an export drive sets off general equilibrium effects that are not easy to trace. Like attempts to get one or another price right, efforts at stimulating particular sectors or activities can easily go awry.[12]

9. Overall Effects of Orthodox Policies

Table 1 presents in summary form the judgments one can reach about the effects of orthodox stabilization policies taken one by one. The results are decidedly a mixed bag. Moreover, it is easy to show with simulation models that often unfavorable effects are strengthened when two policies are applied simultaneously. For example, devaluation coupled with monetary contraction can under certain circumstances lead to extreme output loss, higher inflation and income concentration in the short run.

A second point is the policy effects can differ, depending on conditions under which they are applied. If working capital costs are important, monetary contraction can drive up prices; if it pulls resources from productive loans to the banking system, an interest rate increase will be counterproductive. But in other situations both policies could work well. Orthodox programs implicitly postulate favorable circumstances. Less adventurous packages can be based on the recognition that things are not necessarily going to be all right.

All these complications exist in real economies, and are not put forward to argue that stabilization is not important, or not necessary in some cases. Rather the structuralist view emphasizes

Table 1

Likely Effects of Orthodox Stabilization Policies

	Maintain Output	Improve Balance of Payments	Reduce Inflation	Improve Income Distribution
Monetary contraction				
(a) Working capital important	-	+	-	-
(b) Otherwise	-	+	+	+
Devaluation	- initially + later	+	-	-
Commodity price reform (especially food)	-	+	+	-
Higher interest rates				
(a) Draw resources from idle balances	+	?	+	?
(b) Otherwise	-	?	-	?
Slower crawling peg	+ initially - later	+ initially - later	-	?
Export push (at excess capacity)	+	+	-	-

complexity and the need for wisdom and receptiveness to how the economy at hand seems to work. A structuralist stabilization package would no doubt include many of the policies listed in Table 1 — not many others are known. But it would not apply them all in the usual directions, and would also incorporate distributional considerations and non-market interventions explicitly. The basic question at hand is how best to avoid the ill effects of standard policy tools, and to forge new ones. Structuralists have much work to do in these directions.

NOTES

1. The central figure at ECLA was of course Raul Prebish, whose interests focused more on the long run than the short. The classic Structuralist paper on inflation is by Osvaldo Sunkel (1960).

2. For a book-length, formal exposition, see Taylor (1983).

3. The Fund model was essentially set out a generation ago by Polak (1957). For formal expositions in different variants, see Chapter 8 in Taylor (1983) and Chapter 9 in Taylor (1979).

4. Interest rate cost-push as just discussed in the text has been widely pointed to as a cause of inflation in Latin America--a relatively early paper in English is Morley (1971). Theory is due to Bruno (1979) and van Wijnbergen (1983). The long run model is set out in Taylor (1983).

5. The possibility that devaluation may prove contractionary is emphasized by Krugman and Taylor (1978), following Hirschman (1949), Diaz-Alejandro (1963) and Cooper (1971). To see how a country's trade deficit is likely to prove less than its capital goods imports, note that its investment might be 20 percent of GDP, made up in turn of 60 percent nationally produced goods (construction and simple machinery) and 40 percent imported goods (sophisticated machinery). The capital goods import share in GDP of eight percent will exceed the feasible trade deficit for most countries.

6. One key reason for these interventions is to avoid inflation. If the real cost of food rises for groups such as urban workers, they can easily bid up money wage demands which in turn can be passed along to further price increases and an inflationary spiral. This is the inflation model of Sunkel (1960), neatly formalized by Cardoso (1981).

7. Financial reform along the lines described here has been strongly recommended by the American economists McKinnon (1973) and Shaw (1973). A formalization of their model is given by Kapur (1976).

8. If the exchange rate is fixed when domestic inflation is substantially higher than that of trading partners, imports steadily become cheaper and exporting less worthwhile. Pressures toward devaluation grow, and asset-holders begin to put wealth abroad through legal channels or by over-invoicing imports, under invoicing exports and similar illegal devices. The capital flight forces a maxi-devaluation, typically with severe shocks to the domestic economy. Only the wealthy benefit, by bringing home their assets and enjoying their capital gain.

9. A profit squeeze and consequent cutback in investment at the height of a boom is a moderately convincing theory of the business cycle in a capitalist economy. For details, see section 2.4 and Chapter 6 in Taylor (1983), as well as section 3 here.

10. One imaginative--and nameless--structuralist economist fancies that the IMF team arrives in a country on mission with briefcases full of whips and leather dungarees. Mel Brooks movies to the contrary, such is not the case. But it is at times difficult to avoid reading self-righteousness or class bias into orthodox policy moves.

11. For references see Lustig (1980). Note that distinct consumption propensities between rich and poor for different goods, diverse investment and saving functions and more generally demand composition differentials underlie the discrepant theories mentioned in the text. It is hard to sort out the theoretically dominant forces underlying different income redistribution models, let alone their empirical relevance.

12. For example, in the numerical model for India described in Taylor (1983), devaluation and an export push are strongly inflationary, because they indirectly and directly generate demand for products of the supply-limited agricultural sectors.

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2
Growth and Equity: A Strategy for Reconciliation

Alain de Janvry

I. Growth and Equity: The Record

As a group, the developing market economies have had favorable growth records during both the 1960s and the 1970s, easily out performing the developed market economies. As Table 1 shows, the growth rate in gross domestic product was 6 percent higher in the former than in the latter in the 1960s and 79 percent higher in the 1970s. The performance of the developing countries is even more dramatic in manufacturing where the growth rate was 7 percent higher than in the developed countries in the 1960s and 124 percent higher in the 1970s. While unevenly distributed, this strong growth performance in many newly industrialized countries disproved, at least, the myth of stagnation long advocated by hardcore dependency theorists to explain the persistence of poverty and inequality (Frank). Rapid growth did not, however, create more equitable patterns in the distribution of income nor did it induce social change toward more democratic forms of government. As Table 1 shows, the Latin American countries for which income distribution data are available over time all showed a decline in the share of income received by the poorest 20 percent in the population. Taiwan stands as one of the rare exceptions where rapid growth was accompanied by improvements in the distribution of income. Even in this case, however, and like in a majority of Latin American countries, industrialization and the corresponding creation of new social classes did not satisfy the development economists' expectations of emerging democracy (Hirschman). As a glance at the political map of Latin America, Africa, and Asia reveals, military or repressive regimes generally became the guardians of rapid industrialization in a social context of rising inequalities.

Confronted with the empirical evidence of inequitable growth, in conditions where inequities are already extremely large and where massive poverty is perpetuated by having the bulk of the benefits of growth captured by the upper income levels, a number of policymakers and development theorists have advanced strategies designed to achieve equitable growth. These strategies fall into three categories.

The first consists in accepting the presumed inevitability of

Table 1. Growth and Income Distribution in the Third World.

Countries	Years	Percentage of Income Received By Poorest 20 percent	Years	Average Annual Growth Rates In: GDP	Manufacturing
		Percent			Percent
All developed market economies			1960-1970	5.1	6.3
			1970-1979	3.3	3.3
All developing market economies			1960-1970	5.6	7.1
			1970-1979	6.0	7.2
Argentina	1953	7.5	1960-1970	4.2	5.7
	1960	6.9	1970-1979	2.5	1.9
	1970	4.4			
Brazil	1960	3.8	1965-1970	8.0	8.5
	1970	3.2	1970-1979	8.7	10.1
	MRE[a]	2.8			
Mexico	1950	6.1	1960-1970	7.3	9.4
	1957	4.4	1970-1979	5.2	5.8
	1963	3.5			
	1970	3.4			
	MRE	2.9			
Costa Rica	1960	5.7	1960-1970	6.5	10.7
	1970	5.4	1970-1979	6.1	8.3
Puerto Rico	1953	5.6	1960-1970	7.4	9.4
	1963	4.5	1970-1979	3.7	7.6
Taiwan	1960	5.6	1960-1970	9.1	17.3
	1970	8.7	1970-1977	7.7	13.3

[a]MRE = most recent estimate (World Bank, 1980).

Source: United Nations (1980), Weisskoff, World Bank (1980).

growing inequality in the early stages of economic growth. Empirical evidence for this "law" has been provided by the Kuznets U-Hypothesis, Chenery and Syrquin's normal patterns of development, and the Lewis turning point beyond which surplus labor is resorbed and wages rise in relation to productivity growth. The policy implication, for those concerned with equity, is to accelerate growth as much as can be in order to induce trickle-down effects via employment and the tightening of labor markets. This makes reaching earlier the turning point in the distribution of income and allows the transit into equitable growth. Accelerating growth for the sake of equity has thus been advocated by Ahluwalia, Galenson, and others.

A second strategy also accepts the immediate inequitable nature of growth but proposes to place a floor on poverty by insuring every citizen's basic needs through income redistribution schemes. Taxation of some of the benefits of growth and foreign aid can be used to increase government services delivering minimum requirements of food, shelter, medical care, education, and protection to those below poverty line. Inequitable growth in civil society should thus be compensated by expansion of the welfare state (Streeten, Grant).

A third strategy is directed at altering the structural conditions that make growth inequitable and thus at eventually reconciling growth and equity. Emphasis is placed on different structural conditions by different advocates. For the International Labour Office (ILO), the choice of appropriate labor-intensive technologies adapted to the particular relative factor scarcities of the Third World countries is essential. For the World Bank (1975) and the United States Agency for International Development, the competitive structure and defense of the middle sectors of small entrepreneurs are key. This leads to organization of programs of integrated rural development to raise the productivity of peasants and programs of assistance to small entrepreneurs in the urban informal sector. For the FAO and the Economic Commission for Latin America, the distribution of assets is the main determinant of the relation between growth and equity since the effect of growth is to valorize productive assets. Based on the experiences of Japan, Taiwan, and South Korea, Adelman thus proposes a strategy of structural change to insure subsequent equitable growth that includes massive redistributive land reform and investment in human capital formation, possibly in the context of authoritarian governments to contain the social tensions associated with redistribution and initially slow growth.

What we want to show, in this paper, is that the key structural feature that determines the equity impact of growth is the geographical and social location of the market for the final consumption goods produced by the key sectors of economic growth (de Janvry and Sadoulet). The key growth sectors are those privileged by investment in that they have the highest sectoral gross rates of capital formation.[1] When the market for final consumption goods produced by these sectors is located either abroad or in consumption expenditures that originate in profits and rents, "social disarticulation" prevails and growth leads to growing inequality. By contrast, when it is located in consumption expen-

ditures originating in wages and peasant/informal sector incomes (implicit wages), "social articulation" exists and growth tends to be equitable.

II. The Concept of Social Articulation

In all economic systems, be they capitalist or socialist, sustained economic growth implies the need for a balanced expansion between production and consumption. If this balance is not maintained, either underconsumption or inflationary crises will result. How to use the policy instruments at hand to maintain this balance is the subject of macroeconomics.

Keynes approached the problem from the expenditure side of the circular flow of spending. For him, the balance between production and consumption occurs when the sum of savings, plus tax, plus imports equals the sum of investment, plus government expenditures, plus exports. The level at which this equilibrium occurs and, in particular, whether it is at or below full employment, depends on two highly psychological and, hence, unstable variables: liquidity preference for passive money (hoarding) and the expected rate of return on new investment (Keynes' "animal spirits"). If, for instance, liquidity preference increases in response to a pessimistic economic outlook, the rate of interest rises, investment and consumption fall, and the level of output falls below full employment. Government can thus intervene to compensate for rising interest rates by increasing the money supply and for falling demand by decreasing taxes and increasing government spending.

Marx and Kalecki, by contrast to Keynes, analyzed the balance between production and consumption from the income side of the circular flow of spending. In this case, with profits the fundamental source of investment and wages the source of effective demand for final consumption goods (wage goods), the balance between production and consumption implies an appropriate distribution of income between profits and wages. Just like in Keynes, but for reasons which are not psychological but rooted in social conflicts, this equilibrium is highly unstable. This is due to the fact that the forces of competition and profit making, acting on individual entrepreneurs, push simultaneously labor productivity upwards and wage downwards, both for the sake of minimizing average production costs. The first increases production while the second restricts consumption, leading to eventual imbalances in the necessary relation between the two. There is thus a contradiction between individual entrepreneurs holding down on wage costs while pushing productivity growth and the needs of social capital where consumption and, hence, the mass of wages paid, has to balance the increase in production.

When the key growth sectors produce wage goods, the macroeconomic equilibrium thus implies a necessary balance between profits and wages and, hence, between growth and equity. Specifically, productivity gains in production must, ultimately, be passed along as gains in real wages. This income distribution is always fraught with conflicts and imbalances, resulting in cycles and crises. Yet, a necessary balance must ultimately be stricken between capital and labor, a balance which gives the objective basis for negotiated settlement and eventually democratic forms of

government.

When the key sectors of economic growth are, by contrast, oriented at the production of exportables or luxuries, the necessary balance between production and consumption can hold without balancing the shares of profit and wage in national income (Amin). Examples are export enclaves for which the consumption capacity is externally defined and import substitution industrialization where the key sectors are luxuries such as cars and electrical household appliances. While a car is a wage good in the United States, exactly the same item is a luxury good in the Third World since it is priced beyond the means of wage earners. A same commodity can thus be a wage good on one side of the border and a luxury on the other, implying totally different logics in the consequent relation between growth and equity.

When the key growth sectors produce exportables or luxuries, wages are a pure cost on production for both individual entrepreneurs and social capital. Since, for luxuries, both investment and consumption originate in profits (upper income levels), the cheapening of labor and increasing inequality in the distribution of income serve to stimulate both production and consumption. Accelerated growth feeds on inequality and poverty. Wage determination becomes a purely biological and political problem, limited downwards by subsistence requirements and conceded above that level in response to social conflicts. As the political map of a majority of Third World nations indicates, the logic of growth under social disarticulation negates democratic forms of government and legitimizes authoritarian regimes (Collier). Repression guarantees cheap labor and deepens inequitable growth.

Since market creation for the key growth sectors does not occur significantly out of wage income, large masses of subsistence households are left in the peasant economy and the urban informal sector (Portes and Walton). These labor reserves subsidize wages paid by incurring part of the cost of maintenance and reproduction of the labor force. As a result, wages can be below the level they would have to reach if the labor force had to be maintained on the fully proletarianized status. Semiproletarianization and the maintenance of large peasantries and urban informal sectors are thus part of the logic of disarticulated accumulation. And it is in these sectors that the worst forms of poverty are found, breeding some of the most dramatic reactions to poverty such as the demographic explosion, deforestation, and ecological destruction (de Janvry).

The structural feature of social disarticulation is not a stage of development which is to be transcended by mere economic growth. Disarticulation corresponds to a particular social structure where a class alliance that includes the agrarian oligarchy, comprador merchants, and the dependent bourgeoise gains control of the state and uses this control to oppose the demands of farmers and peasants, workers, and the national bourgeoisie. The minimum point in the Kuznets-U curve and the Lewis turning point are not traveled by the acceleration of growth but by social change. As Wright and Papanek have shown, empirical evidence reveals that egalitarian societies can be observed at all levels of income.

There are several modifications that need to be made to the

pure models of articulation and disarticulation in applying them to the interpretation of concrete situations. One is that articulation and disarticulation are always imbedded class structures, with one dominating over the other at a particular point in time. In the advanced market economies, disarticulation is found within articulation under the form of labor market segmentation. In this case, labor market segmentation redistributes the mass of wages paid (the aggregate consumption capacity for wage goods) on the basis of ethnic, sexual, and legal status differences. In the Third World, struggle for control of the state between the articulated and disarticulated alliances is a major source of political instability. The populist or socialist regimes of Peron in Argentina, Betancour in Venezuela, Paz Estenssoro in Bolivia, Arbenz in Guatemala, Getulio Vargas and Goulart in Brazil, Velasco in Peru, and Allende in Chile were all attempts at establishing dominance of the articulated alliance. Peron's political program, for instance was based on a "social pact" between the General Confederation of Entrepreneurs and the General Confederation of Workers to negotiate a balance between production and consumption under the logic of articulation. Economic and political failures of these attempts led to dominance of the disarticulated alliance with represssive forms of government and increasing inequality in the distribution of income. With dominance of the disarticulated alliance, labor market segmentation is no longer a strategy to redistribute wage income between segments of the working class but one to lower wage income to the benefit of increased profits.

Social disarticulation does not negate the growth of wage goods industries, even though this growth is modest relative to that of the key growth sector producing luxuries and exportables. This is due to two facts. One is, as we just saw, the general existence of articulation even under dominance of disarticulation. The other is that employment creation in the luxury and traded goods sector creates a mass of wage income which, even at constant levels of real wage, leads to an expanding demand for wage goods. The market for luxuries thus expands vertically with rising upper income levels while the market for wage goods expands horizontally with increasing proletarianization at constant wages.

III. Social Articulation and Dual Economy Models

We have identified two key structural features that determine the relation between growth and equity. One is identification of the key sectors of economic growth which concentrate investment. The other is the social origin of demand for key sectors' products which is located in wages under social articulation and in profits and rents under disarticulation.

While by now somewhat dated, the two alternative models of the dual economy formulated by Lewis and Jorgenson remain fundamental contributions to development planning because of the contrasted policy implications they offer to accelerate industrial growth. For Lewis, the key policy implications are to hold down on wages, even as the productivity of labor increases in both agriculture and industry, and to stimulate capital accumulation by increasing the share of capital in industrial income. For Jorgenson, by contrast, industrial growth requires freeing labor from agriculture to make

it available for industrial employment and, hence, stimulating technological change in agriculture.

In these two models, the key sector of economic growth is always the modern sector, usually identified with industry, as it is the only one using capital as a factor of production. That sector consequently concentrates the totality of investment while agriculture, the backward sector, produces with only labor and land. The distinguishing feature between the two models is on the side of the labor supply: in Lewis' classical model, surplus labor implies an infinitely elastic supply of labor at a fixed wage, at least until the Lewis turning point is reached where surplus labor disappears. In Jorgenson's neoclassical model, by contrast, the labor market does not fail and wages reflect the scarcity value of labor. As a result, wages rise with the productivity in industry.

What we suggest here is that the fundamental difference between the models of Lewis and Jorgenson and the contrasted implications they have for the relation between growth and equity are not due to different specifications of labor supply (surplus labor or not) but to the assumption of social disarticulation in Lewis and social articulation in Jorgenson. As a result, the protracted debates in the development literature of the 1960s on existence or not of surplus labor in Third World agriculture missed understanding what was the key issue at stake (Kao, Anschel and Eicher; Schultz).

The social accounting matrix implicit in the Lewis model (as presented by Jorgenson) is constructed in Table 2. With wages at subsistence level, all the workers' income in both agriculture and industry is spent on food. There is, as a result, pure social disarticulation: the key growth sector produces capital goods for investment and luxury consumption goods for nonwage consumption. Since capitalists are assumed to only capitalize, the totality of their fixed share of industrial output is saved and invested. With neither workers nor capitalists consuming industrial products, a purchasing power for the fixed share of industrial output which is not invested must be created. Following Malthus, this purchasing power is created by a landlord class (or a parasitic state bureaucracy) which fulfills two functions: on the one hand, it taxes peasants of any (average) productivity gains beyond the prevailing subsistence wage. These productivity gains occur even without technological change since surplus labor in agriculture is being absorbed by industrial employment faster than population growth. The other is to use this rent, captured from peasants under the form of food, to exchange it with industrial workers for the fixed share of industrial products which they receive. Final consumption of commodities produced by the key growth sector thus originates in rent income.

The Lewis model consequently offers a scientific legitimation for growth under social disarticulation. Suppression of workers' demands for higher wages (in spite of rising productivity) and increasing inequality in the distribution of income are the engines of growth. Justification for disarticulated growth is found in the presumed rapid elimination of surplus labor which will soon tighten up labor markets, raise wages in relation to productivity growth, and turn the distribution of income more egalitarian. There are,

Table 2. Lewis' Model of the Dual Economy in Social Accounting Matrix Form[a]

Sectors	Labor's Final Consumption			Landlord's Final Consumption	Capitalists' Investment	Total Demand
	Agriculture	Industry	Total			
Agriculture	$A\bar{w}$	$M\bar{w}$	$P\bar{w}$	0	0	$P\bar{w} = y$
Industry	0	0	0	$(1 - \sigma)x = M\bar{w}$	σx	x
Labor income	$A\bar{w}$	$M\bar{w} = (1 - \sigma)x$	$P\bar{w}$	[b]		
Landlord income	$M\bar{w}$	0	$M\bar{w}$			
Capital income					σx	
Total income	$P\bar{w} = y$	$(1 - \sigma)x$	$y + (1 - \sigma)x$		σx	$x + y$

[a]Definitions:

- P = total population
- A = population in agriculture
- M = population in industry
- x = industrial output
- y = agricultural output
- $\bar{w}$ = fixed wage
- σ = share of capital in industrial product

[b]Blanks indicate not applicable.

however, many reasons why the model can fail to resorb surplus labor. Industrial growth may create insufficient employment due to labor saving technological change imported from the advanced economies; the rate of population growth, fueled by poverty, may remain too high; and the rate of productive investment of capital income may be low even if the share of capital in the industrial product is high. Under these conditions, which look distressingly familiar to any observer of Third World nations, growth reproduces the conditions of social disarticulation. The key question for development economists is, then: if growth does not articulate, what structural change does? And, since disarticulation is the epiphenomenon of a social class structure, what kind of social change do we need to obtain social articulation? In the Lewis model, for instance, what type of social forces are needed to eliminate the rent-collecting landlord class or the parasitic bureaucratic class? Lewis does not address this issue and the model thus fails to answer a key question of development economics.

The Jorgenson model is equally revealing when analyzed from the side of the social origins of effective demand. The social accounting matrix for this neoclassical model is presented in Table 3. The key sector of economic growth, namely industry, delivers capital goods for investment. Demand for investment originates in the savings of industrial capitalists who capture a fixed share of industrial output. The key sector also supplies final consumption goods demanded by both rural and industrial workers. Growth consequently occurs under social articulation. The level of wages paid increases proportionately to the productivity of labor in industry. And growth and equity are linked by the macroeconomic balance between production and consumption.

The neoclassical model thus explicits the mechanisms of wage determination under social articulation. It postulates a social structure that corresponds to those of the advanced industrial economies and not of most Third World countries. It thus fails on two accounts in terms of development economics. First, it replicates the structural conditions of the more developed countries and not those of the Third World. Second, it begs the key question of development economics, namely: how can the structural conditions of social articulation be created in the Third World today?

In conclusion, the key difference between classical and neoclassical models is in the structural specifications of social disarticulation and articulation. Neither model has much to offer to development economics. The first is an apology of disarticulated accumulation. And the second assumes the answer to the problem by postulating that the structural conditions of social articulation already hold.

IV. Equitable Growth with Surplus Labor and Social Articulation

We can now see why the fundamental difference between the Lewis and Jorgenson models is not the question of surplus labor but that of (1) what the key sector of economic growth produces: luxuries and exportables or wage goods; and (2) the social class structure resulting in productivity gains being either captured as rents (or profits) or passed along to wage gains.

Consider the Lewis model as presented above, including the

Table 3. Jorgensen's Model of the Dual Economy in Social Accounting Matrix Form.[a]

Sectors	Labor's Final Consumption: Agriculture	Labor's Final Consumption: Industry	Labor's Final Consumption: Total	Capitalists' Investment	Total Demand
Agriculture	$qA\bar{y}$	$qM\bar{y}$	$qP\bar{y}$	0	$qP\bar{y} = qy$
Industry	$\frac{(1-\sigma)x}{P}A\mu$	$(1-\sigma)x\left[1-\frac{A\mu}{P}\right]$	$(1-\sigma)x$	σx	x
Labor income	$qy = A\tilde{w}$	$(1-\sigma)x = Mw$	$qy + (1-\sigma)x$		
Capital income				σx	
Total income	qy	$(1-\sigma)x$	$qy + (1-\sigma)x$	σx	$qy + x$

[a]Definitions:

w = industrial wage rate
$\underline{w}$ = agricultural wage rate
$\bar{y}$ = per capita food consumption (fixed)
μ = w/w
q = tenms of trade for agriculture.

P, A, M, y, x, σ, are the same as in Table 2.

specification of surplus labor, but make the following two changes: (1) the key sector of economic growth, industry, produces wage goods (in addition to capital goods as before); and (2) the social structure has been transformed by eliminating the landlord class and the parasitic tribute-levying state. Industrial capitalists keep on earning a fixed share of the industrial product. In a post-feudal society, these structural specifications are certainly more reasonable than those of Lewis. What we have specified is a Third World economy (surplus labor) with social articulation. In this case, as capital accumulation progresses in industry, the required balance between production and consumption implies that wages must rise in spite of surplus labor. This is shown in Table 4. Specifically, the share of industrial product that accrues to industrial labor must be absorbed by workers' consumption in response to rising wages. Wages are thus equal to

$$w = \bar{w} + (1 - \sigma)\frac{x}{p}$$

where $\bar{w}$ is the fixed level of per capita food consumption. Wages consequently increase in relation to the growth in per capita industrial production in the whole economy.

If equitable growth is a goal of economic development, we are thus faced with two alternative strategies. One is to accept social disarticulation (i.e., the social status quo with tribute-levying landlord or bureaucratic classes) and to accelerate growth toward the Lewis turning point. In this case, the type of commodity which the key growth sector produces is irrelevant as long as it allows for rapid growth and employment creation. This is how export-led growth strategies are justified: growth creates employment, eventually tightens up labor markets to the point where wages start to rise, and employment creation and rising wages create an expanding domestic market for wage goods, gradually reorienting the production structure from a disarticulated export enclave to an articulated domestic market-oriented economy. This model may have worked for some resource-rich and small countries in favorable periods of world market expansion. In general, however, today's conditions of labor supply and employment creation (technology) in most Third World countries are such that the strategy is likely to fail. In addition, it should be clear that the Lewis turning point is less a labor market phenomenon--the elimination of surplus labor--than a structural and social change: the redefinition of the key growth sector from a luxury or export-oriented sector to a wage-goods producing sector; and elimination of the parasitic landlord and administrative classes. Even at the Lewis turning point, articulation is thus nothing automatic, but the product of a deep social transformation.

The other strategy for equitable growth consists in challenging the social status quo in refusing the apology of waiting for better days while allowing inequality to increase and in establishing the structural conditions for social articulation, even if conditions of surplus labor prevail. A strategy of transition

Table 4. Social Articulation With Surplus Labor.[a]

Sectors	Labor's Final Consumption: Agriculture	Labor's Final Consumption: Industry	Labor's Final Consumption: Total	Capitalists' Investment	Total Demand
Agriculture	$A\bar{w}$	$M\bar{w}$	$P\bar{w}$	0	$p\bar{w} = y$
Industry	$\frac{A}{P}(1-\sigma)x$	$\frac{M}{P}(1-\sigma)x$	$(1-\sigma)x$	σx	x
Labor income	$A\left[\bar{w} = \frac{x}{P}(1-\sigma)\right]$	$M\left[\bar{w} + \frac{x}{P}(1-\sigma)\right]$	$P\left[\bar{w} + \frac{x}{P}(1-\sigma)\right]$		
Capital income				σx	
Total income	$A\left[\bar{w} + \frac{x}{P}(1-\sigma)\right]$	$M\left[\bar{w} + \frac{x}{P}(1-\sigma)\right]$	$P\left[\bar{w} + \frac{x}{P}(1-\sigma)\right]$		$x + y$

[a]Definitions:

$\bar{w}$ = per capita food consumption.

All other variables and parameters as in Table 2.

toward social articulation is necessarily complex and highly specific to particular countries since it involves social change. We, however, provide some guidelines toward this purpose as concluding comments.

V. The Strategy of Transition to Social Articulation

Two caveats should be evident from the outset in establishing guidelines for a transition to social articulation. The first is that there is not a unique social system able to insure social articulation. Petty-bourgeois capitalism, state capitalism, and different brands of socialism have all made claims at achieving articulation. Not only are the destinations of structural transformation diverse, but so are its origins depending upon the prevailing economic and social structures. Accordingly, strategies of transition must be grounded in detailed analyses of the existing economic and class structure and defined according to specific situations.

The second is that focusing on articulation is not a substitute for concern with growth but only with the social consequences of growth. Rising productivity remains the necessary condition for improving welfare. In particular, as progressive income distribution increases the demand for wage goods--staple foods, for instance--rapidly increasing production of wage goods is essential to contain inflationary pressures.

What the theory of growth under social disarticulation gives us is an identification of the key variables over which control must be established in order to transit to articulation. One is investment policy to transform the wage goods sector into the key sector of economic growth. Wage goods are defined by the level of wages and the Engel's consumption curve. Social articulation thus requires that consumption states not be jumped, for instance, that production of bicycles, scooters, and mass transit systems must come before that of cars as key sectors. The "internationalization of consumption" observed by Cardoso must be resisted as it is an integral element of social disarticulation. Control of investment requires control of the country's investable surplus. Expropriation of part of that surplus and decentralized decision making in its use are likely effective ways of achieving this.

The other is the creation of effective demand for wage goods by reaching a sufficient degree of equality in the distribution of wage incomes to homogenize consumption patterns across wage earners. As we have shown elsewhere (de Janvry and Sadoulet), this implies containing income inequality below a certain threshold that depends on the prevailing average level of wages. As the production of wage goods expands, wages must rise to increase correspondingly the consumption capacity of the system.

How to gain sufficient control over investment and how to reduce income inequality below the necessary threshold are thus the key targets of a strategy of transition to social articulation. Consistency between these two policy instruments--investment and income distribution--needs to be maintained to insure the necessary macro-balance between production and consumption. If income redistribution progresses without sufficient control of investment, as in Chile under Allende, inflationary pressures are created and

destabilization follows. If investment in wage goods occurs--as in the early stages of import substitution industrialization in Latin America--without income redistribution to create the corresponding effective demand, market saturation results and either disarticulation or outward growth become the necessary sources of effective demand to sustain continued growth. Trade itself should be used for the sake of articulation, as in Japan and Taiwan, and not as a substitute for it, as in export enclaves or in outward-oriented industrialization. Social articulation is thus not a call for autarchy, but a set of guidelines for socially purposeful use of the gains from trade.

Notes

1. The gross rate of capital formation is the ratio of gross investment to the stock of capital.

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3
Income Distribution and Development: A Critique of Current Methodology

Jerry B. Eckert

Introduction

During the 1970s, development theorists turned their attention from growth maximization toward the distribution of personal income. It had become apparent that large increases in aggregate measures of income had done little or nothing for the poor. During the course of the decade, a substantial volume of empirical data on distribution was assembled. New theoretical constructs were advanced and older ones empirically tested. Fundamentally, economists sought a growth process which would achieve greater equity as one of its ends. Subsequently, as understanding grew, distribution came to be viewed, not only as an end product toward which an economy could be steered, but also as an economic parameter with important deterministic influences on the process of growth itself.

Incorporating distributional concerns into the theory and practice of development constitutes a major redirection in strategy. This paper provides a historical review of this evolution. We then look at the range of distribution theories available at the start of the 1980s. A third section examines a selection of models which attempt to capture certain distribution concepts and operationalize them as planning tools. Finally we venture a guess concerning what future developments might be needed as economic models of the distribution process continue to evolve.

A Redirection of Development Thought

Theorizing on the process of growth is not new. However, explicit concern with growth in the emerging economies of what is now called the "Third World" essentially dates from 1950. In that year two studies emerged to focus attention on economic development in the non-Western world. Eugene Staley (1950) raised serious issues about the economic plight of LDCs and the Economic Commission for Latin America convened a group of experts to provide strategies for economic growth in Latin America (ECLA, 1950). The following year a similar group of experts met under sponsorship of the United Nations to consider this problem in a global context (UN, 1951). Economic Development and Cultural Change first

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published in 1952 provided a forum for the fledgling literature in the field and by the end of 1952, W.A. Lewis, Rostow, Rosenstein-Rodan and a host of other seminar writers too numerous to mention had laid claim to the parentage of a new field of study. At this point in time nearly all of the economic literature on income distribution dealt with functional distribution; the apportionment of output shares among various productive factors.

Early development theories stressed the resources perceived as most scarce: capital and foreign exchange. A myopic evaluation of the postwar reconstruction of Europe suggested that investment capital was the limiting constraint to economic growth and processes of capital generation for investment in industry became the sin qua non of development strategy during the early period. The careless equated industrialization with development. Even those authors recognizing human end results advocated industrialization as the means toward their ends.

Early writers looked for stimuli, something in the way of economic shock waves, to transform nearly static traditional economies to flourishing, dynamic ones. Much of the early search sought single interventions which would release a process of growth that would ultimately fuel itself. The perception that a clearly defined limiting constraint, when relaxed, would lead to rapid growth probably also arose from watching the impact of Point Four investment in Europe. Fillips to savings and investment received the most attention by development theorists. One of the most discussed yet most simplistic views of the time was Rostow's "Take-off" (Rostow, 1956) in which an external stimulus transformed a society in a relatively short span of years from one with limited savings to one in which the domestic savings rate exceeded 10-12 percent, sufficient to sustain growth in the longer term.

Moving into the 1960s world attention was caught by population growth of unprecedented magnitudes in the developing world. Economic growth was led to an acute awareness of the denominator of the per capita income quantum. The rhetoric of development filled with "accelerate" and "maximize" in an effort to keep the pace of economic change ahead of demographic events. The savings-investment-industrialization strategy remained the dominant paradigm throughout most of the 1960s. Thus the mandate to maximize growth in the face of a ballooning population easily led to strategies to maximize savings. Economic theory suggests that the marginal rate of saving rises with incomes. Therefore, concentrating wealth and incomes among a limited number of recipients was seen as consistent with the need to accelerate economic growth through industrialization.

Encouraging concentration became policy in some nations. Wealth concentrations were tolerated in several others as long as these concentrations led to more rapid change in GNP. Inegalitarian growth strategies received theoretical sanction with the concept of forward and backward linkages which were to cause initial advances made by a few entrepreneurs to "trickle down" to the bulk of the population (Hirschman, 1958).[1]

The distributional perspective of this earlier epoch is succinctly stated in the writings of Nobel Laureate W. Arthur Lewis.

> The central fact of economic development is that the distribution of incomes is altered in favor of the saving class (Lewis, 1954).
>
> We are interested not in the people in general, but only in the 10 percent of them with the largest incomes, who in countries with surplus labour receive up to 40 percent of the national income. The remaining 90 percent of the people never manage to save a significant fraction of their incomes (Lewis, 1954).

In his classical study The Theory of Economic Growth (1955), Lewis saw equality and economic development as "two horses (which) will not go in the same direction" (p. 380). He further states "Economic growth is dependent upon the inequality of income. That this dependence exists cannot be denied...," (p. 428, emphasis added).

With this conceptual structure underlying economic development efforts it can be easily understood that "income distribution" as a topic remained the purview of the functional distribution theorists well into the 1960s and was only tangentially brought to bear on economic growth issues.

If the 1950s was a period in which a theoretical base for economic development was constructed, the 1960s must be seen as an era in which these preliminary foundations came into serious question. With growing frequency, seminal ideas emerged which were ultimately to change not only the strategies of development but also the objectives themselves.

One of the first fresh insights was the idea that small farmers in LDCs were rational individuals who followed a carefully defined optimizing behavior. While this thought had been previously advanced, Theodore Schultz (1964) inserted it squarely into the core of development thinking. The idea was expanded greatly at the 1965 East-West Center Conference on Subsistence and Peasant Economies (Wharton, 1969). Wharton subsequently pioneered a utility framework encompassing the risks associated with being very poor (Wharton, 1968).

Thus it became feasible to move the rural poor from the status of "irrational peasants" to actors on the econmomic scene, who had particular problems and a rationality which economic theory could embrace. This imputing of rationality to the poor was a necessary precondition for serious concern with the size distribution of personal incomes which was to follow.

By the end of the 1960s decade, several researchers including the author were immersed in Third World villages largely in Asia and South Asia empirically testing the small farmer rationality hypothesis. Among the observations to emerge from the village perspective was that, despite rapidly growing national economic aggregates, life for the village-bound majority was not improving and in many cases the conditions of existence for the abject poor were growing worse. In short, large segments of the population were not participating in growth.

Recognizing this Johnston and Kilby (1975) put forth a "unimodal" concept of the development process which provided a strong

counterpoint to the two sector models of Lewis (1954, 1958), Ranis and Fei (1961) and their intellectual descendents. The unimodal idea was one of the first clear statements that equality of participation might lead to a fundamentally different growth process with considerably greater long term viability and more acceptable social consequences.

An agricultural fundamentalism emerged based on 1) the rationality of the small farmer, 2) the unimodal concept of participation and 3) the productive potential of cropping as shown by the "Green Revolution". This strategy had emphasized rural economic activity, the involvement of the majority and technologies and institutions appropriate to the majority. Each of these dimensions was in counterpoint to the urban industrial strategies of the previous two decades. That such a strategy was preferable was suggested in a number of cross-country comparisons (e.g. Owens, 1972; Owens and Shaw, 1972).

A significant redirection arose in the human capital school of thought. Pioneered by Schultz (1968) and supported by literally dozens of other researchers, the thought that direct investment in the skills and capacities of human beings could yield positive economic change was ultimately to lead to a humanizing of the objectives of development. In the process a wholly new set of strategies were opened up for government action. Two derivative effects are noteworthy. First human capital theories proved to be much more powerful in the analysis of distributional issues than the older Harrod-Domar conceptions of the growth process. Second, human capital concepts provided a significant reinterpretation of the post-war European experience which suggested that while investment in physical capital might be important, the economic response would be strongly influenced by the extent of human capital available. This idea called into serious question the efficacy of blindly applying investment oriented development strategies in LDCs.

Thus development entered the 1970s with a new found concern for the economic underdog. The question was finally being asked: are equality and growth really horses headed in opposite directions; or, could distributional objectives be made central to the growth process without sacrificing income growth?

The result was an explosion of theoretical and empirical work on the size distribution of personal income. This research suffered at first from an absence of data which, in itself, attests to the neglect this topic had previously received. Under the leadership of the World Bank the empirical base for research on personal income distribution has grown to the point of serviceability (see e.g., Jain, 1975).

Sahota, in his exhaustive survey of the literature (1978), noted that economists, since the turn of the century, had bewailed the lack of a satisfactory theory of personal income distribution. This complaint can be observed in the literature until 1974. However, Sahota notes this concern was "conspicuously absent" by 1976 and 1977. The corner had at last been turned. The issue of income inequality is now stage center among leading development concerns. And it is possible to trace the evolution of more recent issues, e.g. concern with poverty (as distinct from maldistribution),

basic needs strategies, etc., as a logical extension of the metamorphosis described above.

The Range of Theory

Our ability to develop economic models as policy tools is ultimately constrained by the limits of theory. Presented below is a brief outline of the several major theories in use with respect to personal income distribution. The intent is to sketch the framework within which present and future efforts at policy formation must take place. I am indebted to Gian Sahota's excellent survey (1978) for the taxomony and analysis summarized below.

Personal incomes commonly show positively skewed distributions within most populations. Cases of symmetrical distributions are exceedly rare and negative skewness, if it occurs at all, would reflect an atypical institutional environment. The theories described below were largely developed in an attempt to explain how a positively skewed distribution could arise and be sustained.

Ability Theory: One of the oldest concepts, it is an expression of the thought that "all men are NOT created equal". Incomes are hypothesized to be related to the distribution of natural abilities. However, innate ability is presumed to be distributed normally while incomes are generally found to be lognormally distributed. Considerable work has ensued examining factors which would skew the expression of innate ability toward the lognormal pattern. The search has covered institutional factors, personality factors, the complimentarity of factors and other rationale. Ultimately this logic runs up against the question of acquired capacity vs. inherited capacity, the nature vs. nurture dilemma, and at present it appears to have floundered there. To the extent that acquired abilities become an important factor, one is borrowing from human capital theory which is treated briefly below.

Stochastic Theory: Most econometric models have a "U" or unexplained variance term which is often quite small. The perspective behind this theory essentially elevates the role of chance, "luck", or random circumstances to being significantly determinant influences. If one assumes a multiplicative relationship between random events, a lognormal relationship results. Furthermore, if one assumes that survival is impossible below some minimum level of income, then the left-hand tail of the distribution which might be stochastically determined will be (severely?) truncated in populations where the mean income is only a little way above the survival income level.

The principal weakness of this theory as commonly modeled is that time enters multiplicatively. Thus the variance of the income distribution continues to increase with time. Presumably the inequality within society should behave similarly yet there is no empirical evidence to support this hypothesis as fact.

Individual Choice Theory: This body of concepts, in contrast to the previous two sets, assumes a deterministic influence by the individual based on his or her rationality. It is a logical outgrowth of Friedman and Savage's early work on the association between risk and the utility function for money (Friedman and

Savage, 1948). The theory assumes that the distribution of incomes will reflect the extent to which the population is risk-preferrers or risk-averters. Sahota states, "In general, dynamic societies are characterized by very few high risk-takers and vast majorities of the risk-indifferent and risk avoiders". This situation would result in a positively skewed distribution of personal incomes, assuming that taking higher risks receives higher than average rewards.

Human Capital Theory: This concept recognizes both inherited and acquired capabilities, laying emphasis on the latter. It incorporates human rationality in that the process of acquiring skills is viewed as a rational investment to which optimizing economic concepts can be applied. The idea has been broadened to include the concept of cultural inheritance, e.g., those cognitive skills learned as a child for which the determinant influence was the parents and their choice of environment and/or investment in education.

Incomes are then assumed to be a function of the skills acquired. Human capital adherents view lifetime income streams as the return on investments made to develop skills and capacities. A positively skewed income distribution can result from multiplicative relationships 1) between acquired skills (e.g., from formal schooling and post-school experience), 2) between acquired and inherited skills or 3) from a motivational distribution in which there are a few high achievers and relatively many who are less strongly driven.

Theories of Educational Inequality: The dominant thought in this context is that various environmental factors condition student response to education. Significant among environmental factors is the early childhood environment in which much of the child's cognitive development occurs. Thus, even when exposed to identical educational opportunities, children will learn differentially with those from deprived early childhood environments lagging progressively further behind. One logical implication is that intergenerational mobility between ability levels (and thus income classes) would be limited.

Inheritance Theory: The preceding five categories deal primarily with earned income. This section treats unearned, or property income. An individual can inherit from his or her parents; 1) a genetic endowment of abilities, 2) a cultural inheritance and, 3) property. The first two have been alluded to above. Property ownership and the resulting unearned incomes are often less equally distributed than wages or earned incomes. Conventional treatment suggests that "wealth begets wealth" and that unearned incomes tend to set in motion economic processes by which propertied classes sustain their position of relative affluence. Inheritance of property contributes to intergenerational transfer of these inequalities. While the relative importance of unearned incomes as a share of total incomes has declined over time, it remains a significant determinant of incomes among some classes in non-socialist societies. Finally inherited wealth tends to be positively correlated with the other types of inheritance mentioned above and with greater investments in human capital. Thus, the lognormal distribution of total incomes reflects not only the distribution of

unearned incomes but also their multiplicative relationship with these other factors.

Life Cycle Income Variations: It can be generally observed that incomes rise with age and then decline with retirement. Thus, two individuals of different ages but with identical lifetime earnings paths will at any point in time have differing incomes. Some authors feel that measures of inequality taken at a single point in time will overstate actual inequality due to the influence of this age-wage relationship. It is thus suggested that a more accurate inequality measure would be based on lifetime incomes.

Aside from the difficulty of measuring lifetime incomes there have emerged reasons to question this simple relationship. Chief among them is the fact that younger workers are employed with higher complements of physical and human capital than were the older generation when they began their working careers. This factor would operate to narrow the variance of point-in-time measures and widen that of estimated life cycle income estimates. Therefore, while income variation over a life cycle is an important point to consider, there is no clear concensus regarding its impact on measured inequality at this time.

The Effectiveness of Theory in Structuring Interventions

We are ultimately interested in the usefulness of these theories for policy formation. Throughout the Third World, governments are searching for equitable growth strategies. In part this stems from a serious concern with the quality of life for the poor. It must also be recognized that political stability could frequently be improved if more egalitarian societies were achieved. Thus, mere theorizing is not sufficient; there is a real need to move beyond theory to the forms of national or regional models on which sophisticated distributional policy can be based.

The several bodies of thought described above differ significantly in their ability to support policy. To examine these differences, it is useful to distinguish two generic types of distributive strategies: proactive and reactive. As used here a reactive strategy is one which responds to an existing condition, such as poverty, and attempts to compensate for undesired consequences. Direct welfare payments to the poor exemplify a reactive strategy responding to the condition of poverty among the recipients. Proactive policies or strategies are attempts to influence outcomes which have yet to be realized. A land reform would be proactive if undertaken to influence the future distribution of rural income. The following conventional adage, found on posters in foreign assistance agencies, contains both reactive and proactive stances to the problem of hunger and suggests that there are significant advantages to the latter.

> Give a man a fish
> and he eats for a day,
> Teach him to fish
> and he eats for a lifetime.

Three of the above classes, ability theory, stochastic theory and personal choice theory do not easily lead to proactive strategies to influence income distributions. All three place the determinant factor outside of the normal sphere of government influence. For example, aside from medical influences over birth defects, government has no control over the distribution of genetically inherited capabilities. If these capabilities are unequally distributed, the ability theory suggests that income distribution will reflect that fact. If the inequalities that result are sufficient to cause concern, government's roles are limited to offsetting transfer payments or distorting the institutional setting so that the disadvantaged or less capable are rewarded disproportionately heavily.

Similarly, stochastic theory by definition asserts that the determinants of income distribution are uncontrolled. Interventions in the outcome must, therefore, be reactive.

Adherents of the human choice school of thought can offer something more in the way of prescription. In this school of thought incomes are distributed according to the results of optimizing behavior applied to known sets of alternatives and their probabilities. In a number of proactive ways (e.g., price policy, market development, institutional change, risk bearing by government) government can affect either the structure of available alternatives or their associated probabilities.

Government has considerably less influence on the underlying utility framework in which individuals make their decisions. While the extent of risk aversiveness or risk preference in a population must reflect such factors as the average income level, education, and the presence or absence of social services, instances in which government has attempted to manipulate risk perceptions to achieve distributional goals are few.

Thus proactive policies are conceivable. Complications arise in that the relationships between social psychology and economics have not been well developed and thus provide a weak base for policy experiments. Finally, several of the prescriptions that might be considered are diffuse in their impact and, thus, do not lend themselves to programs aimed at particular target groups.

Human capital theory proves much more powerful as a perspective from which to build distributional strategies. First, the theory deals with investments made to alter future events. Thus by definition, strategies built on this concept are generally proactive. Second, the theory focuses on interpersonal differences thus allowing target groups to be easily defined. Programs of human capital investment can then be aimed at these particular beneficiaries, which is important if selected maldistributions are to be addressed.

Third, the human capital approach is compatible with the Western ethic of free choice. Once skills are obtained, the individual is assumed free to apply them to whatever opportunities exist. This is not to suggest that compatibility with Western ethics is a valid criterion for choosing interventions, but merely that program support through foreign assistance is easier to justify and obtain. Fourth, human capital strategies do not require direct transfers in which one group loses so that another may gain.

Investment in skills and knowledge permits building the stock of income generating resources among disadvantaged target groups without reducing the resource complement of the rest of the population. Thus, domestic social and political support is readily found. Last, these strategies generally require identifiable inputs (teachers, facilities, post-school training, etc.) over which government has significant control. It is relatively easy to redirect the delivery system which is frequently already in government hands toward selected beneficiaries.

Theories of educational inequality suggest proactive strategies. Yet, because of the early ages at which the most significant mental experience is obtained it is difficult for government planners to have a direct effect. The United States has experimented with several programs such as Operation Headstart and apparently successfully so. Still, reaching down into the family structure far enough to significantly affect children between the ages of one and four is exceedingly difficult. It is particularly likely to be impossible in households where the parents are themselves cognitively weak. Children of these households are most likely to grow into adults with weak learning skills and their chances for mobility toward a higher opportunity set and income level than that of their parents will be seriously impaired.

The last theory examined here is the inheritance theory which places the cause of income inequality largely on the distributions of property income (rents). Inheritance, as an institution, provides a microcosm of the growth vs. distribution debate. In the Western world inheritance is seen as a significant stimulus to entrepreneurial energy. The prospect of passing on to one's heirs the accumulated assets of a life's work is generally believed to result in higher savings and investment. On the other hand the same institution permits the intergenerational transfer of wealth and to this extent constrains mobility among income classes. In this abstract sense inheritance would seem to increase growth and perpetuate, if not increase absolutely, inequality. In an extreme scenario, taking inheritance theory and stochastic theory together yields a deterministic process in which the resulting income distribution has only a limited relationship to skills and capacities of the individuals involved. This thought somehow violates this author's view of how the world ought to be organized.

Governments have the capacity to alter the importance of unearned incomes as a component of total personal income and the extent to which property based affluence is inheritable. Therefore, the extent to which inheritance plays its dual roles of economic incentive and preserver of status can be a matter of policy, although this issue is often rooted deep in the political-economy or culture of a nation. It is instructive to note that the U.K. and the U.S. strike somewhat different balances even though both purport to be capitalistic democracies.

At the other end of the spectrum are the socialist nations in which private ownership of physical capital does not generally occur on a large scale. Inheritance theory does not apply to explaining income differences in socialist societies. However it must also be noted that socialist developed countries, e.g., Eastern Europe, tend to show significantly lower inequality in their income distri-

butions than do developed capitalist societies (Ahluwalia, 1976). It would appear that much of this difference can be explained by inheritance theory and its associated concern wth property income.

Whether an asset redistribution program is considered reactive or proactive depends on circumstances and the perspective of the analyst. This point is perhaps best illustrated in the case of land reform. In Latin America the land tenure system and the maldistribution of land resources are often cited as the principal cause of the highly unequal income distributions found on that continent (Todaro, 1977). Conversely African land tenure systems (which do not include inheritance) are frequently cited as a major contributor to relatively equal incomes, at least in rural areas (Eckert, 1980). A land reform such as undertaken by Mexico in the 1930s could definitely be considered reactive. However the 1979 Land Act in Lesotho was clearly proactive legislation in that it sought to preserve the traditional equal access to land while creating new incentives for the more efficient use of land resources. The Lesotho Land Act did establish primogeniture inheritance for the first time and thus set in motion a process that will generate a landless class equalling more than 35 percent of the rural population by the end of this century. However, the principal effect of this legislation was to provide means of separating ownership and management through a leasing system. In this case payment of rents was authorized precisely to ensure that land continued to contribute to equity even though the management function gradually concentrated in the hands of the better farmers.

Methodologies for Modeling the Distributive Process

The theories covered above are each only partial theories. While serving to isolate and clarify one particular causative relationship, none of them can be considered a general theory of income distribution. Although the theoretical base has been measurably strengthened, much work remains to be done.

Many scholars have called for a more wholistic framework that would serve to integrate several, if not all, of the available pieces. In the case of econometric models of the growth process, this has often led to attempts to treat a wider range of variables endogenously. This section looks briefly at selected examples of recent models in order to show the divergent ways in which economists are wrestling with the problem.

Harrod-Domar Type Models

The Harrod-Domar perspective of the growth process, taken alone, has little to say about the size distribution of personal incomes. Yet because of its simplicity it is frequently used as a basis for more elaborate models some of which have attempted to capture the distribution process as well as the growth process.

Ahluwalia and Chenery (1976) provide a typical and instructive example -- the attempt to capture several distributional determinants which are normally omitted. These elements include:

a. dualism, capitalists are distinguished from self-employed,
b. concentration of capital, only the capitalist group receives unearned income,
c. different socio-economic groups have differential access to employment prospects,
d. savings behavior differs between the socio-economic groups, and
e. population groups at different rates within each group.

Ahluwalia and Chenery thus model three separate strata with an economy, each of which is distinguished by the type and supply of capital available, by the prevailing capital-output ratio, and by savings and population growth rates which differ. Lower income strata are allowed to work for themselves and those above them on the income scale. In Harrod-Domar fashion, income is determined by wages and returns to capital (for those who own any) and growth is a function of changes in capital stock. They have essentially created three Harrod-Domar models, one for each stratum, linked by the downward flow of wages.

Their model is used to test alternative redistributive policies by running multiyear scenarios and comparing them with a basic solution in which only productivity and population grows. Significant conclusions result which need not be repeated here.

While offering important new insights the Ahluwalia and Chenery model falls short of being complete due to at least two omissions. The first, which the authors recognize, is that differential consumption patterns between income strata are not modelled. This is signifncant because demand differentials embody significant variations in employment, wage payments and the regional and sectoral distribution of economic activity. A second gap in the model is that it does not include a process whereby capital can be transferred to capitalists. Thus the propensity by the rich to accumulate capital by bidding it away from the poor goes unrecognized. If this were recognized, this process could well offset part of the governmentally induced transfers to the poor and partially negate the modest results obtained.

Simulation-type Models

A second significant modeling effort involves the preparation of highly complex systems of interlocking econometric equations. Two recent examples illustrate this process. In the first, Gupta (1977) has built a model of the Indonesian economy using 700 individually specified variables. A second example which is even more complex is the work done by Adelman and Robinson (1978) on their case study of Korea. The Adelman-Robinson model involves a three-stage process incorporating more than 2,500 equations. Within the mix are equilibrium sub-models, partial equilibrium models, and disequilibrium sub-models, all interlinked with each other in a series of iterative stages.

Examining the detailed content of either of these models is well beyond the scope of this paper. A few general comments will suffice. First, one of the real weaknesses in this type of econometric approach is the severe difficulty in communicating model

content to policymakers in third world nations. This observation is in contrast to the Ahluwalia and Chenery approach in which their model's simplicity lends itself to easy communication. It is difficult to imagine formulating a presentation to the Ministry of Economic Planning based on the Adelman/Robinson type of detail in any but the most sophisticated of developing nations.

While greater precision may be possible in modeling an existing set of data, one wonders about extending such a system in projecting the future. Adelman and Robinson note that their model of South Korea showed only a limited responsiveness to a wide range of policy options. It seems conceivable that this may result from an internal sluggishness which is more a function of 2,500 interlocking equations than it is related to an actual non-responsiveness in the Korean economy.

The third consideration is data. One could ask whether a country whose data system can provide real information for 2,500 equations is properly classified as underdeveloped. Gupta's model of Indonesia may provide a counterpoint, however, the generalization seems defensible.

Social Accounts Matrix

The Social Accounts Matrix (SAM) technology has been developed by Graham Pyatt and several others and has now been applied to a number of third world countries. A SAM is a framework with which to disaggregate an economy in order to focus policy attention on a particular set of parameters. Mathematically, it is a Leontif input-output model subject to the particular closure rule that all actual sectors are endogenous except trade and capital accounts. This modeling technique derives its name from the common practice of including households, in a disaggregated fashion, as explicit factors within the model. SAM thus has the capacity to model income receipts from multiple sources and consumption expenditures to multiple sectors. Its power as an income distribution model arises from the potential of including households representing different income strata.

The SAM methodology leads to a pragramatic tool as opposed to one which is more theoretical in its content. Theoretical content of SAMs can vary widely depending upon the emphasis desired. Analytical rigor is obtained from the internal consistency required by the closed input-output system. One of the strengths of this technique is its ability to depict explicitly those portions of the household sector which government might choose as development beneficiaries. Planners can examine a SAM and clearly see the operation of determinants of income for different household classes and how that income returns to the economy to stimulate total demand and growth. The successful application of SAMs in such countries as Botswana and Sri Lanka suggest that this methodology is not dependent upon highly developed data systems.

Future Needs in Distribution Modeling

It is clear that economics has not yet provided a fully satisfactory complete theory of income distribution. Current worldwide

interest in development with equity necessitates further work. The most important methodological issue is to provide an integrated model of growth and distribution which can serve a wide range of policy analyses. Such a model must be dynamic in order to portray economic change over several years into the planning period. It must be able to segregate populations into groupings that reflect different sources and determinants of income.

As work proceeds on the income distribution models of the future, I would suggest that the following items need explicit attention. First, a process of accumulation and inheritance of human capital needs to be built into the overall structure. Empirical evidence presently shows that severe limits exist to intergenerational mobility between income classes. Several of the determinant factors may be beyond the reach of government policy. However, further work is needed to identify those determinants that can be affected by government when intervening for distributional purposes.

A second major need lies in the area of the explicit modeling of consumption patterns. As noted above, the commodity linkages will vary widely between income or consumption expenditure classes. However, attempts have been occasionally made to model this relationship, though often with a great deal of aggregation. There is a need to disaggregate commodities by the factor proportions involved in their production and to give particular attention to the wage bill component. The SAM methodology can potentially do this but data has not yet been collected in any national setting.

There is a further need for modeling of institutional (non-market) barriers to factor mobility. Finally, it is suggested that distribution models contain endogenously an equilibrating process allowing workers to allocate their own labor among various alternatives.

Postscript

Unfortunately the intensive focus of the 1970s on the size distribution of personal income is now being blurred by new urgencies arising in development thought. Among these are concern with the issues of poverty, basic needs, and rural development. Poverty is currently being separated from maldistribution and receiving considerable attention even though it is not yet a clearly defined concept. The basic needs philosophy, in a way, is a statement that the economy cannot be stimulated to provide certain social services so government will provide them directly. Basic needs investments are now taken as an end product due to their humanistic content. They are not necessarily justified as a means toward higher production.

One gains the impression from these recent developments that dealing with the conditions of the real poor is of such urgency that it could not wait for a theory. It this is true, it is unfortunate. In the particular case of income distribution, a sufficient background now exists that it seems feasible to move toward a fully satisfactory theoretical and modeling basis for government intervention in this critical area of human events.

Notes

1. Interestingly, Hirschman also gave us the terms North and South used in the context of distinguishing between the developed, largely northern hemisphere nations and the underdeveloped nations which lie predominantly below the equator. The trickle down hypothesis was articulated, in part, within a North-South context (Hirschman, 1958).

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4
Farming Systems Research: An Applied Agricultural Research Methodology for Farmers with Limited Resources in LDCs

Willis W. Shaner

Introduction

Recently, farming systems research (FSR) has become popular among many concerned with agricultural research's contribution to the production and welfare of farmers with limited resources in the less developed countries (LDCs). USAID now funds numerous FSR activities throughout the world; in 1978 the Consultative Group on International Agricultural Research (CGIAR) confirmed its interest in the FSR activities of several of the International Agricultural Research Centers (IARCs); and other organizations support the effort, such as Canada's International Development Research Centre (IDRC).

I will begin with some ideas as to why earlier research for the LDCs small farmers was inadequate, then follow by describing the FSR approach and why I think it should work. Next, I will provide a glimpse of some earlier FSR activities as applied to the LDCs, summarize the findings of CSU's recently completed FSR project, present some issues about the FSR approach, and close with a few thoughts about FSRs future.

Why Earlier Research Approaches Were Inadequate

Farmers in the developed countries (DCs) and the larger farmers in the LDCs have generally been well served by agricultural research and extension. But smaller farmers in the LDCs have usually been passed over. These small farmers are poor partly because the research was either not appropriate for them or was not reaching them.

Several reasons explain why prior research and extension did not serve the LDCs small farmers very well. For instance:

1. In many of the LDCs--particularly those that were former colonies--research was directed towards the large-scale production of export crops, whereas small farmers' production customarily centers on food crops.
2. Much of the research in the DCs has been for sole cropping, which often assumes large quantities of purchased inputs and mechanized means of production. In contrast, many of the small farmers in the LDCs intercrop using limited amounts of purchased inputs and labor intensive

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means of production. Subsistence farmers who are able to provide for their family's needs reasonably well usually engage in a variety of enterprises during the year (Harwood, 1979). Where possible the farmers often spread out their crop plantings so that crop harvests will more nearly match the family's food requirements. Or, crops may be stored in the field; e.g., some Central American farmers bend over the corn stalks to protect the ears from rain, some West African farmers plant cassava and leave it in the ground until needed, and as Hart (1982) explains corn may be kept until consumed as food or sold to meet the family's periodic cash requirements. Also, Zulberti et al. (1979) point to small farmers' aversion to changes in technology that require increased cash expenditures.

3. Small farmers' resources, practices, and beliefs often keep them from accepting improved means of production. For example, some Guatemalan Indians are loath to thin corn plants because they associate the life of the young plant with that of the child (Hildebrand, 1977).
4. Supplies and services are often inadequate. Equipment such as backpack sprayers may represent too large an outlay for a small farmer; similarly, improved seed or agricultural chemicals may be sold in packages too large for the farmers' budget; and obtaining credit from a bank may take up more of the farmers' time than they can spare.
5. Technologies developed for DC conditions may not be appropriate. In one instance, Ecuadorian farmers, who intercrop corn and pole beans, found the corn stalks of the dwarf varieties to be too weak to support their bean plants.
6. The inappropriateness of research and extension for small farmers' conditions is partly based on researchers' tendencies to (a) work within their discipline and to leave the integration to someone else, (b) concentrate on technical problems, and (c) allocate their time to research leading to publications in the professional journals. Dillon (1976) characterizes the traditional research approach as one in which (a) research tasks are separated into progressively narrower subject areas to be studied more or less independently and then the results evaluated by standards within the discipline, not by the results' contribution to the whole, and (b) social scientists' activities could more usefully be integrated with those of the physical and biological scientists.
7. Lastly, the research and extension environment in the LDCs frequently differs from that in the DCs. Often, researchers in the LDCs do not have a farming background; the cultural distance between small farmers and extension and between extension and research may be great; information available to the small farmers about markets and technologies and to researchers about farmers' needs may be inadequate; and the private sector's contribution to

research, extension, and services may not play the dynamic role it customarily does in the DCs.

What is FSR?

FSR is an approach to agricultural research and development of technology that views the whole farm as a system. Also, FSR focuses on the interdependencies among the components under the household's control and how these components interact with the physical, biological, and socioeconomic factors not under the household's control.

The "systems" in FSR refers more to the identification of, and subsequent research on, specific types of farming (e.g., paddy rice cultivation in the tropics) than to the use of systems analysis techniques (e.g., linear programming and simulation modeling). However, the general methodologies of systems analysis apply whereby problems of the whole system are identified, system interactions are considered when designing and conducting the research, and solutions to problems are tested within the whole farm context.

Typically, the prime objective of FSR activities has been to improve the productivity and therefore the welfare of LDC small farmers, i.e. poor farmers with limited resources. However, FSR techniques based on overseas experiences are now being applied to small farmers in Florida and Hawaii; and some of us would like to apply the approach in Colorado. Success with these LDC farmers should help increase and stabilize food supply and reduce the disparity in incomes.

In summary form, FSR is

- farmer-based because FSR teams pay attention to farmers' conditions and bring farmers into the research and technology development process,
- problem-solving because the researchers have specific, farmer-related problems and opportunities in mind before initiating the research,
- comprehensive because FSR teams consider the whole farming situation (consumptive needs as well as productive activities) in learning how to improve the farmers' output and welfare, in identifying the environment's flexibility for change, and in evaluating the results in terms of farmers' and society's interests,
- interdisciplinary because researchers and extension staff with different disciplinary backgrounds work with farmers in identifying problems and opportunities, searching for solutions, and evaluating and implementing the results,
- complementary because FSR offers a means for using the outputs of other research and development organizations and for giving direction to others' work,
- iterative because FSR teams use their research results to improve their understanding of the farmers' systems and to design subsequent research and development activities,
- dynamic because FSR teams oftentimes introduce relatively modest changes in farmers' conditions, which are then followed by more significant changes as the teams' successes encourage the farmers to accept greater change,

and

- responsible to society because the FSR teams keep other groups' interests in mind (both future generations and those elsewhere in society), as well as those of the farmers immediately affected.

While much of the above is true of other forms of agricultural research and development programs, the combination and emphasis of these factors help to distinguish FSR from other approaches.

Why FSR Should Work

The FSR approach responds to the conditions commonly encountered in the LDCs, which provides in my opinion a sound basis for improving production and welfare among farmers with limited resources.

- The approach meets the need for more careful planning of research activities based on study of the farmers to be helped and the conditions under which they operate.
- The approach applies systems concepts whereby interdisciplinary teams identify researchable problems on farmers' fields and measure results by the way farmers react to the proposed changes. In this way researchers understand the relevancy of their work and the degree of improvement required.
- Rather than looking only at how a technology fits the physical environment, the approach considers how the technology fits into specific farming systems. The interdisciplinary approach provides the basis for accomplishing this. For instance, (a) an early maturing variety might be sought that allows a second crop to be grown, even though the yield from such a variety is less than for later maturing varieties, (b) net profits from fertilizers could be increased by reducing the application rate to a lower level than is needed to maximize biological yields, (c) recognizing farmers' aversion to risk could suggest a less profitable crop whose yields are more stable under variable growing conditions, (d) social and cultural study could explain why some farmers accept improvements and others do not, so that the resulting technologies apply to more farmers, and (e) integrating the extension service into the FSR process could result in modifications in technology that help the extension service serve farmers more effectively (Shaner et al., 1982a).
- The approach recognizes the farmer as a partner to the research process and as a valuable source of information. The hypothetical situation depicted by Collinson in Gilbert et al. (1980) illustrates the point:

> "Agronomist: We thought of having three cowpea to each maize plant in this treatment.
>
> Farmer: What would you do with all those cowpeas?

There's no market and we only eat about 1/5 by weight of maize.

Agronomist: Ok, let's reduce to say equal maize and cowpea to give a ratio close to the weights needed. We thought of putting the cowpea in the row between the maize plants, which are one foot apart.

Farmer: But that only leaves six inches between the maize and the bushy cowpea plant. How can we get our hoes in for weeding?

Agronomist: Ok, what about putting the cowpeas in between the plants within the maize rows?

Farmer: Well, we weed by putting the hoe between the maize plants and pulling weeds into the inter-row. It will slow us down a lot.

Agronomist: So, what do you suggest?

Farmer: Why not put the cowpea seed in the same hole as the maize seed as we do now?"

- The approach realizes that farmers are both consumers and producers, which influences their choices of crops, cropping patterns, and management practices.
- Finally, the approach is capable of working with farmer and environmental constraints. Perhaps this characterizes FSR as much as anything else. The FSR approach looks specifically at farmers' conditions — those under the farmers' control and those beyond the farmers' control. Researchers then decide whether to try to diminish the constraints (e.g., shortages of supplies) or to accept the constraints as given. Of course, if the researchers find that the farmers' position would not be materially improved through relaxation of a constraint, then little would be gained by trying to remove it. On the other hand, if the researchers find that relaxing constraints could bring about major improvements, these findings could be instrumental in helping policy makers justify the needed changes. Alternatively, where conditions in an area are severe and little opportunity for change exists, more might be gained by having the researchers work elsewhere.

A Brief History of FSR in the LDCs

Aside from whatever farm management techniques might have been transferred earlier, FSR applied to the LDCs is of recent vintage.

An initial effort along these lines was Mexico's Plan Puebla that in 1967 attempted to explain to the Government's Ministry of Agriculture and to the Rockefeller Foundation why the Mexican wheat improvement program had been so successful and the maize improvement program had not. The general objectives of the Puebla

"experiment" were to: (1) develop, field test, and refine a strategy for increasing the yields of one of the small holders' basic crops and (2) train technicians in the resulting strategy. Subsequently, the doubling of maize yields was added as another objective. This effort addressed two of the country's development problems--food shortages and low incomes in agriculture (Winkelmann, 1976).

The Caqueza project, a rural development activity initiated in Colombia in 1971, contains several FSR characteristics. For example, it relies on technical change as a means for rural development and it places strong emphasis on understanding farmers' conditions, multiple cropping, and on-farm research. However, the project goes beyond agricultural production to consider factors influencing rural welfare, such as sanitation, food preparation, nutrition, and child care (Zandstra et al., 1979). In designing the project, Government staff considered rural development experiences elsewhere, such as the Borgo a Mozzano project in Italy, the Comilla project in what was formerly East Pakistan, the Intensive Agricultural District program in India, and the Puebla project.

At about the same time, Richard Bradfield at IRRI, and others, were experimenting in ways to intensify crop production. As I understand the story, Bradfield wished to demonstrate the optimal use of land and water through multiple cropping and intensive use of purchased inputs. Conditions at IRRI permitted year-round cultivation and the use of improved rice varieties in combination with other crops. While conditions of limited-resource farmers do not permit such intensive practices, FSR has benefited from the lessons learned in intercropping and related areas.

More recently, the CGIAR authorized its Technical Advisory Committee (TAC) to conduct a review of the farming systems activities of its member institutions (TAC, 1978). Accordingly, a review team visited FSR activities at ICRISAT, IITA, and IRRI and reviewed the earlier FSR work at CIAT, which had discontinued its program.[1] In addition, the team visited ISRA--the national FSR program for Senegal--and CATIE--the Central American FSR Program headquartered in Costa Rica. This review helped the CGIAR in reaching its decision to continue supporting FSR activities at these and several of its other institutions. These others include CIMMYT, CIP, ICARDA, and ILCA. The latter two organizations have major FSR programs.

In addition to these activities, FSR programs have been underway in several countries for a number of years. These include Ecuador, Guatemala, Honduras, Indonesia, Nepal, Philippines, and Sri Lanka. Of these, the programs in Guatemala and Indonesia are probably the most developed. Moreover, USAID is helping fund other FSR programs around the world--particularly in Africa.

CSU's FSR Project

In 1978 the Consortium for International Development (CID) received a $1.2 million contract to review current FSR activities and prepare a set of guidelines. These guidelines were to be directed primarily to those in the LDCs. CSU became the lead institution, with major contributions by the University of Hawaii and numerous individuals.

When the study began, most of the literature on FSR was being

generated as in-house documents. With a few notable exceptions, little was available in published form because of the recency of the program. Consequently, we were forced to gather documents and information directly from those doing the work. In addition, we invited FSR practitioners to attend workshops in which they reviewed our progress and offered recommendations. Throughout, we concentrated on concepts and procedures that had proved successful in the LDCs because so little FSR was occurring in the United States. Also, research on cropping systems dominated our findings since scant effort was being devoted to livestock or whole-farm systems. Nevertheless, the methodologies incorporated in our synthesis can, in general, be applied to the whole farm. The product of our work is contained in the previously mentioned publication by Shaner et al. (1982a) and in a book of readings on FSR (Shaner et al, 1982b). Below, is a summary of our findings.

Five Basic FSR Activities

We were surprised to find a considerable degree of commonality among the different approaches to FSR being practiced throughout the world. This commonality of methods existed despite the diversity of conditions and the lack of close communication among FSR practitioners at that time. Figure 1 shows the basic activities underlying many of the FSR programs. These activities are (1) target and research area selection, (2) problem identification and development of a research base, (3) planning on-farm research, (4) on-farm research and analysis, and (5) extension of results. Figure 1 also shows (1) the way extension and experiment station activities interact with the five FSR activities and (2) the iterative nature of the approach whereby results from the latter activities feed back to the earlier activities.

Target and Research Area Selection: The basis for selecting the target area is generally a combination of national or regional policy objectives and the area's potential. Once selected, on whatever grounds, the area is stratified according to subareas of commonality. Then, FSR teams select research areas that include one or more of these subareas, depending on research objectives and the importance of individual subareas.

Problem Identification and Development of a Research Base: Interdisciplinary teams study secondary information and conduct field studies to identify problems and opportunities for research. During this phase, the teams become acquainted with the general level of research activity in the area, conduct rapid reconnaissance surveys to learn about farmers' conditions, establish the need for further data collection, and sometimes carry out experiments to learn how the farmers' systems respond to change. An output of this stage is the teams' ranking of research possibilities.

Planning On-Farm Research: At this point the researchers plan their investigation of the identified problems and the opportunities for improvement. Included are (1) deciding on the types of experiments and studies to conduct, (2) selecting farmers to take part in the experiments, (3) establishing design standards for on-farm experiments, such as the number of treatments and replications, (4) deciding on the level of technology at which to conduct

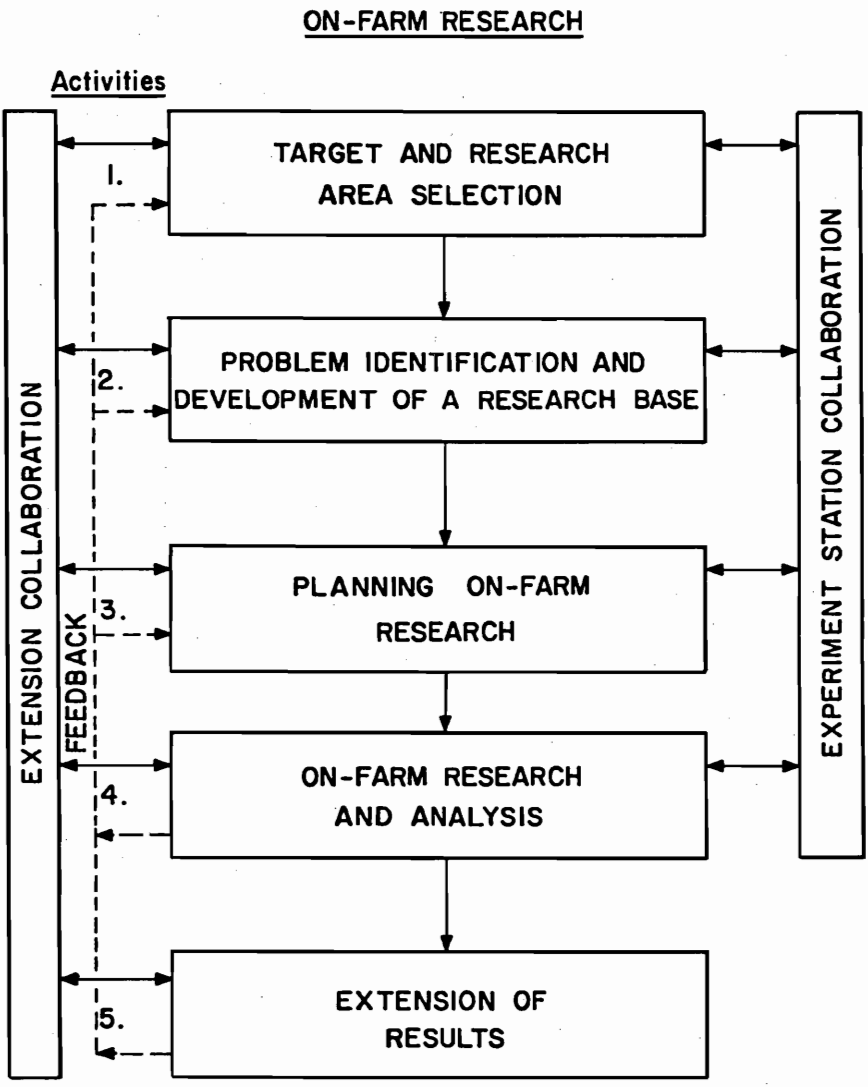

Figure 1. The Five Basic Activities of FSR&D (Shaner et al., 1982).

the experiments, which includes setting the nonexperimental variables at a level that corresponds to either actual conditions or those recommended by extension, (5) agreeing on how results are to be measured, analyzed, and interpreted, and (6) arranging for support from local experiment station staff and othes. An important part of this activity is the ex ante analysis, whereby the FSR team explores the implications of their work based on assumptions about how the research will turn out and what the area's future conditions are likely to be.

On-Farm Research and Analysis: The next activity involves on-farm experimentation and evaluation of results. The main types of on-farm experiments are (1) those that are conducted on farmers' fields under farmers' conditions, but managed by the researchers, (2) those that are managed by the farmers under their conditions, and (3) something in between called superimposed trials. Experiments and environmental conditions are monitored and crop records are kept by farmers who participate in the experiments and by those who do not. The experimental results are then analyzed for their biological significance, followed by partial budget analyses that consider risk, financial, and, where necessary, sociocultural issues.

A distinction between on-farm research and experiment station research centers on the variability of results. Zandstra et al. (1981) point out that in FSR, experimental replications are generally across the area being tested rather than within a farmer's field. What is being sought is an improved technology that applies to farmers operating under similar conditions within the research and target areas. By conducting experiments under farmers' conditions and with replications across farmers' fields coefficients of variation will be higher than when research is conducted at the experiment station or within a farmer's field, where conditions are more uniform. Given this situation, technology recommendations tend to be made at lower levels of confidence than is normally the case.

Another cause of variability in experimental results is the practice that allows the farmers to vary the experiments under their control. Despite the disadvantages from a statistical viewpoint, the way farmers alter experiments provides important insight into their conditions, objectives, and management practices. Of course, the farmers need to have enough commitment and understanding so that the experiments have a chance of being tested. On the other hand, should the farmers find great difficulty in conducting the experiments, then the researchers have probably overlooked something important. Also at issue here is what type of farmers to choose--those that are representative of the area, the more cooperative farmers, or the leading farmers.

Extension of Results: The fifth activity concerns extension of improved technologies. The FSR approach brings the extension service into the process at each of the foregoing stages through the FSR teams' contacts with the area's extension staff and by having extension staff as members of the FSR teams. Technology diffusion also occurs through multilocational testing and pilot production programs (Zandstra et al., 1981). For multilocational tests, researchers extend the results obtained in the research area

to similar areas within the target area. Because of variations in an area's conditions, the researchers may modify their recommended technologies slightly; major modifications are usually not required provided the FSR procedures are followed closely. For pilot production programs, the researchers test how the local environment responds to the introduction of the technology on a limited scale. Availability of supplies, demand for the program's output, and similar factors are the types of information sought from this effort.

Implementing FSR Activities

Our review of FSR activities revealed the breadth of ways in which the approach can be applied. This flexibility applies to the types of organization and staff. Which approach is taken in a country depends on the prevailing conditions within the country and the preferences of those making the decisions. FSR can be initiated as a program, which has long-lasting implications, or as a project, which limits the government's commitment. FSR activities can be carried out within existing organizations, or new organizations can be created. The center of activities can be within a ministry or at an experiment station.

A common approach is to assemble interdisciplinary field teams with from two to five professionals. These teams live and operate in or near the research area. They are supported by full-time technical assistants and periodically by more senior staff from the experiment stations and other research and implementing organizations.

As is perhaps obvious, a key to implementing FSR activities is the training of field teams. New staff can be brought in for training, or existing staff can be trained. But for the most part, new staff have been required. In Guatemala and Honduras, where experienced researchers tend to be scarce, students graduating with B.S. degrees have typically been placed in nine-month programs that simultaneously train and help implement the Government's ongoing research programs. Whatever training approach is taken, some form of initial exposure to FSR concepts and procedures is an essential first step.

Some Issues in FSR

A variety of issues surround FSR. I could have selected many, but the ones below are frequently raised. They provide further insight into the state-of-the-art. These issues concern whether or not FSR is really new, whether FSR is cost-effective, whether meaningful problems can be accurately and quickly diagnosed, how one brings about interdisciplinary teamwork, whether technologies can be designed specifically for small farmers, and what to do about the resistance from those preferring the status quo. My treatment of these issues will be light. Each deserves considerable study of its own accord.

Is FSR Really New?

This question repeatedly came up during our study. Perhaps the most useful presentation on the subject was provided by Glenn Johnson at last year's FSR Symposium at Kansas State University.

Johnson (1982) traced the history of farm management in the United States and compared the approach with that of FSR. According to his account, technical scientists in agriculture developed farm management as a field of study during the early 1900s. What began as a disciplinary effort evolved into an interdisciplinary effort as the broader aspects of farm management became apparent.

These scientists eventually recognized the need for social scientists. Not infrequently, according to Johnson, the head of a farm management department hired a rural sociologist to interpret the meaning of farmers' actions. During the 1920s John Black of the University of Minnesota (later of Harvard) introduced production economics to farm management.

Continuing with Johnson's account, by the late 1950s farm management looked more and more like a sub-field of production economics, which began to lack the interdisciplinary breadth for handling technical, institutional, and human problems. However, production economics did not prevail over the farm management field and work continued on institutional and human issues. Johnson then described some of the more relevant U.S. programs in farm management. Those highlighted were the Balanced Farming program at the University of Missouri, the Farm and Home Development program at the University of Kentucky, and the Interstate Managerial study, which was a large empirical study of midwestern farmers.

Johnson weaves into this account the contributions to farm management of advances in thought and methods of a variety of subjects. These subjects include the interrelationships between the firm and the household, home economics, the distinction between large commercial farms of the Corn Belt and poor farms in the South, the dynamics of decision making, portfolio analysis, analysis of choice involving risk, and related topics. He closes the section on farm management by supporting the IARC's emphasis on farmer-adapted technologies using FSR. But he stresses that FSR is a "continuation of a long standing procedure in the land-grant colleges and universities rather than something new".

My admittedly limited review of farm management texts (Herbst, 1980; Osburn and Schneeberger, 1978; and Upton, 1973) reveals a heavy emphasis on production economics. That, together with present-day tendencies for specialization at the graduate level and the use of sophisticated analytical procedures, suggests that what now stands as farm management in the United States is quite different from how I see FSR being supplied in the LDCs. The approaches diverge because of such differences as the educational levels of those implementing the programs, the data bases, and the commonality of backgrounds among farmers, researchers, and extension agents.

In reviewing these farm management texts, I do not find the broad integration of disciplines or the emphasis on experimental research procedures that I find in the current FSR literature for the LDCs. What I do see in the United States is (1) the effective way farmers' needs feed into the research and extension process, whereas evidence suggests that small farmers' needs in the LDCs are not well understood, (2) applied farm management concerns how to help farmers improve the efficiency of their operations given available technologies, whereas FSR strongly influences the types

of research to be undertaken, and (3) farmers' constraints and opportunities for improvement are often apparent, whereas identifying farmers' problems in the LDCs usually requires careful diagnosis by interdisciplinary teams.

In conclusion, much of FSR concepts and methodologies have their historical precedents in farm management as it evolved in the United States and Europe (e.g., see Case and Williams, 1957; and Conklin, 1982). But present-day farm management differs importantly in its emphasis from FSR currently being applied in the LDCs. Moreover, FSR is new to those in the LDCs (Norman, 1982). This leads me to conclude that more attention does need to be paid to farm management, especially to those earlier writers on the subject, and that we cannot assume that someone who knows present-day farm management in the United States or Europe necessarily understands FSR as applied to small farmers in the LDCs.

Is FSR Cost-Effective?

One of the criticisms we encountered early in our study was that FSR is too site specific. Too many scarce resources are concentrated on too few farmers. In other words, FSR is not cost-effective. However, FSR practitioners argue that the approach is cost-effective.

This effectiveness centers on the relative costs of FSR, rate of adoption of improved technologies, and the speed of implementation (Harrington, 1980). First, while FSR may appear to be costly because of recurring travel and per diem expenditures and its use of interdisciplinary teams, it is not necessarily more expensive than other forms of research. For example, experiment station research can be expensive too when consideration is given to the investments in experiment station facilities and the relatively high cost of station personnel. Second, FSR is believed to lead to a higher rate of adoption per unit of expenditure than more traditional research, although this contention is not well documented. Third, FSR survey and experimental procedures are designed for quickly improving conditions of targeted farmers. This characteristic shows up (1) in the rapid reconnaissance surveys and the advice that a cropping season should not go by without some form of on-farm experiment and (2) in the search for better not necessarily best solutions. The reasoning for this second tactic is that the costs of moving from better to best often exceeds the value of the improvements (Winkelmann and Moscardi, 1982).

Moreover, FSR procedures aid in transferring research results to farmers not participating directly in the on-farm experiments. This possibility underlies the FSR teams' intention of selecting relatively homogeneous farmers and farmers' conditions when identifying subareas and choosing cooperating farmers. Also, FSR teams lay the groundwork for extending their findings by their association with extension and by conducting the multilocational trials and the pilot production programs, as described earlier.

Successful extension of results, however, depends on the FSR teams' abilities to identify enough farmers who operate under similar conditions. This in turn means identifying those key conditions that stratify farmers according to whether or not proposed technological changes will be acceptable to them. In my

judgment, the ability of researchers to adequately stratify farmers' conditions will remain an open question until enough time has elapsed to evaluate the impact of current FSR activities. An evaluation of Guatemala's FSR program revealed a significant increase in highland farmers' use of improved corn varieties (McDermott of USAID, personal communication). However, to date most FSR programs have received only cursory evaluations of their impacts.

How Are Farmers' Problems Diagnosed?

Early in our study I was concerned about how FSR teams could effectively diagnose farmers' problems. My reasoning followed the analogy of a doctor diagnosing a patient's illness. Proper diagnosis is oftentimes difficult, even for experienced practitioners. How then, could relatively young and inexperienced FSR field teams diagnose the problems of seasoned farmers, whose practices often evolved through years of trial and error? If the teams' diagnoses were wrong or the solutions ineffective, the results might be worse than had the teams attempted nothing at all.

However, the procedures of FSR, which have also evolved over time, guard against the foregoing problem. First, the younger staff of the field teams do not work alone. They receive help--especially during the diagnostic and evaluative stages--from experienced trainers and specialists as well as from the area's farmers. Second, the teams bring to the farmers' situation scientific knowledge that the "streetwise" farmers generally do not possess. Such knowledge is especially important where external conditions are forcing the farmers to change their traditional practices. Third, the riskier experiments are conducted as researcher-managed trials, which protects the participating farmers from loss. Finally, proposed changes in technology are introduced incrementally so that researchers "zero in" on correct answers. This approach is part of the iterative process that relies on a team's previous research to improve its subsequent research. Also, the approach suits the farmers' inclination to accept one or two changes at a time, rather than whole packages of changes.

How to Create Interdisciplinary Teamwork?

Much has been said in FSR about the need for interdisciplinary teamwork. (I use this term rather than multidisciplinary to connote effective integration of the disciplines). Yet, how does one bring about such teamwork? During our travels, I repeatedly asked what "tricks of the trade" did the teams use. Below are some answers. But first I want to give two examples of what interdisciplinary teamwork is not.

Hildebrand (personal communication) tells about his early experiences in team-building at ICTA. Upon arriving in a farmer's field, he recounts how the entomologist began looking for bugs, the soil scientist grabbed a handful of dirt, and the sociologist was off talking with the farmer's family. Each was following his or her own professional instincts in trying to identify the farmer's problems. In another example, I attended a graduate seminar in which an "interdisciplinary" team presented the results of its study. Each of the four-person team presented an argument as to

why the critical elements of the study were to be found within the member's discipline. The economist said the overriding problems were marketing; the agricultural engineer said that the most important problems related to irrigation; and so on.

In contrast, the thrust of interdisciplinary teamwork, as I understand it, is to unite the disciplines so that they will identify the farmers' most important problems and work towards their solution. While the problems and solutions may lie outside a member's area of expertise, each member can usually find a way to contribute to the team's overall effectiveness. Some of the ideas and approaches we heard for effecting such teamwork follow.

Team members should be competent and comfortable in their own discipline. In this way, they can contribute to the team's overall objectives, gain the respect of others, and not be overly concerned about defending their own discipline. Participants should also want to become effective members of the team. Furthermore, team leaders can facilitate effective teamwork by (1) helping members interact when identifying problems, proposing solutions, conducting research, and evaluating results, (2) urging members to learn and appreciate the paradigms of others, and (3) adequately recognizing and regarding team accomplishments. FSR team leaders in Guatemala and Honduras guard against the tendencies for specialists to polarize according to their disciplines by having the team focus its attention on the whole farm and by encouraging team members to identify problems and offer solutions outside their own discipline. A product of this approach is that one observing the team might find it difficult to identify the team members' disciplines. Agronomists might speak of marginal returns to labor and agricultural economists might speak of split-plot designs--and both would know what they were talking about. In sum, interdisciplinary teamwork requires understanding of others' disciplines, respect, curiosity, and time.

Can Technologies be Designed Specifically for Small Farmers?

As currently practiced, FSR emphasizes improved technologies and other changes specifically for small farmers. But can technologies be identified and developed that selectively favor small farmers? What is to prevent the larger farmers from capturing the improvements aimed at small farmers thereby leaving small farmers no better off, or possibly worse off, than before? I encountered this argument in Brazil, where an EMBRAPA official reasoned that most technologies (e.g., those related to seed and fertilizer) are scale-neutral and that little could be done to keep the larger farmers from taking advantage of the researchers' efforts to help the smaller farmers. He argued that the real problem of small farmers rested with the ineffectiveness of organizations responsible for assisting them. Improving organizations concerned with credit, extension, and similar activities was the place to put one's effort, rather than looking to research for solutions to small farmers' problems.

However, improving such organizations or otherwise altering the farmers' environment is often difficult. If so, does research have nothing to offer? On the contrary. My interpretation is that FSR allows the researchers to work within existing constraints.

For example, if small farmers have difficulty obtaining credit, then research can be directed towards those technologies that reduce the need for credit. Also, some forms of research in response to small farmer needs simply will not hold much interest for larger farmers. Better intercropping is an example. Although larger farmers should be able to adopt an improved corn-bean combination, their existing technology would probably remain superior. While a corn-bean combination might be scale-neutral, efforts to improve it could be relevant for small farmers and not relevant for large farmers. The issue of scale-neutrality misses the point.

What About Resistance from Existing Organizations?

Change to an organization is likely to meet resistance from those (1) whose positions are threatened, (2) who will be forced to learn new procedures, or (3) who simply carry a healthy measure of skepticism about something new. For such reasons, introducing FSR calls for active support from those able to influence a country's agricultural research and extension programs. Where FSR has been successful, initial support came from those high within the government.

Even with adequate support, problems can arise. In one instance, experiment station scientists quickly learned that they would have to go along with the on-farm research program if they were to receive their share of the budget. They then proceeded to use their funds for on-farm research in a way that furthered their own disciplinary interests. (Note, learning how a technology responds to different physical conditions could be of considerable interest to an experiment station scientist and still not be FSR when the scientists pay little or no attention to farmers' practices). This diversion from the FSR approach was thwarted when the FSR director insisted that the scientists' activities must fit within the FSR program and that their budget the following year was contingent on how well they supported the FSR program.

Of more serious consequence perhaps is the question of cultural differences among the LDCs and the DCs. Hofstede (1980), using data from two detailed surveys of the attitudes of those working for a large multi-national corporation, showed how countries could be classified culturally. He used a statistical approach to distinguish countries according to the degree in which those responding exhibited power-distance, risk avoidance, individualism, and masculinity. Typically, respondents from the LDCs exhibited preference for maintaining authority (i.e., high power-distance), preferred lower-risk situations, were less individualistic, and sometimes showed more masculinity as revealed by attitudes about men-women relationships.

Looking at FSR's characteristics in these terms, we can see that potential conflicts based on cultural differences might arise. For instance, FSR calls for researchers to give increased importance to small farmers, which reduces power-distance, and to quicken the pace at which improvements are introduced to the farmers, which violates risk avoidance. Moreover, those expatriates who have been most influential in helping implement FSR programs at the national level have tended to be low on power-distance, risk takers, and individualistic; further, they have tended to attract

fellow scientists in the LDCs who exhibit similar characteristics. However, two key scientists encountered difficulties in implementing their national FSR programs and have since left the programs.

Whether cultural differences among countries or this instance of the two scientists have significance for FSR requires more understanding of the situation and the social sciences than I possess. But the possibility poses an interesting question.

FSR's Future

Notwithstanding the above reservation, I believe that the FSR approach has something fundamental to offer in helping LDCs' small farmers increase their output and general welfare. AID's present commitment to fund FSR programs in a number of countries, the decisions of U.S. universities to offer courses in FSR, and the literature that is beginning to come off the press all testify to the approach's current acceptability. With such increased activity, much more can be done in evaluating FSR's concepts, methods, and effectiveness.

Moreover, the applied nature of FSR lends itself to expansion into other areas. As a minimum, more attention needs to be given to mixed farming systems (i.e., livestock and crops), irrigation systems, farmer groups, and resource management. Morse (1982), at the East-West Center in Hawaii is applying some of FSR's methodology to rural energy issues; and AID and others have shown at least initial interest in applying the approach to forestry.

But, ultimately, terms like FSR and the attention it currently receives may fade away as the procedures become more ingrained in agricultural research and development projects. The FSR approach, which targets research to specific needs, understands the clients, and integrates the relevant disciplines, to name some of FSR's characteristics, it is just good research methodology and does not need a special name.

Notes

1. See Appendix I for an explanation of these and other acronyms.

APPENDIX I

Acronyms

CATIE	Centro Agronomico Tropical de Investigacion y Esenanza (Tropical Agricultural Research and Training Center), Costa Rica.
CGIAR	Consultative Group on International Agricultural Research, Washington, D. C.
CIAT	Centro Internacional de Agricultura Tropical (International Center for Tropical Agriculture), Colombia.
CID	Consortium for International Development, Arizona.
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo (International Maize and Wheat Improvement Center),

	Mexico.
CIP	Centro Internacional de la Papa, (International Potato Center), Peru.
CSU	Colorado State University, Colorado.
DC	Developed Country.
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuaria (Brazilian Agricultural Research Corporation), Brazil.
FSR	Farming Systems Research.
IARC	International Agricultural Research Center.
ICARDA	International Center for Agricultural Research in the Dry Areas, Lebanon.
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics, India.
ICTA	Instituto de Ciencia y Technologia Agricolas (Agricultural Science and Technology Institute), Guatemala.
IDRC	International Development Research Centre, Canada.
IITA	International Institute for Tropical Agriculture, Nigeria.
ILCA	International Livestock Centre for Africa, Ethiopia.
IRRI	International Rice Research Institute, Philippines.
ISEDS	International School for Economic Development Studies, Colorado.
ISRA	Institute Senegalais de Recherches Agricoles (Senegalese Institute for Agricultural Research), Senegal.
LDC	Less Developed Country.
TAC	Technical Advisory Committee of the Consultative Group on International Agricultural Research, Washington, D.C.
USAID	United States Agency for International Development, Washington, D.C.

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5
Some New Methods of Predicting Changes in Economic Inequality Associated with Trends in Growth and Development

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I. INTRODUCTION

As its title indicates, this paper describes some recently developed methods of measuring comprehensive economic inequality and relating intertemporal changes in economic inequality to basic trends and potential determinants of economic growth and development, to growth in levels of per capita income and expenditure, and to inflationary and deflationary movements of commodity prices, wage rates and to other economic variables. This paper describes a model of economic inequality that is designed for analysis and prediction of directions and rates of intertemporal change of inequality in the personal joint distribution of household expenditures on commodities and on securities, tax payments, and the separate components of household income and wealth. The macroeconomic character, and the modest number of dimensions of the multivariate distribution reflect an effort to keep it usable by private participants in the policymaking process generally, and by executive policymakers and their advisors. The personal joint distribution of consumption of goods and services, of the payments of taxes, of the ownership and control of various forms of property, and of the receipt of various forms of income, constitute the subject matter meeting ground of policymaking and the several distinct social sciences. Politics (according to Harold Lasswell) is the perennial question of Who Gets What, When, How, Lasswell (1958). Political science is concerned at bottom with the changing joint distribution of commodities, wealth and income, especially as it affects the distribution of consumption, deference, and safety in a society. Actualized and developing inequalities in the distribution of wealth and commodities (including safety and deference) constantly provoke attacks on the political and economic systems that are perceived to cause or to permit trends in such inequalities to develop or continue; cf. Lasswell (1958) p. 26, p. 73; Sen (1973) p. 1; Brandt (1980) p. 49.

The model of inequality is composed of two main parts. The cross-section model is a specified multivariate personal distribution of (annual) expenditures on different groups of commodities, including taxation, and receipts of several different components

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of income. Inequalities in the personal marginal distributions of expenditures and components of income depend on parameters of the joint distribution. The parameters are presumed to change from year to year. In broad terms, the parameters of the cross-section model characterize the wants and want-satifying skills of households in relation to their opportunities to satisfy wants. For each year the parameters of the joint distribution reflect the relation among households' wants, their abilities to satisfy those wants directly by economic activities that do not show up in the social accounts, and their abilities to satisfy wants indirectly by purchases of commodities and sales of labor and services that do show up in the social accounts. The model of intertemporal change, called the intertemporal model (of the parameters of cross-section model) relates year-to-year changes in the personal joint distribution of expenditures on commodities and components of income to changes in specified exogenous variables. Among the latter are changes in growth trends, inflationary changes of commodity prices, and so on. Consequently, the intertemporal model predicts year-to-year changes in various measures of economic inequality redistributive effects of taxation, and public transfers, under the impact of such exogenous variables.

Multivariate personal distribution models of economic inequality have many different uses in policy-oriented positive research, normative policy formation, and policy evaluation. We shall mention a few of them in the next few pages. However, space constraints limit illustration of uses of this model of economic inequality to those which appear best to serve the immediate educational objectives of the International School for Economic Development Studies (ISEDS). Accordingly, the illustrations chosen emphasize these uses in positive research:

(1) The use of the multivariate personal distribution model in accounting for empirical regularities among numerical measures of different aspects of economic inequality;
(2) The use of the model to assess the relative importance of economic growth variables versus levels of per capita expenditure prices, wage rates, etc., as potential causes of intertemporal changes in economic inequality;
(3) The use of the model to assess the importance of cultural differences in accounting for contemporaneous differences of economic inequality between countries at either different or same levels of economic development.

In addition to the above, a complete list of uses of the multivariate personal distribution model of economic inequality in policy-oriented research would include all of the by now familiar uses of single variable personal distributions (say) of pre-tax income, of tax payments, of post-tax income, of public transfer payments, and so on.[1] Those single variable personal distributions of economic variables are derivable as marginal distributions from the multivariate personal distribution model. However, the multivariate personal distribution model of economic inequality is able to measure some additional aspects of progressivity of direct and indirect taxation, of horizontal and vertical equity of income tax

burdens, and of the redistributive effects of public transfer payments. For instance, we have extended the Dagum (1980) measures of "distance" between personal income distributions for two distinct regions, job categories, or age groups, to make them apply to the measurement of "distance" between related marginal personal distributions that are derived from the multivariate personal distribution model. For instance, an extended Dagum measure of "distance" between the related marginal distributions of total pre-tax income and of tax payments casts some additional light on the hypothesis that households whose total income is predominantly obtained from an owned business generally pay less tax than households receiving an equal total income composed predominantly of wages and salaries. Aspects of horizontal and vertical equity measured by the "distance" between the marginal distribution of pre-tax income and the marginal distribution of tax payments derived from the joint distribution model are supplementary to the aspects captured by other useful measures of the redistributive effects of taxation such as those proposed by Kakwani (1982; 1983, pp. 21-24). Use of the multivariate distribution model in policy-oriented research is not limited to those just mentioned, of course. The joint distribution approach extends in the same way to the measurement of aspects of the redistributive effects of public transfer payments, and other aspects of economic welfare and the incidence of poverty.

Like any other meaningful policy relevant ethical principle, the normative principles of horizontal and vertical equity presuppose some empirically established positive theory. That is to say, their applicaltion in practice presupposes (a) that the antecedent conditions for the valid use of certain definitions are empirically established, (b) that the definitions are empirically nonempty, and (c) that certain general assumptions are in reasonably good agreement with accepted empirical assumptions called "facts".[2] The normative principles of horizontal and vertical equity presuppose, in the sense just indicated, the basic definitions and general propositions of the neoclassical theory of the utility-maximizing individual consumer; cf Feldstein (1976), Rosen (1978). Other microtheoretical concepts used normatively such as welfare functions and cost-of-living indexes, presuppose the empirical truth of much of microeconomic theory.[3] The multivariate personal distribution model of economic inequality preserves a useful connection between the basic definitions and general propositions of the utility-maximizing individual consumer. Just how the connection is preserved will be described in Section III. It should be emphasized in advance, however, that we do not go as far as many other economists in accepting the less fundamental definitions and propositions of neoclassical consumer demand theory as assumptions of our model of economic inequality. In particular we have avoided making the widely used assumption that individual consumer preferences are unaffected by important economic variables such as market prices (except vacuously)[4], levels of consumer expenditure, economic growth variables, and so on. That assumption is not a meaningful (testable) proposition relative to empirical data that can be obtained from revealed preference experiments

actually performed, cf Battalio et al (1973), consumer expenditure surveys, or by time-series market data.[5] Although that traditional assumption is not meaningless relative to incentive-compatible Thurstone-type experiments, cf Basmann et al (1983), the latter are prohibitively expensive to perform, except on a very tiny scale. For practical policy purposes such as the assessment of horizontal and vertical inequality in taxation and in the distribution of public benefits, cost-of-living adjustments of wages and pensions, it is desirable to design concepts and constructions that are meaningful when the assumption that consumers' preferences are independent of market prices and levels of expenditure cannot be accepted even on faith alone.[6]

Of course, problems of distribution and inequality are not independent of the problems of economic efficiency and economic stabilization. For purposes of estimating changes in social welfare and measuring changes in the cost-of-living, it is useful to interpret the intertemporal model as a model of a medial annual household. Given its wants and want satisfying skills, the medial annual household maximizes a specific direct utility function subject to a pair of constraints, which we shall describe in Section III. Changes in economic development variables (for instance) are considered to be potential causes of alterations in this medial annual household's wants and want-satisfying skills. Changes in the latter are described in terms of changes in the parameters of the medial annual household's direct utility function. The medial annual household responds to changes in trends of economic development by altering the ways in which it acquires income. The parameters of the utility function are also parameters of the joint distribution of expenditures and components of income which is the cross section model of economic inequality. Stability of cost-of-living indexes, whose weights are based on the medial annual household's utility function is thus related (in this model) to intertemporal changes of economic inequality.

In economic development literature, the "growth now-equality later," issue has long been keenly debated:

> Is increasing inequality an inevitable byproduct of modern economic growth? Indeed, can the investment requirements of early capitalist development only be satisfied by the surplus generated by rising inequality? cf. Lindert and Williamson (1976) p. 69.

According to Fields (1977) p. 572, the fundamental question is who (which income class or socioeconomic group) gets what share of the gains from economic growth. Some recent participants in the debate are Fields (1977), Ahlawalia et al (1980), Beckermann and Coes (1980), Fishlow (1980) and Fields (1980). On this issue, see also Kuznets (1955), Chenery et al (1974), Sen (1976) and Loehr and Powelson (1981), especially Chapter 6. It is widely and soundly believed that policies intended to affect trends of economic growth also have impact on the personal marginal distribution of income, primarily because the factors that influence economic growth are precisely the factors that are expected to influence the personal distribution of income. In a general way, at least, it is clear that the personal

marginal distribution of income in any country depends on whether the aggregate demand for goods and services produced is adequate to maintain full employment; it also depends on the distribution of ownership of land and capital and on the existence of very large entrepreneurial incomes presumably due to productive innovation. In addition, change in the personal marginal distribution of income is believed to depend on change in the demand for unskilled labor, as well as for specific types of skilled labor, and on the redistribution of income resulting from progressive (or regressive) taxation and transfer payments; cf. Hagen (1980) p. 40. However, it is not clear what are the specific avenues and strengths of response of income inequality to the various economic growth variables. For example, although Lindert and Williamson found that income inequality (in American economic history) displayed considerable variance since the seventeenth century, some recent authors suggest that, although the rate of economic growth (as measured by GNP) increases, inequality; in the personal marginal distribution of income may remain nearly constant; cf. Sewell (1980) p. 2, Moroney (1979) p. 69, and the World Development Report (1981) p. 182. It is possible, of course, that individual effects of growth trends of income inequality (in U.S.A.) are at all times very weak.

For instance, such an hypothesis does appear to be consistent with the diverse empirical income inequality measures (U.S.A., 1947-1978) presented in TABLE 1.1.[7] For the recent past, variations of these income inequality measures are relatively small when expressed in terms of their coefficients of variation. The latter range from about one and one half percent for the inequality measures B and G to about five percent for the inequality measure C. In comparison with the variation of inequality measures between countries, the recent intertemporal variation of income inequality within the United States has been small. These between-country variations range from about twenty percent for B and G to about forty-six percent for T and K. But the alternative hypothesis that effects of individual growth factors are at all times very strong, but in the recent past have had counteracting effects on the personal marginal distribution of income, also appears to be consistent with the empirical inequality measures shown in TABLE 1.2. Under either of these hypotheses, there would have been little tendency for economic devleopment trends to smooth out inequalities in the personal marginal distribution of income in the recent past; cf. Jarvis (1974) p. 168.

These two alternative hypotheses, however, have differing implications for the future. The former implies that regardless of future changes in patterns of economic growth, variations in measures of income inequality must continue to be approximately what they have been in the past. The latter hypothesis, which includes the former as a special sort of limiting case, implies that, with a change in patterns of economic growth, cessation of canceling out may produce systematic changes in the future personal distribution of income. Economic policymaking that assumes the former, or "negligible effect", hypothesis risks being surprised by events to which it may not be able to respond as quickly as exigencies may require. On the other hand, a considerable reduction in that risk can be obtained from rather inexpensive econometric analysis of past data on economic growth.

Table 1.1. Income Inequality Measures for the United States.

Year	B	G	R	T*	K	C
1947	.791	.485	.364	.159	.141	.129
	.783	.477	.357	.153	.139	.124
	.804	.486	.364	.160	.143	.127
1950	.808	.486	.363	.160	.143	.127
	.773	.466	.346	.147	.132	.116
	.780	.473	.354	.151	.137	.122
	.766	.475	.354	.153	.136	.119
	.807	.484	.363	.159	.144	.126
1955	.792	.476	.356	.153	.138	.121
	.784	.471	.351	.150	.133	.117
	.779	.465	.346	.146	.131	.113
	.786	.469	.351	.149	.136	.117
	.797	.477	.357	.154	.140	.122
1960	.797	.478	.358	.155	.140	.122
	.812	.490	.369	.163	.145	.129
	.789	.477	.359	.153	.138	.121
	.789	.477	.359	.153	.138	.121
	.791	.479	.361	.154	.139	.122
1965	.774	.470	.354	.149	.136	.118
	.762	.465	.351	.145	.133	.116
	.775	.470	.353	.148	.132	.116
	.762	.466	.352	.146	.133	.117
	.772	.471	.355	.149	.134	.118
1970	.783	.478	.361	.153	.136	.121
	.779	.479	.363	.153	.138	.123
	.784	.484	.368	.156	.142	.127
	.776	.481	.366	.154	.139	.124
	.773	.479	.364	.153	.136	.123

Table 1.1. Income Inequality Measures for the United States (continued).

Year	B	G	R	T*	K	C
1975	.777	.482	.368	.154	.137	.124
	.781	.484	.370	.156	.140	.126
	.786	.489	.376	.159	.144	.130
	.788	.491	.376	.160	.142	.129
1979	.788	.491	.376	.160	.144	.131
(C.V. (%))	1.525	1.594	2.252	3.049	2.826	3.868

Source: Current Population Report: Consumer Income 1978 U.S. Department of Commerce Series P-60 No. 123

Notes: (1.1a-b) q_i is the income share of the ith quintile where $0 \leqq q_1 \leqq q_2 \leqq \cdots \leqq q_5$.

(1.2a-b) C.V. is the coefficient of variation where C.V. = $\frac{\text{standard deviation}}{\text{mean}}$ X 100.

The inequality measures are defined by:

(1.3) $B = 1 - n^n \prod_{i=1}^{n} q_i$

(1.4) $G = 1 - \frac{2}{n-1} \left[\sum_{k=1}^{n-1} (n-k)\ q_k \right]$

(1.5) $R = \frac{1}{2} \cdot \frac{n}{n-1} \left[\sum_{k=1}^{n} \left| q_k - \frac{1}{n} \right| \right]$

(1.6) $T^* = 1 + \frac{1}{\log_e n} \left[\sum_{k=1}^{n} q_k \log_e q_k \right]$

(1.7a-c) $K = \frac{\bar{\ell} - \sqrt{2}}{2 - \sqrt{2}}$ where $\bar{\ell}_k = \sqrt{q_k^{\,2} + \frac{1}{n^2}}$ $\bar{\ell} = \sum_{k=1}^{n} \bar{\ell}_k$.

(1.8) $C = \left(\frac{n}{n-1}\right) \sum_{k=1}^{n} \left(q_i - \frac{1}{n}\right)^2$

Table 1.2. Income Inequality Measures[a] for Different Countries.

Country	Year	B	G	R	T*	K	C
Nepal	1976-77	.869	.589	.490	.253	.209	.250
India	1975-76	.717	.481	.374	.159	.138	.148
Malawi	1967-68	.646	.421	.383	.147	.123	.148
Sri Lanka	1969-70	.595	.409	.314	.112	.100	.099
Tanzania	1969	.745	.494	.380	.169	.145	.157
Indonesia	1976	.764	.507	.413	.175	.153	.158
Honduras	1967	.967	.715	.598	.377	.303	.372
Philippines	1970-71	.808	.538	.425	.204	.172	.194
Peru	1972	.957	.671	.525	.317	.262	.289
Turkey	1973	.883	.590	.457	.243	.202	.226
Malaysia	1970	.892	.599	.466	.249	.211	.231
Korea, Rep.	1976	.688	.452	.346	.136	.121	.119
Mexico	1977	.910	.615	.476	.264	.221	.243
Chile	1968	.812	.532	.410	.193	.166	.174
Brazil	1972	.967	.706	.583	.365	.293	.355
Costa Rica	1971	.870	.571	.435	.227	.192	.208
Argentina	1970	.797	.518	.398	.182	.158	.163
Yugoslavia	1978	.568	.380	.283	.094	.087	.076
Venezuela	1970	.891	.588	.460	.236	.202	.208
Trinidad	1975-76	.811	.527	.410	.187	.163	.164
Spain	1974	.636	.419	.316	.115	.104	.097
Italy	1969	.726	.470	.353	.148	.131	.129
United Kingdom	1977-78	.551	.383	.301	.095	.092	.081
Japan	1969	.528	.372	.278	.092	.083	.081
Australia	1966-67	.550	.371	.277	.090	.085	.074
Canada	1969	.671	.423	.316	.118	.108	.095
France	1970	.771	.491	.370	.161	.143	.137
Netherlands	1975	.451	.333	.251	.072	.067	.060
United States	1972	.725	.453	.344	.136	.123	.109

Table 1.2. Income Inequality Measures for Different Countries (continued).

Country	Year	B	G	R	T*	K	C
Norway	1970	.560	.369	.275	.089	.084	.070
Germany, Fed. Rep.	1973	.681	.456	.353	.139	.123	.124
Sweden	1972	.541	.363	.273	.086	.080	.068
(C.V. (%))[b]	1	19.713	20.957	23.330	45.559	40.909	50.677

Source: The World Development Report 1981. Washington, D.C.: The World Bank.

Notes: a. The income inequality measures are defined in the legend of Table 1.1.
b. For an explanation of the C. V. see the legend in Table 1.1.

We want to sort out the separate paths of causation through which individual economic development variables might influence total income inequality and, at the same time, cancel each other out. For this, it is important to take account of the probability that inequalities in personal marginal distributions of individual components of received income are quite differently affected by trends in the different economic development variables (as capital output ratio, etc.). Of course, it is correctly and widely perceived that there is a sort of rough relation between inequalities in the personal marginal distribution of total income on the one hand, and politically significant inequalities in the distribution of consumption expenditure, wealth, deference, justice, personal human dignity, and safety, on the other. Probably no one nowadays believes that inequalities in the distribution of such intangibles as deference, personal dignity, justice, equity, and safety depend only on the inequality in the marginal income distribution. For instance, it is reasonable to assume that inequality in the distribution of personal human dignity (not easily quantified, of course) can differ greatly (say) between two countries even when the marginal personal total income distributions of those countries is the same. Inequalities in the distribution of personal human dignity may be more closely dependent on the marginal distributions of components of total income (such as wages and salaries, transfer payments, etc.) rather than on inequality in the personal total income distribution. Inequality in the distribution of deference that income recipients accord each other is likely to be more closely related to inequalities in the personal distributions of expenditures on some specific commodities or groups of commodities than on inequality in the personal marginal distribution of total incomes. In policymaking, it may be that for one country or other, a prespecified social welfare function or social decision function assigns greater weight to inequality in the marginal distribution of expenditure on some commodity, or inequality in the personal distribution of some component of income, than to inequality in the personal distribution of total income. Accepted economic theory implies that amounts of income consumers receive as wages, public and private transfer payments, profits on private business, etc., and the separate expenditures consumers make on commodities cannot, in principle, be statistically independent. In that way, economic theory suggests that economic inequality can be determined more efficiently from joint statistical estimates of the multivariate distribution of commodity expenditures and components of income than from estimates of marginal distributions separately. It is also possible that economic growth variables may appear to have had only negligible effects on economic inequality in the past because their effects have been masked or canceled by opposing effects of other important variables. In Section IV we shall consider the possibility that growth trends have been opposed by inflationary trends in commodity prices and by growth of expenditure on commodities as causes of intertemporal changes in economic inequality.

In order to illustrate the use of multivariate personal distribution model assessing differences of structural economic inequality between countries we shall use Mexico and the United States. In the present application of the intertemporal model to Mexican and United States economic development (1947-1978) we

focus on inequality in the personal joint distribution of expenditure on five major commodity groups, namely, food, clothing, housing, durables (including automobiles), and medical services. This limitation of the scope of our present exposition has been adopted solely in order to ensure good comparability of the Mexican and United States time-series data. However, the general functioning and use of the complete intertemporal model, including the prediction of changes of inequality in the personal distribution of components of income, proceeds on the same principle.

We shall confine illustration of the use of the model of economic inequality to the prediction of intertemporal changes in the Gini measure of inequality, G. There are several reasons for this. Methods of predicting any of the measures (like those in TABLE 1.1 and TABLE 1.2) from the model are essentially the same as in the case of the Gini measure, but they are lengthier to describe. Moreover, the Gini measure, while it is -- like each of the others -- an incomplete measure of economic inequality , is the most widely known measure of inequality. Finally, there is an empirical regularity which allows close estimates of the other measures B, R, T*, K and C in terms of G; cf. Basmann et al (1983c).

In Section II below, we describe the economic development history of Mexico and the United States during 1947-1978, contrasting the behavior of the basic economic development trends in each country. In Section III the cross section model and the intertemporal model of economic inequality are presented. We start with the familiar personal marginal distribution of total income, and proceeding from the more familiar to the less familiar, describe the joint personal distribution of income components, the comprehensive cross section model of economic inequality, and the submodel of the medial annual household. Section IV describes tests of several hypotheses about the relative importance of prices and economic growth variables as well as the statistical procedures used. It closes with a brief explanation of the obtained results, emphasizing dependence of the Gini measure of inequality on prices, total expenditure, and the classic economic development trend variables.

In Section V we shall examine some aspects of structural economic inequality that are related to the structure of preferences, i.e. wants and needs, of households. Suppose that the Mexican medial annual household, representing the wants and want-satisfying skills of Mexican households, had undergone the American price, total expenditure and economic development experience (1947-1978). Would the higher levels of total expenditure and the higher levels of the economic development variables produce significant changes in measures of economic inequality for Mexico? Alternatively, suppose the Unites States medial annual household with its wants and want-satisfying skills were to face the Mexican economic development experience (1947-1978). Would that growth experience have produced significant changes in the measures of economic inequality for the United States?

II. EXOGENOUS VARIABLES OF THE INTERTEMPORAL MODELS

Endogenous variables in the particular intertemporal model to be presented in Section IV are measure of inequality in the distributions of expenditures of five commodity groups. These groups of commodities are: (1) food, beverages, and tobacco; (2) clothing, shoes, personal care and miscellaneous expenditures; (3) housing, energy, and utilities; (4) consumer durables, household appliances, furniture, and transportation; and (5) medical care, education, and recreation and travel.

Exogenous variables[8] in this intertemporal model are (a) per capita total expenditure on the five commodity groups, (b) the corresponding commodity group price-indexes, and (c) economic growth variables. At the outset of our study we considered six growth variables. These variables, designated as Z_i's (with i = 1, ..., 6), are: (1) capital deepening Z_1, representing the change in capital population, i.e. $\ln(K_t/K_{t-1}) - \ln(L_t/L_{t-1})$, which gives the change in capital stock per worker; (2) change in wage rate, $Z_2 = \ln(w_t/w_{t-1})$, which provides an indication of the relative degree of improvement in workers' well-being; (3) relative productivity of labor, constructed as the logarithm of the ratio of wages and salaries to total payments to capital; (4) the interest rate; (5) the capital-output ratio; and (6) the savings-output ratio. (All the data for the Mexican economy was converted to dollar terms using average annual exchange rates for the respective years, in order to facilitate comparisons between that country and the United States.) As will be explained in Section IV, the intertemporal model presented there does not include wage-rate (Z_2) and interest rate (Z_4) among its exogenous variables.

Before testing empirically for the dependence of inequality parameters on economic development variables, it is convenient to describe the main factors that account for the observed economic development and growth in both countries. The objective of this brief description is to show that the evolution of the six economic trends we chose as exogenous growth variables suffices to describe in broad strokes, at least, the exogenous development and growth phenomena. We begin with Mexico. Mexico maintained an average rate of growth in gross domestic product of about six percent per year, beginning in the early 1930's up to the end of the decade of the 60's. This average rate of growth fell to a level of five percent in the period of 1970-1978. Although average growth rates have been sustained over this long period, we can distinguish three different and contrasting subperiods. The first of these ended in the middle of the 1950's and was characterized by high inflation rates and a succession of currency devaluations. The second subperiod started right after those turbulent years and was characterized by high and sustained growth, with price stability and an exchange rate that remained fixed for 24 years. In these years, also, the rate of growth in income was higher than the rate of population growth, having as a consequence a steady increase in

per capita income, at a higher rate than any other developing country. Finally, the period starting in 1972-1973 and going to 1978, again, was characterized by severe inflationary pressures culminating in a devaluation of the peso in 1976. This was followed by high exchange rate instability.

The main events of economic growth in Mexico have been explained before (Solis, 1979) as a result of a sustained process of capital formation which started in the last century (approximately 1876) with the construction of a rudimentary railroad network. This process was interrupted, and even reversed, during the revolutionary years, 1910-1921, and did not start up again until well after the great depression, 1929-1933.

Starting in 1940, a very dynamic agricultural sector and the volume of exports appear to be the main factors responsible for development up to 1957. Government policies, aimed at protecting the industrial development of the country through the substitution of imports, are responsible for reducing the dynamism of the agricultural sector and, consequently, for reducing the volume of exports. During 1940-1955, agricultural production increased at an average annual rate of seven percent, mainly due to new capital invested in irrigation and communications networks. This growth was enough to fully satisfy domestic demand for these products and raw materials, hence leaving a considerable surplus, which provided a considerable amount of foreign currency when exported. During this period, also, the inflation rate averaged ten percent per year. Public expenditure has been held responsible for this phenomenon since it was financed primarily via money creation.

The new era of stable growth was characterized by high rates of growth of the industrial sector, based on import substitution (and hence dependent on protectionist policies) and an increasing domestic market, which was a result of the steady increase in personal income. The agricultural sector grew at slower rates during these years due in part to the distortions caused by switching production to those crops whose international prices remained most attractive. Other sectors experiencing high rates of growth in this period were electricity and petrochemicals.

Despite the high rates of growth experienced in those years, the natural rate of population growth, combined with heavy immigration flows from rural areas to industrial cities, have caused high rates of unemployment and underemployment. This aggravated some problems, like the distribution of income and the migration of workers to the United States. A stagnant agricultural sector, unable to export, and the low consumption levels observed on the majority of the rural and suburban population seem to be the main obstacles that have decisively slowed down the dynamic development of the country experienced during 1960-1970. The other obstacle to growth has been the public expenditure sector, which has been historically unable to sustain a balanced budget. Tax revenues, on the other hand, have been growing at a very slow rate, representing just a small portion of total spending, and this, combined with high levels of tax evasion and an incipient stock market, have forced the government into inflationary financing.

Turning to the United States, we find that in the 120 years since 1840, U.S. national product increased about sixtyfold, an average annual rate of increase of just under 3.6 percent. These

figures refer to the volume of output, that is, after effects of price level increases have been eliminated. The long run pace of growth was about the same in the 130 years before 1840 as in the 120 years after that date. Judged against the records of any other country, especially against the developed countries, American growth has been extraordinarily rapid.

The sources of American growth are very different from those mentioned in the case of Mexico. In effect, the labor force in the U.S. increased thirteenfold during 1840-1969, the supply of land grew over twelvefold, and the supply of capital 105-fold. Davis, Easterlin, and Parker (1972) have estimated that about four-tenths of the growth of ouput was associated with the growth of the labor force, less than six percent with the growth in the land supply, just under one-fourth with the increase in the capital stock, and just over one-fourth with the rise in factor productivity. Despite this uneven growth in factor proportions, the distribution of income among factors was almost unaffected since factor productivities and technological changes moved in directions that just offset the other force.

The pattern of growth has changed markedly and it has been slowing down over time, as shown by the rate of change of output, which was higher in the nineteenth century than in the twentieth. The relative importances of the diverse sources of growth have shifted, too, since the rate of increase of all three factor inputs dropped significantly more than the rate of change of output. At the same time, the contribution of productivity increased dramatically.

As early as 1710, American income per capita was high by the standards of the day, and in 1840 its level was just slightly below that of Great Britain, which was considered the richest country in the world. In the years following 1840, per capita product increased roughly sixfold, or at an average annual rate of over 1.5 percent. According to an estimated figure for 1840, five percent of the families owned about 50 percent of private wealth. Inequality diminished even after the heavy losses of income and capital in the Civil War. Also, there was a decrease in both regional and sectoral income disparaties, coinciding with a reduction in the degree of income concentration.

All these factors put together account for the fact that although the United States accounted for only about six percent of the world's population in 1950, it produced roughly one third of the world's output. This prominent position of the U.S. is a legacy of some 300 years of extraordinary growth.

Now we turn to a comparison of Mexico and the United States in respect of the specific exogenous variables used in the intertemporal model to be tested in Section IV.

Samuelson (1977), in his chapter on the theory of economic growth, uses what he calls "facts of modern development" to describe how the United States economy has developed during the twentieth century.[9] Comparing the different levels of these variables, as well as the basic trends described by them, he assesses the difference between a developed economy and a developing one. The purpose of this section is to describe the behavior

followed by particular growth variables for the U.S. and the Mexican economies. We analyze these variables in order to gain some insight into the relative degree of development achieved by each country, as well as the pattern or strategy described by the variable.

Capital Deepening, Z_1. This variable (Z_1) represents the relative change in capital stock ($\ln (K_t) - \ln (K_{t-1})$) minus the relative change in population ($\ln (L_t) - \ln (L_{t-1})$), and is interpreted as the growth in the capital per worker ratio. This variable has not really shown a clear trend in either country (see Figures 1(A), 2(A)), showing actual decreases in the Mexican case at the beginning and at the end of the period. In the U.S. this variable exhibits fairly constant behavior, with some jumps at the end of the series. Even though Mexico has experienced a higher rate of population growth, the fact that this variable has followed an upward trend suggests that capital per worker has indeed increased over time and, in those years showing values less than zero, the rate of inflation and the depreciation of the currency account for this phenomenon.

Wage Rate, Z_2. A steady increase in the wage rate in a growing economy is presumed to indicate that growth has not brought about immiserization of working people. (Z_2) is included in this paper as $\ln (W_t/W_{t-1})$. The distinguishing pattern of this variable over the entire period is near constancy in the U.S. economy, and fluctuation in Mexico. This makes it impossible to establish a definite trend, since for the purpose of compatability, we are analyzing all the variables in dollar terms, and the years where this variable has reached values less than zero coincide with the years when the Mexican economy experienced high rates of inflation and currency depreciation. Looking at the years of price stability in Mexico (1954-1970), we observe similar behavior of Z_2 in both countries, i.e., interest rate tending to remain constant, with the level in Mexico being slightly higher than in the U.S.

Relative Productivity of Labor, Z_3. This variable (Z_3) is constructed as the logarithm of the ratio of wages and salaries to total return to property. This variable is an indicator of how the payments to the factor labor have been changing over time. The main contrast here is that, while for the U.S. this variable has values greater than zero during the whole period of analysis, for Mexico it shows values less than zero only, signifying that the payments to labor in the Mexican case are small relative to the payments to capital. In both countries the trend followed by this variable is reversed at about the middle of the period, ending at a higher level in 1978 than in 1947 for the U.S., and at a lower (more negative) level in Mexico.

Interest Rate, Z_4. Samuelson affirms that without innovation and invention the deepening of capital in a growing economy tends to depress the interest rate. In both countries the interest rate (Z_4) has followed an upward trend over the whole period of analysis.

Figure 1(a). Basic trends in Mexican economic development 1947-1973.

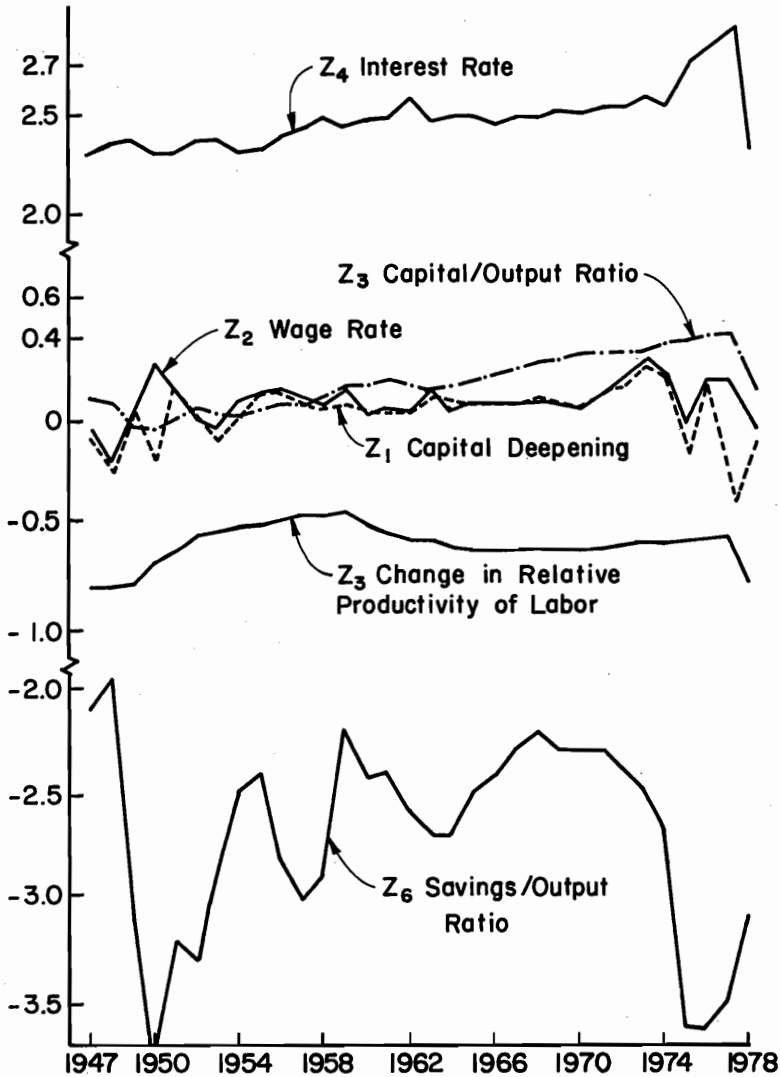
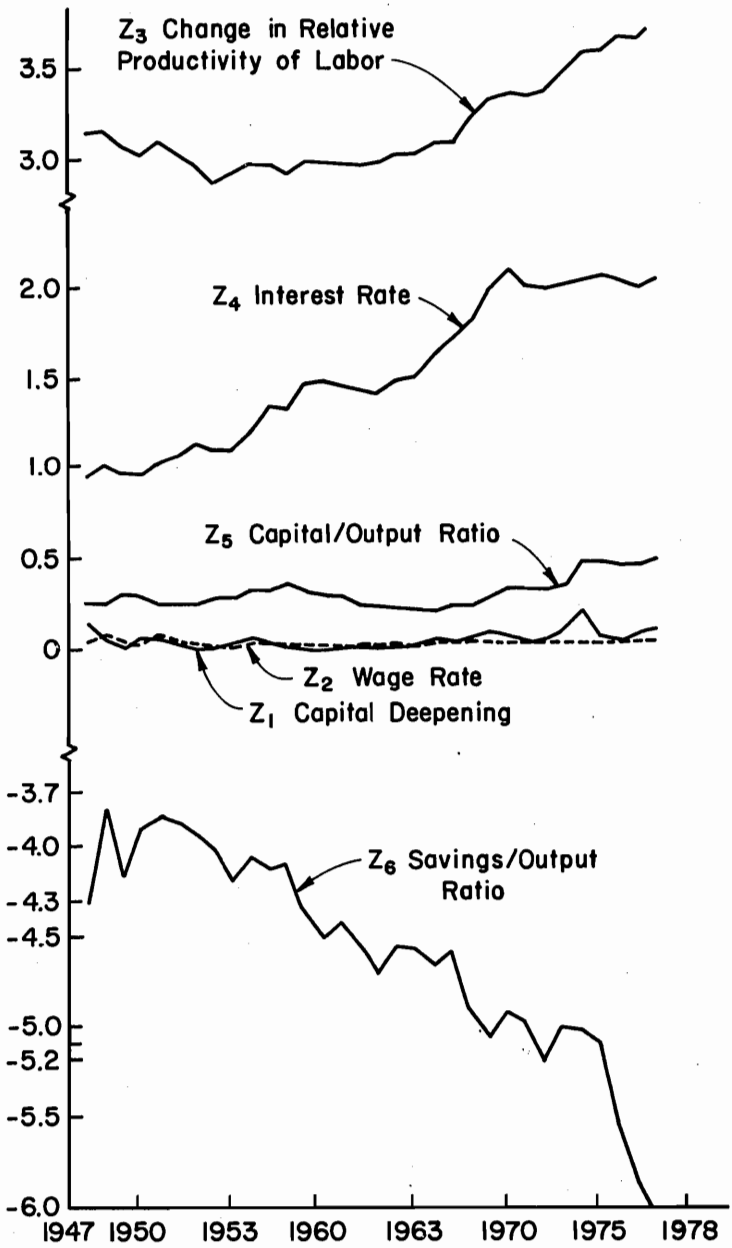


Figure 2(a). Basic trends in American economic development 1947-1978.



Although, if we were to correct for inflation (as suggested by Samuelson), the pattern we would observe will be that of a constant value. In terms of the significance of this variable for each country's development, it indicates that they have experienced technological improvements, without really implying the direction nor the consequences, except that capital's return has not fallen over time.

Capital-Output Ratio, Z_5. This variable (Z_5) is taken as the logarithm of the ratio of capital of output. In terms of the relative productivity of capital, Samuelson asserts that an increasing capital-output ratio when capital deepening is taking place in the economy would invoke the law of diminishing returns; i.e., more capital would be required to produce more output. In the U.S. this ratio remained nearly constant up to 1970, when it started to increase slightly. In the Mexican economy this ratio has followed an upward trend over the whole series with a few jumps just at the beginning and at the end of the series. The significance of this behavior is related to the presence of technological improvements in both countries, and a clear signal that economic growth--in a broad sense--is probably taking place.

Savings-Output Ratio, Z_6. In our model we define this variable (Z_6) as the logarithm of the ratio of total saving to total output. With respect to this variable, Samuelson asserts that its constancy would indicate that the same level of saving is required for several full employment levels of output or, taking into account the approximate constancy of the capital-output ratio, this signifies that national product has generally had a trend rate of growth at a roughly constant percentage rate per year. In terms of our two economies, the behavior observed for this variable is the most erratic we studied. While in the U.S. the trend of Z_6 is downward, in Mexico the savings-output ratio exhibits wide and sharp fluctuations, making it impossible to establish a definite trend.

Commodity Group Prices. The other exogenous variables (in the model presented in Section IV) are commodity group prices P_1, ..., P_5 and per capita total expenditure on commodities.

As it can be observed in Figures 1(B), 2(B), most of the variability in prices for individual commodity groups occurred during 1947-1967. After 1967 prices started to move together, describing an upward trend, characterizing the inflationary environment of those years. This is not to say the relative prices did not fluctuate during the last part of the period; all it says is that these fluctuations were outweighed by the inflation rate.

At the beginning of the period, commodity group 2 (clothing, etc.) represented the highest price and 5 (medical care, etc.) the lowest in the U.S., whereas in Mexico they were in exactly reverse order; i.e., group 5 (medical care, etc.) was the highest priced and group 2 the lowest priced. We cannot really distinguish which price exhibited the greater variability, but in the U.S. economy commodity group 5 was characterized by a steady upward trend. In Mexico, this relatively steady increase is more or less resembled

Figure 1(B). Commodity Group Prices (in natural logarithms) for Mexico, 1947-1978.

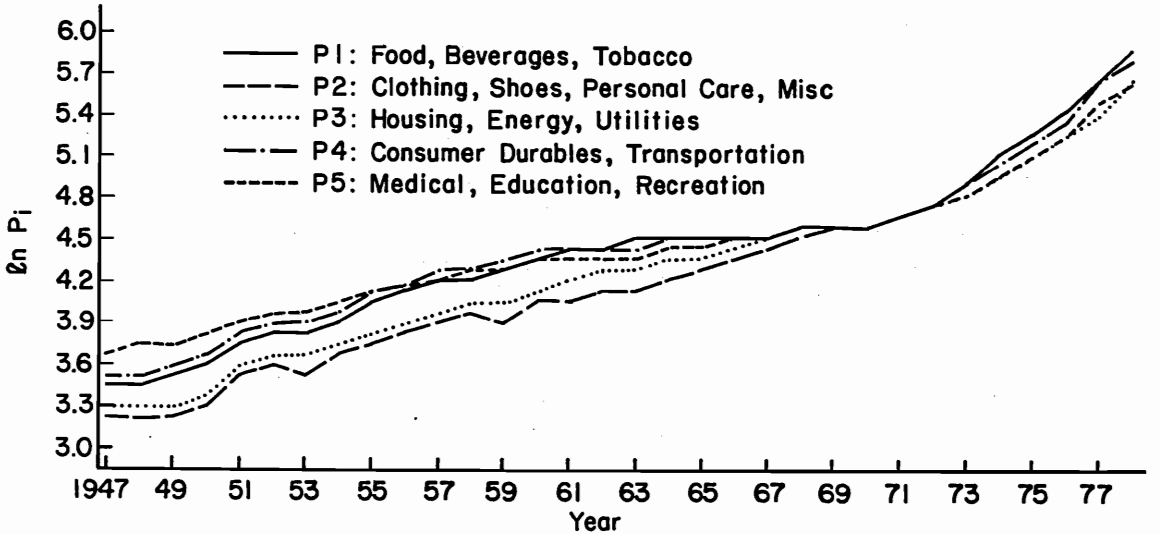
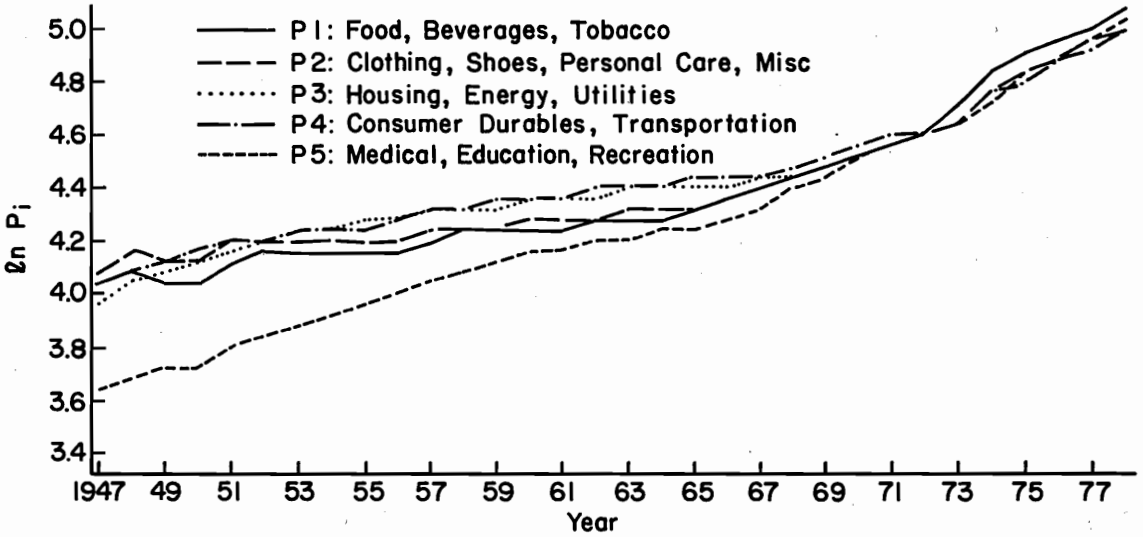


Figure 2(B). Commodity Group Prices (in natural logarithms) for the U.S.A., 1947-1978.



by the price of the same group of commodities; however, it is really less steady in Mexico than it is in the U.S. economy.

Finally, we describe how per capita total expenditure has varied over time in Mexico and the United States. In Mexico, for the years 1947 to 1978, per capita total expenditure increased five fold. However, the increase over time has been almost linear, with only 1949 and 1953 showing lower figures than their preceding years. In general, we characterize the change in per capita total expenditure in Mexico as substantial, but the increase has been steady over time. In the United States, from 1947 to 1978 per capita total expenditures increased approximately five fold. In fact, the increase in per capita total expenditure in the United States has followed almost the same path as in Mexico, a more or less linear increase over time. The only difference is that the United States per capita total expenditure figure was about five times higher than in Mexico in 1947 and still about five times higher in 1978.

III. THE MODEL OF INTERTEMPORAL CHANGES IN ECONOMIC INEQUALITY

This section describes how the model relates year-to-year changes in growth trends, commodity prices, levels of total expenditure, etc., to year-to-year changes in diverse measures of economic inequality, measures of the cost-of-living, and measures of other aspects of economic welfare. In Section I we mentioned the two main parts of the model: (a) a specified multivariate personal distribution of annual expenditures and components of income, which we call the cross-section model and (b) the model of intertemporal (year-to-year) change in this multivariate personal distribution, which we call, for short, the intertemporal model. In order to make clear the relation between these two parts of the model we make use of a physical analogy. The overall model may be likened to a strip of cinema film with a succession of frames, each of which is a "picture" of an ever changing multivariate distribution function during a very short interval of time. Each frame is, so to speak, a "picture" of the cross-section model. (If the distribution is bivariate it can be drawn pictorially,[10] as in textbooks on elementary statistics.) As the film strip is run through a viewer, the shape and location (of the "center") of the pictured distribution function are seen to change. The intertemporal model is concerned with accounting for the frame-to-frame changes of shape and location of the "pictured" multivariate personal distribution of expenditures and components of income.

To sum up: the cross-section model is an hypothesis about the shape and location of the empirical multivariate personal distribution of expenditures and components of received income. The intertemporal model is an hypothesis about the determinants of the year-to-year changes in the shape and location of the empirical multivariate personal distribution of expenditures and components of income.

In describing the cross-section submodel, we shall present its derived marginal distributions in reverse order of their mathematical derivation.[11] This allows the description to proceed from consideration of the very familiar concepts of the personal income distribution and income inequality to the much less familiar concept of the personal joint or multivariate distribution of commodity expenditures and components of income, with its broader concepts of economic inequality. This order of presentation also parallels the order of decreasing availability of survey data for estimating and testing the hypotheses embodied in the cross-section model. Comprehensive surveys such as the United States Consumer Expenditure Survey (from which the comprehensive cross-section model has been estimated for 1972 and 1973; see TABLE 3.2) and the Mexican Encuesta Nacional de Ingresos y Gastos de los Hogares 1977 are too expensive to be repeated annually.[12] On the other hand, survey data for estimating the marginal personal distribution of total income (with which we start our description) are readily available on an annual basis.

An important use of the intertemporal model in values combining annual survey data estimates of the marginal personal distribution of income, or total expenditures, with time-series estimates of conditional expectations of commodity expenditures.[13] This is done for the purpose of interpolating the cross-section model of economic inequality for those years between the taking of comprehensive expenditure surveys such as the Mexican Encuesta Nacional de Ingresos and the U.S. Consumer Expenditure Survey. In other words, the intertemporal model affords, in a sense, a "prediction" of the empirical distribution a comprehensive survey would have discovered if it had been taken in a given year.[14] Of course, such "predictions" are actually tested only in those years for which the comprehensive survey actually is conducted and independent estimates of the multivariate distribution are again available.

We shall use $m_1, \ldots, m_n$ to designate expenditures on commodities $i = 1, 2, \ldots, n$ and m_{n+1} to designate expenditures on securities; we shall use m to designate the sum of all expenditures on commodities,

$$m = m_1 + \ldots + m_n , \tag{3.1}$$

and we shall use y to designate the total expenditures on commodities and securities,

$$y = m + m_{n+1} . \tag{3.2}$$

A household received income in several forms, such as wages and salaries, public transfer payments, private transfer payments, profit on owned enterprises, income from capital assets, sales of securities, inheritances, etc. We shall use $w_1, \ldots, w_q$ to designate various components of income, and we shall use the letter "w" to designate total income,

$$w = w_1 + \ldots + w_q . \tag{3.3}$$

No assumption is made to the effect that total income (annual) equals or exceeds total expenditure (annual) for every household, although the equality of y and w may be the case empirically.

In our cross-section model the marginal personal income distribution is given by

$$(3.4a\text{-}b) \quad g(w) = \frac{K^{b^*} w^{c-1}}{B(c, b)(K + w)^{b^*+c}} \quad , w > 0$$

$$= 0 \text{ otherwise;}$$

where

$$(3.4c\text{-}e) \quad \begin{aligned} c &> 0 , \\ b^* &> 0 , \\ K &> 0 . \end{aligned}$$

The most familiar measure of income inequality is the Gine concentration ratio, which for (3.4a-c) is given by:

$$(3.5) \qquad G_w(c, b^*) = \frac{\Gamma(c + b^*)\Gamma(c + \frac{1}{2})\Gamma(b^* + \frac{1}{2})}{\Gamma(\frac{1}{2})\Gamma(c + 1)\Gamma(b^*)\Gamma(c + b^* + \frac{1}{2})} \times \left(1 + \frac{2c}{2b^* - 1}\right)$$

for $b^* > 1.0$. $G_w(c, b^*)$ diminishes steadily as either c or b^* increases. $G_w(c, b^*)$ is the model, or theoretical, counterpart of Gini measures, G, computed from the empirical distribution in accordance with formula (1.4) in TABLE 1.1. The model counterparts of the other empirical inequality measures such as B, R, T^*, K, and C shown in TABLE 1.1 can be computed from the statistical estimates of parameters K, b^* and c in (3.4a-b); however, the computation of model counter parts of these inequality measures though straighforward is more tedious to describe than $G_w(c, b^*)$. The important points to be born in mind here are (1) that, like (3.5), all of the alternative inequality measures applied to (3.4a-b) depend on the parameters b^* and c, and (2) our intertemporal model specifies explicit dependences of the parameters b^* and c on the basic economic development trend parameters such as capital deepening, the capital-output ratio, etc. like those shown for Mexico in Figure 1 and for the United States in Figure 2. Thus, in our model, any of the alternative measures of income inequality applied to (3.4a-b) depend--like the Gini concentration ratio (3.5)--on the basic economic development trends.

We mention in passing that in the special case c = 1, (3.4a-b) becomes the familiar Pareto distribution, with lower terminal, K. We shall not assume that c = 1, but we shall refer to b^* as the generalized Pareto parameter of (3.4a-b) and to K as the Pareto lower terminal.

Let us turn now to the personal distribution of income components. Comprehensive surveys such as the Mexican Encuesta Nacional de Ingresos y Gastos de los Hogares and the U.S. Consumer Expenditure Surveys readily permit the disaggregation of total income w

into components $w_1, w_2, \ldots, w_q$ according to various criteria depending upon the practical application in question. This makes feasible the estimation of parameters and testing of hypotheses about the personal multivariate distribution of income components, which in our cross section model is given by

$$(3.6a\text{-}b) \quad g(w_1, \ldots, w_q) = \frac{K^{b^*} w_1^{c_1-1} \ldots, w_q^{c_q-1}}{B(c_1,\ldots,c_q,b^*)(K + w)^{b^*+c}}, \; w_j > 0,$$

$$= 0 \text{ otherwise,}$$

where the parameters $c_j > 0$, $j = 1, 2, \ldots, q$ and sum to c. The model counterpart of the empirical Gini measure of inequality in the marginal distribution of a component, w_j, of total income.

$$(3.7) \qquad G_{w_j}(c_j, b^*) = \frac{\Gamma(c_j + b^*)\Gamma(c_j + \frac{1}{2})\Gamma(b^* + \frac{1}{2})}{\Gamma(\frac{1}{2})\Gamma(c_j + 1)\Gamma(b^*)\Gamma(c_j + b^* + \frac{1}{2})} \times \left(1 + \frac{2c_j}{2b^*-1}\right)$$

If $c_j > c_k$, then $G_{w_j}(c_j, b^*) < G_{w_k}(c_k, b^*)$. In other words, according to our cross-section model, inequality in the personal marginal distribution of components of income, w_j, is greater or less according as the associated parameter c_j is less or greater. For that reason, we refer to parameters $c_1, \ldots, c_n$ of (3.6a-c) as interincome inequality parameters. On the Gini measure (3.7), there is less inequality in the personal marginal distribution of total income w than in the marginal distribution of any of its components.

The marginal personal income distribution (3.4a-b), the concentration ratio (3.5), and alternative measures of total income inequality, are derived from (3.6a-b). Consequently, the income components distribution (3.6a-b) and income components inequality measures (3.7) possess whatever policy relevance is possessed by the total income distribution and total income inequality themselves. Knowledge of the interincome inequality parameters $c_1, \ldots, c_q$ always yields knowledge of the total income inequality (3.5) but, of course, the converse does not hold. Optimum design of a progressive income tax schedule (for example) may require, or at least be more readily achieved with, knowledge of (3.6a-c).

In TABLE 3.1 we present survey estimates of the multivariate distribution of ten income components (3.6a-b) for selected years in the United States. The annual estimates of the generalized Pareto parameter, b*, and the lower terminal K shown in TABLE 3.1 are used in Section IV for estimating Gini measures of inequality in the expenditures on major groups of commodities. Our intertemporal model specifies the dependences of the interincome inequality

Table 3.1.

The Components of Income Used in Estimating the Interincome Inequality Parameters[1]

The individual components of income used to derive the interincome inequality parameters were categorized in the following way:

1) Wages and Salaries
2) Income from Dividends
3) Income from Interest on Assets
4) Income from Pensions and Annuities
5) Income from Rents and Royalties
6) Income from Business, Professions and Farms
7) Income from Partnerships
8) Income from Sale of Capital Assets
9) Income from Estates and Trusts
10) Other Income[2]

Estimates of the Interincome Inequality Parameters for Individual Components of Income and the Attendant K, C and b* used in the Derivation[3]

Year	c_1	c_2	c_3	c_4	c_5	c_6	c_7	c_8	c_9	c_{10}	c	b*	K
1952	11.43	.39	.12	.04	.20	1.07	.59	.16	.11	.05	14.15	5.03	1088
1957	13.88	.56	.20	.04	.19	1.24	.57	.21	.04	.10	17.03	5.20	1154
1962	12.80	.48	.33	.06	.15	1.08	.42	.26	.03	.09	15.71	4.51	1240
1967	11.79	.41	.43	.14	.09	.88	.33	.40	.03	.08	14.59	3.80	1503
1972	13.68	.37	.60	.24	.09	.85	.29	.37	.04	.09	16.62	3.92	1715
1978	16.07	.47	.90	.52	.08	.84	.22	.37	.05	.09	19.62	3.89	2674

The Gini Measures of Inequality[4] for the Various Components of Income and Total Income

$G_{w_j}(c_j, b^*)$

Year[5]	1	2	3	4	5	6	7	8	9	10	w
1952	0.316	0.717	0.874	0.956	0.814	0.544	0.648	0.842	0.884	0.940	0.308
1957	0.304	0.653	0.815	0.945	0.818	0.519	0.649	0.808	0.957	0.926	0.298

(continued)

Table 3.1. (continued)

Year[5]	1	2	3	4	5	6	7	8	9	10	w
1962	0.327	0.684	0.749	0.930	0.852	0.550	0.706	0.782	0.963	0.901	0.321
1967	0.358	0.717	0.712	0.862	0.906	0.595	0.752	0.722	0.967	0.913	0.351
1972	0.348	0.734	0.654	0.797	0.908	0.599	0.771	0.731	0.953	0.907	0.343
1978	0.351	0.725	0.615	0.711	0.962	0.651	0.769	0.767	0.955	0.858	0.345

Notes:
1. The source of the data used in computing these interincome inequality parameters is: Internal Revenue Service, Statistics of Income - 1952-1979, Individual Income Tax Returns, Washington, D.C.
2. The category Other Income includes categories such as Alimony, State Income Tax Refunds, Small Business Corporation Profits and miscellaneous income sources.
3. Slottje (1983) estimated the c_j's and c using the I.R.S. data described in Note 1 by using (3.4a-b) and (3.6a-b) and applying the generalized method of moments to find the c_j's, c, and b*. The derivation of k is described in the text.
4. The Gini measures are estimated using (3.7) and the c, c_j's, and b* derived via Note 3.
5. We report only five year intervals here because the general trend doesn't change within these five year intervals.

parameters $c_1, \ldots, c_n$, and b^* on prices, per capita total expenditure, and the basic economic development trend parameters such as interest rates, savings-output ratios, ratio of wages and salaries to total returns to property, etc.

Lluch (1973), Lluch, Powell, and Williams (1977) pp. xxi-xxii, p. 97, p. 259, and Kakwani (1977), esp. pp. 722-725, (1980) pp. 156-160, have examined relations between inequality measures for personal distributions of commodity expenditures and measures of inequality in total income. Personal hardship and social unrest may well be more closely related to inequality in the personal distribution of expenditures on commodities than on inequality in the personal distribution of total income. In our cross-section model, the personal two-variate distribution of total expenditure on commodities and securities and income is given by

$$(3.8a\text{-}c) \quad g(y,w) = \frac{K^{b^*} y^{a^*-1} w^{c-1}}{B(a^*,c,b^*)(K + y + w)^{b}}, \; y > 0, \; w > 0$$

$$= 0 \text{ otherwise,}$$

$$= b^* + a^* + c$$

where $a^* > 0$ and c is the sum (3.6c). The concentration ratio measure of inequality in the distribution (3.8a-b) of total expenditure, y, is

$$(3.9) \qquad G_y(a^*,b^*) = \frac{\Gamma(a^* + b^*)\Gamma(a^* + \frac{1}{2})\Gamma(b^* + \frac{1}{2})}{\Gamma(\frac{1}{2})\Gamma(a^* + 1)\Gamma(b^*)\Gamma(a^* + b^* + \frac{1}{2})} \times \left(1 + \frac{2a^*}{2b^*-1}\right)$$

The personal distribution of total expenditure on commodities, m, and total income, w, is given by

$$(3.10a\text{-}b) \quad g(m,w) = \frac{K^{b^*} m^{a-1} w^{c-1}}{B(a,c,b^*)(K + m + w)^{b}}, \; m > 0, \; w > 0$$

$$= 0 \text{ otherwise,}$$

where $0 < a < a^*$. The concentration ratio measure of inequality in the personal distribution of total expenditure on commodities can be obtained from (3.9) by replacing a^* by a where a^* appears. The estimation of b^*, a^* and c in (3.8a-b) can be obtained using the Encuesta in Mexico and the Consumer Expenditure Survey in the U.S.A. See TABLE 3.2.

All of the distributions of income components and total expenditure considered so far are derived from the following personal multivariate distribution of expenditures on commodities and securities, and components of income.

$$g(m_1, \ldots, m_n, m_{n+1}, w_1, \ldots, w_q)$$

$$(3.11a\text{-}b) = \frac{K^{b^*} m_1^{a_1-1}, \ldots, m_{n+1}^{a_{n+1}-1} w_1^{c_1-1}, \ldots, w_q^{c_q-1}}{B(a_1, \ldots, a_{n+1}, c_1, \ldots, c_q, b^*)(K + y + w)^b}, \quad m_1 > 0, \; w_k > 0$$

$$= 0 \text{ otherwise,}$$

where $a_1 > 0$ and

$$(3.11c) \qquad a_1 + \ldots + a_n = a$$

The concentration ratio measure of inequality in the personal distribution of expenditure on commodity i is given by

$$(3.12) \qquad G_{m_1}(a_i, b^*) = \frac{\Gamma(a_i + b^*)\Gamma(a_i + \frac{1}{2})\Gamma(b^* + \frac{1}{2})}{\Gamma(\frac{1}{2})\Gamma(a_i + 1)\Gamma(b^*)\Gamma(a_i + b^* + \frac{1}{2})} \times \left(1 + \frac{2a_i}{2b^* - 1}\right)$$

The parameters a_i, $i = 1, 2, \ldots, n+1$ are called intercommodity inequality parameters. The greater is a_i, the smaller is the measure $G_{m_i}(a_i, b^*)$. According to our model there is less inequality in the distribution of total expenditure, m, on all commodities than in the expenditure, m_i, on any single commodity.

TABLE 3.2 displays weighted averages of estimates of the multivariate personal distribution function[15] (3.11a-b) for twelve distinct occupational groups in the American economy for 1973. The parameters K, a_i, c_j, b* of (3.11a-b) were estimated from the U.S. Consumer Expenditure Survey (1973) for each of the following subpopulations, characterized by occupation of consumer unit head. Self employed, salaried professional and technical workers, clerical workers, sales workers, craftsmen, operatives, unskilled and household workers, service workers, heads not working and not retired, retired, other heads including armed forces personnel living off post. Each subpopulation inequality parameter (say) $a_i^{(\nu)}$, $\nu = 1, 2, \ldots, 12$ was weighed by its own fraction of the total population and these were summed to obtain the magnitude shown in TABLE 3.2[16]

Conditional expectations of commodity expenditures m_i given total expenditure, m, on commodities, or total expenditure, y, on commodities and securities, and conditional expectations of income components, w_j, given total income, w, constitute the theoretical link between the cross-section model and the intertemporal model of the medial annual household. These conditional expectations, derived from the multivariate distribution of expenditures and components of income, i.e., (3.11a-b) are

Table 3.2. Estimates of the Parameters of the Multivariate Joint Distribution Function from the Consumer Expenditure Survey for 1973.

Estimates of the Expenditure Components, a_i			The Gini Measure
		Component Name	Estimate	$G(a_i, b^*)$
i =	1	Food	2.935	0.438
	2	Alcoholic beverages	0.129	0.873
	3	Tobacco products	0.211	0.816
	4	Shelter	2.241	0.466
	5	Residential fuel	0.692	0.632
	6	Household operations	0.497	0.686
	7	House furnishings	0.672	0.637
	8	Dry cleaning	0.128	0.874
	9	Men's clothing	0.272	0.781
	10	Boy's clothing	0.083	0.912
	11	Women's clothing	0.427	0.711
	12	Girls' clothing	0.096	0.900
	13	Infants' clothing	0.026	0.969
	14	Clothing materials	0.045	0.950
	15	Transportation	2.750	0.445
	16	Health care	0.791	0.610
	17	Personal care	0.164	0.847
	18	Owned vacation home	0.016	0.981
	19	Vacation trips	0.396	0.723
	20	Recreational vehicles	0.159	0.850
	21	Other recreation	0.509	0.682
	22	Reading	0.083	0.913
	23	Education	0.173	0.840
	24	Miscellaneous	0.134	0.870
	25	Insurance and pensions	1.372	0.527
	26	Gifts and contributions	0.827	0.603
Estimates of the Income Components, c_i				The Gini Measure $G(c_i, b^*)$
i =	1	Wages and salaries	16.095	0.345
	2	Private transfer payments	0.343	0.746
	3	Public transfer payments	1.732	0.497
	4	Own enterprise	1.525	0.513
	5	Interest and dividends	0.741	0.621
	6	Sale of financial assets	0.892	0.591
	7	Refunds and gifts	0.836	0.602

(continued)

Table 3.2. (continued)

Sums of Components	Overall Gini Measures
$a = \sum_{i=1}^{26} a_i = 15.825$	$G(a,b^*) = 0.345$
$a^* = \sum_{i=1}^{26} a_i + a_{n+1} = 17.140$	$G(a^*,b^*) = 0.343$
$c = \sum_{i=1}^{7} c_i = 22.163$	$G(c,b^*) = 0.337$

For 1973, the Generalized Pareto Parameter is 3.90.

For 1973, the parameter $b = b^* + a^* + c = 43.2$.

For 1973, the lower terminal K is 1821.60.

$$E(m_i/m) = \frac{a_i}{a} \quad , \; i \leq n$$

$$(3.13a\text{-}c) \quad E(m_i/y) = \frac{a_i}{a^*} y \; ,$$

$$E(w_j/w) = \frac{c_i}{c} w \; ,$$

$i = 1, 2, \ldots, n$, $j = 1, 2, \ldots, q$. The intertemporal model of the medial annual household specifies the theoretical dependence of the inequality parameter ratios a_i, c_j, b^* on the various economic magnitudes, such as average annual commodity prices, interest rates, wage rates, unemployment rates, and so on the basic trend parameters of economic development such as are depicted in FIGURE 1 for Mexico and FIGURE 2 for the United States. TABLE 4.2(A) and TABLE 4.2(B) show, for Mexico and the United States, respectively, the statistically estimated dependence of parameters a_i on annual commodity prices and the basic economic development trend parameters shown in FIGURE 1(A, B) and FIGURE 2(A, B) in Section II.

We shall look more closely at the statistical estimates in TABLE 4.2(A) and TABLE 4.2(B) later. For the present it is important to notice that the ratios a_i/a_k, c_j/c_r and the conditional expectations (3.13a-c) can be estimated from <u>time-series</u> data alone. In order to estimate any of the parameters b^*, a, a^* and c, one does not require highly disaggregated expenditure and income cross section data. For that reason, survey-based estimates of b^*, a, a^* can be more frequently revised than can survey-based estimates of the individual intercommodity and interincome inequality parameters a_i, c_j. However, when the time-series estimates of the ratios a_i/a_k, and c_j/c_k are combined with estimates of b^*, a, a^*, and c from inexpensive "mini surveys" of total expenditure and total income, the <u>intertemporal model of the medial household</u> generates unique annual estimates of the individual intercommodity and interincome parameters a_i, c_j and--in turn-- estimates of the individual Gini measures of inequality (3.7) and (3.12).

The personal multivariate distribution of annual expenditures on commodities $m_1, \ldots, m_{n+1}$, and components of annual income $w_1, \ldots, w_q$ implicitly defines a concept of a <u>medial annual household</u> that behaves <u>as if</u> it maximizes a specific form of direct utility function subject to (1) a total expenditure constraint, and (2) a total income constraint. A brief explication should suffice: consider the population stratum or cell containing just those real households making a total expenditure y, and receiving a total income, w. For that (y, w) cell, per capita expenditures on commodities and per capita components of received income are given by the conditional expectations (3.13b-c), which are the maximizing values of arguments of the following <u>direct utility function</u>,

$$(3.14a\text{-}b)\quad U^* = \left(\prod_{i=1}^{n+1} m_i^{a_i}\right)\left(\prod_{j=1}^{q} w_j^{c_j}\right),\ m_i > 0,\ w_j > 0\ ,$$

subject to the double constraint

$$m_1 + \ldots + m_{n+1} = y\ ,$$

(3.15a-b)

$$w_1 + \ldots + w_q = w\ .$$

In this paper attention is focused on inequality in the distribution of consumer expenditures on commodities. Accordingly, we shall describe only the consumer aspects of the model of the medial household primarily in any detail. For that reason and since, in the present case, the expenditure data to which the model is applied are annual data, we refer to the consumer activities of the medial household as constituting the medial annual consumer. The system of expenditure functions for the medial annual consumer is the system of conditional expectations (3.13a) of expenditure m_1 given total expenditure m on commodities $i = 1, 2, \ldots, n$.

The medial annual consumer is a statistical concept defined with reference to a specified population of individual real consumers, such as households whose heads are clerical workers. The medial annual consumer is conceived of as making an annual total expenditure, m_t, that is equal to the per capita annual total expenditure over all real consumers in the population; the medial annual consumer's annual expenditure $m_{t,i}$ on (ith commodity) is defined to be equal to the average or per capita annual expenditure on the ith commodity; the medial annual consumer's demand $X_{t,i}$ for the ith commodity is defined as equal to the per capita annual demand for the ith commodity. Finally, the medial annual consumer is presumed to pay a price $P_{t,i}$ for the ith commodity and $P_{t,i}$ is defined as the average purchase price of the ith commodity taken over all transactions made by all real consumers during the annual period, t.

The medial annual consumer behaves, so to speak, as if it were a real consumer who makes a single purchase $X_{t,i}$ of each commodity i during each annual period t. Or, alternatively, the medial annual consumer behaves as if it were a real consumer who makes several or many distinct purchases of commodity i summing to $X_{t,i}$ during a given annual period, t, but all these purchases being made at a single price $P_{t,i}$. Of course, for the ith commodity he pays the same price per unit. Finally, in this study we assume that, in general, real consumers all over the U.S. do not all pay the same purchase price for a given commodity at a given instant of time.

Returning attention to the direct utility function (3.14a-b) we find that the medial annual consumer behaves as if it maximizes a direct utility function

$$(3.16a\text{-}b)\quad U = \left\{ \prod_{i=1}^{n} x_i^{a_i} \right\}$$

$$x_i > 0 ,$$

subject to the budget constraint

$$(3.16c)\quad P_1x_1 + \ldots + P_nx_n = m,$$

where the a_i, $i = 1, 2, \ldots, n$, are the intercommodity inequality parameters of the personal joint distribution of commodity expenditures and components of income (3.11a-b).[17]

Theoretical dependence of the inequality parameters a_i, and c_k on commodity prices and growth variables can be specified in a variety of ways and tested empirically. We have found it convenient to express those dependences in terms of constant logarithmic derivatives, or mathematical elasticities as follows:

$$(3.17a\text{-}c)\quad \ln a_{t,i} = \ln\beta_i + \sigma_{i0} \ln \bar{m}_t + \sum_{j=1}^{n} \sigma_{ij} \ln P_{tj} + \sum_{h=1}^{s} \sigma_{iz_r} \ln Z_r + u_{t,i}$$

$$\ln c_{t,k} = \ln\gamma_k + \pi_{k0} \ln m_t + \sum_{j=1}^{n} \pi_{kj} \ln P_{tj} + \sum_{r=1}^{s} \pi_{kz_r} \ln Z_r + v_{t,k}$$

$$\ln b^* = \ln\delta_k + \tau_0 \ln \bar{m}_t + \sum_{j=1}^{n} \tau_j \ln P_{tj} + \sum_{r=1}^{s} \tau_{zr} \ln Z_r + v_t$$

$$i = 1, 2, \ldots, n, \quad k + 1, 2, \ldots, 1$$

where $u_{t,i}$, $v_{t,k}$ and v_t are random variables with zero means and finite variances.[18]

In order to estimate the coefficients that appear in (3.17a-b) from time-series data we proceed as follows: Making use of the fact that from the conditional expectation (3.13a) one derives

$$(3.18)\quad \ln\left(\frac{a_i}{a_k}\right)_t = \ln \frac{m_{t,i}}{m_{t,k}} ,$$

we fit the following equations to the expenditure, price, and growth data

$$(3.19a\text{-}f)\quad \ln \frac{m_{ti}}{m_{tk}} = \ln \left(\frac{\beta_i}{\beta_k}\right) + \sigma_{i0}^{(k)} \ln \bar{m}_t + \sum_{j=1}^{n} \omega_{ij}^{(k)} \ln P_{tj}$$

$$+ \sum_{h=1}^{6} \omega_{k,z_h}^{(k)} \ln Z_{t,h} + \eta_{ti}^{(k)} ,$$

$$\omega_{i0}^{(k)} = \sigma_{i0} - \sigma_{k0} \ ,$$

$$\omega_{ij}^{(k)} = \sigma_{ij} - \sigma_{kj} \ ,$$

$$\omega_{i,z_h}^{(k)} = \sigma_{i,z_h} - \sigma_{k,z_h} \ ,$$

$$\eta_{ti}^{(k)} = u_{ti} - u_{tk} \ ,$$

$$E(\eta_{ti}^{(k)} \ / \ \eta_{t-1,i}^{(k)}) = \rho \ .$$

From the statistical estimates of the parameters in (3.19a-f) together with (3.18) one obtains estimates of the ratios a_i/a_k. From this point, one may proceed in one of two directions: If survey data on total expenditure are avaiable, one can estimate the parameter $\underline{a}$ from the marginal distribution of $\underline{m}$ and $\underline{w}$ (3.10a-b), then one uses the equation

$$(3.20) \qquad \frac{1}{a_k} = \frac{1}{a} \sum_{i=1}^{n} \left(\frac{a_i}{a_k}\right) ,$$

together with the estimates of ratios (a_i/a_k) obtained from (3.19a-f), in order to obtain estimates of the individual intercommodity inequality parameters a_i, $i = 1, 2, \ldots, n$.

Another approach to statistical estimation of the individual intercommodity inequality parameters a_i involves use of the hypothetical constraint

$$(3.21) \qquad a_t = B^* \bar{m}_t P_t^{-1}$$

where P_t is an overall price index of the individual commodity group price indexes $P_{t1}, \ldots, P_{tn}$. This hypothesis asserts that if the per capita total expenditure of a population of consumers, $\bar{m}_t$, and the overall price index P_t change in the same proportion, then there is no <u>ceteris paribus</u> change of Gini inequality in the marginal personal distribution of total expenditure on commodities. Under this hypothesis one fits the following equations to the per capita expenditure, price, and growth data in order to estimate the parameters σ_{i0}, σ_{ij}, and σ_{iz_k} directly

$$(3.22) \qquad \ln \frac{\bar{m}_{ti}}{P_t} = (-\ln B^* + \ln \beta_i) + \sigma_{i0} \ln \bar{m}_t + \sum_{j=1}^{n} \sigma_{ij} \ln P_{tj} + \sum_{r=1}^{s} \sigma_{iz_r} \ln Z_r + u_{t,i}$$

$$i = 1, 2, \ldots, n.$$

An estimate of B* in (3.21) is obtained from the estimated intercept coefficients in (3.22) and the estimates of β_i, i = 1, 2, ..., n obtained from (3.19a-f).

IV. TESTS OF HYPOTHESES. ESTIMATES.

This discussion of economic inequality began in Section I with the consideration of two very broad proffered explanations for the tendency of intertemporal changes in measures of income inequality to be small. One of the proffered explanations mentioned was that individual effects of growth trends on income inequality are at all times very weak. Let us interpret this explanation in terms of the cross-section model (3.11a-c) in Section III and the marginal personal distribution of income (3.4a-e) derived from (3.11a-c), the Gini measure of inequality (3.5), and the hypothesized dependences (3.17a-b) of parameters a_i, i = 1, 2, ..., n, c_j, j = 1, 2, ..., q, and b on intertemporal changes in per capita total expenditure, $\overline{m}$, commodity prices P_1, ..., P_n, and growth variables Z_1, ..., Z_5.

Suppose the historical fact to be accounted for is that empirical measures of income inequality fluctuate only negligibly over time. For instance, TABLE 1.1 describes an historical fact about income inequality to be accounted for; cf. Basmann (1965) p. 167. Our model proffers this broad "explanation": During the historical period in question, the trends in $\overline{m}$, P_1, ..., P_n, and in the growth variables probably were related to each other in such a way as to move the parameters c and b* along an isoquant of the Gini measure of income inequality (3.5). There are several ways in which this movement along an isoquant might occur. We consider these two: Under the strong influences of the expenditure, price and growth variables, all of the parameters a_i, i = 1, 2, ..., n, c_j, j = 1, 2, ..., q, and b changed (during the historical period in question) so that an increase (decrease) in c tended to be compensated in the Gini measure in (3.5) by a decrease (increase) in the generalized Pareto parameter b* = b - a - c. This proffered explanation includes, as a limiting case, the proffered explanation that the per capita expenditure, the prices, and the growth variables in question simply do not affect the parameters in (3.11a-c); i.e., that each of the coefficients in (3.17a-b) in zero.

For the United States, the succession of annual surveys (Internal Revenue Service) yielding estimates of c and b* (TABLE 3.1) tend to disconfirm the hypothesis that commodity prices and economic growth variables have no effect on those parameters. The best statistics for exclusion of capital deepening (Z_1) productivity of labor (Z_3) capital/output ration (Z_5) and savings/output ration (Z_6) from (3.17b-c) as explanatory regressors for c and b* had outcome probabilities of only about 0.17. The outcome probabilities for exclusion of commodity prices from (3.17b-c) as explanatory regressors for c and b* were 0.06 and 0.002 respectively. (However,

the hypothesis that per capita total expenditure, $\bar{m}$, does not affect c or b* is in very good agreement with the U.S. Internal Revenue Service data used in TABLE 3.1. The outcome probabilities for exclusion of $\bar{m}$ from (3.17b-c)are 0.85 and 0.88 respectively.) Slottje (1983).

From these empirical results it appears that the influence of commodity prices and growth variables on the intercommodity inequality parameters, a_i, i = 1, 2, ..., n, actually does come into play in tending to stabilize the Gini measure of income inequality (3.5). Moreover, as we mentioned in Section I, inequalities in the personal distributions of expendutures on major commodity groups are interesting in their own right from the point of view of economic policy.

We begin by reporting the results of some tests of null hypotheses that were performed in order to examine the impacts of price variables, per capita total expenditure, and economic growth variables on the marginal personal distributions of five major commodity group expenditures listed in Section II for both Mexico and the United States. The commodity groups are food, clothing, housing services, durables services, medical and health care. There are thirteen different maintained hypotheses, each characterized by (3.19a-f) and a specification of the autocorrelation parameter ρ. We use $H_m(\rho)$ to designate a specified maintained hypothesis. Under each of these thirteen alternative maintained hypotheses, the (unobservable) random disturbance terms are intertemporally dependent, according to a simple Markov process with autocorrelation parameter ρ. The specifications for this parameter are ρ = -0.95, -0.9, -0.7, ..., -0.1, 0, 0.1, 0.3, ..., 0.9, 0.95. The equations used to confront the price, total expenditure, and economic development data directly in the general linear hypothesis form one expression for the logarithm of the commodity expenditure ratios (3.19a-f). The rationale for the hypotheses that the nonobservable random variables are normally distributed is the classical Laplacean rationale. The Fisherian reference class for all tests of significance used in this paper is the hypothetical infinite population of random samples (Fisher, 1922, pp. 311-312, Fisher, 1956, p. 33, p. 77) of commodity group expenditures m_1, ..., m_5, total expenditure m, commodity group prices p_1, ... p_5, and economic development variables Z_1, ..., Z_6, being fixed and identical with those actually used in estimation. Hence, the random disturbance terms in (3.19a-f) are distributed independently of logarithms of per capita total expenditure m, prices P_j, and economic development variables Z_h. Under these circumstances, generalized least squares estimates of the intercepts and coefficients are unbiased, minimum variance, and minimum generalized variance, normally distributed estimators. Furthermore, the F ratios for testing null hypotheses are distributed exactly as Snedecor's F statistics with determinate degrees of freedom.

Null Hypothesis $H_0^{(1)}(\rho)$. Our first null hypothesis is that the economic growth variables (Z_1, capital deepening, Z_3, relative productivity of labor, Z_5, saving-output ratio, and Z_6, capital output ratio[19]) do not affect the ratios ($\frac{a_i}{a_k}$) of intercommodity inequality parameters. That is to say, $H_0^{(1)}(\rho)$ implies that a one percent change in a growth variable has the same proportionate effect on each of the intercommodity inequality parameters a_i, $i = 1, 2, \ldots, 5$.

For each of the thirteen specifications of the Markov process parameter ρ we tested $H_0^{(1)}(\rho)$ against the unrestricted alternative hypothesis $H_m(\rho) - H_0^{(1)}(\rho)$. Null hypothesis $H_0^{(1)}(\rho)$ implies that each of the Gauss-Aitken maximum likelihood test statistics ($F_i(\rho)$) is distributed as a central F with 4 and 22 degrees of freedom. TABLES 4.1(A) and 4.1(B) show the sample test statistics and outcome probabilities under $H_0^{(1)}(\rho)$ for Mexico and the United States.

The structural economic assumption that each of the economic growth variables Z_1, Z_3, Z_5 and Z_6 has no effect on the distribution of commodity group expenditures via the intercommodity inequality parameters a_i deductively implies the null hypothesis $H_0^{(1)}(\rho)$. If we reject $H_0^{(1)}(\rho)$ in favor of the alternative $H_m(\rho) - H_0^{(1)}(\rho)$ then, to be consistent, we have to reject the assumption that the above growth variables have no effect on the intercommodity inequality parameters a_i, $i = 1, 2, \ldots, 5$, in (3.11a-c) with $n = 5$.

If we do not reject $H_0^{(1)}(\rho)$ in favor of the alternative $H_m(\rho) - H_0^{(1)}(\rho)$, then, of course, that outcome does not decisively favor the structural economic assumption that none of the growth variables Z_1, Z_3, Z_5, and Z_6 has an effect on the intercommodity inequality parameters a_i, $i = 1, 2, \ldots, 5$ in (3.11a-c) with $n = 5$. (In other words, the conclusion that $\omega_{iz_h}^{(k)} = 0$ implies only that $\sigma_{iz_h} = \sigma_{kz_h}$ not that $\sigma_{iz_h} = 0$. See (3.19d).) If $H_0^{(0)}(\rho)$ is not rejected against the alternative $H_m(\rho) - H_0^{(1)}(\rho)$ then there are several different procedures for a subsequent test of the more stringent null hypothesis that the above growth variables have no effects on the intercommodity inequality parameters a_i. One of the procedures we have used in other studies will be sketched later on.

Table 4.1A. Test Statistics[1] and Outcome Probabilities[2] For Different Null Hypotheses Nested in Maintained Hypotheses for Various Specifications of ρ, Mexico.

$H_0^{(1)}(\rho)$: The economic growth variables do not affect the distributions of commodity group expenditures. (See equation (3.19a-f). $\omega_{iz_h}^{(3)} = 0 \quad h = 1, 3, 5, 6.$

$\ln\left(\frac{a_i}{a_3}\right)_t$	ρ												
i	-0.95	-0.90	-0.70	-0.50	-0.30	-0.10	0.0	0.10	0.30	0.50	0.70	0.90	0.95
1	13.4	13.2	12.1	10.3	8.3	6.5	5.7	5.0	3.9 (.017)	1.9 (.044)	2.2 (.100)	1.7 (.190)	1.6 (.214)
2	26.2	26.0	24.8	22.1	18.6	15.0	13.3	11.7	8.8	6.6	4.9	3.6 (.023)	5.7 (.030)
4	45.8	45.6	42.8	37.2	30.4	23.8	20.8	18.2	13.6	10.2	7.8	6.0	5.7
5	9.6	9.6	8.8	7.4	5.9	4.4	3.8 (.017)	3.3 (.031)	2.4 (.079)	1.9 (.157)	1.5 (.248)	1.6 (.351)	1.1 (.373)

1. Under the null hypothesis the test statistic is distributed as an F with 4 and 22 degrees of freedom.

2. The number in parenthesis is the probability that the test statistic $F_{(4,22)}$ is greater than or equal to the F calculated from the sample. When the outcome probability is less than .01 no figure is reported.

Table 4.1A. (Continued)

$H_0^{(2)}(\rho)$: The commodity price variables and per capita total expenditure do not affect the distributions of commodity groups expenditures. (See equation 3.19a-f), $\omega_{i0}^{(3)} = 0$, $\omega_{ij}^{(3)} = 0$. $i,j = 1, 2, 4, 5$. See Legend.

$\ln (\frac{a_i}{a_3})_t$	ρ												
i	-0.95	-0.90	-0.70	-0.50	-0.30	-0.10	0.0	0.10	0.30	0.50	0.70	0.90	0.95
1	11.0	10.9	9.9	8.3	6.6	5.0	4.3	3.7	2.8 (.037)	2.2 (.082)	1.9 (.136)	1.5 (.244)	1.3 (.294)
2	14.5	14.4	13.8	12.2	10.1	7.8	6.8	5.8	4.3	3.2 (.023)	2.4 (.064)	1.7 (.173)	1.5 (.233)
4	26.1	26.0	24.6	21.5	17.4	13.4	11.6	9.9	7.3 (.0003)	5.4	4.0	2.6 (.047)	2.2 (.089)
5	9.8	9.7	9.0	7.6	5.9	4.3	3.6 (.012)	3.0 (.028)	2.1 (.104)	1.4 (.257)	1.0 (.429)	0.8 (.613)	0.7 (.673)

1. Under the null hypothesis the test statistic is distributed as an F with 6 and 22 degrees of freedom.
2. The number in parenthesis is the probability that the test statistic $F_{(6,22)}$ is greater than or equal to the F calculated from the sample. When the outcome probability is less than .01, no figure is reported.

Table 4.1A. (Continued)

$H_0^{(3)}(\rho)$: The commodity price variables do not affect inequality in the distributions of commodity group expenditures. (See equation 3.19a-f).

$\omega_{ij}^{(3)} = 0 \quad i,j = 1, 2, 4, 5.$

$\ln(\frac{a_i}{a_3})_t$	ρ												
i	-0.95	-0.90	-0.70	-0.50	-0.30	-0.10	0.0	0.10	0.30	0.50	0.70	0.90	0.95
1	10.5	10.4	9.5	8.0	6.3	4.6	3.9	3.4 (.02)	2.5 (.067)	1.9 (.130)	1.7 (.187)	1.5 (.235)	1.4 (.255)
2	11.9	11.9	11.2	9.9	8.1	6.2	5.4	4.7 (.005)	3.5 (.019)	2.7 (.049)	2.2 (.089)	1.8 (.149)	1.7 (.189)
4	21.9	21.9	20.4	17.6	13.9	10.5	8.9	7.6	5.5	4.0	3.2 (.027)	2.5 (.062)	2.3 (.087)
5	10.5	10.4	9.6	8.1	6.3	4.6	3.8 (.013)	3.1 (.029)	2.1 (.108)	1.4 (.265)	1.0 (.419)	0.9 (.529)	0.8 (.569)

1. Under the null hypothesis the test statistic is distributed as an F with 5 and 22 degrees of freedom.

2. The number in parenthesis is the probability that the test statistic $F_{(5,22)}$ is greater than or equal to the F calculated from the sample. When the outcome probability is less than .01 no figure is reported.

Table 4.1B. Test Statistics[1] and Outcome Probabilities[2] for Different Null Hypotheses Against Alternative $H_m(\rho) - H_0^{(i)}(\rho_i)$: United States.

$H_0^{(1)}(\rho)$: The economic growth variables do not affect the distributions of commodity group expenditures. (See equation 3.19a-f). $\omega_{iz_h}^{(3)} = 0 \quad h = 1, 3, 5, 6.$

$\ln(\frac{a_i}{a_3})_t$	ρ												
i	-0.95	-0.90	-0.70	-0.50	-0.30	-0.10	0.0	0.10	0.30	0.50	0.70	0.90	0.95
1	1.9 (.134)	2.0 (.127)	2.2 (.1001)	2.5 (.0730)	2.9 (.047)	3.4 (.026)	3.8 (.018)	4.1 (.013)	4.6	4.9	4.6	3.2 (.032)	2.7 (.056)
2	3.2 (.034)	3.2 (.033)	3.3 (.031)	3.4 (.076)	3.7 (.019)	4.2 (.012)	4.4	4.7	5.1	5.3	4.8	3.3 (.030)	2.8 (.050)
4	35.2	34.7	30.9	24.6	17.8	12.4	10.3	8.6	6.1	4.5	3.4 (.0302)	1.9 (.144)	1.6 (.210)
5	12.8	12.6	11.3	9.5	7.6	5.9	5.2	4.7	3.9 (.016)	3.6 (.023)	3.7 (.020)	3.2 (.034)	2.8 (.050)

1. Under the null hypothesis the test statistic is distributed as an F with 4 and 22 degrees of freedom.
2. The number in parenthesis is the probability that the test statistic $F_{(4,22)}$ is greater than or equal to the F calculated from the sample. When the outcome probability is less than .01 no figure is reported.

Table 4.1B. (Continued)

$H_0^{(2)}(\rho)$: The commodity price variables and per capita total expenditure do not affect the distributions of commodity group expenditures. (See equation 3.19a-f).

$\omega_{i0}^{(3)} = 0, \ \omega_{ij}^{(3)} = 0 \quad i,j = 1, 2, 4, 5.$

$\ln(\frac{a_i}{a_3})_t$	ρ												
i	-0.95	-0.90	-0.70	-0.50	-0.30	-0.10	0.0	0.10	0.30	0.50	0.70	0.90	0.95
1	112.3	113.9	121.2	127.9	133.2	136.2	136.4	135.4	127.0	105.7	70.3	32.4	24.1
2	189.5	191.9	200.7	207.3	209.0	206.8	202.1	194.9	170.4	129.5	77.4	32.8	24.4
4	166.2	164.8	149.9	122.2	91.3	65.6	55.5	47.1	33.9	23.4	14.6	9.2	8.7
5	25.5	25.2	23.2	20.3	16.9	14.1	12.9	11.8	10.3	9.1	7.9	5.9	5.5

1. Under the null hypothesis the test statistic is distributed as an F with 6 and 22 degrees of freedom.

2. The number in parenthesis is the probability that the test statistic $F_{(6,22)}$ is greater than or equal to the F calculated from the sample. When the outcome probability is less than .01 no figure is reported.

Table 4.1B. (Continued)

$H_0^{(3)}(\rho)$: The commodity price variables do not affect inequality in the distributions of commodity group expenditures. (See equation 3.19a-f).

$\omega_{ij}^{(3)} = 0 \qquad j = 1, 2, 4, 5.$

$\ln(\frac{a_i}{a_3})_t$	ρ												
i	-0.95	-0.90	-0.70	-0.50	-0.30	-0.10	0.0	0.10	0.30	0.50	0.70	0.70	0.95
1	9.7	9.7	9.6	9.4	9.2	8.7	8.6	8.4	8.3	8.4	8.0	6.4	6.0
2	20.5	20.5	21.5	19.7	19.9	18.6	18.4	18.1	17.3	15.7	12.4	7.8	6.9
4	115.71	114.5	102.5	81.5	58.9	40.7	33.8	28.3	20.5	15.8	12.5	10.3	10.1
5	23.21	22.9	21.0	18.3	15.5	12.0	11.0	11.2	9.9	9.0	7.9	5.9	5.5

1. Under the null hypothesis the test statistic is distributed as an F with 5 and 22 degrees of freedom.

2. The number in parenthesis is the probability that the test statistic $F_{(5,22)}$ is greater than or equal to the F calculated from the sample when the outcome probability is less than .01 no figure is reported.

Null Hypothesis $H_0^{(2)}(\rho)$. Our second null hypothesis is that neither per capita total expenditure $\bar{m}$, nor commodity group prices $P_1, \ldots, P_5$, affect the ratios $(\frac{a_i}{a_k})$ of intercommodity inequality parameters. In other words, $H_0^{(2)}(\rho)$ implies that a one percent change in $\bar{m}$, or a commodity group price has the same proportionate effect on each intercommodity inequality parameter a_i, $i = 1, 2, \ldots, 5$.

For each of the thirteen specifications of ρ we have tested $H_0^{(2)}(\rho)$ against the unrestricted alternative hypothesis $H_m(\rho) - H_0^{(2)}(\rho)$. Null hypothesis $H_0^{(2)}(\rho)$ implies that each of the Gauss-Aitken test statistics is distributed as a central F with 6 and 21 degrees of freedom. TABLE 4.1(A) and TABLE 4.1(B) show the test statistics and outcome probabilities under $H_0^{(2)}(\rho)$ for the thirteen specifications of ρ, and for Mexico and the United States respectively.

If we reject $H_0^{(2)}(\rho)$ in favor of the alternative $H_m(\rho) - H_0^{(2)}(\rho)$ then we have to reject the structural economic hypothesis that per capita expenditure and commodity prices do not affect the intercommodity inequality parameters a_i. If we do not reject $H_0^{(2)}(\rho)$, then that immediate outcome is not decisive for the structural economic assumption, as already explained in the case of $H_0^{(1)}(\rho)$.

Null Hypothesis $H_0^{(3)}(\rho)$. Our third null hypothesis is that commodity group prices $P_1, \ldots, P_5$ do not affect the ratios $(\frac{a_i}{a_k})$ of intercommodity inequality parameters. For each of the thirteen specifications of ρ we have tested $H_0^{(3)}(\rho)$ against the unrestricted alternative $H_m(\rho) - H_0^{(3)}(\rho)$. Null hypothesis $H_0^{(3)}(\rho)$ implies that each of the test statistics is distributed as F with 5 and 22 degrees of freedom. TABLE 4.1(A) and TABLE 4.1(B) show the test statistics and outcome probabilities under $H_0^{(3)}(\rho)$ for the thirteen specifications of ρ, and for Mexico and the United States respectively.

The implications of rejection and nonrejection of $H_0^{(3)}(\rho)$ against its alternative $H_m(\rho) - H_0^{(3)}(\rho)$ are the same as in the case of $H_0^{(1)}(\rho)$ and $H_0^{(2)}(\rho)$.

The null hypothesis $H_0^{(1)}(\rho)$ does not appear to be in good agreement with either the Mexican data or the United States data.

In TABLE 4.1(A) for Mexico none of the test statistics has an outcome probability as large as 0.5, and most are smaller than 0.01, and many are less than 0.0001. The maximum test outcome probability is 0.373, corresponding to the ratio $(\frac{a_5}{a_3})$ under $H_m(\rho)$ with the specification $\rho = 0.95$. In TABLE 4.1(B) for the United States, the maximum test outcome probability is 0.134 corresponding to the ratio $(\frac{a_1}{a_3})$ under $H_m(\rho)$ with the specification $\rho = -0.95$. Consequently, the structural economic assumption to the effect that none of the growth variables Z_1, Z_3, Z_5 and Z_6 has an effect on the intercommodity inequality parameters $a_1, \ldots, a_5$ does not appear to be in good agreement with either the Mexican data or the United States data.

Our second null hypothesis $H_0^{(2)}(\rho)$ does not appear to be in good agreement with either the Mexican data or the United States data. Under the two alternative maintained hypotheses specified by $\rho = 0.90$ and $\rho = 0.95$ and only for the ratio $(\frac{a_5}{a_3})$ of Mexican intercommodity inequality parameters, outcome probabilities are greater than 0.5; see TABLE 4.1(A). For the United States all of the outcome probabilities are very small for all specifications of the maintained hypothesis; see TABLE 4.1(B). Thus it appears that the structural economic assumption to the effect that none of the per capita total expenditure and commodity prices has an effect on intercommodity inequality parameters a_i, $i = 1, 2, \ldots, 5$ is not in good agreement with either the Mexican data or the United States data.

Our null hypothesis $H_0^{(3)}(\rho)$ is not in good agreement with the empirical data for either Mexico or the United States; see TABLE 4.1(A) and TABLE 4.1(B). For the Mexican case outcome probabilities for $H_0^{(3)}(\rho)$ are favorable exactly where outcome probabilities are favorable for $H_0^{(2)}(\rho)$. For the United States, all outcome probabilities for tests of $H_0^{(3)}(\rho)$ are very small under every $H_m(\rho)$.

For Mexico the maintained hypothesis $H_m(\rho)$ that is in best agreement with the relevant data[20] is that for which $\rho = -0.1$. For the United States the $H_m(\rho)$ is best agreement with the relevant data is $\rho = 0.5$. Under the maintained hypothesis $H_m(-0.1)$ for Mexico, all test statistics for all three null hypotheses have very small outcome probabilities; see TABLE 4.1(A). Under the maintained hypothesis $H_m(0.5)$ for the United States, all tests of all three null hypotheses have very small outcome probabilities.

Our next step is to make a comparison of the relative strengths of the effects exerted by per capita total expenditure, $\overline{m}$, and prices, on the one hand, and the growth variables Z_1, Z_3, Z_5, and Z_6, on the other. In order to do that we used the general linear hypothesis (3.22) to estimate the elasticities σ_{i0}, σ_{ij} and σ_{iz_r} in (3.17a) under each of thirteen different maintained hypotheses $H_m(\rho)$ with specifications of the autocorrelation parameter, ρ, and the constraint (3.21). Space does not permit presenting the estimates under all thirteen maintained hypotheses. On the basis of the Durbin-Watson test applied to estimates of the random disturbances, u_{ti} in (3.22), the specification $\rho = -0.3$, for Mexico and the specification $\rho = 0.5$, for the United States are the best agreement with the data.

The first part of TABLE 4.2(A) presents estimates of equation (3.17a) under the maintained hypothesis $H_m(-0.3)$ and the hypothetical constraint (3.21) for Mexico. The second part of TABLE 4.2(A) presents the estimated Mexican intercommodity inequality coefficients a_i, $i = 1, 2, \ldots, 5$ and a for the period 1947-1978. The latter are computed from the coefficient estimates in the first part of the table and the Mexican per capita total expenditure, price and growth data. TABLE 4.2(B), strictly analogous in form to TABLE 4.2(A) presents the corresponding coefficients and intercommodity inequality parameters for the United STates under $H_m(0.5)$.

In general, in both countries the effects of commodity prices and total expenditure on inequality in the marginal distributions of the five commodity-group expenditures appear to be much stronger than effects of economic growth trend variables. By "much stronger effects" we are referring to larger absolute magnitudes of the per capita expenditure and price coefficients σ_{i0}, σ_{ij}, that are also highly significant in comparison with the magnitudes and significance levels of the coefficients σ_{iz_h} economic growth trend variables.

For Mexico (TABLE 4.2(A)) we see that of the twenty coefficients of the growth variables, fully half of them have elasticities less than 0.4 and 95 percent have elasticities greater than .05, 77 percent have coefficient elasticity estimates larger than 0.4, and 20 percent have elasticities greater than 1.0. The difference becomes even more marked when we notice that, at a 10 percent level of significance (for instance), only 30 percent of the economic growth trend variables are significant while 57 percent of the price and per capita total expenditure coefficient estimates are significant at the 10 percent level of significance.

For the United STates (TABLE 4.2(B)) we see that the effects of prices and total expenditure relative to the effects of growth variables on inequality in the distribution of expenditures on different commodity groups are even stronger than in Mexico. Again, half of the coefficients of the growth variables are smaller than 0.05. All twenty of the growth variables have coefficients less than 0.4. All of the price and expenditure

Table 4.2(A). THE DEPENDENCE OF INTERCOMMODITY INEQUALITY PARAMETERS ON PER CAPITA TOTAL EXPENDITURE, COMMODITY PRICES, AND ECONOMIC GROWTH VARIABLES[1]: MEXICO

	$\ln \beta_i$	σ_{i0}	σ_{i1}	σ_{i2}	σ_{i3}	σ_{i4}	σ_{i5}	σ_{iz_1}	σ_{iz_3}	σ_{iz_5}	σ_{iz_G}	R^2
$\ln a_{t1}$	-0.477	0.914 (.0001)	0.247 (.122)	0.103 (.372)	-0.430 (.0001)	-0.421 (.049)	-0.609 (.004)	-0.007 (.172)	-0.114 (.133)	0.144 (.104)	0.002 (.851)	.9998
$\ln a_{t2}$	-2.409	1.027 (.0001)	-0.401 (.170)	-0.584 (.010)	0.242 (.132)	-1.051 (.010)	0.879 (.019)	-0.004 (.620)	0.385 (.009)	0.093 (.557)	-0.006 (.742)	.9901
$\ln a_{t3}$	-4.313	1.343 (.0001)	-2.036 (.002)	-0.772 (.081)	-0.677 (.042)	1.540 (.054)	0.677 (.347)	0.014 (.421)	-0.755 (.011)	1.260 (.0007)	0.046 (.215)	.9997
$\ln a_{t4}$	-1.898	0.807 (.0001)	0.412 (.346)	-0.281 (.382)	0.748 (.004)	-1.935 (.003)	0.378 (.479)	0.007 (.593)	0.649 (.004)	-0.915 (.0008)	-0.059 (.042)	.9815
$\ln a_{t5}$	-.2069	0.735 (.0001)	0.583 (.194)	0.076 (.815)	0.045 (.852)	-0.854 (.151)	-0.591 (.282)	-0.013 (.338)	-0.147 (.485)	-0.001 (.998)	-0.032 (.253)	.9993

1. See equations (3.17 a-b) and (3.22) in the text. The estimates are presented for the alternative maintained hypothesis that $\rho = -0.3$. The figures in parentheses represent the prob $\{t_{(21)} > |\hat{t}|\}$, where $\hat{t}$ is the calculated statistic for H_0: $\beta_i = 0$.

BEST AVAILABLE

Table 4.2(A). CONTINUED . . . INTERCOMMODITY INEQUALITY COEFFICIENTS[1] 1947-1978

YEAR	a	a_1	a_2	a_3	a_4	a_5
1947	3.567	1.158	0.881	0.427	0.617	0.484
	3.512	1.098	0.861	0.441	0.635	0.477
	3.553	1.068	0.838	0.472	0.688	0.487
1950	3.726	1.070	0.845	0.512	0.789	0.510
	3.674	1.084	0.849	0.520	0.723	0.499
	3.712	1.103	0.853	0.549	0.700	0.508
	3.834	1.100	0.850	0.588	0.761	0.534
	3.847	1.096	0.833	0.623	0.740	0.555
1955	4.073	1.114	0.856	0.658	0.852	0.593
	4.133	1.127	0.870	0.682	0.830	0.623
	4.131	1.129	0.850	0.692	0.825	0.634
	4.082	1.124	0.836	0.708	0.764	0.649
	4.273	1.145	0.867	0.735	0.840	0.686
1960	4.326	1.140	0.869	0.758	0.841	0.718
	4.343	1.142	0.874	0.780	0.805	0.743
	4.486	1.142	0.905	0.810	0.860	0.770
	4.607	1.145	0.922	0.834	0.903	0.803
	4.795	1.175	0.964	0.858	0.948	0.849
1965	5.001	1.217	0.998	0.887	1.016	0.883
	5.197	1.258	1.057	0.904	1.053	0.924
	5.278	1.247	1.079	0.925	1.058	0.969
	5.484	1.279	1.116	0.946	1.134	1.008
	5.573	1.279	1.131	0.962	1.148	1.054
1970	5.550	1.295	1.112	0.972	1.100	1.072
	5.679	1.268	1.121	1.010	1.179	1.101
	5.974	1.302	1.176	1.061	1.272	1.162
	6.163	1.355	1.210	1.091	1.313	1.195
	6.057	1.360	1.175	1.095	1.237	1.189
1975	6.059	1.362	1.149	1.108	1.217	1.222
	6.330	1.386	1.170	1.158	1.331	1.285
	6.549	1.398	1.188	1.219	1.404	1.285
1978	6.738	1.417	1.220	1.265	1.441	1.395

1. The a and a_i 's are estimated using the method stated on the preceding page.

Table 4.2(B). THE DEPENDENCE OF INTERCOMMODITY INEQUALITY PARAMETERS ON PER CAPITA TOTAL EXPENDITURE, COMMODITY PRICES, AND ECONOMIC GROWTH VARIABLES[1]: UNITED STATES

	$\ln \beta_i$	σ_{i0}	σ_{i1}	σ_{i2}	σ_{i3}	σ_{i4}	σ_{i5}	σ_{iz_1}	σ_{iz_3}	σ_{iz_5}	σ_{iz_6}	R^2
$\ln a_{t1}$	-0.291	0.193 (.260)	0.364 (.028)	-0.340 (.151)	-0.309 (.145)	-0.143 (.476)	-0.158 (.346)	0.141 (.103)	0.039 (.601)	-0.171 (.465)	-0.022 (.107)	.9999
$\ln a_{t2}$	-1.872	0.907 (.0001)	-0.073 (.517)	-0.082 (.621)	-0.531 (.002)	-0.392 (.012)	-0.109 (.366)	0.086 (.162)	0.034 (.528)	-0.092 (.103)	-0.001 (.005)	.9999
$\ln a_{t3}$	-2.931	0.284 (.105)	-0.252 (.119)	-0.941 (.0005)	0.259 (.220)	0.162 (.423)	1.087 (.0001)	0.309 (.001)	-0.152 (.051)	-0.261 (.023)	0.041 (.005)	.9998
$\ln a_{t4}$	-6.876	2.595 (.0001)	-1.039 (.001)	-1.221 (.008)	0.157 (.680)	0.563 (.135)	-1.546 (.0001)	-0.110 (.476)	0.019 (.890)	0.244 (.127)	0.002 (.950)	.9995
$\ln a_{t5}$	-3.123	0.760 (.0023)	-0.470 (.031)	-0.325 (.290)	-0.921 (.003)	0.042 (.873)	1.097 (.0001)	0.207 (.070)	-0.090 (.356)	0.012 (.926)	-0.003 (.848)	.9997

1. See equations (3.17 a-b) and (3.22) in the text. The estimates are presented for the alternative maintained hypothesis that $\rho = 0.5$. The figures in parentheses represent the prob $\{t_{(21)} > |\hat{t}|\}$, where $\hat{t}$ is the calculated statistic for $H_0: \beta_i = 0$.

Table 4.2(B) Continued . . . INTERCOMMODITY INEQUALITY COEFFICIENTS[1] 1947-78

YEAR	a	a_1	a_2	a_3	a_4	a_5
1947	3.691	1.554	0.744	0.583	0.531	0.283
	3.175	1.341	0.636	0.501	0.456	0.240
	2.322	0.979	0.467	0.367	0.324	0.176
1950	2.733	1.067	0.586	0.353	0.518	0.210
	3.010	1.227	0.620	0.358	0.579	0.226
	2.887	1.148	0.590	0.353	0.578	0.219
	2.807	1.112	0.611	0.327	0.540	0.219
	2.523	0.934	0.472	0.232	0.441	0.173
1955	2.107	0.861	0.425	0.200	0.442	0.179
	2.149	0.864	0.447	0.203	0.449	0.183
	2.283	0.922	0.474	0.246	0.464	0.176
	2.365	0.967	0.500	0.227	0.484	0.186
	2.377	0.947	0.520	0.262	0.460	0.184
1960	2.284	0.942	0.474	0.248	0.444	0.173
	2.304	0.937	0.481	0.236	0.471	0.179
	2.404	0.962	0.498	0.226	0.510	0.209
	2.490	1.017	0.503	0.236	0.522	0.211
	2.693	1.081	0.558	0.271	0.556	0.228
1965	2.736	1.132	0.557	0.277	0.551	0.219
	2.811	1.166	0.590	0.289	0.550	0.216
	2.847	1.141	0.626	0.297	0.555	0.228
	2.928	1.208	0.632	0.297	0.570	0.222
	2.950	1.218	0.596	0.286	0.606	0.243
1970	3.095	1.230	0.632	0.379	0.619	0.235
	3.160	1.287	0.650	0.376	0.608	0.237
	3.273	1.293	0.711	0.380	0.630	0.257
	3.398	1.358	0.734	0.380	0.656	0.269
	3.428	1.424	0.717	0.352	0.672	0.261
1975	3.472	1.435	0.708	0.349	0.697	0.280
	2.184	0.878	0.451	0.220	0.451	0.184
	1.911	0.781	0.386	0.181	0.400	0.162
1978	1.972	0.789	0.409	0.186	0.418	0.171

1. The a and a_i 's are estimated using the method stated on the preceding page.

coefficients are greater than 0.05; 70 percent of the price and expenditure coefficients are larger than 0.4, and 23 percent are greater than 1.0. When we note the significant coefficients at a 10 percent level we find that only four of the economic growth trend variables are significant while 50 percent of the price and total expenditure coefficients are significant at the 10 percent level.

Capital deepening (Z_1) appears to have a significant ceteris paribus effect on inequality in the United States but not in Mexico. Inequality in the marginal distributions of expenditure on housing (m_3) and medical services (m_5) is significantly, but inelastically, reduced by increases in the growth in capital stock relative to growth in population. In each case, however, the elasticity coefficient of capital deepening is considerably smaller than the significant estimates of coefficients of prices.

Relative productivity of labor (Z_3) seems to exert significant effects on inequality in both countries. In Mexico, an increase in relative productivity of labor significantly reduces inequality in the marginal distributions of expenditures of clothing and durables. In both countries, an increase in relative productivity of labor significantly increases inequality in the marginal distribution of expenditure on housing. In the United States the increase in inequality is very small compared to the corresponding increase in Mexico. However, in the case of those commodity groups for which Z_3 has significant effects on inequality, there are prices which have significant and considerably larger effects than Z_3, and none that are significantly smaller. This holds for both countries.

The capital output ratio (Z_5) appears to have significant effects on inequality in the marginal distributions of Mexican expenditures on housing and durables. It has a significant effect only on inequality in the distribution of expenditures on housing in the United States. Its elastic ceteris paribus effect is to decrease inequality in Mexican housing expenditures; the decrease of inequality in Mexican expenditures is about five times as strong as the increase of inequality in the United States. The almost elastic effect of Z_3 is to increase inequality in the Mexican distribution of expenditures on durables. For Mexico, where the coefficient of Z_5 is significant, it is larger in magnitude than several of the significant estimates of coefficients of prices; but not larger than all, since in each case, one of the prices turns out to have a considerably greater effect on inequality than the capital output ratio. In the case of inequality in the distribution of expenditure on housing (m_3) the effect of an increase in the price of food is about twice that of an equal increase of Z_5; in the case of inequality in the expenditure on durables (m_4), the ceteris paribus effect of an increase in the price of durables is about twice that of an equal increase in Z_5.

For the United States the capital output ratio (Z_5) has a significant effect only on inequality in the distribution of expenditures on housing. The price of clothing (P_2) and the price of medical services (P_5) also have significant effects on inequality in the distribution of expenditures on housing in the United States, and these effects are much stronger than the effect of the capital output ratio (Z_5).

The savings-output ratio (Z_6) seems to exert a significant, though very inelastic, effect in Mexico, tending to increase inequality in expenditures on durables. In the United States significant effects of changes in the savings-output ratio are confined to the marginal distribution of expenditures on housing; the very inelastic effect of Z_6 is to decrease inequality in that marginal distribution. In Mexico, an increase of the savings-output ratio (Z_6) tends to increase inequality in expenditures on durables, but in comparison with the significant effects of the prices of housing (P_3) and durables (P_4) the effect of the savings-output ratio is very weak. In the United States, the effect of an increase in the savings-output ratio is to decrease inequality in the distribution of expenditures on housing. However, that effect is very weak in comparison with the significant effects of the price of clothing (P_2) and medical services (P_5).

The total expenditure inequality parameter $\underline{a}$ is the sum of the intercommodity inequality parameters $a_1, \ldots, a_5$; see formula (3.11c). In order to examine the effect of per capita total expenditure, m, or the effect of a price, or the effect of an economic growth variable on the intercommodity parameter $\underline{a}$, we use the logarithmic derivative of $\underline{a}$ with respect to the economic variable in question. Let this logarithmic derivative of $\underline{a}$ with respect to a variable ν be denoted by $E_{a,\nu}$, where ν denotes any of m, $P_1, \ldots, P_5, Z_1, Z_3, Z_5, Z_6$. $E_{a,\nu}$ is related to the parameters $\sigma_{i,\nu}$ by the equation

$$(4.1) \qquad E_{a,\nu} = \sum_{i=1}^{5} \frac{a_i}{a} \sigma_{i,\nu} .$$

For instance, E_{a,z_1} denotes the logarithmic derivative of the inequality parameter $\underline{a}$ with respect to capital deepening, Z_1, i.e., E_{a,z_1} is the percentage change in the inequality parameter $\underline{a}$ related to a one percent increase in capital deepening, Z_1. We may call E_{a,z_1} the expenditure inequality parameter $\underline{a}$ with respect to capital deepening Z_1. The elasticities (4.1) vary from year-to-year and we have computed them for the entire succession of years 1947-1978. In TABLE 4.3(A) and TABLE 4.3(B) we present the average

TABLE 4.3A
AVERAGE ELASTICITY OF TOTAL EXPENDITURE
INEQUALITY PARAMETER a
MEXICO 1974-1978

ν	$\bar{E}_{a,\nu}$	C.V. (%)	E_{MIN}	E_{MAX}
m	0.81	2.83	0.77	0.87
P_1	-0.081	54.81	-0.20	-0.04
P_2	-0.23	4.10	-0.24	-0.21
P_3	-0.05	55.32	-0.13	-0.02
P_4	-0.67	9.61	0.73	-0.47
P_5	0.04	30.74	0.02	0.06
Z_1	-0.002	10.02	-0.002	-0.001
Z_3	0.07	39.43	-0.008	0.09
Z_5	0.04	101.72	0.001	0.15
Z_6	-0.009	20.90	-0.01	-0.004

$\bar{E}_{a,\nu}$ is the average value of the total expenditure elasticity with respect to the various economic variables for the years 1947-1978.

C.V. is the coefficient of variation, i.e.,

$$C.V. = \frac{\text{standard deviation}}{\text{mean}} \times 100.$$

E_{MIN} is the total expenditure elasticity reported for the year that gives the minimum value.

E_{MAX} is the total expenditure elasticity reported for the year that gives the maximum value.

TABLE 4.3B
AVERAGE ELASTICITY OF TOTAL EXPENDITURE
INEQUALITY PARAMETER a
UNITED STATES 1947-1978

ν	$\bar{E}_{a,\nu}$	C.V. (%)	MIN $E_{a,\nu}$	MAX $E_{a,\nu}$
m	0.93	2.81	0.87	0.97
P_1	-0.25	13.35	-0.30	-0.17
P_2	-0.69	1.72	-0.7	-0.65
P_3	-0.27	3.10	-0.29	-0.26
P_4	0.03	65.61	-0.02	0.05
P_5	0.08	45.29	-0.007	0.12
Z_1	0.12	3.71	0.11	0.13
Z_3	-0.02	32.15	-0.03	-0.01
Z_5	-0.03	10.87	-0.04	-0.02
Z_6	0.001	149.82	-0.003	0.003

$\bar{E}_{a,\nu}$ is the average value of the total expenditure elasticity with respect to the various economic variables for the years 1947-1978.

C.V. is the coefficient of variation, i.e.,

$$\text{C.V.} = \frac{\text{standard deviation}}{\text{mean}} \times 100$$

E_{MIN} is the total expenditure elasticity reported for the year that gives the minimum value.

E_{MAX} is the total expenditure elasticity reported for the year that gives the maximum value.

values of total expenditure inequality elasticities along with coefficients of variation, minima and maxima.

The level of per capita total expenditure, $\bar{m}$, has a much stronger ceteris paribus effect on inequality in the marginal personal distribution of total expenditure than does any of the commodity prices and economic development variables. This holds true for both countries. In Mexico, only the effect of the price of durables, P_4, on inequality in the personal distribution of total expenditure rivals the ceteris paribus effect of level of per capita expenditure, $\bar{m}$, in magnitude. In the United States, it is only the effect of the price of clothing, P_2, that comes close to the ceteris paribus effects of per capita total expenditure, $\bar{m}$, on inequality in the personal distribution of total expenditure.

At the beginning of this section we mentioned that a previous study of independent survey data on income indicated that the parameter b* does not depend on per capita total expenditure $\bar{m}$ for the United States. This means that the ceteris paribus effect on intercommodity inequality parameters a_i alone determines the change of Gini inequality (3.12). From TABLE 4.2(B) it is apparent that $\sigma_{i0} > 0$ for all commodity groups. Consequently the effect of an increase in $\bar{m}$ is to decrease inequality in each of the personal marginal distributions of expenditures on commodity groups in the United States. If prices are stable and growth variables are constant, an increase of per capita total expenditure reduces Gini inequality in the personal distributions of commodity expenditures in the United States. We conjecture that inequality in the distributions of major commodity group expenditures decrease with increasing per capita real total expenditure when growth variables are constant.

For Mexico, it appeared that the generalized Pareto parameter is nearly constant and ≈ 7.5. Mexican survey data was not suitable for estimating b* annually. For Mexico, the ceteris paribus effects on Gini inequality of each of the variables is the only effect. The effects of per capita total expenditure $\bar{m}$, of prices, and of growth variables, on (3.12) is opposite to the sign of the estimate of σ_{i0}, σ_{ij}, σ_{iz_r} in TABLE 4.2(A) as the case may be. As in the case of the United States, increases of per capita expenditure decrease Gini inequality.

Commodity prices $P_1, \ldots, P_5$ have a greater ceteris paribus effect on inequality in the distribution of total expenditure than do the economic development variables, Z_1, Z_3, Z_5, Z_6. This comparison holds true in both countries. In Mexico capital deepening (Z_1) and the savings-output ratio (Z_6) are negligible in their ceteris paribus effects on total expenditure inequality in comparison with effects of all prices. Relative productivity of labor (Z_3) and the capital output ratio (Z_5) are negligible in their effects on expenditure inequality relative to the prices of food, clothing and durables except for the years 1947-1949.

Averaged over the thirty-two years, the ceteris paribus effects of growth variables on inequality in the distribution of total expenditure in Mexico is negligible. In contrast to this, the prices of clothing and durables appear to have a significant effect, which is to increase inequality. In the United States, capital deepening (Z_1) has a significant effect on inequality in the distribution of total expenditure, but the other growth variables have only negligible effects relative to the effects of prices of food, clothing and housing services.

An increase of per capita total expenditure, $\bar{m}$, produces a ceteris paribus decrease of inequality in the marginal distribution of total expenditure. Where they are not negligible in magnitude, the effects of price increases are to increase inequality in the distribution of total expenditure, and the effects of increases in the economic development variables is to decrease inequality. The one exception is the effect of increases in the price of medical services, P_5, which is small but positive in both countries. In Mexico, the price of durables, P_4, has the strongest ceteris paribus effect of increasing inequality in the distribution of total expenditure. In the United States, the price of clothing, P_2, has the strongest ceteris paribus effect of increasing inequality in the distribution of total expenditure. In Mexico, ceteris paribus effects of increases in the prices of food, P_1, clothing, P_2, and housing, P_3, are considerably weaker than corresponding ceteris paribus effects in the United States. In Mexico, ceteris paribus effects of growth variables on inequality in the distribution of total expenditure tend to be larger in magnitude than the corresponding ceteris paribus effects in the United States, and opposite in sign. The one exception (on the score of magnitude) is the effect of capital deepening (Z_1); the positive elasticity of the parameter $\underline{a}$ with respect to Z_1 in the United States is about sixty-six times as large as the corresponding elasticity (negative) with respect to capital deepening in Mexico.

V. INTERCOUNTRY COMPARISONS OF INEQUALITY OVER 1947-1978 CONCLUSION

In this section we compare Mexico and the United States in respect of the degree of inequality in the marginal personal distributions of commodity group expenditure. Here inequality is expressed by the Gini measures for each of the countries. For Mexico the Gini measures of inequality in the distributions of total expenditure and expenditures on five commodity groups are given in TABLE 5.1(A). For the United States, the Gini measures of inequality in the same components are given in TABLE 5.1(B).

A comparison of TABLE 5.1(A) with TABLE 5.1(B) shows that, in general, inequality in the distributions of total expenditure and five commodity groups is greater in Mexico than in the United States. Comparing inequality in the distributions of total

expenditure, we see that although in 1947-1948, 1959-1963, and 1966-1975, total expenditure inequality was less for Mexico than for the United States, for other years inequality in the distribution of total expenditure in the United States was less than in Mexico. Comparing expenditure inequality by commodity groups, we see that for four of the five commodity groups, the United States had less inequality in the personal distributions of expenditure than Mexico. Only in the case of expenditures of food did Mexico (in some years) have less inequality than the United States. (In the distribution of expenditures on food, inequality was greater in the U.S. during 1947-1954, in 1958, and during 1963-1975.) In the other years Gini inequality in the personal distribution of expenditure on food was greater in Mexico. The magnitudes of these Gini measures are about the same in both countries, ranging from 0.50 to 0.54. In the distribution of expenditures on clothing, for all years analyzed inequality was greater in Mexico than in the United States; the Gini concentration ratios are approximately 0.55 for the United States and around 0.65 for Mexico in the clothing group. Inequality in the marginal personal distribution of expenditures on housing is greater in Mexico than in the United States, expect for the years 1947-1948. Notice the different trends of inequality in housing expenditure over time in the two countries. In Mexico, housing expenditure inequality clearly increased over time, from 0.63 to 0.81, while just the opposite happened in the United States, where inequality in the marginal personal distribution of expenditure on housing decreased from 0.70 to 0.52. Again in the distribution of expenditure on durables, we see for every year inequality in the distribution of expenditure on durables is greater in Mexico than in the United States. The trend over time has been for inequality in the distribution of expenditures on durables to fall in the United States (from 0.63 to 0.50) while inequality in expenditure on durables in Mexico has been relatively constant, fluctuating near 0.66. In all years the United States shows less inequality in the distribution of expenditures on medical services than does Mexico. Also, over time, the degree of inequality in the distribution of expenditures in medical services in the United States has decreased, from 0.68 in 1947 to 0.51 in 1978. In Mexico the opposite has occurred, with inequality in the distribution of expenditures on medical services increasing from 0.75 in 1947 to 0.83 in 1978. To summarize, it appears that (in total expenditure and five commodity groups) Mexico has experienced more economic inequality than the United States. The trend in the United States for inequality in expenditures on most commodity groups decreases over time, while in Mexico inequality in those expenditures either increases or stays relatively constant over time.

In this model of economic inequality, differences between the inequality measures in TABLE 5.1(A) and in TABLE 5.1(B) are attributed to two main determinants: (1) Differences between the Mexican structural parameters in TABLE 4.2(A) and those in TABLE 4.2(B) for the United States. The structural parameters are interpreted as representing the wants and want satisfying skills of households. Consequently, a part of the differences between Mexico and the United States in respect of economic inequality is

Table 5.1(A). GINI COEFFICIENTS OF INEQUALITY[1] IN PER CAPITA EXPENDITURES, MEXICO, 1947-78

YEAR	$G(a,b^*)$	$G_1(a_1,b^*)$	$G_2(a_2,b^*)$	$G_3(a_3,b^*)$	$G_4(a_4,b^*)$	$G_5(a_5,b^*)$
1947	0.353	0.464	0.589	0.632	0.650	0.757
	0.369	0.487	0.616	0.660	0.676	0.783
	0.407	0.539	0.672	0.714	0.730	0.826
1950	0.386	0.524	0.631	0.721	0.653	0.803
	0.375	0.501	0.621	0.718	0.633	0.792
	0.380	0.512	0.630	0.721	0.634	0.796
	0.383	0.518	0.624	0.734	0.646	0.796
	0.411	0.548	0.670	0.788	0.682	0.829
1955	0.420	0.562	0.689	0.809	0.682	0.825
	0.417	0.562	0.680	0.807	0.679	0.821
	0.409	0.550	0.669	0.779	0.673	0.826
	0.404	0.541	0.660	0.791	0.668	0.819
	0.409	0.545	0.653	0.767	0.675	0.820
1960	0.408	0.546	0.668	0.778	0.681	0.829
	0.402	0.547	0.667	0.786	0.670	0.824
	0.398	0.542	0.661	0.792	0.656	0.803
	0.388	0.533	0.659	0.785	0.652	0.802
	0.386	0.522	0.640	0.764	0.640	0.790
1965	0.383	0.515	0.640	0.761	0.642	0.794
	0.378	0.510	0.630	0.754	0.642	0.798
	0.377	0.513	0.619	0.749	0.641	0.790
	0.372	0.504	0.617	0.750	0.636	0.796
	0.370	0.502	0.628	0.756	0.625	0.781
1970	0.372	0.501	0.617	0.709	0.621	0.786
	0.370	0.493	0.612	0.710	0.624	0.784
	0.366	0.493	0.596	0.708	0.617	0.772
	0.362	0.485	0.590	0.708	0.610	0.766
	0.361	0.477	0.595	0.721	0.606	0.770
1975	0.360	0.476	0.597	0.722	0.599	0.759
	0.415	0.558	0.678	0.796	0.678	0.821
	0.433	0.579	0.706	0.823	0.699	0.837
1978	0.427	0.577	0.696	0.820	0.692	0.831

NOTE: 1. The Gini coefficients for Mexico were estimated using estimates of the a and a_i 's given in Table 4.2(A) and letting $b^* = 7.5$ and by combining the a, the a_i 's and b^* in (3.12).

Table 5.1(B). GINI COEFFICIENTS OF INEQUALITY[1] IN PER CAPITA EXPENDITURES, UNITED STATES, 1947-1978

YEAR	$G(a,b^*)$	$G_1(a_1,b^*)$	$G_2(a_2,b^*)$	$G_3(a_3,b^*)$	$G_4(a_4,b^*)$	$G_5(a_5,b^*)$
1947	0.396	0.535	0.579	0.702	0.639	0.680
	0.396	0.543	0.582	0.696	0.633	0.682
	0.394	0.547	0.586	0.684	0.619	0.678
1950	0.389	0.546	0.584	0.670	0.596	0.670
	0.389	0.543	0.583	0.666	0.610	0.674
	0.387	0.540	0.581	0.657	0.615	0.670
	0.381	0.538	0.580	0.643	0.599	0.660
	0.383	0.541	0.585	0.635	0.605	0.655
1955	0.367	0.531	0.575	0.620	0.576	0.639
	0.376	0.536	0.578	0.619	0.585	0.634
	0.374	0.534	0.580	0.615	0.585	0.630
	0.389	0.543	0.590	0.618	0.605	0.633
	0.387	0.541	0.585	0.612	0.590	0.624
1960	0.384	0.540	0.583	0.606	0.589	0.615
	0.385	0.541	0.584	0.602	0.597	0.611
	0.383	0.542	0.578	0.596	0.587	0.605
	0.384	0.543	0.577	0.593	0.580	0.599
	0.384	0.541	0.572	0.590	0.574	0.592
1965	0.383	0.537	0.567	0.586	0.564	0.586
	0.393	0.540	0.565	0.589	0.566	0.586
	0.395	0.543	0.564	0.588	0.567	0.580
	0.395	0.540	0.560	0.585	0.558	0.575
	0.388	0.537	0.555	0.579	0.553	0.565
1970	0.390	0.536	0.558	0.579	0.560	0.564
	0.387	0.538	0.556	0.572	0.549	0.559
	0.383	0.534	0.549	0.564	0.537	0.551
	0.380	0.528	0.544	0.559	0.532	0.546
	0.380	0.526	0.547	0.558	0.540	0.545
1975	0.378	0.525	0.549	0.555	0.541	0.540
	0.373	0.521	0.545	0.547	0.527	0.532
	0.383	0.527	0.550	0.546	0.527	0.533
1978	0.355	0.509	0.531	0.526	0.507	0.511

Note: 1. The Gini coefficients for the United States were estimated using the a and a_i 's given in Table 4.2(B). The b* was found by Slottje (1983) using I.R.S. data and is given in Table 3.1. The a, a_i 's, and b* are combined in (3.12) to estimate the Gini measures.

attributed to differences in wants and want-satisfying skills of households in the two countries. (2) A part of the difference is attributed to differences between the successions of levels of per capita total expenditure, prices, and growth variables in the respective countries.

TABLE 5.2(A) has been constructed as follows: Intercommodity inequality parameters a_i, $i = 1, 2, \ldots, 5$, and a, have been computed from the (Mexican) coefficients in TABLE 4.2(A) and the United States per capita total expenditure, price, and growth data; then the respective Gini measures have been computed using the equations in Section III. TABLE 5.2(A) affords an interesting conjecture respecting how inequality in Mexican personal distributions of expenditures would have been different from what they actually were in 1947-1978 if (contrary to fact) Mexico had undergone the same succession of levels of per capita total expenditures, prices, and growth variables as the United States. TABLE 5.2(B) has been constructed on the same principle. (Interchange 'Mexico' and 'United States' in the foregoing description.)

There are six meaningful pair wise comparisons among the four tables of Gini measures. A comparison of TABLE 5.1(A) with TABLE 5.1(B) has already been made. When TABLE 5.1(A) is compared with TABLE 5.2(A), one can form a notion of the effect (on inequality in Mexican personal distributions of expenditures) of changing the succession of levels of per capita expenditure, prices, and growth variables experienced by Mexico to the succession actually experienced by the United States (1947-1978). Here the effect is attributable only to that change. For every marginal personal distribution, and for every year, the effect of such a change is to increase inequality in Mexico.

When one compares TABLE 5.1(B) with TABLE 5.2(B) one can form a notion of the effect (on inequality in United States personal distributions of expenditures) of changing the succession of levels of per capita total expenditure, prices, and growth variables experienced in the United States to the succession actually experienced by Mexico (1947-1978). For every marginal personal distribution, and for every year, the effect of such a change would be to reduce inequality in the United States.

When one compares TABLE 5.1(A) and TABLE 5.2(B), the differences of the inequalities can be attributed only to differences between the structural coefficients in TABLE 4.2(A) and TABLE 4.2(B), i.e., to the structural differences between the Mexican and United States households. For every marginal personal distribution and every year, the inequality measures in TABLE 5.2(B) are smaller than in TABLE 5.1(A). In a like manner, when one compares TABLE 5.1(B) with TABLE 5.2(A), the differences of inequalities can only be attributed to differences between the structural coefficients in TABLE 4.2(A) and TABLE 4.2(B). Again the inequality measures associated with the Mexican structural coefficients in TABLE 4.2(A) are uniformly larger than the inequality measures associated with the United States structural coefficients in TABLE 4.2(B).

Finally, comparison of TABLE 5.2(A) and TABLE 5.2(B) shows that the inequalities associated with Mexican structural coefficients in TABLE 4.2(A) and United States per capita total expenditure, price,

TABLE 3.2(B): GINI COEFFICIENTS OF INEQUALITY IN PER CAPITA EXPENDITURES IN MEXICO AT UNITED STATES STAGE OF DEVELOPMENT, 1947-1978

YEAR	$G(a,b^*)$	$G_1(a_1,b^*)$	$G_2(a_2,b^*)$	$G_3(a_3,b^*)$	$G_4(a_4,b^*)$	$G_5(a_5,b^*)$
1947	0.486	0.637	0.765	0.801	0.813	0.887
	0.511	0.663	0.788	0.821	0.834	0.901
	0.565	0.719	0.831	0.860	0.870	0.925
1950	0.536	0.704	0.800	0.864	0.817	0.912
	0.520	0.680	0.792	0.863	0.802	0.907
	0.527	0.691	0.799	0.864	0.802	0.909
	0.531	0.697	0.794	0.872	0.812	0.909
	0.570	0.727	0.829	0.905	0.838	0.926
1955	0.582	0.741	0.843	0.916	0.838	0.924
	0.579	0.740	0.836	0.915	0.836	0.922
	0.568	0.729	0.829	0.899	0.832	0.925
	0.561	0.721	0.821	0.906	0.826	0.921
	0.561	0.725	0.817	0.893	0.833	0.922
1960	0.568	0.726	0.828	0.899	0.837	0.926
	0.566	0.727	0.827	0.903	0.829	0.924
	0.559	0.722	0.822	0.907	0.819	0.913
	0.553	0.712	0.821	0.903	0.816	0.912
	0.539	0.702	0.807	0.890	0.807	0.906
1965	0.536	0.694	0.807	0.888	0.809	0.909
	0.532	0.669	0.799	0.884	0.809	0.910
	0.529	0.692	0.790	0.882	0.808	0.906
	0.525	0.683	0.789	0.882	0.804	0.907
	0.523	0.681	0.797	0.886	0.795	0.900
1970	0.515	0.679	0.789	0.856	0.792	0.903
	0.512	0.671	0.785	0.857	0.795	0.902
	0.506	0.670	0.771	0.850	0.789	0.895
	0.499	0.661	0.766	0.856	0.783	0.891
	0.498	0.653	0.770	0.864	0.780	0.894
1975	0.496	0.652	0.772	0.865	0.773	0.888
	0.576	0.737	0.835	0.909	0.835	0.922
	0.599	0.756	0.854	0.923	0.850	0.930
1978	0.594	0.754	0.847	0.921	0.844	0.927

Note 1. The Gini measures above were estimates using coefficient estimates given in Table 4.2(B) combined with United States price, per capita expenditure, and growth variables. The new a and a_i are then combined with $b^* = 7.5$ in (3.12) to give the new Gini measures.

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Table 5.2(B). GINI COEFFICIENTS OF INEQUALITY[1] IN PER CAPITA EXPENDITURES IN THE UNITED STATES AT MEXICAN STAGE OF DEVELOPMENT, 1947-1978

YEAR	$G(a,b^*)$	$G_1(a_1,b^*)$	$G_2(a_2,b^*)$	$G_3(a_3,b^*)$	$G_4(a_4,b^*)$	$G_5(a_5,b^*)$
1947	0.329	0.406	0.435	0.533	0.480	0.514
	0.328	0.410	0.437	0.527	0.475	0.515
	0.326	0.412	0.439	0.516	0.463	0.512
1950	0.323	0.411	0.437	0.504	0.445	0.504
	0.322	0.409	0.436	0.501	0.456	0.507
	0.320	0.406	0.434	0.492	0.459	0.503
	0.315	0.403	0.432	0.480	0.446	0.494
	0.319	0.407	0.437	0.474	0.452	0.491
1955	0.302	0.395	0.425	0.459	0.425	0.473
	0.315	0.403	0.431	0.461	0.437	0.474
	0.312	0.400	0.432	0.458	0.435	0.469
	0.329	0.414	0.445	0.465	0.456	0.477
	0.329	0.413	0.442	0.462	0.446	0.471
1960	0.326	0.412	0.440	0.457	0.444	0.463
	0.329	0.414	0.442	0.455	0.451	0.461
	0.328	0.414	0.438	0.451	0.444	0.457
	0.331	0.416	0.439	0.450	0.441	0.454
	0.333	0.417	0.436	0.449	0.438	0.450
1965	0.334	0.415	0.434	0.447	0.432	0.447
	0.348	0.423	0.439	0.455	0.440	0.453
	0.351	0.427	0.440	0.455	0.442	0.450
	0.352	0.426	0.438	0.454	0.437	0.448
	0.345	0.421	0.432	0.448	0.431	0.439
1970	0.347	0.422	0.435	0.448	0.436	0.439
	0.345	0.422	0.433	0.443	0.429	0.435
	0.342	0.419	0.428	0.438	0.421	0.429
	0.340	0.415	0.425	0.434	0.418	0.426
	0.339	0.413	0.426	0.432	0.421	0.425
1975	0.337	0.411	0.426	0.430	0.421	0.421
	0.333	0.408	0.422	0.423	0.411	0.414
	0.346	0.418	0.431	0.429	0.417	0.421
1978	0.315	0.394	0.407	0.404	0.392	0.395

Note 1. The Gini measures above were estimated using coefficient estimates given in Table 4.2(A) combined with Mexico's price, per capita expenditure, and growth variables. The new a and a_i's are then combined with the b^* (whose derivation is explained in 5.1(B)) in (3.12) to give the new Gini measures.

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and growth experience (1947-1978) are uniformly larger than the inequalities associated with United States structural coefficients in TABLE 4.2(B) and Mexican per capita total expenditures, price, and growth experience (1947-1978).

For the personal distributions of total expenditure, and the personal distributions of each commodity groups expenditure, the greatest Gini inequality occurs when the structure of wants and want-satisfying skills of Mexican households is combined with the succession of per capita total expenditure, prices, and growth variables actually experienced by the United States during 1947-1978. In the case of each of the marginal distributions of expenditures, total and group, the least inequality occurs when the structure of wants and want-satisfying skills of households in the United States is combined with the succession of per capita total expenditure, prices, and growth variables actually experienced by Mexico (1947-1978).

The relation between inequality in the marginal personal distribution of total expenditure and of major commodity group expenditures, on the one hand, and per capita total expenditure, on the other, might be that of the Kuznet's curve or inverted U, cf Kuznets (1963), Hagen (1980) pp. 58-61. If so, then both Mexico and the United States appear to be situated on the branch of ascending inequality. As with income inequality and per capita income, (cf Nugent (1983), pp. 395-396) inequality in personal distributions of expenditure does tend to increase with increasing per capita total expenditure.

At first glance, this statement might appear to contradict what we said in Section IV, namely, that an increase in per capita expenditure tends to decrease. However, the latter remark involved a ceteris paribus clause and presupposed that the structure of wants and want-satisfying skills remain constant. With respect to the ceteris paribus clause, the difference between the Mexican (average) stage of economic development during (1947-1978) and the United States stage of economic development is very great in terms of productivity of labor (Z_3). The productivity of labor in the United States was about fifty times the productivity of labor in Mexico for the period in question. With respect to the presupposition that the parameters reflecting wants and want-satisfying skills remain constant, it appears improbable that such would be the case if some national economy (say) Mexico were to be moved so far from its actual state of economic development (1947-1978) to that experienced by the United States.

TABLE 5.1(A) and TABLE 5.1(B) do not indicate any definite increase of expenditure inequality in Mexico and the United States from 1947-1978, although Mexican inequalities are highest in the last three years. There is a tendency towards decreasing inequality in all expenditure distributions in the United States. Assuming that the relation between expenditure inequality and economic growth does accord with some form of inverted-U curve, it might well be that the United States is near the point of diminishing inequality. Such are not more than conjectures, however, and their pursuit is beyond the scope of this paper.

As discussed in Section I, this paper describes a model of economic inequality that is designed for analysis and prediction of directions and rates of intertemporal change of inequality in the personal joint distribution of household expenditures on commodities and on securities, tax payments, and the separate components of household income and wealth. While this model has many different uses in policy-oriented research, we have focused on three primary uses of the model in this study. First, we demonstrated the use of the multivariate personal distribution model in accounting for empirical regularities among numerical measures of different aspects of economic inequality (recall TABLE 1.1 and the discussion about it). Second, we showed how the model can be used to assess the relative importanct of economic growth variables versus levels of per capita expenditure prices, wage rates, etc. as potential causes of intertemporal changes in economic inequality. Finally, we discussed the use of the model to assess the importance of cultural differences in accounting for contemporaneous differences of economic inequality between countries at either different or same levels of economic development.

Of course, many other policy-relevant uses of the model exist, we have attempted here just to explore a few and hopefully motivate subsequent use of the model for future policy applications.

NOTES

1. Most of these uses are exemplified in the recent study of redistribution effects of income tax and cash benefits in Australia by Nanak Kakwnai (1983).

2. For a nonmathematical but rigorous treatment of the underlying concepts see the article by Basmann (1974) esp. Section 2 and Section 5.

3. Literature on the construction of cost-of-living indexes and welfare functions based on the assumption that consumer preferences are fixed is voluminous. We cite only a few major works. Konus (1924; 1936) p. 11; Klein and Rubin (1947) p. 87; Samuelson and Swammy (1974) p. 587. For recent surveys see Deaton (1980), Diewert (1981).

4. An example of a vacuously price dependent direct utility function $W(X;p)$ is

$$W(X;p) = F(p)V(X) + H(p),$$

where $V(X)$ is a direct utility function whose parameters are independent of prices, $F(p)$ and $H(p)$ are positive valued functions of the price vector p. Since the indifference surfaces of $W(X;p)$ coincide everywhere in X with the indifference surfaces of $V(X)$, the derived consumer demand functions are unaffected by replacement of $V(X)$ by $W(X;p)$.

5. In the construction of cost-of-living indexes, consumer equivalence scales, welfare functions and measures of economic inequality from systems of empirical demand functions it is convenient to consider the latter under two mutually exclusive heads:

(A) Systems X(p,M) that fail to possess one or more of the Slutsky-Hicks properties of (a) zero degree of homogeneity in prices and total expenditure; (b) symmetry; (c) negative semi-definiteness.

(B) Systems X(p,M) that possess all of the above Slutsky-Hicks properties.

In a forthcoming article in American Economic Review, Basmann et al (1983), we prove that in both of the cases (A) and (B) the system of demand functions X(p,M) can be rationalized by a direct utility function U(X;θ) having the Fechner-Thurstone form with its vector θ of preference parameters dependent on budget constraint prices. (In Section III, utility functions (3.14a-b) and (3.15a-b) are of that form.) An empirical system X(p,M) of demand functions whose preferences necessarily are influenced by changes in budget constraint prices and/or changes in the level of total expenditure, M. Moreover, even if the system X(p,M) of demand functions falls under heading (B), i.e., if it possesses the properties of zero degree of homogeneity, symmetry, and negative semidefiniteness, still it cannot validly be inferred fron that fact alone that the consumer preferences underlying X(p,M) are independent of prices and total expenditure.

6. Feldstein (1976) pp. 79, 87 and Rosen (1978) p. 309 discuss horizontal equity under the assumption that consumers' direct utility functions V(X;θ) have parameters θ that are independent of prices, total expenditure, and the tax schedules. However, a generalized Fechner-Thurstone direct utility function with price-dependent parameters (Basmann et al 1983, formulas (3), (4)) necessarily fits Rosen's empirical data equally as closely as the generalized CES utility function he proposes; cf. Rosen (1978) formula (1), p. 309. Obviously this is not a criticism of Rosen's specification of a direct utility function. In the absence of the relevant experimental data capable of detecting a difference between the alternative direct utility functions, the needs of practical policy formation call for analysis of horizontal equity under both alternatives.

7. G, defined by (1.4), and R, defined by (1.5) in TABLE 1.1, are the well-known Gini concentration ratio and relative mean deviation. T*, defined by (1.6), is a normalized form of Theil's entropy measure, and K, defined by (1.7a-c), is a measure of inequality proposed by Nanak Kakwani. For a discussion of these and several other measures of inequality see Kakwani (1980) Chapter 5. The measures B, defined by (1.3), and C, defined by (1.8), have been proposed by Basmann et al (1983c) along with several others. B is designed to be highly sensitive to transfers of income away from the poorest n-tile of income recipients, being equal to one if the poorest n-tile receives a zero share.

On our interpretation, each of the numerical inequality measures B, G, R, T*, K, and C, defined in TABLE 1.1, and others not presented here, refers to, or represents, a different system of those biological, physiological and social psychological aspects of economic reality of which policymaking must take account if it is to succeed in its purposes. These different systems of aspects of real economic inequality probably overlap to a considerate extent. Of course we do not pretend to know anything very precise about which aspects

of real economic inequality are represented by which measure. Nor do we pretend to know which, if any, of the different inequality measures represents the most important aspects of real economic inequality. In the literature one finds severe criticisms of the Gini measure, G, and other widely used inequality measures. However, such criticisms appear to rest on the assumption that economists believe that real economic inequality can be adequately measured by a single numerical measure, which, presumably some economist will someday be clever enough to define. Obviously, the present authors do not consider discovery of such a measure to be just around the corner. On the other hand, the practicability of representing most of the aspects of real ecnomic inequality by a combination of two or three of the diverse inequality measures does not appear remote at all.

Participants in the policymaking process are not primarily concerned with numerical measures of economic inequality such as those in TABLE 1 and TABLE 2 but with economic inequality as it is experienced by human beings. Their practical interest in numerical magnitudes of (say) B, G, and K is of a secondary or derived character in the same way as the practical interest of factory managers and union stewards in the numerical magnitudes of (say) illuminance on work benches, temperature, and humidity is of a secondary character. Real economic inequality (as we shall call it to distinguish experience from numerical measurements) is--in a sense--the ambience of biological, psychological, and social life of human beings. At bottom, interest in numerical measures of economic inequality stems from their potential descriptive correlation with behavior of individuals in extracting what biological, psychological, and social advantage they can from their relative shares of the social product.

It might be supposed that economists ought to first form a quantitive concept of economic inequality and only thereafter develop numerical measures of inequality to represent it, otherwise (it might seem) inequality measures such as are shown in TABLE 1 would lack an economic rationale. Such a methodological value judgment might seem to be supported by the incorrect assumption that precise formulation of the basic quantitative physical concepts, such as temperature, duration, and length, preceded the initial development and subsequent improvement of methods of measuring them. However, it is most probable that, as in the case of temperature, duration, and distance, useful and continually improving concepts of economic inequality will only develop after, and out of, the process of measuring.

8. 'Endogenous', and 'exogenous' are terms that denote relations between variables and models. Thus exogeneity of (say) capital deepening is a relation that variable bears to one model (as in Section IV) and not to some other model. It is a weakness of econometric jargon that it often gives the false impression that exogeneity and endogeneity of variables are properties of economic reality, not merely properties of models and hypotheses.

9. We make no claims of special merit of superiority for Samuelson's concept and characterization of economic growth except that their familiarity to participants in the policymaking process

serves the cause of brevity in presenting a version of our model that is designed especially for ISEDS purposes.

10. For instance, the joint distribution function of total expenditure on commodities and securities and income defined by (3.8a-b) below can be represented pictorially. To determine frame-to-frame changes in the drawings one specifies a sequence of changes in the parameters K, a*, b*, and c.

11. In mathematical terms, one starts with the distributions function (3.11a-b), "integrates out" expenditures to get the marginal joint distribution function of income components (3.6a-b), then "integrates out" the components of income, subject to their sum being fixed at w, to obtain the marginal personal distribution of income characterized by (3.4a-b). Joint distributions of expenditures and income characterized by (3.8a-b) and (3.9a-b) are derived from the multivariate distribution (3.11a-b) by the operations.

12. The cost of the U.S. Consumer Expenditure Survey (1972-73) and the subsequent (1978) revision of the Consumer Price Index (CPI) for the United States has been estimated at $56 million 1975 dollars. See The Consumer Price Index: Concepts and Content over the Years. Bureau of Labor Statistics, Report 517, p. 15.

13. This combining of independent estimates of distribution functions should not be confused with the pooling of cross-section data and time-series data.

14. Use of such "predictions" in practical design of surveys is explained in textbooks. E.g. Cochran (1977). See Chapter 4, pp. 52-53.

15. For each specified subpopulation ν, $K^{(\nu)}$ is estimated by the minimum sum of expenditures and income y + w over all households in that subpopulation. $b^{*(\nu)}$ is estimated from the sample generalized variance of all expenditures and income components, their sample means, and the theoretical generalized variance of (3.11a-b). Finally the parameters $a_i^{(\nu)}$, $c_i^{(\nu)}$ are estimated by equating theoretical means of expenditures and components of income to the respective empirical means.

16. It is interesting to compare results from the Consumer Expenditure Survey (1973) with corresponding estimates from the Internal Revenue Service data for comparable income components in (1973). From the IRS data the estimate of the generalized Pareto parameter b* is 3.96 for 1973. The IRS estimate of income inequality $G_w(c,b^*)$ is 0.347, just slightly larger than the Gini concentration ratio computed from the data in TABLE 3.2. The IRS income parameter c is 16.9 for 1973, considerably smaller than the weighed average c of 22.2 obtained from the U.S. Consumer Expenditure Survey.

17. (3.16a-b) with the parameters a_i dependent on prices and total expenditure, is the generalized Fechner-Thurstone direct utility function. In Basmann et al (1983) we show that every system of demand functions can be rationalized by a direct utility function of the form (3.16a-b).

Let $U^{(\nu)} = \prod_{i=1}^{n} X_i^{a_i^{(\nu)}}$, where $\nu = 1, 2, \ldots, N$, be the generalized Fechner-Thurstone direct utility function attributable to household $\underline{\nu}$. Then (3.16a-b) is the geometric mean of the household direct utility functions, and a_i is the arithmetic mean of the household parameters $a_i^{(\nu)}$ for the population in question.

18. In another paper Basmann et al (1983d) we examine a model of these stochastic variations of inequality parameters. Briefly, $\underline{U}_t$ is a random vector where

$$\underline{u}_t = Q\underline{u}_{t-1} + \varepsilon_t$$

with ε_t independently, identically normally distributed with zero mean and variance-covariance matrix Λ, $q_{ij} = q_j$ for $i \neq j$, $q_{ii} = q_i + \rho$.

19. We have examined a maintained hypothesis that included as independent variables the change in a wage rate (Z_2) and the interest rate (Z_4). Under this initial maintained hypothesis we found that the observations strongly favored the null hypothesis that the interest rate (Z_4) has little or no effect on expenditure inequality for either the United States or Mexico. The wage rate (Z_2), too, was found not to affect significantly any of the inequality parameters for Mexico and had a significant but weak effect on the inequality parameter for durable expenditures in the United States. For both countries over 1947-1978 the wage rate (Z_2) was also found to be highly correlated with the relative productivity of labor (Z_3). Omitting Z_2 was not expected to affect the conclusions drawn respecting null hypotheses and parameter estimates. It is important to remark that omitting the wage rate (Z_2) and the interest rate (Z_4) had no effect on estimates of coefficients of the other growth variables, the prices, and total expenditures, in terms of their signs, or on the significance of the coefficients, and had little effect on their magnitudes.

20. The autocorrelations coefficient, ρ, is not estimated from data, of course. For each specified value of ρ, the dependent and independent variables of (3.19a-f) and (3.22) undergo transformation to remove autocorrelation from the residuals in the transformed equations. The $H_m(\rho)$ that is said to be in best agreement with the data is that for which the five Dubin-Watson test statistics tend to be nearest the magnitude 2.00.

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Part 2

Agricultural and Rural Development Strategies

6
Economics of Agricultural Growth: The Case of Northern India

Robert E. Evenson

Growth in the supply of agricultural commodities, particularly of food grains, has been of clear policy importance in developing countries. The debates in the 1970s of "growth vs. equity" issues diverted attention for a time from the basic importance of growth and some of the associated literature had a strong anti-growth, anti-technology character. One need only look at the implications, however, of slow agricultural supply growth in the presence of rapid population growth to understand why growth itself has a prominent place once again on the research agenda of most development economists.

Several projections made in the early 1970s (notably one by the International Food Policy Research Institute, 1977) indicated that foodgrain production in India and several other Asian countries would grow at a slow rate during the 1970s, primarily because the expansion of cultivated land area would be very slow. These projections were made after the introduction of high-yielding "green revolution" wheat and rice varieties. They were basically agronomic as opposed to economic projections. They implied that India could be importing on the order of 50 million tons of foodgrains per year by the early 1980s. The implications of such an import requirement for the Indian development policy generally and for the welfare of Indian families specifically are quite obvious. Major adjustments in trade and investment programs would be required. Given the costs of these adjustments and of the imports themselves, it is highly likely that a substantial decline in food consumption per capita and the attendant mortality and health consequences would take place.

Fortunately, these projections were wrong. India today is approximately self-sufficient in foodgrains in spite of an abnormally poor production year in 1980-81. The projections were wrong because they reflected a poor understanding of the economics of agricultural growth. In this paper I will reexamine Indian agricultural production and supply data and attempt to interpret its growth performance in an economic as opposed to an agronomic framework. Specifically, I will attempt to incorporate both the importation of technology from abroad and the production and diffusion of Indian produced technology into my analysis.

Section I of the paper reports a summary of Asian rice supply data and illustrates the application of simple agronomic accounting methods to these data. These methods have been used extensively in growth studies.

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Section II develops a broader economic perspective on supply growth for agricultural producers. A model is developed to deal with the cases where farmers produce more than one product. This development incorporates the supply responsiveness of farmers to prices, to improved markets and to the access to new technology. Section III reports econometric estimates of a system of equations describing producer supply responses for North Indian farmers. A discussion of the economic accounting for growth is provided.

Section IV of the paper then considers a further analysis of the foundation of economic growth. It analyzes the "determinants of the determinants" of growth, at least in a partial sense. One of the most important of these determinants is the impact of population pressure or density on the rural economy. The effect is realized basically in three ways. The most direct and immediate effect of an increase in population growth is on demand. More mouths to feed means an increase in demand for food and other products. This affects food prices. A second effect is realized through labor supply. As children mature they provide more labor to the family farming enterprise or to labor markets outside the family enterprise. This affects wage rates (even if they are paid in kind) and family incomes. A third effect is more subtle. It is the effect of population pressure on the "structure" of agricultural production.

By structure I mean such factors as size of farm, tenancy, fragmentation of farms, rural services, rural electrification, irrigation investments, land clearing and drainage, and schooling, research and extension investments. These factors reflect both private and public decisions. These decisions are responsive to a number of factors including prices and wages. Population pressure, however, can influence them in important ways and thus effect welfare indirectly. Ester Boserup in her Conditions of Agricultural Growth (1968) argued the case for these structural effects persuasively for long spans of history.[1]

Section V summarizes the findings and discusses the effects of alternative growth investment, not just on the supply of agricultural products, but on their prices as well.

I. Agricultural Supply Growth and Agronomic Accounting.

Tables 1 and 2 provide data on the production and the growth rate of production of rice, the most important crop in Asia. Table 1 illustrates the simplest form of agronomy accounting. Output growth is divided into two components, growth in area harvested and growth in yield per hectare.[2] The table shows the proportion due to yield growth. In many countries it can be seen that the proportion due to yield growth is increasing over time. In India, for example, it increases from 55 percent in 1953-63 to 72 percent in 1972-79. As the costs of increasing area become higher, growth becomes more dependent on yield growth. In general, those countries able to produce substantial yield increases are also those realizing substantial production gains.

Table 2 provides a somewhat richer, though still basically agronomic or technical growth accounting for rice in Asia. In this table production growth is allocated to growth in irrigated area, unirrigated area, and yield. A further breakdown of yield growth into a component due to fertilizer growth and a residual is made.

Table 1. Annual growth rates of rice production in Asia[a]

Site	1978-80 production (thousand t)	1953-63		1963-73		1972-79	
		Output growth rate	% from yield	Output growth rate	% from yield	Output growth rate	% from yield
China	140,500	2.54	85	2.86	59	2.82	71
India	74,989	3.37	55	2.15	67	2.46	72
Indonesia	26,443	1.79	39	4.38	67	3.80	67
Bangladesh	18,318	1.29	79	2.80	20	1.97	71
Thailand	16,500	2.25	55	4.89	55	2.96	25
Vietnam	10,468	1.71	n.a.	1.13	n.a.	-0.05	n.a.
Burma	9,940	4.18	35	1.02	75	3.07	68
Korea, Republic of	7,607	4.81	69	2.11	87	4.37	87
Philippines	7,272	3.89	24	4.89	76	5.39	85
Pakistan	4,893	3.00	19	7.24	72	4.95	4
Taiwan	3,258	3.99	100	1.80	100	0.40	100
Nepal[b]	2,027	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Malaysia	1,942	3.93	45	5.10	29	2.69	-26[c]
Sri Lanka	1,885	5.65	0	4.25	62	4.99	4
Asia	347,115	1.62	60	1.62	62	1.73	64

[a]Calculated from 5-year averages centered on the years shown, except for the last 2 columns which use 2-year averages. [b]n.a. = data not available. [c]Yields declined over the period.

Source: Herdt (1982).

Table 2. Percentage points of the annual compound growth rate in rice production attributed to irrigated area, nonirrigated area, yield increases from fertilizer, and residual yield increases, Asia, 1965-79.

Site	Period[a]	Average growth rate	Percentage points in growth rate attributable to[b]: Total area	Irrigated area	Nonirrigated area	Yield	Fertilizer	Residual
Bangladesh	1967-72	-0.1	0	0	0	-0.1	0.2	-0.3
	1972-77	2.8	0.8	0.2	0.6	2.0	0.5	1.5
Burma	1967-72	1.1	0.3	0.4	-0.1	0.8	0.2	0.6
	1972-77	2.5	0.7	0.3	0.4	1.8	0.3	1.5
India	1967-72	3.1	0.7	0.5	0.2	2.4	1.2	1.2
	1972-77	2.9	0.9	0.4	0.5	2.0	0.7	1.3
Indonesia	1967-72	4.8	1.4	1.9	-0.5	3.4	1.5	1.9
	1972-77	6.4	1.6	1.6	0	4.8	1.7	3.1
Korea, Republic of	1967-72	2.4	-0.3	1.3	-1.6	2.7	1.7	1.0
	1972-77	5.4	0.5	0.4	0.1	4.9	0.5	4.4
Malaysia (West)	1967-72	7.9	6.3	5.3	1.0	1.6	1.1	0.5
	1972-77	2.1	3.6	0.7	2.9	-1.5	-0.6	-0.9
Pakistan	1967-72	5.9	0.4	0.4	0	5.7	0.2	5.3
	1972-77	5.2	4.5	4.5	0	0.7	1.1	-0.4
Philippines	1967-72	3.1	0.6	0.6	0	2.5	1.9	0.6
	1972-77	5.4	1.3	0.6	0.7	4.1	0.5	3.6
Sri Lanka	1967-72	5.3	2.4	2.5	-0.1	2.9	3.4	-0.5
	1972-77	1.5	0.2	0.5	-0.3	1.3	-0.7	2.0
Taiwan	1967-72	-0.1	-0.8	0.9	-1.7	0.7	-2.6	3.3
	1972-77	1.0	0.3	0.2	0.1	0.7	3.5	2.8
Thailand	1967-72	2.1	3.3	0.7	4.3	0.1	-1.3	-1.2
	1972-77	3.0	3.3	n.a.	n.a.	0.4	-0.7	-0.3

[a] Five-year averages centered on the years indicated, thus 1967 is the average of 1965-69, etc.
[b] n.a. = data not available.
Source: Herdt (1982).

For India the 3.1 percent growth rate from 1967-72 is accounted for by irrigated area growth (.5), unirrigated area growth (.2) and fertilizer use growth (1.2). This accounting leaves a residual "unexplained" yield growth of 1.2 percent. The 1972-77 period also shows a substantial residual yield growth component of 1.3 percent.

Table 2 does provide a general perspective on growth that is quite useful, however. The expansion of irrigated area contributed to output growth in all countries, while a number of countries experienced a reduction in unirrigated area planted to rice. Substantial unexplained components of yield growth (including negative growth) emerge in every country.

Agronomic accounting methods can be used, of course, to make projections of agricultural output. It is useful to disaggregate growth into area and yield components when we have a basis for projecting area growth from data on the area which can be converted to cropland. Nonetheless, unless we have a basis for understanding why yields change we can do little more than extrapolate from the past.

II. An Economic Perspective on Supply Growth

Figure 1 provides an overall perspective on the economics of agricultural supply. It depicts three basic components. The central component is the model core. It consists of equations describing the behavior of farm producers as they attempt to maximize profits. This behavior produces farm level output or product supply functions and input or factor demand functions. The remaining two components of the larger model are factor markets and the product markets.

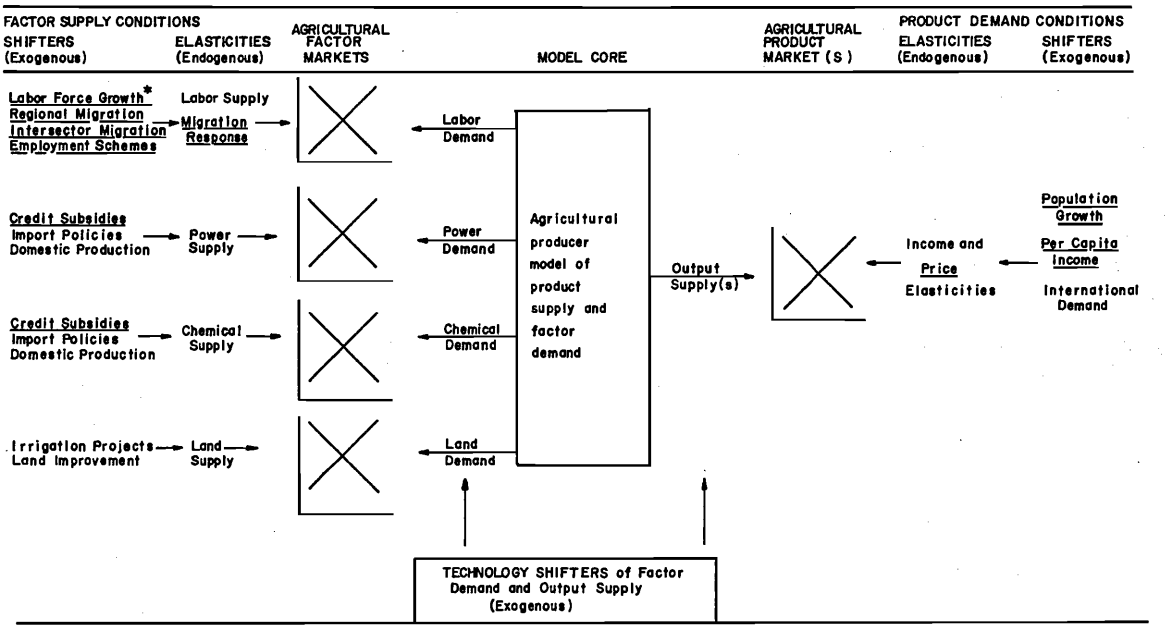
The factor markets have a demand side which is the aggregated factor demands by farmers. The supply side of these markets is derived from various sources. Labor supply is based on population growth, migration between rural and urban sectors and between regions and the basic labor-leisure choice that individuals make. The supply side of the mechanical power and farm chemical markets is determined by the cost structure in these industries. Animal power supply is determined by food costs on the farm to a considerable extent. Land may be fixed in supply, but improved land is not. Irrigation and other land improvements can increase its supply.

The agricultural product markets have a supply side which is the aggregated output supplies of individual farm units. They have a demand side determined by the number of domestic consumers, their incomes and tastes and prices. For some commodities an international demand exists. For others an international supply must be added to domestic farm supply.

Each of the factor and product markets will be in equilibrium when markets clear, i.e., when no excess demand or supply exists. Equilibrium in this sense is not inconsistent with the holding of commodity stocks in inventory by public agencies or private firms. It is also possible that the costs of searching for and migrating to jobs is such that considerable apparent unemployment is consistent with equilibrium as well. This equilibrium will consist of an equilibrium set of outputs and output prices (relative to a numeraire bundle of non-agricultural goods prices) and factor employments and factor prices.

The items described as "shifters" in Figure 1 are factors which shift one or more of the supply or demand functions in the model.

Figure 1. Distributional Policy Analysis Model: Schematic Representation



Note: The core model and underlined items will receive particular emphasis in estimation and policy simulation

Each shift will then produce a new equilibrium of all outputs, factors and prices. Shifters are grouped according to whether they shift output demand functions (population growth, income growth, trade policy); factor supply functions (labor force growth, nonfarm employment demand, credit and trade policies); or the technology of production.

Equilibrium output supply will change in response to any of these shifters. So will all other endogenous variables in the model. We are particularly interested in those shifters affecting the factor markets and the technology shifters. Technology shifters are embedded in the model core.

In the empirical work in the section to follow I will be specifying a system in which farmers choose among four variable crops or crop combinations; rice, wheat, coarse cereals (corn, sorghum and millet) and other crops (pulses, sugar, cotton, etc.). They also employ four variable factors of production; fertilizer, animal power, tractors and labor. The structure of these farms (i.e., the factors over which the individual farm has little or no control in the short run) is measured by the degree of rural electrification, investment in roads, rainfall and climate, irrigation investment, net cropped area, and the availability of new technology as measured by the proportion of area planted to high yielding varieties and past investment in agricultural research and extension.

The theoretical basis for deriving the core relationships rests on the "duality" between maximized profits and the technical transformation function relating the four variable outputs to the four variable factors and the structure variables. When certain restrictions hold for the maximized profits function, duality theory insures that they also hold for the transformation function. The important thing about this fact is that we can specify a functional form for the maximized profits function directly. This is much simpler than specifying a functional form for the transformation function and "solving" for the maximized profits function. Furthermore, the maximized profits function does not include any choice or endogenous variables. Most importantly, however, we can apply the Hotelling-Shephard lemma which states that the first partial derivatives of the maximized profits function with respect to an output or factor price are the output supply and factor demand functions.[3] Thus by taking eight partial derivatives, we end up with a system of 4 output supply functions and 4 factor demand equations. Each equation relates the quantity supplied (or demanded) to the eight variable prices and the structure variables.[4]

The producer core estimates reported in Part III of this paper utilize the Normalized Quadratic Functional form, one of several "flexible functional forms" available. This core system of 8 equations measures the responsiveness of farmers to prices and to structural variables. In Part IV of the paper I develop a set of equations designed to measure the responsiveness of some parts of agricultural structure to prices and to population pressure. This essentially involves treating the structural variables as subject to choice by aggregates of farmers and by state and local governments.

The structural variables treated in this way include research investments, rural electrification investments, literacy, net cropped area, and irrigation intensities. Prices are treated as not

being under the control of those making decisions regarding structure. Population pressure is the key variable determining structure along with the importation of high yielding varieties and rainfall and climate variables.

Population growth then has several impacts on the economic model depicted in Figure 1. First, it affects the supply of labor in the agricultural labor market. An increase in labor supply, other things equal, will result in a decrease in wages. This wage change in turn will affect farm production (given farm structure). A decrease in wages will generally lead to an increase in output supply of most commodities and this in turn will lead to a decrease in output prices.

A second impact of population change is on the structure of agriculture. As we will see in the next section of the paper, population pressure causes a decrease in average farm size, an increase in total land farmed and an increase in irrigation intensity. It also causes an increase in the ratio of landless laborers to cultivators. These changes in structure in turn shift the demand functions for inputs and the supply of outputs.

A third impact of population growth is contributed through the demand for agricultural products. An increase in population increases the demand for agricultural and other products.

These three impacts of population growth will be incorporated in a policy simulation exercise reported in Part IV of the paper. A general equilibrium model, the details of which are reported in related work, is used up to compute an initial equilibrium set of factor employments and factor prices, and product supply and product prices.[5] The model is then "shocked" by a simulated increase in population pressure. A short term effect is calculated holding farm structure constant but allowing for the population effects on labor market supply and on output demand. A longer run effect is also calculated allowing population pressure to change farm structure.

One of the central questions addressed in this paper is how the "supply side" effects of population growth compare to the "demand side" effects. A secondary question is how other policy actions affecting the supply side of agricultural production can be used to offset differences between the supply side and demand side effects of population growth.

III. The Producer Core: Agricultural Output Supply and Factor Demand for Given Agricultural Structure in North India.

In this section I report estimates of eight equations describing farm production in North Indian agriculture. The eight equations, four variable output supply equations and four variable input demand equations are derived from a maximized profits equation. The Appendix to this paper provides a formal derivation of these equations and also reports the actual estimated equations along with "t" ratios. For our purposes here we can best concentrate on the estimated "elasticities" instead of the actual coefficients.

The estimates were obtained using district level data from the states of Punjab, Haryana, Uttar Pradesh and Bihar. These districts can be grouped into two major groups: a primarily wheat producing area (Punjab, Haryana and Western Uttar Pradesh) and a primarily rice producing one (Eastern Uttar Pradesh and Bihar). Table 3

provides a variables dictionary for the data set and reports means for the two areas.[6]

In Table 3 a short description of the definition of each variable is provided. The variables are also classified as variable farm outputs, variables farm inputs, prices, and structure variables. In this analysis it is presumed that farmers maximize variable profits by choosing the appropriate mix of variable farm outputs and variable farm inputs. These variables are thus choice or "endogenous" variables. I am assuming in this model that the typical farm has no control over farm prices. My assumption that in the short run the individual farm has no control over the structure variables is a little more questionable. Clearly farmers can change irrigation intensities and farm size, given time. In Part IV of the paper I am treating these structure variables as subject to long run choice. In this section the results have a short run interpretation.

Table 4 reports elasticities computed at the means of the data for the eight equations. By reading down each column one obtains the elasticity effects of each price and structure variable on the output supply or input demand variable in question. For example, in the first column we can see the estimated effects on wheat supply of the wheat price, the rice price, etc. (All statistically significant variables are indicated by asterisks.) We note that the wheat supply elasticity with respect to its own price is .370. This means that a 10 percent increase in the wheat price, holding all other prices and structural variables constant will cause a 3.7 percent increase in the supply of wheat. We can also see the consequences of a wheat price increase, holding everything else constant, not only on wheat supply but on the supply of rice, coarse cereals and other crops and on the demand for fertilizer, bullock labor, tractors, and labor by reading across the wheat price row in the table. We thus find that a 10 percent increase in the price of wheat causes a 3.7 percent increase in the quantity of wheat supplied, a 2.07 percent decrease in the quantity of rice supplied, a 2.24 percent increase in the quantity of coarse cereals supplied, etc.

Our a priori expectations of the sign and magnitude of these elasticities are borne out by these data with only one exception. We expect all own price elasticities of supply to be positive and they are. We expect the own price elasticities of demand for inputs to be negative. They are with the exception of fertilizer demand. Only the labor demand elasticity is significant. The cross-price effects are generally as expected. In the output block when a cross-price elasticity is negative it means that the crops are "substitutes." We note that wheat and rice and other crops and coarse cereals are good substitutes. Interestingly we note that wheat and coarse cereals are "complements", i.e., an increase in the price of one of the pair induces an increase in the supply of both. This can happen when the two crops fit well together in an annual rotation.

Table 3. Variables Dictionary: North Indian Data Set Observations on 22 Regions, 1959-74.

Variable Definitions	Means: Wheat Region	Means: Rice Region	Means: All
1. Variable Farm Outputs			
Wheat	20678.19	10124.76	16360.88
Rice	4319.35	22083.35	11586.44
Cereal Grains	5660.20	4467.06	5172.10
Other Crops	25833.99	16114.35	21857.78
2. Variable Farm Inputs			
Labor	22006.25	41818.24	30111.16
Animal Power	21841.10	50139.95	33417.90
Tractor Services	1038.04	256.74	718.42
Fertilizer	4155.17	2641.76	3536.05
3. Prices			
Wheat	2.215	2.291	2.246
Rice	2.058	1.879	1.984
Cereal Grains	2.174	2.390	2.262
Other Crops	2.898	3.288	3.058
Labor	2.041	2.111	2.070
Animal Power	1.790	1.371	1.619
Tractor Services	1.577	1.577	1.577
Fertilizer	1.278	1.307	1.290
4. Structure Variables			
Rural Electrification (percent of villages electrified)	38.99	15.25	29.28
Roads (km of roads per 10 km^2)	2.08	1.11	1.68
Research Expenditures (cumulative expenditures, 1955 to t-2)	9.56	4.61	7.54
Research Intensity (current expenditures/net cropped area)	1.49	.865	1.23
High Yielding Varieties (percent of gross cropped area under high yielding varieties of rice, wheat and maize)	10.79	7.09	9.27
Irrigation Intensity (percent of gross cropped area irrigated)	40.97	25.31	34.57
Net Cropped Area (000 hectares)	1299.03	1711.52	1467.78
Farm Size (net cropped area/number of cultivators)	.0017	.0012	.0015
Agricultural Laborers/Cultivators	.265	.430	.332
Literacy (percent of rural males who are literate)	25.80	27.13	26.34

We generally expect crop prices to have positive effects on input demands. Our results are not very robust on this score. We obtain few significant estimates here. Since input prices raise costs we generally expect them to have negative effects on output supply (this need not be the case for every elasticity, however). Our results are not highly conclusive on this score.

Within the input block, negative cross-elasticities indicate that the input pairs are substitutes. Our data show that fertilizer may be a complement to labor and to tractors.

Perhaps of most interest, however, are the "structure" shifters. Our results indicate that rural electrification biases the output mix in favor of coarse cereals and other crops. It biases input demand in favor of fertilizer and against labor. Roads on the other hand create biases in favor of coarse cereals and against other crops and are biased against fertilizer and in favor of tractor demand. It should be noted, however, that this variable and perhaps others may be reflecting geographical factors and we should not presume therefore that it is easily subject to policy manipulation. The rainfall variable is a strictly geo-climatic variable and not subject to policy modification.[7]

Irrigation intensity and net cropped area, on the other hand, are subject to policy manipulation. Increased irrigation investment increases all outputs and inputs, but is quite clearly biased toward wheat and coarse cereals on the output side and fertilizer and tractor use on the input side. As net cropped area in the typical district expands holding farm size constant, it is biased in favor of rice and coarse cereals and against wheat. It increases the demand for fertilizer, but decreases the demand for tractors. An increase in average farm size, holding total net cropped area constant, on the other hand, is biased against rice and favors other crops, fertilizer and tractor demand. It is biased against labor employment. Conversely, a decrease in farm size would reduce the demand for fertilizer and tractors and increase the demand for labor.

Much has been written about the "Green Revolution" and general technical advance in India. The general presumption of much of the literature is that the introduction of high yielding varieties did not have biases on the input side, though it was clearly biased in favor of wheat and rice.[8] Our HYV variable clearly confirms the bias in favor of wheat and rice. It also quite clearly shows that when high yielding wheat and rice varieties are made available the supply of coarse cereals and other crops is reduced. The results also show a bias in favor of fertilizer on the input side.

The Indian agricultural research system, on the other hand, has a strong bias in favor of other crops. It also appears to have quite strong biases on the input side. It produces technology that is fertilizer and tractor using and labor saving. It is important to note here that most of the high yielding varieties in the HYV variable are actually Indian varieties (see Table 6 below). In the early period of adoption of HYV wheat and rice varieties, the varieties were imported (from CIMMYT and IRRI), but after initial adoption these varieties were replaced by Indian bred

Table 4. Elasticity Estimates: North Indian District Data Set 1959-1975.

Elasticity with Respect to	Elasticities of Output Supply				Elasticities of Input Demand			
	Wheat	Rice	Coarse Cereals	Other Crops	Fertilizer	Bullock Labor	Tractors	Labor
Wheat Price	.370**	-.207**	.224*	-.031	-.007	.016	.010	.001
Rice Price	-.128**	.392**	-.076	-.030	-.198*	.008	-.051	-.060**
Coarse Cereal Prices	.073*	-.040	.040	-.040*	-.155	-.005	.112	.093**
Other Crops Price	-.058	-.090	-.227*	.176**	.348**	.006	-.016	.011
Fertilizer Price	.001	.042*	.062	-.024**	.195*	-.038**	.160	.122**
Bullock Price	-.025	-.019	.025	.005	-.440**	-.010	-.010	.048**
Tractor Price	.001	.003	-.011	.001	.038	-.001	-.084	-.155**
Labor Price	-.232**	-.079	-.038	-.046	.217**	.023**	-.103	-.061**
Electrification	-.025	.011	.057*	.084**	.245**	.006**	.034	-.026**
Roads	-.110	-.465**	.373**	-.362**	-.325**	-.086**	.291*	.029
Rainfall	.161**	.407**	-.173*	.019	.456	.012*	.208*	.055**
Irrigation Int.	1.123**	.271*	.919**	.276**	1.203**	.056**	1.851**	.117**
Net Cropped Area	-.139	1.485**	1.048**	.609**	.289	-.022	-1.266**	.042
Farm Size	.224*	.379**	-.027	-.210**	-.744**	.060**	.693**	-.285**
HYV's	.278**	.109**	-.074**	-.128**	.259**	.012*	-.122**	.030*
Indian Research	.023	-.085**	-.102**	.176**	.249**	-.002	.537**	-.084**

*Asympotic "t" < 2.0 >> 1.5
**Asympotic "t" > 2.0

varieties. Thus, the inclusion of the HYV variable in the same equations with the Indian research variable requires a rather specialized interpretation for the Indian research variable. Specifically it is the technology associated with the non-HYV crops and the non-varietal technology for the HYV crops (rice, wheat, maize).

With this in mind we can better appreciate the elasticities associated with the Indian research variable. It is not surprising that it has a high elasticity effect on the supply of other crops and negative elasticities on those crops that are reasonably good substitutes for other crops, i.e., coarse cereals and rice. The fact that Indian research creates a bias in favor of fertilizer use and mechanization is also reasonable given that it is primarily non-varietal technology being produced.

To interpret the full effect of the Indian research system we must recognize that a change in the HYV variable, holding the Indian research variable constant, means that non-HYV research has been reduced.

It is of interest to compare the effect of some of the structural variables on aggregate output and input use. The elasticities of total output, total input and variable factor productivity computed from Table 4 are summarized in Table 5.

Table 5. Elasticities of Output, Input and Productivity with Respect to Structural Variables

	Total Output	Total Input	Total Variable Productivity
Electrification	.03357	-.00859	.04216
Roads	-.23908	.01057	-.24966
Rainfall	.12465	.06475	.05990
Irrigation Intensity	.58752	.23477	.35275
Net Cropped Area	.61071	-.04438	.65509
Farm Size	.06043	-.16189	.22232
HYV's	.04796	.02265	.02531
Indian Research	.04929	-.02037	.06966

Not all of these elasticities are meaningful as measures of productivity effects. The fact that roads appear to have a negative effect on output, for example, probably reflects geographic factors. Rainfall is not subject to policy manipulation, but the productivity effect is measuring the value of rainfall. It would appear that rural electrification has a modest effect on productivity. Irrigation intensity has a substantial effect. Interestingly an expansion of net cropped area holding irrigation intensity constant has an effect a little over twice as large as the irrigation intensity effect. This implies that unirrigated land has a larger effect than irrigated acreage.

The farm size variable is showing what appears to be very substantial variable factor scale economies. Expanding farm size by 10 percent increases output and decreases inputs holding total net cropped area constant. This is a large scale effect and

somewhat at odds with the accepted interpretation of Indian agricultural facts.[9]

Table 6 reports the pattern of high yielding variety adoption in India during the 1970s. Several important facts emerge from this table. First, the area under HYV's has expanded in all three classes of crops. The popular literature on green revolution HYV's does not even include the coarse grains as being subject to improvement. This literature would further have us believe that the HYV's in India are imported; from CIMMYT in the case of wheat and IRRI in the case of rice. While this may have been true in the early years of the green revolution, it ceased to be true after 1970 or so. Virtually all of the expansion in HYV area reported in Table 6 is based on Indian produced HYV's not on imported HYV's. It is true that much of the germplasm utilized in the breeding of the Indian HYV's was imported from CIMMYT and IRRI, but the HYV's themselves were not.

When we incorporate the HYV data from Table 6 with the estimated elasticity effects reported in Table 5, we have a good deal of the explanation for the fact that Indian agriculture performed very well during the 1970s. The 2.8 fold increase in area under HYVs produced by this estimate a 13 percent increase in output, a 6.5 percent increase in inputs and a 6.5 increase in productivity change (i.e., output per unit of input) over the decade.

The Indian research variable is actually constructed as a cumulated sum of past research intensities weighted by the output mix in the relevant district. That is

$$R_{it} = \sum_{j} S_{ij} \sum_{m} W_{t-m} E_{jt-m}$$

where the Sj represents the share of the jth commodity in production in the ith district. E_{jt} is the spending on research specific to commodity j in the region to which district i belongs divided by the area under production of the jth commodity. This is a research intensity index for commodity j. The weights W_{t-m} reflect the timing of research effects. In this case they are imposed on the basis of other studies to be 0 in years t, t-1 and t-2 then rise linearly to 1 in t-7. Research which was not allocated to commodities was added to the stock in proportion to the ratio of allocatable and nonallocatable research for the region. Regions were defined as in Evenson and Kislev (1975).

An accounting of the growth in output, variable factors and in variable factor productivity for the 1959-75 period is reported in Table 7. Here we can see that increases in irrigation intensity accounted for almost 70 percent of total output growth and 58 percent of variable factor productivity growth in North India for this period. Indian research and HYV adoption accounted for 44 percent of output growth and 50 percent of variable factor productivity growth. (The negative contribution of roads as noted is probably indexing the change in topography and is thus a measure of declining land quality.)

Table 6. India: Expansion of the Area Under High Yielding Varieties of Specified Grains, 1969/70 - 1980/81.

(in million hectares)

Year	Rice			Wheat			Coarse Grains[a]			Total		
	Total Area	HYV Area	%	Total Area	HYV Area	%	Total Area	HYV Area	%	Total Area	HYV Area	%
1969/70	37.68	4.34	11.50	16.63	4.92	29.60	36.96	2.14	5.80	91.27	11.40	12.50
1970/71	37.59	5.59	14.90	18.24	6.48	35.50	36.14	3.31	9.20	91.97	15.38	16.70
1971/72	37.76	7.41	19.60	19.14	7.86	41.10	34.22	2.90	8.50	91.12	18.17	19.90
1972/73	36.69	8.11	22.10	19.46	10.00	51.40	33.07	3.98	12.00	89.22	22.09	24.80
1973/74	38.29	9.98	26.10	18.58	11.02	59.30	36.67	5.02	13.70	93.53	26.02	27.80
1974/75	37.89	10.84	28.60	18.01	11.29	62.70	33.34	4.89	14.70	89.24	27.01	30.30
1975/76	39.48	12.74	32.30	20.45	13.45	65.80	33.63	5.97	17.80	93.56	32.16	34.40
1976/77	38.51	13.73	35.60	20.92	14.69	70.20	32.52	6.06	18.60	91.95	34.48	37.50
1977/78	40.28	16.12	40.01	21.45	15.80	73.65	33.10	7.01	21.18	94.83	38.93	41.05
1978/79	40.48	16.90	41.74	22.64	16.10	71.11	33.29	8.10	24.33	96.41	41.10	42.63
1979/80	38.97	15.99	41.03	21.96	15.03	68.44	32.14	7.36	22.89	93.07	38.38	41.23
1980/81[b]	39.79	18.51	46.54	22.10	17.39	78.68	33.22	9.38	28.24	95.07	45.28	47.62

[a] Includes sorghum, corn and spiked millet.

[b] Anticipated achievement.

Sources:

1. Estimates of Area and Production of Principal Crops in India, Directorate of Economics and Statistics, Ministry of Agriculture, GOI.
2. Economic Survey, GOI, 1981-82.

The North India region is actually itself one of the major regions of the world (with a population in 1981 of more than 200 million people). It includes some of India's most progressive districts (Punjab - Haryana) and some of its least progressive districts (Bihar and Eastern Uttar Pradesh). This analysis, then, is not simply based on the most successful regions of India. The willingness to invest in agriculture differs greatly among the districts in the analysis and these differences have enabled us to identify with a fair degree of precision the importance of growth factors in North India.

This analysis implied very large returns to investment in Indian research. Since I do not have an extension variable in this analysis it is probably reasonable to suppose that the research variable is picking up both a research and an extension effect. Spending on research and extension combined represented approximately .70 percent of the value of agricultural product in the early 1960s. A 10 percent increase of this spending (.07 percent of output) is estimated to produce a 0.7 percent increment to net output. This can be converted to a rate of return by noting that an expenditure of .07 percent of output generates a stream of net output amounting to 0.7 percent of output after seven years. This implies an internal rate of return to this investment of 72 percent.[10]

Table 7. Growth Accounted for by Structural Factors: North India 1959-1975

	Total Variable Output	Total Variable Input	Total Variable Productivity
Electrification	4.88	-1.25	6.13
Roads	-8.11	.37	-7.73
Irrigation Intensity	22.75	9.09	13.66
Net Cropped Area	2.23	- .16	2.39
Farm Size	.67	-1.80	2.47
HYV's	9.59	4.53	5.06
India Research	4.83	-1.99	6.82
Total	32.38	8.79	23.59
Annual	2.15	.59	1.57

IV. Determinants of Agricultural Structure

I now turn to the question of determinants of agricultural structure in North India. I am particularly interested in whether population pressure, as measured by rural population density, has an impact on structure. As noted in an earlier section, we know that population growth impacts on the demand for food and non-food goods. We also know that it affects the supply of labor. Here we are concerned with its additional supply

side effects through the agricultural structure variables. If we can identify the impact of population pressure and other variables on the structural variables, we can combine the estimates of this section with the short run estimates of the previous section to identify output supply and input demand effects. (In the section to follow I will also compute price effects.)

The central conceptual issue in the treatment of the structure variables is that of simultaneity between prices and the structural variables. I am treating prices as determinants of structural variables in this section. There is, of course, the question as to whether structure determines prices. I am dealing with this in two ways. First, and most importantly, I am arguing recursiveness. Prices affect structure with a lag and structure affects current prices. Thus in the regressions reported in Table 8, all independent (right-hand) variables are lagged an average of four years (actually I use a distributed lag equally weighted over t-1 to t-4 lagged periods). In this way I attempt to avoid the simultaneity problem. Second, I also use the exogeneity argument that applied in the previous section to bolster the case for treating prices as exogenous. The issue here is whether the independent, right-hand-side variables are determined or chosen by the agents determining the dependent variables. In the case of the structural variables which are determined by farmers, i.e., farm size and the ratio of cultivators to laborers, one can say that the independent variables are exogenous for that reason. The argument also holds for variables such as rural electrification, roads, literacy and irrigation intensity to the extent that local political units determine these investments taking into account the existing structure.

Table 8 reports two versions of the recursive model elasticities (the regression results are given in the appendix). Panel A treats lagged prices as predetermined or fixed. Farmers, politicians and other decision-makers are presumed to make choices influenced by these prices as well as by the population density, rainfall and research and HYV variables. Panel B treats only the latter variables as exogenous.

In my judgment, the Panel A results are defensible and accordingly I will concentrate my discussion on them. Both sets of results show that when price regimes and technology variables are included in the analysis, population density impacts positively on all structural variables except farm size. Much of this effect is realized through political processes. The population density effect on electrification, road building, irrigation, research intensity and literacy operates generally in this fashion. Population density effects on farm size and the ratio of laborers to cultivators operate through decision-making by farm families and through the functioning of rural markets. Scale economies to farming are probably the major factor accounting for the negative population density effect on farm size.

Note that in the Panel A results, I am allowing price regimes to influence structure. If we look at farm size we note that it is negatively affected by the price of wheat, the price of fertilizer and the price of tractors. A fall in the relative prices of these items will lead to an increase in farm size largely

Table 8.

	Electricity	Roads	Literacy	Research Intensity	Farm Size	Net Cropped Area	Laborers/ Cultivators	Irrigation
A. Recursive Model Elasticities								
Price of Wheat	-1.7436**	-.6352**	-.3784**	.3218*	-.6374**	-1.0763**	-.8020**	-1.1175**
Price of Rice	1.9138**	1.0342**	.1029*	.3339**	.1586*	.1729*	.0098	.9128**
Price of Coarse Cereals	2.8819**	-.3051*	-.3769**	-.5082**	.1459	.1581	.3619*	.5567**
Price of Other Crops	-3.0499**	.1527	.4544**	.1963*	.3129**	.8665**	.2404	-1.3020**
Price of Fertilizer	-1.4351*	-.7758**	-.0743	1.6050**	-.2222	.0075	-.3644	-.2197
Wage	.6100**	-.1479	.3837**	-.1453*	.4460**	.1023	.6530**	1.1860**
Price of Animal Power	.0514	1.2540**	.2806**	.2751**	.2358**	-.7798**	.0385	.2856*
Price of Tractor Services	2.3469**	-.6395	-.7976**	-2.7432**	-.6974**	-.1888	-.8885**	-.5296
Population Density	.1426	.6052	.4969	1.0228	-.6898	.5647	.6741	.4502
Research Expenditures	.1339	.0685	-.0238	.6900	.0891	.0876	.0077	-.1170
High Yielding Varieties	.0506	-.0199	.0532	.1335	-.0271	.0742	.2060	.1469
Rainfall	-.4329*	-.4120**	-.3047**	-.0025	.0159	.0277	.2166	-1.1390**
B. Jointly Determined Model Elasticities								
Population Density***	.4331	.0916	.3342	.7478	-.6488	.7752	.6704	.2351
Research Expenditures***	.6311	.2555	.0156	.5153	.2254	-.0994	.1137	.0403
High Yielding Varieties***	.2019	.0356	.0362	.0244	-.0457	.0415	.1157	.1266
Rainfall	-.6176**	-.9485**	-.4169**	-.2378**	.0628	.1212	.1730	-1.3955**

*t ratio between 1.5 and 2.
**t ratio greater than 2.
***Significance levels were not calculated for these variables.

through scale economy effects. The effect of the price of rice, coarse cereals and other crops on farm size is positive. A fall in these prices will lead to a reduction in farm size. A fall in wage rates and in bullock rental prices leads to a decrease in farm size. In addition to these price effects, as population density increases it has a negative impact on farm size. Note, however, that this effect is not large enough to reduce farm size proportionately with population growth (the elasticity is -.68, it would be -1.0 if the number of farms were to grow proportionately with population, holding net cropped area constant). Research programs in India appear to be producing scale biased technology but this is not the case for HYV's.

The ratio of agricultural laborers to cultivator family workers is affected by prices in a manner very similar to the price effects on farm size. A rise in wage rates causes an increase in farm size and in the ratio of laborers to cultivators, for example. This is, of course, to be expected given the organization of most Indian farms. If the farm size is expanded, more labor will be hired, while cultivator labor may remain the same. Population density, on the other hand, has a positive effect on the ratio since farm size decreases less than proportionately with density. Net cropped area in the typical district also responds to prices in a similar fashion as does farm size.[11]

In general wheat prices appear to have negative effects on public investment variables while rice prices have positive effects. One should perhaps be cautious in interpreting these effects since there is some possible technical change effects not really captured by the HYV and research variables.

The research intensity or investment variable is of some interest. Note that this is current investment per unit of net cropped area whereas the research variable treated as a determining or independent variable is lagged cumulated research expenditures weighted by cropping patterns. In general, rising output prices increase research investment as does a rising fertilizer price. Research investment appears to be stimulated by falling tractor prices. Population density has a substantial positive effect.[12]

We can now proceed to compute the "long run" effects of population density, research investment and high yielding varieties. These can be computed as:

$$E^L_{iP} = \sum_{i=1}^{5} E_{ij} E_{iP}$$

$$E^L_{iR} = \sum_{i=1}^{5} E_{ij} E_{iP} + E^S_{iR}$$

$$E_{iHYV} = \sum_{i=1}^{5} E_{ij} E^S_{jHYV} + E_{iHYV}$$

where the E's denote elasticities.

For the population density elasticity this involves multiplying the elasticity of population density on the ith structural variable from Table 3 by the elasticity of the ith structural variable or the ith endogenous variable from Table 4 and summing them up. In the case of research and high yielding varieties I also add the short-run elasticity estimated in Table 4 since that was estimated holding constant the other structural variables.

It is important to recall that the analysis of structural variables in Table 8 essentially viewed the determinants as only partial determinants. Actual structural variable levels of roads, rural electrification, etc., would be expected to have a component determined by political decisions unrelated to those included in my analysis. Given this it will be useful to undertake an accounting analysis of the extent to which changes in the independent variables in Table 8 accounted for the actual changes in the dependent variables over the time period of the data base. This accounting is provided in Table 9.

Table 9 shows that the structural determinants analysis reported in Table 8 by no means completely accounts for the variations in the structural variables. There are substantial exogenous policy based determinants of most of these variables. It would be inappropriate to attribute all of the structural effects to population density and the other variables shown in Table 8.

I now wish to proceed to calculate the "long run" elasticity effects of population density, research investment and HYV importation on the four output supply and four input demand equations. This is done in Table 10.

Consider first the population density effects. These tabulations show that as population density increases, population induced structural changes causes increases in both output supply and input demand. Both Panel A and B estimates show that the output expansion favors coarse cereals. Both sets of estimates also show that population density strongly favors fertilizer growth and that it also has a moderately strong effect on labor demand. The A estimates, which I regard to be reasonable, show that a ten percent expansion in population density has a structural effect causing a 4.3 percent increase in output and a 1.9 percent increase in input use. This productivity expansion is not costless, however, since roads, electrification, irrigation and land expansion all have costs. Thus, we cannot say on the basis of these estimates whether these induced investments have had a high pay-off.

The remaining calculations in Table 10 deal with the induced structural effects of research investment and HYV importation and production. The short run elasticities for these two variables reported in Table 4 are also reported in Table 10. They show that, holding structure constant, research program investment increased total output, but actually caused a decrease in rice and coarse cereal output. They also caused a small net decrease in input use, but actually caused an increase in fertilizer and tractor use while saving labor. The calculations in Table 10 show that the induced structural effects tend generally to "correct" for output

Table 9. Accounting for Changes in Structural Variables. Percent Change 1959-1975, North Indian Data.

Structural Variables	Actual Change	Attributed to Change in					
		Population Density		Research Intensity		HYV's	
		A	B	A	B	A	B
Electricity	1.4548	.0293	.0891	.2230	.7214	.1012	.4038
Roads	.3528	.1245	.0188	.1141	.424	-.0398	.0712
Literacy	.1996	.1022	.0687	-.0396	.0259	.1064	.0724
Research Intensity	.9797	.2104	.1538	1.1493	.858	.267	.0488
Farm Size	.1114	-.1419	-.1335	.1484	.3754	-.0342	-.0914
Net Cropped Area	.0365	.1161	.1595	.1492	-.1649	.1484	.083
Laborers/Cultivators	.8909	.1387	.1379	.0128	.1894	.412	.231
Irrigation Intensity	.3872	.0926	.0484	-.1948	.067	.2938	.2538

Notes - A attributions based on Panel A elasticities Table 8.
B attributions based on Panel B elasticities Table 8.

Table 10. Long-run Elasticity Calculations.

Elasticities with Respect to	Elasticities of Output Supply					Elasticities of Input Demand				
	Wheat	Rice	Coarse Cereals	Other Crops	All Output	Fertilizer	Bullock	Tractors	Labor	All Inputs
Panel A - Structural Estimates										
Population Density	.202	.422	1.258	.404	.427	1.052	-.1189	-.177	.287	.193
Research	-.126	.103	.016	-.011	-.019	-.170	-.008	-.242	-.024	-.038
HYV's	.150	.149	.209	.091	.132	.237	.007	.155	.026	.036
Panel B - Structural Estimates										
Population Density	-.018	.951	1.104	.676	.566	1.058	-.0481	-.910	.236	.118
Research	.066	-.161	.057	-.136	-.060	-.076	-.005	.452	-.073	-.027
HYV's	.118	.065	.187	.075	.096	.237	.002	.166	.025	.035
Research Elasticities										
Short-run	.023	-.085	-.102	-.176	.049	.249	-.002	.537	-.084	-.020
Long-run A	-.103	.018	-.087	.164	.030	.079	-.010	.295	-.108	-.057
Long-run B	.089	-.246	-.045	.040	-.011	.173	-.007	.989	-.157	-.046
HYV Elastiticities										
Short-run	.278	.109	-.074	-.128	.048	.259	.012	-.122	.030	.023
Long-run A	.428	.258	.135	-.037	.180	.496	.019	.033	.056	.060
Long-run B	.396	.174	.113	-.053	.144	.496	.014	.044	.055	.059

biases by favoring coarse cereals and working against other crops. The A estimates show a roughly similar pattern on the input side while the B estimates show the structural effects to reinforce the tractor-using, labor-saving bias of the original estimate.

The short-run HYV effect showed a strong bias in favor of wheat and rice and against coarse cereals and other crops. The induced structural effects favor coarse cereals most and tend to correct the initial biases to a small degree. The structural effects on input use favor fertilizer use as do the short-run effects. They are also biased in favor of tractor use while the short-run effects were not.

Since we do not have cost data for the induced structural changes, we must be careful not to draw cost-benefit conclusions from the long-run elasticities for either HYV's or research.

V. Implications for Policy

Figure 1 depicted what could be described as a "Distributional Policy Analysis Model". By specifying the full model, i.e., by adding factor supply equations and output demand equations to the producer core estimates we have a "small" general equilibrium model with four outputs, four output prices, four variable factors and four factor prices as endogenous variables. We can thus compute the effect of any "shifter" variable or set of shifter variables on the full set of endogenous variables.

The model is a distributional model in the sense that knowledge of the effects on equilibrium prices (relative to the non-agricultural goods price index) allows one to say something about distributional effects. We have already noted that high yielding varietal improvement in wheat or rice may shift the supply curve of other crops to the left. It will result in a decrease in wheat and rice prices and an increase in the prices of other crops. These price changes will affect consumers according to their consumption patterns.

Price effects for factors can also be computed. These, of course, also have distributional implications. An increase in wage rates, for example, will obviously improve the income of families relying heavily on wage income. An increase in land rents, on the other hand, improves the income and welfare of land-owners and possibly of tenants.

The procedure for determining the effects of shifter variables on the endogenous variables in the system can be handled in different ways. The simplest procedure is to derive an impact multiplier matrix. This matrix allows the reader to determine the specific effect of any shifter in an output demand function, a factor supply function or in the producer case itself on all endogenous variables. The matrix is formed by first expressing all equations in the system in terms of rates of growth. (See Quizon and Binswanger, 1982, for more details). This system of equations can be written in matrix form as:

$$\zeta X' = K^*$$

where ζ is a matrix of all elasticities in the system, X' is a row vector of endogenous variables and K* is column vector of shifter variables (one for each equation). The solution expressing the endogenous variable X' in terms of estimated elasticities and shifters is:

$$X' = \zeta^{-1}K^*$$

Table 11 reports computations based on the ζ^{-1} matrix for the North India system. The elasticities utilized in its computation are from Table 4 and from a study of consumer demand by Binswanger, Swamy and Quizon (1982). The elasticity of labor supply is difficult to specify. Rosenzweig (1977) has estimated a standard labor supply elasticity of 0.1. This is a reasonable elasticity only if all wages in all sectors and regions are to change simultaneously. In the case where a wage rate in one region or sector changes relative to wages in other regions or sectors a migration process will be set in motion, and the elasticity of labor supply would be higher. No fertilizer, bullock or tractor supply elasticities have been estimated for India. The fertilizer and tractor supply elasticities are likely to be quite high at least in the medium run. We would consider elasticities of four to be reasonable. Finally, the supply elasticity of bullock labor is set at 2.0.

In Table 11 three separate elasticities due to changing population density are computed. The first two are the "standard" effects. Column 1 shows how prices and quantities change if one only considers the effect of population growth on demand. We note that both output and input prices increase because of this demand expansion, but that the increases for outputs exceed those for inputs. We find very little effect on the price of labor.

The second column shows the effect on labor supply presuming that a one percent increase in population growth will eventually cause a one percent increase in the supply of labor to the agricultural sector. Here we note that input prices fall, particularly for labor. This causes a decrease in production costs, hence a fall in all output prices. Note that the supply of rice and coarse cereals increases. A one percent increase in the supply of labor causes a 1.957 percent decrease in wages and a .805 percent increase in employment.

The first two effects combined present us with the basic Malthusian arithmetic of the effect of population growth. This arithmetic ignores induced structural effects and other policy-related effects such as investment in research, importing HYV's or investing in irrigation and roads. I have included the population induced structural effect and the irrigation investment, research investment and HYV effects in the table to illustrate how the basic Malthusian arithmetic is changed when they are considered. Note first that the induced population density effects reduce output prices by increasing outputs. They generally cause an increase in input prices and an increase in input demand. They clearly have a welfare improving effect offsetting the picture obtained in the first two columns. This shows that the Boserup effect is serving to mitigate the Malthusian effect.

Table 11. Effects of Population Density, Irrigation, Research and HYV's Treating Prices as Endogenous.

	Effects of a One Percent Change in:					
	Population Density			Irrigation	Research	HYV's
Impact on	On Demand	On Labor Supply	On Structure	Intensity	Short-run	Short-run
Output Prices						
Wheat	.560	-.297	-.125	-.486	-.080	-.023
Rice	.812	-.466	-.217	-.180	-.098	.025
Coarse Cereals	.976	-.550	-.419	-.400	-.160	.098
Other Crops	.628	-.369	-.176	-.167	-.129	.080
Input Prices						
Fertilizer	.043	-.246	.038	-.006	-.009	.007
Bullock Labor	.598	-.039	-.020	-.033	-.001	.003
Labor	.021	-1.957	.001	-.099	-.176	.099
Output Quantities						
Wheat	-.062	-.330	.162	.039	.003	.052
Rice	-.015	.148	.112	.315	.011	-.006
Coarse Cereals	.096	.379	-.047	.020	-.001	.012
Other Crops	.022	-.125	.154	.121	.053	-.040
Input Quantities						
Fertilizer	.172	-.982	.205	.048	-.039	.020
Bullock Labor	.023	.077	.011	-.065	-.007	.006
Labor	.061	.805	-.009	-.010	-.018	.010

Source: Computed from Quizon and Binswanger, 1982.

The columns showing the effects of investment in irrigation, research and high yielding varieties also generally show that these investments increase output and decrease output prices. Only the HYV effect actually increases the demand for labor and raises wages. Irrigation and research are substitutes for labor. Note, however, that by decreasing the price of output, the real wage can be increased.

On the whole, these calculations, while incomplete, provide the policy-maker with a picture of the options open to enable an economy to overcome the Malthusian effect of population growth. Some of this offset occurs naturally through induced effects. The policy-maker has other options available to reverse these effects in the form of investment in irrigation, research, roads, etc. A further option is to encourage migration out of the rural areas. The second column shows that a reduction in labor supply to agriculture does have quite significant effects on agricultural laborers.

Table 12 shows the average percentage change in the variables in the North Indian data set over the 1959-60 to 1974-75. It is useful to review these changes against both the results of the study discussed in previous sections of the paper and against the background of the literature on the world food problem.[13] The general picture of agricultural change in Table 12 is moderately encouraging. Wages have risen slightly more than commodity prices. Production per capita has increased. Part of this increase is due to an expansion of input use, particularly of fertilizer and tractors. Nonetheless, the weighted average output growth (.428) has exceeded the weighted average input growth (.312) by a substantial amount. Even when considering the growth in net cropped area and irrigation intensity we are left with a healthy productivity residual. This is in considerable contrast to at least some and perhaps most projections made in the early 1970s.[14] Furthermore, it was accomplished with very low investments in land expansion.

It is also quite clear from Table 12 that structural variables have changed over the period, and from the analysis presented in this paper, the variables have had much to do with the performance of the India agricultural economy. Investment in irrigation, roads, electrification, research, HYV importation and clearing new land have more than offset the tendency for population pressure to force a decline in rural wages. A considerable part of these changes can be said to have been induced by population growth itself. Our data suggest, however, that this induced structural change would have been insufficient to offset the declining real wage effects of population growth. Purposive policy action was required to enable this.

India has enjoyed a substantial inflow of high yielding variety technology over the period of analysis.[15] This technology appears to have been labor using to some degree. Virtually all other structure effects including investment in India's agricultural research system have had relative labor savings effects. Our

Table 12. Percentage Changes: North India Variables 1959-60 to 1974-75.

	Prices	Quantities
Output		
Wheat	1.0082	.9181
Rice	.8855	.2549
Coarse Cereals	1.0527	.1277
Other Crops	1.1537	.2175
Inputs		
Fertilizer	.8711	1.7990
Tractors	.9572	1.5765
Bullocks	.9033	.0961
Labor	1.1762	.2063
Agricultural Laborers		.8170
Structural Variables		
Literacy	.1996	
Electrification	1.4548	
Roads	.3528	
Irrigation	.3872	
Farm Size	.1114	
Laborers/Cultivators	.8909	
Research	1.6657	
Population Density	.2057	
Net Cropped Area	.0365	

data also showed that substantial scale economies appear to have characterized North India agriculture over the 1959-75 period.

When we recognize that the inflow of HYV's from outside India had pretty much run its course by 1975 and that technical change had produced some scale economies it would appear that the "labor absorptive capacity" of the India agricultural sector could not continue as it had during the study period. From 1959-75 the landless labor force in North India grew by eighty percent while the number of cultivators grew very little. It appears that the Green Revolution with its labor using bias was the major factor allowing the expansion of the landless labor force without a decline in real wages.[16]

Two other factors may also have mattered. The first is the rather poor performance of India's industrial sector in terms of providing employment. The second is the possible changes in the institutional structure of rural labor markets which could shift some laborers from cultivator family status to agricultural labor status.[17]

In any case this study has shown that the agricultural sector does not have a high capacity for absorbing increases in the labor force. The Green Revolution period was a bit of an aberration in this regard. The 1981 census data are now revealing that a significant decline in the share of the labor force in agriculture has taken place. This has occurred in spite of continued poor industrial employment performance. It would appear that it will continue into the next two decades with high rates of rural-urban migration in the offing. If this rural to urban migration does not take place, real wages to the large agricultural labor force in India and the earnings of family labor will not rise.

NOTES

1. See Boserup (1965, 1981) for the treatment of population pressure.

2. Actually there is also an interaction term for large changes, but this is generally ignored. For small changes this accounting is based on the following:

$$P = A \times \frac{P}{A} = A \times Y \qquad dP = dA \times Y + dY \times A$$

$$dP/P = dA \times \frac{Y}{P} + dY \times \frac{A}{P} = \frac{dA}{A} + \frac{dY}{Y}$$

3. See Binswanger (1975), Diewert (1973), Lau (1969), and Yotopolous and Lau (1973).

4. Formally let:

(1) $H(Y,X,Z) = 0$ be the transformation function by which a vector of variable factors X and a vector of fixed factors (including farm structure) Z are transformed to a vector of outputs Y.

Then the maximized profits function will be:

(2) $\Pi^* = (P_i, P_j, Z)$

where the P_i are output prices and the P_j factor prices. Then Hotelling-Shephard lemma shows that:

(3) $\partial\Pi^*/\partial P_i = Y_i = Y_i(P_i, P_j, Z)$

(4) $\partial\Pi^*/\partial P_j = X_j = X_j(P_i, P_j, Z)$

are the factor demand equations.

5. See Quizon and Binswanger (1982) for a discussion of this model.

6. See Evenson (1982) for further details of the data set.

7. See Evenson (1976) and Evenson and Kislev (1973), for a treatment of the role of climate in technology diffusion.

8. See the Asian Development Bank's (1977) Survey for a discussion of these exhibits. Also Mellor (1976).

9. See Krishna (1975), Sidhu (1974).

10. See Arndt, et al (1977), Boyce and Evenson (1975), Evenson (1968), Evenson and Jha (1973), Jha and Evenson (1974) and Mohan, Jha and Evenson (1973) for previous estimates of research productivity in India.

11. Few previous studies have examined the determinants of net cropped area. See Yamaguchi and Binswanger (1975) for an attempt to do so.

12. In recent paper, Judd, Boyce and Evenson (1983) report an investment analysis for research consistent with these results.

13. See Asian Development Bank (1977) and Bardham and Srinivasan (1974) and Mellor (1976).

14. See International Food Policy Research Institute (1977) for a major projection of this type, also NCAER (1970).

15. See Evenson and Kislev (1975), Hayami and Ruttan (1972) and Judd, Boyce and Evenson (1983).

16. Hayami and Herdt (1976) provide an analysis of subsistence farming showing how small farmers are affected by technology.

17. See Clay (1976), Krishna (1975) and Binswanger and Ruttan (1978).

APPENDIX
SYSTEMS OF OUTPUT SUPPLY AND FACTOR DEMAND

Systems of output supply and factor demand equations can be derived from a profit function. It should be noted that systems of output supply and factor demand equations could exist independently of the behavioral mechanisms of profit maximization, as long as the behavior of individual agents is sufficiently stable over time and can be aggregated over farmers. Therefore, the estimated equations are useful for economic analysis regardless of whether the theory restrictions of profit maximization hold. However, if profit maximization does not hold, we cannot make inferences from the supply and demand equations about the production function underlying them, since behavioral and technological relationships are then confounded in those equations.

We now adopt the following convention. There are n commodities, Y_i, of which the first m are outputs and those indexed m + 1...n are variable inputs under the control of the individual agent, i.e., we have an (n x 1) vector of commodities Y such that

$$Y_i \geq 0 \text{ for } i = 1...m \text{ and } Y_i \leq 0 \text{ for } i = m + 1...n. \quad (1)$$

These commodities have prices $P_i \geq 0$ for all i. Π is variable profits or return to fixed factors of production and $\Pi = P$ where P is an (n x 1) vector. Since inputs are defined as negative quantities they subtract from revenues of the positive outputs. There are also k fixed factors of production, Z_k, k = 1...k such as fixed capital or land quality. Let t stand for time or technology index. If a sufficiently "well-behaved" transformation function (for the conditions which must be imposed on the transformation function see Diewert, 1978) exists, g(Y,Z,t) = 0 and agents maximize variable profits Π, then a profit function exists which relates maximized profits Π^* to the price of the variable commodities, the fixed factors and time

$$\Pi^* = \Pi^* (P,Z,t) \quad (2)$$

which has the following properties (where Π^*_i and Π^*_{ij} are derivatives of the profit function with respect to the subscripts):

(i) The profit function is monotonically increasing in P if it is an output price and monotonically decreasing in P if it is an input price. The output supply and factor demand curves are

$$Y_i = \Pi^*_p (P,Z,t) \begin{matrix} \geq 0 & i = 1,...m \\ \leq 0 & i = m + 1,...n. \end{matrix} \quad (3)$$

(ii) The profit function is symmetric, i.e.,

$$\Pi_{ij} = \Pi_{ji} \quad (4)$$

(iii) The profit function is convex, i.e., the (singular) matrix of its cross derivatives Π_{ij} is <u>positive semi-definite</u> or all its characteristic roots are positive or zero.

(iv) The profit function is homogeneous of degree one and the supply and demand equations are homogeneous of degree zero. The matrix

$$[\eta_{ij}] = \left[\frac{\partial Y_i}{\partial P_i} \frac{P_j}{Y_i} \right]$$

defines the factor demand and output supply elasticities and the following constraint on these elasticities holds:

$$\sum_{j=1}^{n} \eta_{ij} = 0 \quad (5)$$

We considered two functional forms for equation (2) in our empirical work. The Generalized Leontief is written as

$$\Pi^* = \sum_{ij}\sum b_{ij} P_i^{1/2} P_j^{1/2} + \sum_{ik}\sum b_{ik} P_i Z_k + \sum_i b_{it} P_i t \tag{6}$$

The corresponding factor demand and output supply system is given in Panel A of Appendix Table 1. All n equations can be estimated jointly but the profit function (6) is not linearly independent since it is the linear combination $\sum_{i-1}^{n} Y_i P_i$ of the individual equations. Note that in this system homogeneity is not testable since for each equation η_{ii} is estimated residually and we have no other independent estimates of it. This characteristic is also a serious liability when data sets are not complete.

The second functional form is derived from the Normalized Quadratic profit function. (For a discussion of normalized profit functions see Lau, 1977). A normalized profit function is derived by stating the initial profit maximizing problem in terms of normalized prices $q_i = \frac{P_i}{P_n}$ where all prices and profits are divided by the price of the n'th commodity. Normalized profits then are written as

$$\tilde{\Pi} = \frac{\Pi}{P_n} = \sum_{i=1}^{n-1} Y_i q_i + Y_n \tag{7}$$

Shephard's Lemma then reads that $\frac{\partial \tilde{\Pi}}{\partial q_i} = Y_i$. The quadratic normalized profit function is written as

$$\tilde{\Pi} = a_o + \sum_{i=1}^{n-1} a_i q_i + \frac{1}{2} \sum_{i=1}^{n-1} \sum_{j=1}^{n-1} b_{ij} q_i q_j + \sum_{i=1}^{n-1} \sum_k b_{ik} q_i Z_k + \sum_{i=1}^{n-1} b_{ik} q_{it} \tag{8}$$

The output supply and factor demand curves for the first n-1 outputs and factors are given in Panel B of Appendix Table 1, written in terms of the original prices. Homogeneity of degree zero is imposed on the equations and cannot be tested. Symmetry is tested in the usual way. Note that in this system we do not have the n'th commodity equation which has to be derived from equation (8) and the commodity equations

$$Y_i = a_i + \sum_{j=1}^{n-1} b_{ij} q_j + \sum_k b_{ik} Z_k + b_{it} \tag{9}$$

Appendix Table 1. Output Supply and Factor Demand Formulae and Restrictions.

	A. Generalized Leontief	B. Normalized Quadratic
Form of Factor Demand and Output Supply Equations	$Y_i = a_i + \sum_{j \neq 1} b_{ij} \left(\frac{P_j}{P_i}\right)^{\frac{1}{2}} + \sum_k b_{ik} Z_k + b_{it}\, t$ $i = 1, \ldots, n.$	$Y_i = a_i + \sum_{j=1}^{n-1} b_{ij} \frac{P_j}{P_n} + \sum_k b_{ik} Z_k + b_{it}\, t$ $i = 1, \ldots, n-1$ $Y_n = a_o - \frac{1}{2} \sum_{i-1}^{n-1} \sum_{j-1}^{n-1} b_{ij} q_i q_j$
Homogeneity	Imposed, not testable	Imposed, not testable
Symmetry	$b_{ij} = b_{ji}$ $i \neq j$	$b_{ij} = b_{ji}$ $i \neq j,\ i \neq n$
<u>Elasticities</u>		
Cross price $i \neq j,\ i \neq n$	$\eta_{ij} = \frac{b_{ij}}{2Y_i} \left(\frac{P_j}{P_i}\right)^{\frac{1}{2}}$	$\eta_{ij} = b_{ij} \frac{P_i}{Y_i}$ $i \neq j$ $i \neq n$
Own price $i \neq j,\ i \neq n$	$\eta_{ii} = - \sum_{j \neq i} \frac{b_{ij}}{2Y_i} \left(\frac{P_j}{P_i}\right)^{\frac{1}{2}}$	$\eta_{ii} = b_{ii} \frac{P_i}{Y_i}$ $i \neq j$ $i \neq n$ $\eta_{nj} = - \frac{P_j}{P_n^2 y_n} \sum_{i=1}^{n=1} b_{ij} P_i$

From equation (7) we can compute $Y_n^* = \mathcal{Y}^* - \sum_{i=1}^{n-1} Y_i^* q_i$ and substituting into this equation (8) and the commodity equations we have

$$Y_n = a_o - 1/2 \sum_{i=1}^{n-1} \sum_{j=1}^{n-1} b_{ij} q_i q_j \tag{10}$$

The derivatives of this equation with respect to individual prices $j < n$ are

$$\frac{\partial Y_n}{\partial P_j} = - \sum_{i=1}^{n-1} b_{ij} \frac{P_i}{P_n^2} \tag{11}$$

from which we can compute the elasticities for the n'th equation as

$$\eta_{nj} = \frac{\partial Y_n}{\partial P_j} \cdot \frac{P_j}{Y_n} = - \frac{P_j}{P_n^2 Y_n} \sum_{i=1}^{n-1} b_{ij} P_i \tag{12}$$

Finally, η_{nn} can be determined residually via equation (5) as $\eta_{nn} = - \sum_j \eta_{nj}$. Note that one could include equation (6) in the estimation process or leave it out and estimate the elasticities of the n'th equation residually.

All equations reported in this study are estimated jointly by Generalized Least Squares, taking account of error interdependence across equations (Zellner, 1963). Dummy variables for effects are included in the equations. Restrictions across equations are then tested via F tests. The functional form reported in Appendix Table 2 is the normalized quadratic. Elasticities at the means are reported in Table 4 in the text. Appendix Table 3 reports the structural regressions utilizing the same form. All independent variables are lagged five years.

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Appendix Table 2. Third Stage System Estimates, Producer Core Model.*

	Parameter Estimate	t Ratio
Dependent Variable: Quantity of Wheat Produced		
Intercept	-1197.45	-2.4851
Wheat Price/Wage	5440.989	3.2911
Rice Price/Wage	-2132.65	-2.0897
Cereal Grains Price/Wage	1058.865	1.5029
Other Crops Price/Wage	-629.323078	-0.6134
Fertilizer Price/Wage	22.301092	0.0386
Animal Power Price/Wage	-506.639154	-1.1681
Tractor Services Price/Wage	6.277948	0.0507
Electrification	-13.876884	-0.9460
Roads	-1074.92	-0.8653
Rainfall	2.820626	2.2577
Irrigation Intensity	531.500936	9.3836
Net Cropped Area	-1.546093	-0.5752
High Yielding Varieties	493.962476	8.1636
Research Expenditures	56.419306	0.4753
Research Expend. x HYV's	-0.588203	-0.2170
Farm Size	2438525	1.5920
Dependent Variable: Quantity of Cereal Grains Produced		
Intercept	-443.311078	-2.3914
Wheat Price/Wage	1058.865	1.5029
Rice Price/Wage	-405.296967	-0.6999
Cereal Grains Price/Wage	186.649789	0.2898
Other Crops Price/Wage	-786.500457	-1.4914
Fertilizer Price/Wage	509.900050	1.2650
Animal Power Price/Wage	165.486012	0.5173
Tractor Services Price/Wage	-72.608036	-0.7421
Electrification	10.081343	1.6553
Roads	1146.224	2.1268
Rainfall	-0.960473	-1.8464
Irrigation Intensity	137.579023	5.6064
Net Cropped Area	3.694543	3.0805
High Yielding Varieties	-55.250082	-2.0909
Research Expenditures	-87.251138	-1.6966
Research Expend. x HYV's	1.851418	1.5651
Farm Size	-93529.8	-0.1412
Dependent Variable: Quantity of Other Crops Produced		
Intercept	641.019085	1.9463
Wheat Price/Wage	-629.323078	-0.6134
Rice Price/Wage	-680.926556	-0.7972
Cereal Grains Price/Wage	-786.500457	-1.4914
Other Crops Price/Wage	2606.748	2.4520
Fertilizer Price/Wage	-851.788963	-2.1325
Animal Power Price/Wage	-146.604434	-0.4728
Tractor Services Price/Wage	7.589516	0.0866
Electrification	62.660977	4.6665

Appendix Table 2. Third Stage System Estimates (continued)

	Parameter Estimate	t Ratio
Dependent Variable: Quantity of Other Crops Produced (continued)		
Roads	-4693.74	-3.9472
Rainfall	0.444560	0.3901
Irrigation Intensity	174.971537	3.1077
Net Cropped Area	9.074169	3.1901
High Yielding Varieties	-367.511199	-6.5680
Research Expenditures	429.798486	3.8922
Research Expend. x HYV's	8.850072	3.5335
Farm Size	-3061838	-2.0909
Dependent Variable: Quantity of Rice Produced		
Intercept	-775.723504	-2.4734
Wheat Price/Wage	-2132.65	-2.0897
Rice Price/Wage	4568.581	3.8078
Cereal Grains Price/Wage	-405.296967	-0.6999
Other Crops Price/Wage	-680.926556	-0.7972
Fertilizer Price/Wage	745.379959	1.7360
Animal Power Price/Wage	-277.414093	-0.8357
Tractor Services Price/Wage	37.401099	0.3870
Electrification	4.312607	0.3173
Roads	-3202.39	-2.6435
Rainfall	5.051735	4.4227
Irrigation Intensity	90.774764	1.5748
Net Cropped Area	11.719774	3.9995
High Yielding Varieties	74.393351	1.3432
Research Expenditures	-210.165998	-1.9080
Research Expend. x HYV's	8.162760	3.2981
Farm Size	2929818	1.9699
Dependent Variable: Quantity of Fertilizer Used		
Intercept	171.292420	1.0334
Wheat Price/Wage	22.301092	0.0386
Rice Price/Wage	745.379959	1.7360
Cereal Grains Price/Wage	509.900050	1.2650
Other Crops Price/Wage	-851.788963	-2.1325
Fertilizer Price/Wage	-1126.49	-1.7798
Animal Power Price/Wage	2030.338	5.5226
Tractor Services Price/Wage	-181.613799	-0.8123
Electrification	-29.545975	-7.0766
Roads	682.668488	2.0718
Rainfall	-1.724165	-4.6318
Irrigation Intensity	-123.070252	-8.6705
Net Cropped Area	-0.696963	-1.1624
High Yielding Varieties	-62.475835	-3.1985
Research Expenditures	-72.195838	-1.9851
Research Expend. x HYV's	-4.810002	-5.5671
Farm Size	1754791	4.3328

Appendix Table 2. Third Stage System Estimates (continued).

	Parameter Estimate	t Ratio
Dependent Variable: Quantity of Animal Power Used		
Intercept	-371.779063	-9.4215
Wheat Price/Wage	-506.639154	-1.1681
Rice Price/Wage	-277.414093	-0.8357
Cereal Grains Price/Wage	165.486012	0.5173
Other Crops Price/Wage	-146.604434	-0.4728
Fertilizer Price/Wage	2030.338	5.5226
Animal Power Price/Wage	430.536348	1.0960
Tractor Services Price/Wage	8.630087	0.0800
Electrification	-7.165255	-2.1220
Roads	1714.507	5.4410
Rainfall	-0.414171	-1.4668
Irrigation Intensity	53.978481	3.5673
Net Cropped Area	0.494309	0.6095
High Yielding Varieties	-35.989254	-2.3036
Research Expenditures	18.966421	0.6136
Research Expend. x HYV's	-1.197031	-1.7059
Farm Size	-1343605	-3.4518
Dependent Variable: Quantity of Tractor Services Used		
Intercept	48.739176	2.2464
Wheat Price/Wage	6.277948	0.0507
Rice Price/Wage	37.401099	0.3870
Cereal Grains Price/Wage	-72.608036	-0.7421
Other Crops Price/Wage	7.589516	0.0866
Fertilizer Price/Wage	-181.613799	-0.8123
Animal Power Price/Wage	8.630087	0.0800
Tractor Services Price/Wage	77.294228	0.3457
Electrification	-0.838375	-0.8338
Roads	-124.059874	-1.3528
Rainfall	-0.159763	-1.9400
Irrigation Intensity	-38.459232	-9.1392
Net Cropped Area	0.619420	2.8422
High Yielding Varieties	31.585602	8.1358
Research Expenditures	-24.006107	-3.0092
Research Expend. x HYV's	-2.934679	-15.8097
Farm Size	-331818	-2.9152
Dependent Variable: Quantity of Labor Used		
Intercept	-921.155221	-6.8206
Wheat Price/Wage	-34.690542	-0.0293
Rice Price/Wage	1858.665	2.1220
Cereal Grains Price/Wage	-2558.63	-2.7385
Other Crops Price/Wage	-222.292059	-0.2739
Fertilizer Price/Wage	-5846.62	-1.9950
Animal Power Price Wage	-1853.24	-1.6699
Tractor Services Price/Wage	6101.832	2.1297

Appendix Table 2. Third Stage System Estimates, (continued).

	Parameter Estimate	t Ratio
Dependent Variable: Quantity of Labor Used (continued)		
Electrification	26.439776	3.1173
Roads	-523.776095	-0.6578
Rainfall	-1.779467	-2.4936
Irrigation Intensity	-101.984933	-2.7016
Net Cropped Area	-0.869722	-0.4394
High Yielding Varieties	-85.239690	-2.0578
Research Expenditures	350.020782	4.3136
Research Expend. x HYV's	-1.727959	-0.9377
Farm Size	5720340	5.8094

*Because the input quantities used in this system of equations are negative, signs on the parameter estimates in these equations (fertilizer, animal power, tractor services, and labor) are actually the reverse of those reported.

Appendix Table 3. Structural Regression Estimates.

Dependent Variable: Electrification

SSE	121167.2	F Ratio	27.49
DFE	271	Prob>F	0.0001
MSE	447.111349	R-Square	0.5868

	Parameter Estimate	t Ratio
Intercept	-133.766756	-5.8090
Price of Wheat	-29.399558	-2.8177
Price of Rice	36.474351	6.0571
Price of Cereal Grains	49.701674	6.9758
Price of Other Crops	-38.427199	-7.7470
Price of Fertilizer	-44.032752	-1.6989
Wage Rate	11.487319	2.2739
Price of Animal Power	1.238055	0.1605
Price of Tractor Services	58.181465	3.0137
Population Density	0.065372	8.6372
Population Density^2	-.0000078506	-9.1079
Research Expenditures	1.132107	1.0187
Research Expenditures x HYV's	-0.058108	-1.7971
High Yielding Varieties	0.634444	1.0355
Rainfall	-0.016356	-1.9128

Dependent Variable: Roads

SSE	48.896006	F Ratio	67.78
DFE	271	Prob>F	0.0001
MSE	0.180428	R-Square	0.7779

	Parameter Estimate	t Ratio
Intercept	-0.126595	-0.2737
Price of Wheat	-0.535722	-2.5559
Price of Rice	0.985959	8.1507
Price of Cereal Grains	-0.263224	-1.8391
Price of Other Crops	0.096245	0.9659
Price of Fertilizer	-1.190657	-2.2868
Wage Rate	-0.139293	-1.3726
Price of Animal Power	1.510272	9.7464
Price of Tractor Services	-0.792984	-2.0448
Population Density	0.001140733	7.5027
Population Density^2	-1.07994E-07	-6.2370
Research Expenditures	0.007569518	0.3391
Research Expend. x HYV's	0.001418811	2.1843
High Yielding Varieties	-0.014343	-1.1654
Rainfall	-0.000778557	-4.5325

Appendix Table 3. Structural Regression Estimates (continued).

Dependent Variable: Literacy

SSE	2006.656	F Ratio	40.70
DFE	271	Prob>F	0.0001
MSE	7.404637	R-Square	0.6777

	Parameter Estimate	t Ratio
Intercept	20.467601	6.9068
Price of Wheat	-4.881591	-3.6356
Price of Rice	1.501175	1.9372
Price of Cereal Grains	-4.973343	-5.4241
Price of Other Crops	4.380572	6.8625
Price of Fertilizer	-1.745470	-0.5233
Wage Rate	5.528046	8.5031
Price of Animal Power	5.168894	5.2070
Price of Tractor Services	-15.129330	-6.0897
Population Density	0.0097219	9.9813
Population Density^2	-7.89157E-07	-7.1144
Research Expenditures	-0.053049	-0.3709
Research Expend. x HYV's	-0.00580319	-1.3946
High Yielding Varieties	0.234861	2.9788
Rainfall	-0.00880914	-8.0053

Dependent Variable: Research Intensity

SSE	16.740868	F Ratio	180.22
DFE	271	Prob>F	0.0001
MSE	0.061774	R-Square	0.9030

	Parameter Estimate	t Ratio
Intercept	0.707046	2.6122
Price of Wheat	0.214362	1.7479
Price of Rice	0.251432	3.5523
Price of Cereal Grains	-0.346260	-4.1346
Price of Other Crops	0.097705	1.6758
Price of Fertilizer	1.945580	6.3862
Wage Rate	-0.108067	-1.8199
Price of Animal Power	0.261703	2.8863
Price of Tractor Services	-2.686744	-11.8400
Population Density	0.0002472118	2.7788
Population Density^2	-2.94844E-08	-2.9101
Research Expenditures	0.158221	12.1125
Research Expend. x HYV's	-0.00202262	-5.3218
High Yielding Varieties	0.038976	5.4122
Rainfall	-.0000037578	-0.0374

Appendix Table 3. Structural Regression Estimates (continued)

Dependent Variable: Farm Size

SSE	.00001410938	F Ratio	147.47
DFE	271	Prob>F	0.0001
MSE	5.20641E-08	R-Square	0.8840

	Parameter Estimate	t Ratio
Intercept	0.003607859	14.5192
Price of Wheat	-0.000455319	-4.0440
Price of Rice	0.0001281146	1.9716
Price of Cereal Grains	0.0001065672	1.3861
Price of Other Crops	0.000166964	3.1193
Price of Fertilizer	-0.000288797	-1.0326
Wage Rate	0.0003557744	6.5262
Price of Animal Power	0.0002404754	2.8890
Price of Tractor Services	-0.00073248	-3.5161
Population Density$_2$	-6.76366E-07	-8.2813
Population Density	5.19124E-11	5.5812
Research Expenditures	.00001784506	1.4881
Research Expend. x HYV's	2.78546E-07	0.7983
High Yielding Varieties	-.0000073742	-1.1154
Rainfall	2.54022E-08	0.2753

Dependent Variable: Laborers/Cultivators

SSE	3.719489	F Ratio	54.63
DFE	271	Prob>F	0.0001
MSE	0.013725	R-Square	0.7384

	Parameter Estimate	t Ratio
Intercept	0.735273	5.7631
Price of Wheat	-0.142578	-2.4664
Price of Rice	0.001965327	0.0589
Price of Cereal Grains	0.067373	1.7067
Price of Other Crops	0.031940	1.1622
Price of Fertilizer	-0.117876	-0.8209
Wage Rate	0.129643	4.6318
Price of Animal Power	0.009777923	0.2288
Price of Tractor Services	-0.232224	-2.1711
Population Density$_2$	-0.000212669	-5.0715
Population Density	3.38411E-08	7.0862
Research Expenditures	-.0000678433	-0.0110
Research Expend. x HYV's	.00006712723	0.3747
High Yielding Varieties	0.009984877	2.9415
Rainfall	.00008634149	1.8225

Appendix Table 3. Structural Regression Estimates (continued)

Dependent Variable: Irrigation Intensity

SSE	27445.53	F Ratio	66.11
DFE	271	Prob>F	0.0001
MSE	101.275012	R-Square	0.7735

	Parameter Estimate	t Ratio
Intercept	12.967776	1.1833
Price of Wheat	-19.463449	-3.9195
Price of Rice	17.970854	6.2705
Price of Cereal Grains	9.917366	2.9247
Price of Other Crops	-16.944410	-7.1776
Price of Fertilizer	-6.964110	-0.5646
Wage Rate	23.069265	9.5949
Price of Animal Power	7.102814	1.9347
Price of Tractor Services	-13.560755	-1.4759
Population Density	0.034903	9.6895
Population Density^2	-.0000037892	-9.2369
Research Expenditures	-0.440711	-0.8333
Research Expend. x HYV's	-0.026459	-1.7194
High Yielding Varieties	0.907554	3.1124
Rainfall	-0.044533	-10.9427

Dependent Variable: Net Cropped Area

SSE	23473647	F Ratio	30.18
DFE	271	Prob>F	0.0001
MSE	86618.62	R-Square	0.6093

	Parameter Estimate	t Ratio
Intercept	5353.014	16.7015
Price of Wheat	-756.520328	-5.2093
Price of Rice	137.331376	1.6385
Price of Cereal Grains	113.665028	1.1462
Price of Other Crops	455.100045	6.5918
Price of Fertilizer	9.622916	0.0267
Wage Rate	80.267170	1.1415
Price of Animal Power	-782.665611	-7.2898
Price of Tractor Services	-195.094706	-0.7261
Population Density	-1.500906	-14.2473
Population Density^2	0.0001654346	13.7895
Research Expenditures	23.331758	1.5084
Research Expend. x HYV's	-0.561569	-1.2478
High Yielding Varieties	18.643815	2.1863
Rainfall	0.043662	0.3669

Appendix Table 3. Structural Regression Estimates (continued).

Dependent Variable: Electrification

SSE	173905.7	F Ratio	31.91
DFE	279	Prob>F	0.0001
MSE	623.317966	R-Square	0.4069

	Parameter Estimate	t Ratio
Intercept	-58.739008	-3.4938
Population Density	0.042742	6.1177
Population Density^2	-.0000047906	-6.2782
Research Expenditures	4.287136	6.5770
Research Expend. x HYV's	-0.131509	-6.8516
High Yielding Varieties	1.855950	4.9592
Rainfall	-0.023336	-2.5227

Dependent Variable: Roads

SSE	87.429272	F Ratio	70.57
DFE	279	Prob>F	0.0001
MSE	0.313367	R-Square	0.6028

	Parameter Estimate	t Ratio
Intercept	0.598078	1.5865
Population Density	0.001202233	7.6744
Population Density^2	-1.43488E-07	-8.3867
Research Expenditures	0.071298	4.8783
Research Expend. x HYV's	-0.00113566	-2.6389
High Yielding Varieties	0.015658	1.8660
Rainfall	-0.00167909	-8.0954

Dependent Variable: Literacy

SSE	3685.073	F Ratio	32.06
DFE	279	Prob>F	0.0001
MSE	13.208148	R-Square	0.4081

	Parameter Estimate	t Ratio
Intercept	20.109746	8.2169
Population Density	0.006548752	6.4390
Population Density^2	-5.31972E-07	-4.7893
Research Expenditures	0.073645	0.7761
Research Expend. x HYV's	-0.00148201	-0.5304
High Yielding Varieties	0.143087	2.6265
Rainfall	-0.012052	-8.9499

Appendix Table 3. Structural Regression Estimates (continued).

Dependent Variable: Research Intensity

SSE	32.123924	F Ratio	203.34
DFE	279	Prob>F	0.0001
MSE	0.115140	R-Square	0.8139

	Parameter Estimate	t Ratio
Intercept	0.534105	2.3374
Population Density	0.0003503171	3.6892
Population Density^2	-5.38607E-08	-5.1935
Research Expenditures	0.114950	12.9751
Research Expend. X HYV's	-0.00107578	-4.1238
High Yielding Varieties	0.011881	2.3357
Rainfall	-0.000355031	-2.8239

Dependent Variable: Farm Size

SSE	.00002048216	F Ratio	229.56
DFE	279	Prob>F	0.0001
MSE	7.34127E-08	R-Square	0.8316

	Parameter Estimate	t Ratio
Intercept	0.003857714	21.1430
Population Density	-.0000010357	-13.6595
Population Density^2	9.36524E-11	11.3093
Research Expenditures	.00005009734	7.0818
Research Expend. x HYV's	1.38882E-08	0.0667
High Yielding Varieties	-.0000093653	-2.3059
Rainfall	-1.00550E-07	-1.0016

Dependent Variable: Laborers/Cultivators

SSE	4.693217	F Ratio	94.35
DFE	279	Prob>F	0.0001
MSE	0.016822	R-Square	0.6699

	Parameter Estimate	t Ratio
Intercept	0.739966	8.4723
Population Density	-0.000361956	-9.9726
Population Density^2	5.21914E-08	13.1664
Research Expenditures	0.004469568	1.3199
Research Expend. x HYV's	0.0002486863	2.4941
High Yielding Varieties	0.004187066	2.1536
Rainfall	.00006898596	1.4356

Appendix Table 3. Structural Regression Estimates (continued).

Dependent Variable: Irrigation Intensity

SSE	50896.7	F Ratio	64.22
DFE	279	Prob>F	0.0001
MSE	182.425452	R-Square	0.5800

	Parameter Estimate	t Ratio
Intercept	56.454312	6.2069
Population Density	0.011048	2.9230
Population Density^2	-.0000010842	-2.6264
Research Expenditures	0.234804	0.6658
Research Expend. x HYV's	-0.00216685	-0.2087
High Yielding Varieties	0.643282	3.1773
Rainfall	-0.054466	-10.8837

Dependent Variable: Net Cropped Area

SSE	38515997	F Ratio	26.03
DFE	279	Prob>F	0.0001
MSE	138050.2	R-Square	0.3589

	Parameter Estimate	t Ratio
Intercept	3734.558	14.9260
Population Density	-1.198719	-11.5288
Population Density^2	0.0001375912	12.1164
Research Expenditures	-21.071222	-2.1721
Research Expend. x HYV's	-0.098281	-0.3441
High Yielding Varieties	8.976008	1.6116
Rainfall	0.190834	1.3862

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7
Agricultural Development Planning: The Thailand Case

Earl O. Heady

Developing countries have many things in common. These common characteristics include a shortage of research and educational resources and a general lack of capital. Also, it is not uncommon for them to use pricing policies for basic commodities that favor consumers over farmers and provide disincentives for food production and agricultural transformation. But also, they often have meager agricultural planning ability and are unable to come up with plans that are consistent with their development goals and which have means of implementation. Sometimes they are even confused with and over their developmental goals. An important reason for the lack of planning capabilities is the lack of a well organized and trained group of agricultural economists. The void typically exists because adminstrators or planners who do prevail have not yet recognized agricultural economics as a worthy field, resources do not exist for training personnel, salaries are too low to keep graduate degree personnel together in a government agency once they are trained and occasionally the political administrators do not want systematic analysis and planning conducted.

While some developing countries have considerably more economic analysis and planning ability than 30 years ago, a fairly large proportion still have only meager capabilities. In others, the bureaucratic construction and insolation of departments burdens planners to an extent they mainly perform routine and mechanical monitoring tasks. In some cases, their duties mainly simmer down to seeing that appropriated project funds are actually spent in whatever way. Perhaps, in more cases, economic analysis and planning is highly handicapped by the lack of statistics. In a few cases, even the population isn't known with any great accuracy.

Thailand is a country which has been trying to improve this situation and is moving into a realm where it may have one of the best analytical and planning groups in the developing world. Thailand, as a country, has several interesting characteristics. One is that throughout the time that the rest of Southeast Asia served as colonies, Thailand was sufficiently adept at international politics that it remained an independent country, even though neighboring countries served in the empires of strong European powers. Its warring and defense abilities undoubtedly also helped it somewhat in this respect. The Royalty of the nation has almost

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a worshipful respect by its people, even though political democracy has hardly ever prevailed and frequent coups serve as substitutes for elections. Yet, even though these frequent government changes take place and the ministers "go" with them, the country has a quite efficient civil service system for professional persons. Their employment is not withdrawn after a coup and the stability of tenure makes it possible for programs to be developed and maintained. Also, salaries in government agencies are kept high enough to retain most trained professionals.

Over the last 10 years, Thailand has begun to upgrade its economic analysis and planning agency in the Ministry of Agriculture and Cooperatives. At Iowa State University we have participated in these strengthening efforts over this same period of time. It was possible to institutionalize several aspects of this program and to incorporate into it the Thais who had been sent abroad for advanced degrees. In general, it was a very successful program. As we completed the supposedly final year of the project, it "stayed in place" and could and did run on its own momemtum. This is in contrast to many AID-financed projects over the world with which I am acquainted. They simply "faded away" soon after their U.S. advisers left, even though the United States spent several million dollars on them. Outstanding examples were in Peru, Korea, Nigeria, and others. Perhaps, the majority fall in this category.

I now will give a bit of historic perspective on this project and the outlook for it in the future. After a gap of three years, we signed an extension of this program. The purpose is not to "shore up" a flagging project but rather to help in an extension and enlargement of a program which remained viable and active after we initially finished it.

A graduate student named Somuk Sriplung enrolled for a Ph.D. degree in agricultural economics at Iowa State University in the fall of 1964. Studying intensely, he completed his degree in three years and returned in spring 1967 to a government agency, the Division of Agricultural Economics, as an ordinary research worker. The then-director retired shortly after his return and, as the only person with a Ph.D. degree, but mainly because of his drive and imagination, Somuk became the new director. Working furiously for long days, he was able to lead a small staff of agricultural economists (or perhaps just half agriculturalists without degrees in economics) of B.S. people, sprinkled with perhaps eight M.S. persons, to do some relevant research and to begin to supply information which was useful for national policy decisions. He stationed small research units in the countryside to generate answers to farm management problems. He also strengthened Thailand's agricultural statistics system and set up a crop reporting service equal to or better than that of the United States. By 1970, policymakers and administrators in the Ministry of Agriculture and the National Economic and Social Development Board were asking him for much more help than he could develop from a small staff with elementary degress. They were asking him to answer the usual policy questions with some emphasis on ones such as: should we use the funds that foreign donors have offered us and which we have appropriated for more dams, for improved water distribution systems, for an expanded extension service, for more farm credit or for an

enlarged research program? Should we develop a rice buffer stock? Should we extend the rice premium (export tax) to other commodities? Should we conduct a land reform? Thailand had had an export tax since immediately after World War II when the victorious allies, led by England, required that Thailand pay an indemnity (for declaring war on Japan's side while never firing a shot during the duration — they were occupied by Japan) and required the country to deliver rice which had accumulated during the conflict (due to the inability to ship and export) to neighboring countries occupied by the Japanese.

When Somuk returned in 1967, the Division of Agricultural Economics (DAE) had only 68 employees, including clerks, secretaries, drivers and some deadwood. With the demand for more economic intelligence and extended agricultural statistics, he petitioned the government for more resources and research aid from international organizations. The government asked FAO to provide the research and modeling capability needed by the DAE to enlarge and upgrade its program. Also, Art Coutu of North Carolina State and I were asked to come to Bangkok in 1971 and outline a plan of work and modeling needed to answer the wide range of problems foreseen in Thailand. We outlined a program, hopefully of 10 years if donor funds were sufficient but minimally of 5 years, which would help meet the needs for policy analysis and planning in the DAE. Included in the set of activities was building certain analytical models which could be updated and used continuously. FAO asked me to stop in Rome and discuss the proposed modeling and research program. However, FAO said that it did not have a staff capable of implementing such a program. Hence, the Thais turned to the U.S. Agency for International Development (AID) and Iowa State University. While these negotiations were underway in 1972 (for a project to begin in 1973), we had time to observe some of the data voids and plan for their correction. Since one of the models planned was an interregional and national mathematical programming one, we arranged for a sample of 20,000 farms to be taken in 1972 to provide technical coefficients which would be used in the process. Of course, the 20,000 national random sample also was used for other things such as analysis of capital and credit use, labor employment, the distribution farm income, etc.

The project was initiated in July 1973, with a team representing Iowa State University typically made up of five persons, aided by short-term consultants. From the outset, our plan was to work ourselves out of a job in the 5-year span of the project. We adopted several procedures to be sure that we would do so and that the program being undertaken could be perpetuated. In the first place we "became Thais" in the sense that we lived, during working hours, in the same offices with the Thai members of the DAE. This was an important step because other ministry advisers funded by AID maintained their working headquarters in the AID building (with the air conditioning). However, they were never able to build up the rapport and trust of the Thai staff in the manner that our team did. Too, rather than have a counterpart Thai named for each of our team members, Dr. Somnuk declared that his whole staff and our entire team would be counterparts all with each other.

Our duties were sixfold: (1) to build a set of models for

analytical and planning purposes; (2) to serve as research consultants or advisers to the Thai staff; (3) to provide policy analysis and guidance as needed; (4) to conduct research; (5) to help organize a statistics center for data acquisition and processing; and (6) to provide training and skill upgrading of the Thai staff.

The training phase was begun immediately and just ended last year (although the project officially ended in 1978). It was implemented through three means: one means was graduate training at the M.S. and Ph.D. levels -- 20 and 12 persons, respectively, at each level. The formal graduate training was done in the United States at four institutions but mainly at Iowa State University. A second means by an in-house training program whereby our team members taught graudate level courses within the DAE to its employees. A wide range of subject matter was covered including micro and macro theory, statistics, econometrics, agricultural policy and mathematical programming. The third method was on-the-job, one-on-one training of the DAE staff by our staff through their work assignments. Typically, each of our team members had a group of Thais who worked with them on their specified projects. Some of these Thais became rather highly skilled through this work guidance and experience. In fact, through this on-the-job training and the in-house courses, some of the Thai staff members who remained in the DAE and worked on the various projects were more practically skilled in modeling and economic analysis than those who had gone abroad for further graduate training (at the time the latter returned, although they soon came up to speed).

Of the five long-term staff members we kept in Thailand, we tried to maintain a marketing-demand analyst, an agricultural economist with modeling ability, an agricultural policy specialist, a general economist with modeling and quantitative ability and a statistician with some computer science knowledge. We had an excellent team and actually all of them (the statistician to a lesser extent) could serve as agricultural economic analyst, statistician, modeler and administrator. The team was off and running almost as soon as it arrived. After allowing the team families a few days to locate housing, our team and all branch leaders from the DAE traveled to Ching Mai in north Thailand where we all lived together in a conference house of the forestry department. For a week, we lived and ate together while we became acquainted and reviewed and developed the program for the upcoming five years. In this manner, the group of 30 persons became quickly acquainted, in a manner impossible had we remained in Bangkok at the desks in the Ministry. Also, as a part of this immediate orientation program, some Thai leaders and our team spent about 10 days visiting all major regions of Thailand by means of helicopter. Then, further in orientation, the DAE staff had assembled a large library of literature on the nature and problems of the Thai agriculture and economy and the various prescriptions for solutions of these problems. Our team studied this literature for most of a month and were soon as, or more, knowledgeable as their Thai colleagues on the economic aspects and problems of Thai agriculture. But while we conducted an intensified orientation in the first month, we also were immediately introduced to short-run policy problems with needs for immediate answers. World grain and livestock prices had sky-

rocketed in 1973. The United States had placed an embargo on soybeans to dampen price increases and had some general price controls in effect. The Thai government wondered if it should limit rice exports and ban exports of buffalos. The buffalo were moving to Hong Kong for meat while the growing price of rice was burdening urban consumers. The government also wanted to know whether it should put into effect a rice buffer stock program -- and if so, what kind and how large. Within the first month our team had specified a rice buffer stock model which, with a bit of additional work later, eventually became the ASEAN countries rice buffer stock model. It is still in place and the only international buffer stock program ever put into effect and some countries outside the ASEAN organization are now thinking about joining it.

The Thai government cabinet was anxious to get agricultural policy solutions and they came willingly to the DAE for them. Dr. Somuk was continuously called to the cabinet meetings to explain economic problems or provide solutions for them. It was not uncommon for him to return from a cabinet meeting with a problem for which he needed a solution in five days. What data and good logic that were available had to be marshaled, synthesized and analyzed quickly. Work was sometimes furious and went through the night even on the weekend. Thais work hard and play hard and they usually got the work done. Since our team members were senior to the DAE staff as economists, they were generally called upon to help or do the task. While we shortly had to limit the amount of time our team could work on short-term, put-out-the-fire policy problems, they continued to do so throughout the project. Their involvement was gratifying to them. Frequently, they would finish a policy analysis one week and read in the paper the following week that Parliament had voted to adopt it. A large set of problems were analyzed including grain prices and storage policies, whether to invest in improved truck or barge transportation for rice, farm credit programs and rural development strategies. The members of the team were requested to determine the best place to relocate the Bangkok fish market. Applying a transportation model, their answer was in the northwest part of the city near the airport along a major highway. Ministry officials were stunned to hear that the location wasn't on the Cha Pao River as it always had been until they were shown that 50 percent more fish were transported into the city by truck than by boat. When the government decided to build a large farm market in or around Bangkok so that farmers could market direct to consumers, restaurants and wholesalers, team members were again asked to designate the location.

Since our main mission was the building of analytical and planning models, conducting research and upgrading the abilities of the DAE staff, we had to determine the proportion of time that team members spent on these policy problems. Too, at the outset, there had been requests for personnel from the ISU team to appear before the cabinet. After some discussion, we decided that it was alright for our staff to work on policy problems but that they shouldn't appear before the cabinet because it might take on a political tinge if government administrations changed. Dr. Somnuk, with his Thai civil service status, could provide the better linkage to the decision makers. This was probably the right decision because

there were several coups during our stay. While one was fairly violent and our office building was pockmarked by machine gun bullets, subsequent generals generally brought down the previous government without bloodshed. Curfews were sometimes in effect. If members of our team were doing statistical work or solving models at the Computer Center at night and ran past 10:00 p.m., they would have to spend the rest of the night on a cot in the Center — until the curfew expired at 6:00 a.m. the next morning.

When we arrived in Bangkok the DAE had no computer and the Ministry of Agriculture and Cooperatives had only one, an IBM 1130, computer in the irrigation department. It was not easily accessible to our group. Yet, here we were going to develop an agricultural statistics center and construct large-scale models to be solved. Our 20,000 farm sample being summarized by hand calculators would still not be completed in three years if we retained this method. Hence, the DAE asked AID to finance a computer and almost immediately we got a used IBM 1130. A new problem immediately emerged: the DAE had no computer programmers, nearly the case for the whole Ministry of Agriculture and Cooperatives. Hence, our team members who were agricultural economists with some courses in computer science, taught classes in computer programming to members of the DAE. When the latter were trained, they taught subsequent DAE groups and we were supplied with programmers. In less than a year, the computer was used full time during regular working hours; in two years, it ran 24 hours a day much of the time. Subsequently, as we began solving very large models, we got access to an IBM 360 computer acquired by another government agency. The DAE now has its own IBM 360.

As mentioned earlier, our mainstream mission was to do research on agricultural economic relationships and problems and build analytical and planning models. The Ministry of Agriculture and Cooperatives especially wanted some type of a model to more readily and effectively make five-year plans. A new five-year plan was to be developed by 1976 and they wished the model to be available for it. We developed a long list of research projects and models which might be accomplished over a long period. Of course, in five years we were not able to complete all of this work. However, by the time we had been there for two months we had our main core programming model specified. Thailand was getting various offers from donors and international agencies in different countries to finance projects. The projects would relate to different regions of the country — the North, the productive Central Plains, the low-income Northeast and industrial-crop South. The nation also had their own developmental budget. Dams for irrigation were possibilities in some locations. In several locations, dams had been built but water distribution systems, especially at the secondary and tertiary levels, were ineffective. Great improvements were needed in production of industrial crops in the South. Farmers in some regions lagged far behind the technology used by farmers in other regions. New crops such as soybeans, corn and cotton were possibilities, especially in the Central Plain region. Thus, it appeared that a national programming model developed on a regional and interregional basis could be useful in the model set. In the development and planning problems facing the

country, there was need to know where the country's investment should be made and how large it should be in each location. A national and interregional programming model could help determine and identify these interregional interdependences and linkages. The plan also was to build a macro econometric model of the national economy with sufficient relationships specified for agriculture that analysis could be made of the impact of different macro policies on agriculture. Types of policies to be analyzed were those of monetary and fiscal policy affecting interest rates, trade policy, etc. We wished to know how these and others affected employment, investment, prices, and income of agriculture. We also had planned to build a stand-alone national econometric model of the agricultural sector which could be simulated recursively. However, since so much work was left to do in estimating demand functions (even in getting useful time series data to do so), we were not able to complete this phase during our relatively short stay and small staff. And we did many other things, as I explain later.

Rather than to develop a national programming model in "one fell swoop" we decided to do it region by region. Then, as the first region was finished, we could explore development possibilities for the region while models were being built for other regions. When all regions were finished, they could be linked together in a national model. We also decided to build regional input-output models so that we could trace developmental effects throughout subsectors of the regional economy. With the help of soil, water and other agricultural scientists, we divided the country into 19 agroeconomic zones or regions with three land classes in each. We developed our first regional model for the Northeast, the region of lowest per capita incomes and with transgression and security problems through North Vietnam, Laos, and Cambodia.

Great detail went into the programming models. As mentioned previously, the 20,000 farm sample survey, plus another 7,000 detailed farm survey over Thailand, was used along with experimental and judgemental figures in establishing technical coefficients of crop and livestock activities. We went into extreme detail for each region: glutinous rice - old variety, glutinous rice - new variety, non-glutinous rice - old variety, non-glutinous rice - new variety and each of these without fertilizer and each with two levels of fertilizer; etc., for other crops. Of course, each region included more crops than would a typical U.S. region. Industrial crops such as rubber and oil palm under different technologies were included in the South. We had a bovine submodel in the overall model which selected between producing cattle and buffalo for power or food — and both of these as compared to a two-wheeled garden tractor. Land and water resource restraints were established from soil maps and geological data which are quite good in Thailand. Since multiple cropping is a prevalent use and possibility, land restraints were defined for twelve months out of the year. Labor restraints, mainly family as inventoried from the surveys, also were specified for 12 months in a calendar year. Capital restraints were defined seasonally in relation to crop harvesting. These restraints were defined for each land class:

lowland paddy, upland paddy and upland nonpaddy. For the regional models, the objective function was one of income maximization at the agroeconomic zone level. Later, the input-output model could be attached to trace different developmental, technological and policy events throughout the rural sector. We were solving a model of this specification for the Northeast region while we were working on other regional models.

Starting from scratch and working region-by-region, even to the extent of having different rubber technologies for the South, we were able to complete all of the regional models and link them together in a national model in two years. That is better than we generally have been able to do in the United States. We also were able to meet the Ministry of Agriculture and Cooperatives' goal of using the model for the new five-year plan. As outlined later, we interacted with policy makers in testing the outcomes of different policy alternatives through the initial model.

Our initial objective, on this first "go around" was to have the national, interregional model, with the regions made interdependent through regional demand sectors and a transportation submodel, with restraints defined at the regional level. Then we would define typical farms for different capital and tenure situations in the various land groups and agroeconomic zones. We expected, after we tried policy alternatives at the regional and national level, we would then run them through the individual farm models and see how they affected production, employment, capital requirements, income and other important quantities. We could then estimate how individual farms in various zones and under different tenure, size, capital and technology conditions would fare. We were not able to complete all the typical farms before our project closed.

While we were completing the national and interregional programming model, we also made progress on other fronts. We completed the macro econometric model in two years and had it linked with the interregional programming model as a recursive model in another year.

Commodity crop analysis was conducted for as many crops as we could handle during the period. As "stand alone models" they are used in a variety of ways. They were used for short-term forecasting of demand quantities and prices. Knowledge of the price and income elasticities were useful in analyzing policies such as the export tax on rice. Equations were estimated for domestic demand, export demand and stocks. Analysts have had trouble in obtaining an estimate of a domestic rice demand function which is not positively sloped. As in many other developing countries, time series data are poor and the first assessment of these demand analyses was that the "spurious" results were caused by poor data, part of which had been synthesized. However, after a further analysis, it appears that there is some basis for an upward sloping rice demand curve: with rice as a major component of diets, an increase in price of rice drives up the family outlay for food. Consequently, with rice still being a lower-cost food source, people eat more of it to "stay within their income." It is possible to obtain, depending on the data series used, rice demand functions with either positive or negative slope — although the

same problem does not arise for other major commodities. If one selects the negative slope, then domestic rice demand is less price elastic than export demand. Hence, the rice export tax will, as it reduces export demand quantity, increase domestic market supply and reduce domestic rice price both to consumers and farmers. The export tax was probably mainly used for this purpose in recent times. However, we believe our analyses kept the Thai government from extending the export tax to other major commodities, as it was proposing to do at one time and encouraged it to minimize the use of the rice export tax to maintain lower prices for consumers. It isn't called a tax by the Thai government but goes under the name "rice premium". It was first used to siphon away some of the profit made by domestic rice marketing firms as they handled shipments of rice (accumulated during the war) to other countries. A joint product of this assessment was funds for the treasury. Hence, at times is was increased for the latter purpose. Then its emphasis as a price depressing instrument came forward. Hopefully, it will be fazed out shortly. The price distortion effects have not been as bad as in some other developing countries where consumers are favored over farmers. Extreme cases are those such as Egypt where straw from wheat has more value than grain, and burseem clover rather than maize is produced because meat prices are not controlled while grain prices are held at low delivery levels.

During the period of our project, a statistical center was established in the DAE. The DAE thus was given the responsibility of collection, processing, interpreting, and publishing all agricultural statistics. It was given extended responsibility for agricultural outlook, price forecasting and crop area, yield and production. Our team perfomed many miscellaneous professional activities including the best design and statistical analysis methods for estimating crop yield response to fertilizer at a sample of sites in the country. It helped design questionnaires for the many sample surveys which the DAE takes. It designed a study of nutritional status for the country. It helped develop a Social Accounting Matrix for several regions for assessing developmental possibilities. It revived programs for integrated rural development and means for increasing the welfare of the "poorest of the poor". It worked with and had fun with its Thai colleagues.

We were far enough along in our analysis and model work to make the new five-year plan as proposed. However, rather than make a plan, we made a dozen alternative plans. Before we ran off the alternative plans, we interacted with the policymakers and administrators (a) to better understand the objectives they favored in economic development, (b) to develop communication so that it would later be easier to bring the results back to them, and (c) so that we could measure quantitatively the trade-offs among different policy goals, and decision makers could then apply their own weights against these trade-offs in selecting an alternative among the many plans generated. For example, we ran off one solution where the objective was maximum agricultural development at a given level of investment over the five years. Then, since income and security is so low in the Northeast, we ran off a plan solution where income in this region was restrained to grow 40 percent faster than in other regions. Compared with the first plan, it

showed how much national agricultural development must be sacrificed to accelerate income growth in the Northeast. We also ran a plan solution where capital investment was restrained to give a more rapid growth in the South to generate more foreign exchange through export of industrial crops. This solution then could be compared with the two above, to estimate the sacrifice in national development or income improvement in the Northeast. We also solved the models to test plans which accelerated agricultural development to measure the capital, employment and income effects. We made solutions which alternatively emphasized or de-emphasized building dams, water delivery systems, fertilizer producing facilities, improved extension activities, greater agricultural research, and other investment alternatives. After these analyses were complete, they were summarized to the administrators and planners mentioned previously. The final selection was theirs.

This planning approach and ability greatly impressed the administrators and they did something as a result. When Dr. Somnuk first went back to Thailand, the DAE had 66 employees and he was the only one with a Ph.D. degree. It was called a division while all other administrative units were called departments and were made up of divisions. Somnuk, as head of a division, didn't have the status of a department head, although he was the giant when it came to requests for policy aid from the Ministry of Agriculture and Cooperatives (MAC), the cabinet, and other planning groups. In Thailand's short experience with democracy, he was appointed by the king to the committee which was to decide the procedures for holding elections and establishing a parliamentary democracy. But his unit was held to a division because agricultural economics did not yet have an established background and Somnuk had been in the Ministry for too short a time to be a department head. If his division had been a department, they would have had to replace him as head. They didn't want to lose his imagination and drive. But by the time the above analytic and planning ability had been put in place, he now had the seniority to become a department head. However, instead of converting his unit to a department, the government elevated it to an even higher level to the Office of Agricultural Economics (OAE), above all other department heads in the MAC. Instead of giving him the title, department head, he was given the title, Secretary General of the Ministry of Agriculture and Cooperatives. In addition to its usual duties of agricultural economics research, policy and planning analysis, and statistical collection and evaluation, he was also given the responsibility of monitoring and evaluation of all agricultural development projects in all departments of the MAC. He has very heavy responsibilities. In addition, his organization operates the ASEAN (Association for Southeast Asian Nations) Planning Center, the institution created by the grant from other ASEAN countries to help train personnel from them in analytical and planning ability based on our example. He now has 1,000 employees, as compared to 66 initially. Perhaps his staff will grow to 1,500 with the current World Bank project to further strengthen the OAE and extend its regional and data gathering capabilities. Fortunately, he has lost very few of his trained staff -- and these mainly to high administrative posts in the MAC. Whereas he once was chief of the single division of agricultural

economics, there now are 12 division heads in the OAE.

With these vast responsibilities, he decided he again needs help. Hence, he petitioned AID to negotiate a new contract with us. That step has been completed and we started up on Bangkok again in August, 1982. We have three long-term persons there now and will have a fourth in the spring. We are conducting the project cooperatively with Utah State University and Western Illinois University. However, the focus is different from our earlier project. We will help to upgrade analytical, modeling, policy, and planning ability but we also will help in project evaluation and monitoring. One of our present team effectively helps Dr. Somnuk administer the OAE but also specializes in project specification. Another serves in ongoing project monitoring and evaluation. A third serves as a researcher and adviser in agricultural economic analysis, modeling, policy analysis and planning. The statistician who will arrive in March will advise and assist the statistical center in expanding, improving and speeding the collection, processing, and use of agricultural statistics. We need to add a systems analyst to help the computing center of the OAE with its expanded and more complex functions. Too, while a few persons were trained to the M.S. and Ph.D. levels in the previous project, a considerable number of persons should go abroad for training during the current term. Several fields, emphases, and institutions should be included in this training.

The Royal Thai Government is attempting to develop policies and programs to increase employment opportunities in the rural areas and reduce the discrepancies in rural-urban income equity, while providing for expanded food production to meet projected domestic consumption goals, and simultaneously maintaining or expanding export levels. Decision makers face the complex problem of choosing and allocating the scarce government resources (personnel and capital) among competing policy or program alternatives that have widely varying impacts on the short- and long-run development of the Thai economy. Raising income levels of the poorest segment of the economy merits immediate attention, but extreme care must be exercised to identify and develop alternatives that are complementary to rather than competitive with the ongoing economic growth. A misallocation of scarce Thai resources could result in even lower relative income levels for the poor rural majority.

The following several characteristics make the Thai-ISU sector project analysis effort somewhat unique:

1. Several facets of the sector analysis program were initiated in a relatively short time, even with the initial absence of a data processing mechanism, basic data banks, and trained Thai personnel. Regional and national programming models reflecting spatial competition were operational approximately two years after full initiation of the project. A version of the macromodel was also completed in two years after arrival of the macroeconomist on the ISU team. These are rather rapid accomplishments considering the nature and availability of data; the void in trained and experienced manpower; and the necessity to divert a large number of ISU personnel to the on-the-job training program, research advisory activities, and

policy analysis support for the DAE.

2. The project emphasized a complete meshing and integration of ISU and Thai staffs in the development and implementation of models and policy analysis conducted within this model framework. This accomplishment was made possible through common working conditions and complete interpersonal trust between DAE and ISU staff members, which was built through the intensive person-to-person training and research approach established by DAE leaders as the means to implement interaction of ISU and DAE staffs.
3. Within the capabilities of their training, the DAE staff has been able to comprehend the model developments and applications. They are capable and have independently formulated policy questions and conducted the analysis utilizing the analytical systems developed.
4. The major models have been applied to the real world and important Thai policy problems. Thai administrators and institutions are acquainted with availability of the models for policy analysis and with the purposes for which they are designed. However, accomplishments are small relative to the possibilities posed for the future. The present models are being extended and updated, but presently they can facilitate a wide range of policy analyses on the future of the agricultural sector, and plans exist for the implementation of a range of policy studies. These possibilities now exist with the maturation of the models to their present status and the return of many of the DAE senior staff from graduate training programs.
5. The models are detailed and can relate economic impacts back to the zone level. In this sense they contrast to others that can generate results only at national levels. The Thai models are directed to answer not only "what" at the national level but also "where" and "by how much" at the zone level. Extension of specifications to changwats (provinces) and typical farms will ultimately provide this analytical capability to the changwat governor's staff for local analysis.
6. The accomplishments of this project have been recognized by other less developed countries of Southeast Asia, which have suggested that an agricultural sector analysis center be established at the DAE in Bangkok to catalyze similar developments in other countries of the region.

Policymakers and researchers in Thailand's agricultural sector face many issues and problems similar to those faced in other developing countries. Thailand is concerned about growth in income and employment and about reducing income and employment disparities between the rural and urban people, among regions, and between the agricultural sector and the rest of the kingdom. Thailand is also concerned with expanding the potential for increasing agricultural production to ensure adequate food supplies and earn foreign exchange. Export expansion and import substitution are recurring topics in discussions of Thailand's agricultural potential. Thailand has an unusually large and still dominant agricultural sector in terms of gross national product, population, and export earnings.

Rapid expansion of domestic demand, primarily as a result of the increasing population, can slowly erode these important sources of foreign exchange and reduce per capita productivity in the sector. For many years agricultural production has been expanded primarily by land-extensive methods, which cannot be relied upon in the future as the government acts to promote the forestry industry and protect its environment from excessive land conversion.

Thailand also faces some rather unique political and economic challenges in large portions of the rural sector where poverty is common and unrest has the opportunity to expand. There appears to be sufficient motivation among farmers and government policymakers to explore the potential of expanding irrigation, to push for higher participation in multiple cropping systems, and to utilize improved farming technologies. Underemployment is a serious problem for agricultural laborers. Currently there is a high rate of immigration from low-income rural areas into the urban centers (primarily Bangkok), which accentuates problems of congestion and unemployment in the nonagricultural sector.

There is no scarcity of issues and problems to provide a focus for continued research and program development. Those with some chance to be addressed within the limit of DAE facilities include: (1) price and income response for major agricultural commodities including demand analysis and commodity supply responses; (2) land and irrigation expansion potentials and alternative methods for increasing per rai and per capita productivity (new varieties, fertilizer, management); (3) investment in expanded agricultural research and educational programs for relevant crops in the various zones; (4) analysis of fertilizer use alternatives for rice and upland crops; (5) resource utilization, including capital-for-labor substitution; (6) agricultural marketing and transportation; (7) distributional impacts of national programs on agriculture and of agriculture on the national economy; and (8) relationships between retail prices of selected food crops, foreign exchange earnings, and farm income.

In our work, we have emphasized that ISU team members conduct research with, not for, Thai colleagues. The selection of alternative research and modeling techniques should be compatible with the skills and training of the Thai staff and the ease with which a technology transfer could occur. An end product of every effort should be understanding by Thais of the method and the implications of the results. All research methods, models and results should be shared jointly by Thai and ISU personnel.

Notes

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8
Agricultural Finance and Rural Development

Ronald L. Tinnermeier

Since the declaration of the United Nations' First Development Decade (1960-1970), the low-income countries (LICs) have been searching for more effective economic development models and strategies. The First Development Decade emphasized an increase in output through increased capitalization, much of it in the form of foreign aid. Industrialization was heavily stressed during that period. However, it was soon recognized that increases in output were not reaching the lives of ordinary people in terms of jobs, income distribution, and the alleviation of poverty. This led to the Second Development Decade (1970-1980) when social goals and rural areas were given more explicit attention.

During the second decade, and more recently, a number of approaches to development have surfaced: growth with distribution, employment-oriented growth, meeting basic needs, self-reliant development, anti-poverty strategy, and the forming of a new international economic order (NIEO), among others.

The view of agriculture's role within an overall economic development strategy also has changed over that period. In the early years, commercial, mechanized farming was stressed which was consistent with the capitalization emphasis in the First Development Decade. More recent agricultural development efforts have, at one time or another, focused on food production, land reform, helping the rural poor, meeting basic needs in rural areas, integrated rural development, and farming systems. One element that has been included in almost all of these agricultural development strategies is agricultural credit, either as a specialized program or as a component of a broader strategy like rural development. Adams (Dec. 1982) estimated that the international donors have granted or lent in excess of 15 billion U.S. dollars to developing countries for agricultural credit over the past three decades. In addition, LIC governments have allocated significant resources for this purpose.[1]

Even with these large capital flows, LICs have experienced many serious problems in establishing effective credit institutions to get credit to farmers. Few farmers receive institutional credit, but even if they do, credit appears to have little effect on productivity. Lending institutions often are not financially strong or viable and tend to disappear, reorganize, or become decapitalized

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over time. Relatively high administrative costs are commonplace. Individuals hold savings in non-financial form (jewelry, animals, etc.) rather than financial form (bank accounts, treasury bills, bonds, etc.). Financial instruments have short maturities. And the Central Banks heavily intervene in setting interest and foreign exchange rates, rationing of credit and, in general, controlling the financial system. Shaw (1973) refers to these general characteristics as "shallow finance", a major constraint to economic development.

The purposes of this paper are: (1) to review some major policy issues and experiences relating to rural financial markets and agricultural credit, and (2) to propose needed changes in agricultural credit policies. The comments and conclusions are based upon a review of a large number of studies and materials about rural finance and the author's own experience in working with and evaluating a number of agricultural credit programs in various LICs (primarily in Latin America). It is interesting to reflect back on the author's first credit program evaluation of 15 years ago (Tinnermeier, 1968). At that time the policy recommendations resulting from the study were felt to be of little relevance to other LICs because of the "uniqueness" of the program under study. However, in retrospect, that program wasn't all that unique since the same experiences (problems) have been identified in country after country by other researchers since that time.

Credit Policy Issues

Rural Financial Markets

Rural financial markets (RFMs) include all the rural institutions (man-made rules and regulations which guide the behavior of people) which affect the accumulation of savings and their use, the flow and holding of funds in the rural sector, the allocation of investment capital (public and private), and the integration of rural financial activities with national and international financial markets. As such, RFMs include activities of public and private institutions like state banks, agricultural development banks, commerical banks, credit unions, credit cooperatives, postal savings banks, savings and loan banks, and the like. These are generally referred to as formal or institutional sources of credit. RFMs also include activities of private moneylenders (shopkeepers, traders, farmers, friends and relatives), local rotating credit associations, landlord-tenant share arrangements, and other less formally organized relationships. These are called informal or non-institutional credit sources. Also, RFMs include all other institutions which affect the flow of funds into, out of, and within the rural areas. These include institutions relating to customs, practices, and attitudes toward saving (institutional saving vs. hoarding and non-monetized saving like jewelry), religious and other cultural practices which affect savings, consumption, and investment by and among rural people, and inter-family mechanisms for transferring funds into and out of the rural areas (Tinnermeier, 1977). Thus, RFMs include much more than the study of formal agricultural credit and savings activities, the general

focus of this paper.

Long (1981) outlines four major functions performed by the financial sector. The first, and most obvious, is as a medium of exchange. Money or currency is considerably more efficient than bartering as a medium of exchange in dynamic, specialized or growing economies. Financial intermediation essentially reduces the costs of exchanging real resources.

A second function is to mobilize savings and allocate capital among competing uses. If this service were not available, then only those persons able to save would do the investing. This likely would lead to reduced development. The financial system must provide a linkage between savers and investors so that capital is allocated to the investments with the highest returns to society. This implies that asset-holders (savers) must hold their savings in financial form rather than as unproductive tangible assets (gold, jewelry, hoarded money, etc.).

The transformation and distribution of risk is the third function of a financial system. Levels of risk aversion vary from individual to individual and need to be accounted for in a well-functioning system. Most investors expect to be compensated for taking additional risk, otherwise little innovation would take place. The financial system may also help investors diversify their risk (small participation in many investments rather than large participation in one or a few) or even reduce financial risk (part of the reason for recent development of financial futures in the U.S.).

Finally, Long suggests the financial system is used to help stabilize economies which often face cyclical changes in prices and outputs. Governments attempt to manipulate the financial system to control or balance both the domestic economy as well as the country's foreign position.

Adams (1983) would add a couple more financial system functions to the list. He states that financial intermediation allows for the immediate purchase of large or lumpy types of items, like a tractor, before enough savings are accumulated by the purchaser. And, that intermediation helps meet family needs over the life cycle of the family. Capital needs (for consumption and investment) are high in the early years and less in the later years of life. Financial intermediation (outside the extended family) permits the family to adjust to these changing needs.

We could identify a seventh function for the financial system -- being flexible or dynamic. As economies grow and change over time the financial system also needs to change. Financial forms, institutions, and procedures appropriate at one point in time may be completely inappropriate during other periods. Thus, the financial system must be dynamic to allow change over time with changing conditions. The nature and extent of intervention in the financial system by governments is a critical but unresolved issue in development. It is within this context that RFMs, and, more specifically, agricultural credit programs must operate.

Role of Agricultural Credit

There are many different views on the role of agricultural

credit in developing countries. How one views the role of credit largely determines whether or not credit is considered a constraint to agricultural and rural development. Discussion about the role of credit often becomes confusing because no distinction is made between: (1) the role of all credit for the farm family as a unit, and (2) the role of formal or institutional credit (of primary interest to governments) for that same unit. It is easy to argue conceptionally that credit is important in development. Access to capital (credit) in the form of either accumulated savings or financial markets is necessary to undertake fixed investments or to invest in new innovations. Since savers and investors normally are not one and the same, credit plays an important role. However, one should not commit the error of assuming that because credit (whatever the source) is important, therefore, formal credit also is important. The remaining discussion on the role of agricultural credit will be in terms of the formal sources, primarily from the public sector.

A number of roles often are identified for credit. Perhaps the most commonly assumed role for formal credit is to increase or speed up the adoption of new technology. However, the evidence is very mixed. Lipton (1976) concluded that formal credit seemed crucial for new techniques to "spread beyond the top few farmers" but that small farmers seldom had access to such credit due to land tenure and other institutional constraints. Bhalla (1979) also found that credit affected the rates of adoption in India. Carrillo-Huerta (1979) found agricultural credit to be particularly important in Mexico. David and Meyer (1981) reviewed a number of studies that found availability of formal credit positively related to income and technological change but questioned those conclusions because of methodological problems in the studies.

On the other hand, a number of other authors have argued that credit is not a major constraint to innovation. Schutjer and Van der Veen (1977) cited studies that found profitability to be the key to new technology adoption. If technology is profitable, farmers find ways of generating the additional cash needed to purchase the necessary inputs. Von Pischke (July 1978) also questioned the need to provide credit before adoption takes place. Howse (1974) and Penny (1968) found credit to poor farmers often was not necessary and could do more harm than good. As Penny states, "most farmers do not have to be bribed with cheap credit to adopt profitable innovations...". Two recent adoption studies reach similar conclusions about the importance of the institutional environment within which adoption must take place. They argue that the continual development of new technology must be combined with institutional reforms (land tenure and credit, for example) which make the technology more attractive to users (Feder, et al. 1982; Herdt, 1979).

Another perceived role of formal credit can be categorized as income transfers, either for the sector or for specific target groups. This transfer can take many forms. A sector transfer results when credit is used to try and make agriculture more profitable. A cheap food policy is commonly used by LIC governments which results in low returns to agriculture, even with improved technology. As a consequence, many see farmers needing credit if

progress is to occur. Von Pischke (July 1980) calls this "the farm credit need-creed". Credit is "needed" to help offset low product prices.

Income transfer through credit to a specific target group is usually associated with the rural poor. Here, credit takes on tones of a welfare program and often leads to serious institutional and farmer credit discipline problems. Credit is looked upon as a grant or gift from government. In this regard, considerable disagreement relates to the role of credit in financing consumption along with productive activities, especially for small farmers. Many credit agencies insist they only provide loans for productive purposes. This belief, however, completely overlooks the fungibility or interchangeability of units of money.[2] That is, money ostensibly lent for production may in fact be used for consumption without the credit agency's knowledge. As Lipton (1976) stated, this is because the household "decides how much credit is worth taking for all requirements whether conventionally classified as consumption, education, investment, or producer inputs...and how best to allocate available credit among those uses... Failure to realize this has led to endless time-wasting by credit agencies seeking to tie loans to particular production purposes". This would include the commonly held practice of extending credit in-kind rather than as cash to small farmers to supposedly prevent such diversion.

Another commonly expressed role for formal agricultural credit, especially in Asia, is to replace the informal, "exploitive" moneylenders. This attitude was evident in Wadhva's (1980) review of the All-India Rural Credit Survey Report and other studies concerning the moneylender problems in India. However, Adams and Graham (1981) state that a number of more recent studies include a more positive attitude about informal sources of credit in that they "are thought to provide valuable services, and impose lower costs on most borrowers than had been generally thought". No doubt the more critical and pessimistic view of moneylenders prevails in most of the LICs, especially at the policy making and formal credit institution level. Where the informal market provides from one-half to over three-fourths of all agricultural credit in many countries, it may be rather presumptuous to suggest or conclude that the formal market (especially the public sector) can or even should replace the informal market. Perhaps a more appropriate public sector role might be to offer competing sources to lower total interest and borrowing costs and to assure moneylenders don't exploit because of a monopolist position in a village or area. The Indian experience seems to support this policy position. Despite the tremendous growth of primary agricultural credit societies (cooperatives) in India, reportedly reaching 97 percent of all villages by 1976, it was estimated that the informal sources still accounted for two-thirds of all agricultural credit in the country (Wadhva, 1980).

The final, and perhaps most appropriate, view of formal agricultural credit is that it increases the farmers liquidity (Baker, 1981). In this sense, credit refers to borrowing capacity rather than money actually lent. As such, availability of this "borrowing capacity" can provide the farmer with more flexibility in utilizing

his own cash reserves. All farmers appear to hold some of their own cash for contingencies. If credit is made available, this effectively releases some cash from their own liquidity reserves for other uses. The amount released depends on the reliability of the credit. The more dependable the credit source, the more the farmer can use it to substitute for his cash holdings and still maintain the same level of liquidity. Viewing credit in this way may explain why many small farmers still work with informal lenders, even with the establishment of subsidized, formal credit in the area. If the formal source is considered unreliable and temporary compared with the informal source, then the formal credit accomplishes little in terms of increased liquidity or flexibility and the farmer may prefer to continue working with the informal lender if liquidity is important.

To conclude this section, it is clear there are widely differing views about the role of credit. The appropriateness of or justification for many of those views can and should be seriously challenged. It appears the general conclusion of the 1973 Spring Review is still valid. "Credit is necessary in the long term process of capital formation on small farms, but that an infusion of new public credit is not always needed and the conditions under which those funds can successfully affect small farmer productivity are more restrictive than commonly supposed" (AID, Vol XX).

Interest Rate Policy

Low, subsidized interest rates (often negative in real terms) have been widely used by LICs as a means of implementing the credit roles discussed in the previous section. If one or more of those commonly perceived roles is accepted, then it is an easy next step to propose or accept concessionary rates of interest since that further strengthens credits perceived role. For example, if credit is needed for adoption of new technology, then cheap credit should further speed up adoption. Or, if credit is needed to make agriculture more profitable, then cheap credit should make it even more profitable. Unfortunately, the underlying premises about the role of credit are highly suspect which makes the case for cheap credit also suspect. In addition, the negative effects of subsidized interest rate policies are clearly covered in the literature.[3] In summary, these are:

1. Revenue from interest on loans is not enough to cover administrative costs. This results in financial institutions moving towards larger loans at the expense of smaller borrowers.
2. Financial institutions are unable to compete for loanable funds in open markets since the permitted loan rate often is less than their cost of capital. This leaves them dependent on and, thus, vulnerable to government and political pressure.
3. Inter-temporal decisions by savers and investors are affected. Present consumption is preferred over future consumption (present investment).
4. Few voluntary savings are mobilized by the financial

system since a restriction on loan interest rates restricts the rate that can be paid on savings, which is often negative in real value terms.

5. Demand will exceed the supply of subsidized credit. Thus, non-market allocation of credit will take place, increasing the potential for corruption, payoffs, and political influence.
6. The total supply of loanable funds may actually decline. Money may flow out of the country, savings will likely be reduced, and the formal credit may just replace informal credit.
7. Subsidized credit will make capital appear cheap relative to labor and may lead to the adoption of more capital intensive techniques of production. Thus, employment will be less as compared with higher interest rates.
8. Interest subsidies are regressive in nature. Large farmers (more wealthy) receive large loans and large subsidies while small farmers (less wealthy) receive small loans and small subsidies. This further concentrates the distribution of incomes.
9. Those borrowers getting access to the cheap formal credit (larger farmers generally) may relend to those not getting access (small farmers and landless) but at higher rates. This leads to additional income concentration.
10. Since interest income doesn't cover administrative and other costs, financial institutions try to make loans more secure by increasing collateral and other requirements which tend to exclude the smaller farmers.

The net result of subsidized interest rates is greater inequity in income distribution, distorted resource allocation and investments, and a generally negative effect on economic growth, employment and stability. Unfortunately, the perceived benefits, as discussed in the section on the role of credit, are zero or much less than that assumed by those arguing for cheap credit policies. In summary, the new "conventional wisdom" is that interest rates should be allowed to rise to more truly reflect the opportunity cost of capital for society (at or near an equilibrium or market rate). However, Roe (1982) accepts the case against setting interest rates too low but warns that there are parallel dangers in setting them too high. Vogel (1981) reviewed the problems of actually implementing interest rate reform and concluded that there may be a couple of serious political barriers to reform: (1) there may be serious short-run disruptions and losses to existing borrowers that have invested in fixed capital with low returns (its value may be heavily discounted with higher interest rates), and (2) domestic financial reform cannot be separated from international economic policies (international effects may run counter to domestic effects of financial reform). Interest rate reforms are needed but may be difficult to carry out unless some transitional compensatory devices are implemented to help those injured by the reform.

Rural Savings

The neglect of savings mobilization in LICs, especially in the

rural areas, has been widespread. Rural finance projects have consistently stressed low interest rates while forgetting about the other side of the coin — savings (Vogel, 1983). There are many reasons for this neglect. Since many of the rural inhabitants are poor, it's assumed they can't save, or if they do, it will be spent on consumption. International donors and central governments have consistently channeled funds to domestic financial institutions making it less necessary for them to generate loan capital through domestic savings. Also, low rates of interest on loans automatically meant interest on savings deposits would be low, reducing the incentive to save. Few financial institutions are prepared to add savings to an already overworked and high cost lending system. Finally, many are concerned that any savings mobilized in the rural areas will be channeled to urban investments, just the reverse of what they think should take place.

It can be argued that the last two mentioned problems, adding savings to credit institutions and keeping funds from flowing out of the rural areas, can be resolved by forming more effective financial institutions at the local level. At least, some institutional forms like credit unions and agricultural cooperatives or farmer organizations would appear to have some advantages over the traditionally structured banks, either public or private, or postal savings institutions, and other urban based organizations.

The effect of heavily subsidized international lending on domestic financial markets and institutions is not clear but one could hypothesize that some of the same effects of subsidized domestic interest rates discussed in the previous section may be found at the international level. This problem, although important, cannot be adequately covered in this paper and will not be discussed further.

The savings question of primary interest to economists is whether a savings potential exists in rural areas, and, if so, can such savings be effectively mobilized or institutionalized to strengthen the financial system. Or, said another way, do rural people presently save or would they save under certain conditions? Can those savings be attracted to formal, financial institutions?

Savings can be viewed a couple of ways (Von Pischke, 1978). The traditional approach is to define savings as what's left after consumption. Economists use average propensity to save (APS) and marginal propensity to save (MPS) to estimate this form of saving. The APS measures the percent of total income which is saved over a period of time, usually annually. The MPS measures the percentage of an increase (or change) in income which is saved. The latter is of more interest but also is most difficult to estimate. A second way of viewing savings is the amount of cash (savings) held <u>before</u> consumption. Any income not disbursed the instant it is received can be regarded as savings until actual expenditure takes place. This is particularly important for agriculture since income flows tend to concentrate at harvest times but consumption/investment may be spread out over the year. Thus, there may be relatively large balances available during certain times of the year. If these balances were in financial form (in a financial system), they could increase the amount of funds available for lending to other farmers or regions with differing income and cash flows. It is not at all

clear whether or not the APS and MPS measure these temporary balances. If not, the savings potential could be even greater than that indicated by those propensity estimates.

A number of readings in Adams, et al. (1983) and Von Pischke, et al. (1981) discuss savings mobilization in LICs and generally conclude that considerable potential exists. Most measures of APS range from about 12 percent to 37 percent. The MPS estimates are somewhat higher -- 29-60 percent (for every $100 increase in income, from $29-$60 goes into savings). For very poor countries, like Ethiopia, the APS estimates were found to be significantly lower (.11-.14). Bhalla (1978) looked at the effect of non-agricultural versus agricultural sources of income and investment opportunities on savings in India. He concluded that the propensity to save out of non-agricultural income was higher than the propensity to save out of agricultural income, contrary to what one might expect, and that "poor households save more, and rich households save less, in response to an increase in investment opportunities" (reflecting differences in relative access to financial markets).

Many authors argue that subsidized interest rate policies result in reduced savings and that a more flexible interest rate structure would significantly increase financial savings. Limited experiments with raising interest rates in a few LICs have resulted in increases in savings. However, it is not clear how important the interest paid on savings is compared with other attributes of savings programs like: relationship (access) to credit and other services; confidence in institution; extent of local involvement and orientation; promotional efforts; accessibility; and convenience. Ahsan (1981) argues it is possible to mobilize savings in certain Islamic countries even with no interest and a service charge on savings deposits. Credit unions often have mobilized significant rural savings even with low or negative interest (in real terms) paid on deposits (Ladman, et al., 1977). However, there is empirical evidence showing that raising the interest paid on savings deposits, other factors remaining constant, does increase financial savings in rural areas (Adams, 1983; Von Pischke, 1981; and Poyo, 1981). Interestingly, the Poyo study also found that credit unions which promoted savings were better able to adjust to financial problems resulting from inflation.

Loan Delinquency

Relatively low loan repayment seems to an intractable problem faced by many formal LIC lending institutions, particularly in the public sector. Donald (1976) and the World Bank (1975) presented estimates of delinquency rates for credit institutions in many regions of the world. Few experienced less than 10 percent delinquency on loan values and many faced rates above 50 percent. Even assuming data and measurement errors, these figures are depressing. Of course, some delinquency is not incompatible with development if there are significant social and economic benefits resulting from the infusion of credit into the rural areas. Nevertheless, delinquency does negatively impact upon the financial viability of the credit institution itself and it does suggest problems in the

system. Without ways to replace those losses, decapitalization within the credit institutions can rapidly take place, especially if accompanied by low or negative real rates of interest on loans. Unfortunately, delinquency may also lead to further income inequities in the rural areas if those getting access to the formal credit are already relatively well off economically (Ladman and Tinnermeier, 1981). Care should be taken when comparing cross-sectional delinquency rates since no standard procedure is followed in calculating rates. The most common method compares value in arrears to total value outstanding but other methods give quite different results.

Some examples of financial institutions facing serious delinquency problems known to the author are the agricultural development banks of Bolivia and Honduras. The Bolivian bank was experiencing delinquency rates on loan values above 50 percent in the mid-1970s (Ladman, et al., 1977) and the Honduran bank went from 33.6 percent delinquency in 1970 to 50.2 percent in 1980 (Cuevas and Graham, 1981). Both banks are major agricultural lenders in their respective countries. Such high rates also are common in many other LICs.

The causes of delinquency are many and are difficult to measure. Sanderatne (1978) developed a useful conceptual framework to help understand the underlying reasons for arrears.[4] He identified six categories of reasons for delinquency:

- Defects in the agrarian structure
- Variability in incomes caused by fortuitous, seasonal, or unforseen factors
- Defects and inadequacies in disbursing credit
- Attitudinal conditions not conducive to repayment
- Misallocation of borrowed funds
- Other miscellaneous reasons

The first two reasons are largely outside the control of the farmer. Land tenure constraints, low prices, floods, poor infrastructure, and low productivity fall in these two categories and determine the environment within which the farmer, especially those with smaller farm size, must operate. Here, the farmer may be willing but unable to repay. The third category relates specifically to the rules and procedures of the credit institution. Poor loan supervision, inadequate loan terms and procedures, inaccessibility, poor records, and poor loan recovery procedures are examples of credit organizational defects. The fourth category relates to the unwillingness of the farmer to repay even if the ability exists. Viewing government loans as income transfer rights or grants is common in LIC rural areas. This view sometimes is supported by credit agents and organizations mistakenly assuming the income transfer or welfare role of credit. Contrary to what one might think, there is no conclusive evidence that repayment by small farmers is worse than large farmers. In fact, some studies show higher delinquency rates for large farmers. Unwillingness to pay because of political or other influences seems to be characteristic of those large defaulters.

The fifth reason relates to diversion of funds for purposes

other than that intended for the loan. The loan might have been used to repay a loan from an informal source, to pay for family consumption or education, or to finance a non-farm activity like a taxi. Such diversion may be quite rational economically for the farmer but, if it is a longer-term investment, there may not be enough cash flow to pay off the shorter-term loan, resulting in delinquency. The "other" category includes reasons that are not easily placed in the earlier categories — death, corruption and graft, robbery, etc.

A study of delinquency in Sri Lanka by Sanderatne showed the seasonal factors to be quite important. About one-third of the loans in arrears were said to be due to crop failures, although he felt that was an overestimate. Defects in the agrarian structure, primarily reflected by lower yields and incomes for the defaulters, and attitudinal problems (felt no obligation to repay) were the next most important factors. Defects in loan collection procedures by the credit agency and misallocation or diversion of funds also were identified as problems in the program.

An earlier study in Peru by Tinnermeier, et al. (1968) found a significant and positive association between delinquency and farm size, percent of cultivated area financed, amount of credit/ha., and certain crops. Two recent studies have applied discriminant analysis in order to suggest factors which credit institutions might use for borrower selection to reduce delinquency (Igben, 1978; Errunza, 1981). Igben found in Nigeria that amount of investment, labor intensity, and measures of operational efficiency were positively correlated with farm productivity (which was assumed to be related to loan repayment) while motivation for farming was negatively related. Errunza looked at differences between defaulters and non-defaulters in El Salvador. The factors which contributed most to the prediction of repayment performance were: extent to which farmer expanded through land leasing, type of program (cash credit was better than credit in-kind), type of crop (cash crops led to more delinquency), value of crops (the higher the value, the greater the delinquency) and loan supervision (the more visits the greater the delinquency). Farm size, past credit record, and educational level were not found to be important for predicting repayment.

As can be seen, a review of delinquency studies from selected countries does not lead to any supportable conclusion about the major reasons for delinquency since they seem to vary from country to country. This means reasons for delinquency may be country or even site specific. Research in each LIC is necessary to provide more insight on causes for delinquency. If the agrarian structure is found to be most restrictive, then these deficiencies will have to be reduced. A land redistribution or tenancy reform policy may be necessary. If prices are low, this may suggest price policy changes, price guarantees, improved markets, lower production costs from technological change and/or improved infrastructure. One thing is clear, credit policies by themselves will not solve the agrarian or other structural problems mentioned previously. Significant changes in the structure and procedures of the credit institutions may be necessary to resolve inefficiency, inadequate service, attitudinal and delinquency problems. In fact, new and

innovative institutional forms may be needed to work within the rural environments of most LICs.

Policy Recommendations -- A Summary

A review of literature on LIC rural financial markets and agricultural credit programs in the previous section shows that there are a number of problems in how the markets function, especially in terms of credit reaching rural people. The accomplishments of most such credit programs often fall far short of the expectations of the donors and host countries alike. There is sufficient evidence to show that the present LIC markets and policies result in misallocation of resources, further concentration of income and assets, high delinquency, few savings, a heavy reliance on government and external funds, considerable political involvement and patronage, and a poor environment for forming and nourishing viable financial institutions or intermediaries. A number of policy changes are needed to make the system operate more effectively in terms of overall financial and economic development goals.

Flexible Interest Rates

As stated elsewhere, "clearly, the most harmful policy which is widespread in rural financial markets is reflected in the low interest rates that are charged on formal loans, and the even lower interest rates that are paid on savings deposits" (Von Pischke, et al., 1981). These low rates greatly distort credit use at the farm, agency and national levels. These negative effects are being increasingly documented in the literature. Allowing more flexible interest rates at positive real rates of interest will provide a much more favorable environment within which the various financial institutions can operate. These higher rates also should lead to greater mobilization of savings in rural areas, an important step for reducing internal and external dependency. However, the implementation of this recommendation will require a major change in interest rate policy in most LICs. Many individuals and groups have considerable vested interests in maintaining the status quo. Thus, such a major policy change may not be politically feasible unless the international donors and financial agencies put considerably more pressure on governments and central banks to modify these policies. Furthermore, as stated earlier, mechanisms may be needed to compensate those most directly affected by the move to positive real rates of interest to gain their needed support.

It should be noted, however, that raising interest rates in and of itself may not guarantee efficient and effective RFMs. Interest rate reform is a necessary, but not a sufficient condition for improving RFMs. Policy changes outside the financial area may be needed since many other policies also affect the performance of the financial markets. Policies on investment, foreign exchange rates and trade, technology development, prices, and land tenure directly affect the profitability and dynamism of agriculture and thus the operation of RFMs. An unfriendly economic environment,

even with high interest rates, does not make it easy for financial institutions to function. An additional policy question relates to the institutional or organizational form which works best in the LICs.

Organizational Form

Experience to date has shown there is no particular institutional form which performs better than others. Credit unions and cooperatives work well in some places but not in others. Rural commercial banks sometimes are effective but not always. Informal group credit works in some areas but not in others. Nevertheless, the following tentative conclusions or principles are proposed:

- Regardless of the organizational form, savings and lending programs should be institutionalized within the same organization,
- Financial and other policies should allow and even encourage diversity in form with multiple sources of funds. Organizational structures most feasible for the time and place likely will emerge through trial and error,
- Well-trained management and credit personnel is a must, regardless of the structure,
- Specialization in terms of target groups or crops often makes the institution more vulnerable if changes occur external to the program and it is not, therefore, recommended,
- Mixing welfare, income transfers, and other social goals with credit usually causes attitudinal and operational problems,
- Simplified forms and procedures must be developed to serve small farmers in a cost-effective manner,
- Services must be available at the local level either through branch offices or a local network of some form,
- Marketing, savings, and credit activities can be successfully integrated within the same organization for commodities that have few market outlets (such as coffee and other export or specialized crops),
- Significant financial market integration must be in place before private credit institutions can effectively extend longer-term loans (public programs may have a legitimate role in this area until significant integration takes place),
- Farmer and borrower participation in decision making by financial institutions needs to be greatly strengthened, and
- The system must move towards an integrated system (ties with other financial markets) over time to truly accomplish the functions expected of financial intermediaries.

The above listing of conclusions does not lead one to recommend one institutional form over another because it would appear that all could hypothetically apply these principles. In practice, however, cooperatives or farmer groups have, in some LICs, been

able to accomplish more of these principles over a sustained period of time than have agricultural development banks or rural commercial banks. In particular, credit unions (savings and loan cooperatives) have been gradually gaining strength in the world. This may be because they tend to be local, grass roots organizations with considerable local participation in decision making. Loans are not limited to just one purpose — agriculture — and operating costs appear to be lower. Nevertheless, many credit unions have traveled, and still are traveling down very rocky roads, facing many obstacles to success. General purpose service cooperatives, with credit being one of many services offered, probably have seen more difficult times, perhaps because of the greater complexity of their operations and, thus, of the requirements on management.

In the final analysis, the wisest approach will likely be to encourage multiple institutional forms. Certainly, more experimentation is needed to find ways of organizing agricultural development banks and commerical banks to effectively extend credit to small producers and landless rural people. Present structures generally are not working. To be cost-effective in reaching small farmers, banks will have to either (1) develop their own type of local moneylender to work on a one-to-one basis, or (2) form local credit groups to help cover organizational and other costs of lending small amounts to large numbers.[5] Furthermore, as countries attempt to extend credit to non-farmers, such as landless laborers, small merchants and entrepreneurs in the rural areas, the specialized institutions oriented just towards agriculture may find it difficult to expand to meet these new needs.

Operating Procedures

It is difficult to separate operational questions from institutional questions because the two often are related. For example, agricultural development banks and commercial banks tend to require more elaborate forms, more borrower data, and more collateral than are needed for small loans due to the influence of lawyers and accountants within those institutions and procedures established for larger loans. It's assumed these activities lead to improved institutional performance and loan repayment even though there is little or no evidence to confirm this assumption, especially for small farmers.

Nevertheless, all credit institutions, regardless of form, must find ways to reduce lending costs if they are to effectively serve small producers in LICs. Total transaction costs (costs over and above the interest cost) per unit lent increase with smaller loan size, for both the lender and the borrower. There are essentially two ways for the credit institution to lower their costs: (1) transfer many of the costs to another entity, like a cooperative or informal group, which will absorb these costs or use volunteers to meet the same loan requirements, or (2) internally change the requirements and lending procedures to lower costs, the focus of this recommendation.

No empirical cost analysis studies are known by the author which would indicate how costs are incurred by activity within

financial institutions. In the absence of such data, it is difficult to know which activities contribute most to high lending costs. It would appear, however, that two activities, the gathering and recording of information, and maintaining loan accounts, are the most important.

Considerable information on credit activities is collected by most institutions. This process usually involves many people from the first contact by the field credit agent with the potential borrower until the loan is repaid. Data are collected and reported at all levels -- local, regional, national, and international (if a foreign donor is involved). The same information tends to be gathered on each farmer regardless if a person is getting a loan for the first time or it's the tenth time, or if the person has always repaid on time or seldom repaid on time.

The second activity that may contribute to high lending costs in many credit institutions is the accounting system. Accounts and procedures are the same for a $50 loan as for a $50,000 loan. As more and more small loans are made, this could significantly increase costs. Small farmers often have more than one loan which leads to further costs.

Recommended changes in policies and procedures to reduce the cost of these two activities include:

- Implementing studies to measure the cost and effectiveness of the various information activities on loan repayment (this stresses information collection about the operations and effectiveness of the institution itself),
- Establishing a simple, but functional accounting system for small loans,
- Eliminating multiple loans, withdrawals, and installments so there are fewer transactions on the accounts,
- Classifying borrowers according to credit risk so resources can be concentrated on those likely to face problems (little time spent on those who repay well and more on those who don't),
- Removing restrictions on credit use and types of crop/livestock financed (which recognizes the money fungibility problem that restrictions can't control),
- Developing a one-time-only form for gathering baseline data about first-time borrowers,
- Developing a combined loan application and contract form requesting very basic but minimal information for repeat borrowers,
- Simplifying application and evaluation procedures so loans are extended the same day of application, and
- Establishing follow-up procedures to encourage on-time loan repayment and to collect from delinquent borrowers.

Conclusions

The recent literature on rural financial markets has challenged many of the strongly held traditional views and policies found in LICs. The new focus is on finding ways of eliminating or at least reducing the many constraints faced by RFMs so they can function more efficiently and equitably.

A number of the RFM policy issues in the LICs were reviewed in the first part of this paper: the functions or role of RFM and credit in agricultural and economic development; interest rate policy; rural savings; and high delinquency. The second part suggested needed changes in: (1) the overall setting within which credit programs operate, (2) the institutional form or mechanisms for mobilizing savings and delivering credit to the end user, and (3) operational procedures to reduce high operating costs — that is, policy changes needed at the national, institutional, and local or agency level.

The main message is that just simply increasing the amount of cheap credit available in the rural areas is not enough. Indeed, if that is all that happens, such a policy may be self-defeating.

Financial intermediation is an extremely important process for development and if operating well, allows the transfer of claims on resources from those individuals and areas with a surplus (savings) to those individuals and areas in need (credit). This process can lead to improved equity, resource allocation, economic growth, and less reliance on external borrowing over time. Thus, governments must establish a set of policies which permit and encourage the establishment of an integrated financial system if development is to proceed at a satisfactory rate.

Nevertheless, changes in national financial policies, like allowing flexible interest rates, will not take place quickly. Furthermore, changes in the economic and political structures of many LICs are needed to allow financial markets to carry out their proper role. These structural reforms may be even more difficult to implement than financial reforms. As a consequence, complementary efforts are needed in continuing to study and identify preferred institutions and operating procedures which will get credit to the rural areas in a cost-effective manner, while also being consistent with the longer-run objective of establishing efficient rural and national financial markets. This author is confident that significant progress can be made in each area — national policies, institutions, and operations — and we need to get on with the work, even if inadequate progress takes place in any one area.

Notes

1. For a review and details of many of these programs see Agency for International Development (1973), Donald (1976), and World Bank (1975).

2. For a complete discussion of the fungibility of money problems at the farm, credit agency, and country level see Von Pischke and Adams (1980).

3. See Donald (1976), Von Pischke, et al. (1981), Adams, et al. (1982), and Ladman and Tinnermeier (1981).

4. In this paper the term delinquency and in arrears refers to all forms of non-repayment of loans. Default implies a longer term and more permanent form of non-repayment.

5. More successful informal credit group schemes are discussed in Schaefer-Kehnert (1981) and in Parks and Tinnermeier (1983);

one that was less successful is reviewed in Adams and Pablo (1983).

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9
Midcareer Training: A Development Investment—Is It Worth the Cost?

R. Michael Haviland

Midcareer Training for Development

Economic and social development is dependent upon trained manpower for planning, implementing, and maintaining programs and structures. The Humphrey Fellowship Program seeks to utilize efficiently the scarce resources available to prepare midcareer professionals from developing countries for the complex task of managing development-related programs.

The Origins of the Program

The Humphrey Fellowship Program resulted from initiatives by the U.S. government, and specifically the White House, made in 1978. President Carter, in meetings with several heads of state of developing countries, had discussed and responded positively to the suggestion that the U.S. increase its support for the training of persons from developing countries. Later that year, statements about increased support for such training were made in speeches by the President and Vice President. The task of translating the interests of the President into a functioning program was assigned to the United States Information Agency (USIA) which, in turn, sought the assistance of the Institute of International Education (IIE) to plan, develop, and implement the program.[1]

The first draft of a program plan for the Humphrey Fellowship Program was discussed at a special White House meeting held in November 1978 to which high-ranking U.S. government officials and the presidents of 40 major U.S. universities were invited. This unique meeting resulted in enthusiastic support for the program at the university level and made possible the implementation of a program which would depart from the traditional format of study programs for international students. Rather than fitting international students into an established graduate degree program curriculum, the Humphrey Fellowship Program would allow fellows to select from the university--and indeed from the entire country--those resources most appropriate for the work they do at home and incorporate those diverse elements into an individualized program.

The rationale for the new direction is based on the assumption

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that the needs for academic and technical knowledge of the Humphrey Fellows, be it in the fields of agriculture or urban planning, vary substantially from country to country and from region to region. Since the program would be extended to as many as 80 developing countries, existing graduate degree programs would not be able satisfactorily to supply all the resources needed by a group of Humphrey Fellows.[2] Also, the fellows themselves would not be recent university graduates, as is the case in most international education programs, but rather midcareer professionals, individuals with successful work records as well as sound academic backgrounds. Midcareer professionals would be chosen to maximize the impact of the program by making the fellowships available to those already in decision-making positions. Persons with leadership qualities and the potential for obtaining positions of significant responsibility in future years would be the program's clients.

The needs of midcareer professionals from developing countries for academic and professional training vary substantially from those of recent undergraduates. The program design places stress on both academic and practical "hands on" administrative experience. It is one year in length (most fellows are not able to spend more than one year away from their professional positions) and nondegree by design. In the Humphrey Fellowship Program, the university is viewed as a base of operations for the fellows from which contacts with counterparts throughout the U.S. would be made and internships or agency visits arranged. The constraints of most graduate degree programs, particularly those which can be completed in one year, preclude substantial participation in activities off campus and thereby limit severely their utility for midcareer professionals.

The development of the Humphrey Fellowship Program has been guided by a national Advisory Committee which was appointed after the White House meeting. The Advisory Committee discusses and decides upon the components of the program and its key administrative procedures. The Advisory Committee, working with the United States Information Agency and the Institute of International Education, finalized the initial program plan. It was then announced by the USIS posts in 90 developing countries, and recruitment for the first program year, 1979-80, was begun. A pilot group of 27 fellows from 24 countries were offered grants and undertook fellowships the first year. Since that time, 311 fellowships have been completed. In its fifth year, 1983-84, 125 fellowship grants were made by the Board of Foreign Scholarships, the presidentially-appointed oversight body for educational exchange programs administered by USIA; the program is expected to remain at this level or grow modestly in the years ahead.

The Program Design and Implementation

1. Recruitment and application

The United States Information Service and/or the Fulbright/Educational Foundation offices are responsible for publicizing the Humphrey Program abroad. While the recruitment activities vary from country to country, in most cases the host government offices

which coordinate study and training overseas are informed of the program and asked to submit applicants. In those countries which have a Fulbright Commission or Educational Foundation office, the Humphrey Program is generally advertised along with other study-abroad opportunities, such as the Fulbright Program. The program accepts candidates from the private and public sectors, and women, who currently receive 25% of the grants, are encouraged to apply. Persons interested in the Humphrey fellowships file an application with the USIA/Fulbright Commission in their own countries.

2. Selection

Humphrey fellowships are competitively awarded to applicants who have strong academic backgrounds which include an undergraduate or graduate degree, a minimum of five years of progressively responsible professional work experience, English language capability, and strong references from their professional colleagues and supervisors. The fellowship grants provide for living expenses, international travel, training-related costs (courses and books) a travel allowance for attending professional meetings and visiting organizations of interest, and health insurance. Humphrey Fellows attend two special workshops organized by the program itself, one in Washington, D.C., and the other in Minneapolis, Minnesota, to discuss development-related questions.

The fellowship applicants are screened abroad, and the best-qualified are submitted to the Institute of International Education which assembles selection committees to make a final review and recommendations to the Board of Foreign Scholarships. The Board, which oversees the USIA-sponsored exchange programs, makes the fellowship grants. Interested persons submit applications abroad from September through November/December of each year, and fellowship awards are announced in March or April. Fellows are notified of the awards in April of the year in which the fellowship will begin. Fellowships generally run from mid-August through June unless supplemental English language training is required, in which case the fellowship begins in June. All applicants are required to take the TOEFL test. Those with scores below 550 will generally require additional English training.

3. Fields of study

The fellowships are offered to persons whose work in either the private or public sectors is directly related to the economic and social development of their country. The specific fields of study offered are: agriculture, public health, nutrition, public administration, planning and resources management. The program is best suited to administrators and planners in these fields rather than technicians or research-oriented scientists. In all cases, the work of the applicant will have a public service orientation as well as a relationship to economic and social development.

Within these categories of professional work, the program allows for a broad range of diversity. For example, within the planning and resources management category, there will be Humphrey Fellows who study urban and regional planning, manpower development, mineral resources management, public management, or environmental control of pollution. Similarly, the other categories of

study are broadly interpreted, allowing the nomination of persons whose field of study is directly related to a country's development needs.

4. The qualifications of Humphrey Fellows

Applicants who have proven by their professional records that they are technically competent, have leadership ability and potential for holding positions of substantial responsibility, have strong academic records and English language competence, are sought for fellowship grants. It is the goal of the program to identify persons who will rise to important positions in the coming years and offer them grant opportunities.

The selection committees favor applicants who have shown that they have the ability to obtain positions of increasing responsibility and whose performance in each of their positions has been outstanding. In most cases, a minimum of five years of professional experience is required; the Humphrey Fellows currently average 36 years of age, and most have eight or more years of professional work. Applicants who have achieved excellent grades in fields related to their professional work, and who have continued to acquire professional qualifications through study and training beyond the undergraduate level, are favored. Several candidates each year have completed Ph.D.s and about half have master's degrees. Since the Humphrey program is a nondegree fellowship, those seeking degrees are strongly discouraged from applying.

5. The U.S. training

Humphrey Fellows are based at U.S. universities which have departments with programs directly related to the fellows' professional work in their home country. The program assigns a multinational group of approximately 10 Humphrey Fellows to each university. Each group is assigned a coordinator who serves as the first and principal contact of the fellow during the program year.

Each participating university was selected competitively by independent selection committees which reviewed proposals prepared by 110 leading universities throughout the United States. Those universities selected for participation in the program have demonstrated their ability to provide the training resources of interest to Humphrey Fellows.

The following institutions have participated in the program for one or more years since 1979:

The American University -- Washington, D.C.
The University of Arizona -- Tucson, Arizona
Auburn University -- Auburn, Georgia
Boston University -- Boston, Massachusetts
Brandeis University -- Waltham, Massachusetts
The University of California -- Berkeley, California
Colorado School of Mines -- Golden, Colorado
Colorado State University -- Fort Collins, Colorado
Columbia University -- New York City, New York
Cornell University -- Ithaca, New York

The Fletcher School of Law and Diplomacy,
Tufts University -- Medford, Massachusetts
George Washington University -- Washington, D.C.
Harvard University -- Cambridge, Massachusetts
Howard University -- Washington, D.C.
Hunter College/CUNY - New York City, New York
The University of Maryland -- College Park, Maryland
Massachusetts Institute of Technology -- Cambridge, Massachusetts
The Massachusetts Mental Health Center -- Boston, Massachusetts
The University of Massachusetts -- Amherst, Massachusetts
The University of Miami -- Coral Gables, Florida
The University of Michigan -- Ann Arbor, Michigan
The University of Minnesota -- Minneapolis, Minnesota
Pennsylvania State University -- College Park, Pennsylvania
Princeton University -- Princeton, New Jersey
The University of Southern California -- Los Angeles, California
Stanford University - Palo Alto, California
State of New York Maritime College -- Bronx, New York
Texas A&M University - College Station, Texas
Tulane University -- New Orleans, Louisiana
West Virginia University -- Morgantown, West Virginia
Williams College -- Williamstown, Massachusetts[3]

The Humphrey Fellows assigned to each university work under the direction of a coordinator attached to a specific university unit. For example, at the American University, fellows are affiliated with the International Development Program; at Cornell, the International Agriculture Program. University units with programs and faculty resources closely matched to fellows' interests are selected for participation in the program. The group of universities changes each year in accordance with the interests of the fellows.

6. The study/training program

The goal of the program is to provide the Humphrey Fellows with a series of training experiences which will enhance their ability to contribute to the development of their countries. As the fellows come from 75 different developing countries and their professional responsibilities vary considerably, it is necessary that individualized training programs be tailored to the specific interests and needs of each fellow. At the beginning of the program year, the coordinators and advisers at each university work closely with the fellows to design their programs. The university staff assists the fellows to identify the most suitable academic courses, workshops, research projects, professional organizations, development institutions, and projects available at the university and throughout the United States. The fellows are encouraged to become familiar with off-campus programs and organizations in the immediate area of their university early in the program year.

Later, national and international organizations which are located in Washington, New York, or other metropolitan areas distant from the university base are visited. A fellow whose university base in is Boston would be assisted in locating the most appropriate course work available in the area. If, for example, his field is finance related, he might meet officials from and study the administration of a commercial bank or the Federal Reserve Bank.

During the second half of the program year, more time is spent off campus, often in other cities. Fellows may have internships of two or more weeks with institutions such as the World Bank, a United Nations agency, or a U. S. or state government office. They meet and work alongside colleagues from multinational and U.S. organizations which have ongoing development activities in their respective countries. The contacts of Humphrey Fellows are often enhanced by their participation in the annual conference of professional organizations.

7. Program workshops

The Humphrey Program workshops, two week-long meetings, are an important component of the fellowship year. The first takes place in Washington during November and the second in Minneapolis at the end of the program year. The latter site was chosen because Hubert Humphrey made his home in Minnesota and, after his death in 1978, a public affairs institute was established at the University of Minnesota in his honor.

At both workshops, the entire group of fellows meets to discuss foreign and domestic policy issues and development problems. It is a time when the group coalesces into a mini United Nations to share perspectives and concerns. The workshop is an ideal setting for establishing collegial relationships with fellows from all over the world. It is a time when they exchange views with policy-level officials from the U.S. government and multinational organizations.

The topic of the November workshop in Washington is the foreign and domestic policy of the United States and the relationship of that policy to other nations. High-ranking government officials, senators and congressmen, and representatives of the press address the group. As a part of the orientation, the U.S. government visits are arranged to several departments, such as Agriculture, Health, State, and the Office of Management and Budget. Time is allocated for visits to the World Bank and other development-related organizations, and fellows most often visit their embassies. While there typically is insufficient time for Humphrey Fellows to visit all the agencies in which they are interested during the workshop week, they make arrangements to stay on or return to Washington later in the fellowship year.

8. The Minnesota workshop

At the completion of the fellowship year in June, the fellows meet again at the Hubert H. Humphrey Institute of Public Affairs of the University of Minnesota. The purpose of this workshop is to provide an opportunity for the fellows to share their development experiences, expertise and perspectives. In preparation for the workshop, the fellows meet in their university groups and prepare issue-oriented papers for presentation to their colleagues. The

papers focus on development-assistance problems considered from the perspective of the donor and recipient countries. The fellows engage in a dialogue with colleagues from seventy countries.

A very special aspect of the workshop is the hospitality offered the fellows by various groups in the Twin Cities. Multinational corporations, banks, international organizations, and individuals host receptions. Urban and rural tours led by agronomy and geography specialists are arranged.

At the completion of the workshop, the fellows receive certificates of commendation signed by the President of the United States and the Director of the United States Information Agency.

Early Program Results

In June 1983, the fourth group of Humphrey Fellows completed their fellowships, bringing the total number of alumni to 311. While it is too early in the life of the program to document its impact, it can be shown that two important concerns--the efficient use of limited program funds and the successful reentry of fellows into their professional positions at home--can be addressed.

1. The efficient use of available training funds

The Humphrey Program seeks to make efficient use of its limited funds by providing fellowships for individuals who have exhibited strong professional capability and leadership qualities. A high multiplier effect is expected in the years after a fellow returns home. Two program trends are noteworthy: the rise in the average age and corresponding experience levels of the fellows from 1979-1983, and the progressively higher standard of academic credentials held by successful candidates for fellowships.

a. Increased average age. During the first four years of the the program, the average age of the fellows rose from 29 to 36. The most direct result of that rise is that fellows now have significantly more years of professional work experience than the first group in 1979. In the first two program years, one-half of the candidates were 31 or younger and some had very limited work experience. Now it would be rare for a fellowship to be offered to a candidate with less than five years of work experience, and the majority have eight or more years of significant professional experience in positions of increasing responsibility.

b. Academic qualifications. As competition for the fellowship awards has grown through increased publicity efforts of USIA, the Fulbright Commission offices abroad, and program alumni, the academic qualifications of the awardees has also risen. While an undergraduate degree or its equivalent has been a requirement since the beginning of the program, now more than 50 percent of the fellows have completed a master's or doctoral degree, and those without graduate degrees have most often had professional training beyond the undergraduate level, often abroad. While these two factors do not, of themselves, assure that the recipients of the fellowships will be future leaders and policy makers, the selection process--which seeks persons with specific qualifications--is likely to identify persons of substantial potential.

The Humphrey Program has achieved its goal of attracting midcareer professionals and is offering awards to persons who have demonstrated their professional competence. In each year of the program, the number of highly qualified candidates has risen and, with it, the overall level of the fellowship class.[4]

2. The reentry of Humphrey Fellows

While some study programs in the U.S. for students from other countries provide funding for two or more years of residence, the time usually required to obtain a master's degree (doctoral study often requires four or more years of study), the Humphrey Fellowship Program provides one year of funding. Also, since the Humphrey fellowships are awarded to persons who have positions of substantial professional responsibility and who are, in general, "established" in their countries, there is very little tendency for them to contribute to the "brain-drain" problem. In addition to limiting the U.S. government support of any fellow to 12 months, visa regulations made extended stays difficult. Fellows enter the United States with J-1 visas which designate them as exchange visitors rather than students. The Institute of International Education, on behalf of USIA, serves as the fellows' sponsor and thereby controls the renewal of the visas. IIE will not provide for the extension of a fellow's visa beyond 12 months without the approval of the fellow's government or employer. In any case, the visa extension is limited to 12 additional months beyond the fellowship year, and the financial support required for the extension must be provided by the fellow or another sponsor.

In the early years of the program few fellows have expressed such an interest in becoming permanent U.S. residents. Of the first 311 fellows, only two (both of whom have married Americans) are expected to reside permanently in the U.S. Short extensions of three to six months are granted to approximately 15 percent of the fellows annually to allow them to undertake additional study or internships, and an additional 10 percent remain for a full year. The program experience has been that, within six months of the completion of the program year in June, 90 percent of the fellows will have returned to their home countries.

The typical Humphrey Fellow is age 36, married, has children, and has a secure position or professional practice at home. The fellows usually maintain a lifestyle common among professionals throughout the world. Such a person has little to gain from staying in the United States on a permanent basis; on the contrary, most have promising careers at home and, even if they decide to stay in the United States for an additional year, are not likely to seek permanent residence in the U.S.

The Humphrey Fellowship Program is best suited to an individual who has already acquired his professional credentials and degrees, and who chooses to use the year to enhance his knowledge and experience in a specific area--much like a university professor during a sabbatical. Economic conditions vary substantially in the countries which have participants in the program[5] as does the opportunity for an individual to obtain a graduate degree at home. In some countries, the acquisition of graduate degrees is essential for promotions. In such cases, it is natural for fellows who come

to the U.S. to seek degrees within the Humphrey Fellowship Program context. While it is not generally feasible to obtain a master's degree in one year and undertake an internship as well as meet other program goals, this can be achieved in 18 or 24 months. Recognizing both the interest of governments and employers in fellows' obtaining gradute degrees while in the United States and the need for such credentials imposed by local structures, the program does, under the previously stated conditions, allow fellows to remain in the U.S. for a maximum of 12 additional months. At present, approximately 25 percent of the fellows have been utilizing this program provision.

The most promising program results have come from that group of Humphrey Fellows who have both undertaken academic courses and utilized the year for research, extended internships in appropriate organizations, and the establishment of collegial relationships with professionals throughout the United States who are experts in their field of endeavor. Such persons establish contacts which will serve them and their countries for many years to come. They study and visit national and multinational organizations and professional associations in the U.S., and establish themselves internationally as professionals in their fields. They take full advantage of their time in the U.S. and will return home knowledgeable in regard to development theory, techniques of program implementation, and familiar with the national and multinational organizations promoting the economic and social development of their countries.[6]

Summary and Conclusion

1. The Humphrey Fellowship Program has sought to maximize the impact of its available resources by offering its grants to midcareer professionals with records of outstanding professional achievements and academic qualifications. The grant recipients are administrators and managers who have broad-based responsibility for development-related programs.
2. The fellowships are individually tailored to the interests and needs of each fellow and contain both academic and practical work-related experiences.
3. Through placement in groups at major U.S. universities, Humphrey Fellows have the opportunity to study development-related questions with both faculty and their counterparts from countries around the world. The program's stress on the establishment of contact with professionals in development-related organizations provides them with a support base following return to their countries.
4. Since the fellows are well established administrators and managers rather than scientists and technicians, and their stay in the U.S. is limited to a maximum of two years, few are lost to the "brain drain".
5. While it is too early in the life of the program to judge its success, the fellows have distinguished themselves by their work at major universities in the U.S., completed successful internships in national and multinational organizations, and

in many cases have been promoted upon return to their countries. The number of highly qualified applicants for the program has steadily grown and the fellows themselves have positively evaluated their training experiences in the United States.

Notes

1. The IIE, a private, not-for-profit corporation, has administered international study programs since its establishment in 1919 and since 1946 has administered the foreign and U.S. Fulbright Programs on behalf of USIA.

2. Humphrey Fellows are based at universities in groups of 5-15 fellows. Each university group shares a common field of study, e.g., urban planning, but fellows have diverse interests within that area.

3. In the above list are both institutions which have received a group of 5-15 Humphrey Fellows and those used for specialized placements.

4. A detailed analysis of the rising level of qualifications of the Humphrey Fellows has not yet been undertaken. Perhaps the best available indication of their competence level is that they have been welcomed and have performed with distinction at major universities throughout the United States. (See list of universities where fellows have been based.)

5. The per capita income of low- and middle-income countries as defined by the World Bank ranges from about $100 to $3,500. Such countries with which the U.S. maintains diplomatic relations are eligible for participation in the program. OPEC countries of the Middle East and East European Soviet-bloc countries are not eligible for participation.

6. In June 1982, the Humphrey Fellows formed an International Alumni Association through which communication among themselves is facilitated. Since long-term solutions to developing countries' problems are likely to come from the leadership in developing countries, the Association has the promise of supplying an essential link in the complex web of communications needed to resolve the critical problems which their countries face.

10
Problems of Rural Development: Some Contrast Between Asia and Africa

Uma Lele

This is intentionally a broad-brush paper. It draws on the comparative rural development experiences of Asia and Africa in their respective post-independence periods. It is important to review this experience at a time when the poor performance and the consequent problem of agricultural and rural development in Africa are seen as one of the greatest challenges facing the international development community. It is a period when, rightly or wrongly, the international community perceives problems of agricultural and rural development as being largely "licked" in Asia.[1] What explains this general shift of interest from Asia to Africa? How justified is the perception of Asia's relative success compared to Africa's generally alleged dismal failure? What lessons can be drawn from the rural developmental experiences of Asian and African countries? The paper will address these questions, albeit in very general terms.

Performance of food and agricultural production has been relatively better in Asia in the 1970s than in Africa. (Tables 1 and 2.) However, as will be illustrated, the factor endowments are drastically different in Asia. In the labor surplus economies of Asia, the increased food production has not necessarily been seen to improve the employment and income earning capacity for several of the lowest income deciles. In Indonesia, for instance, where a growth rate in rice production of about 3.6 percent per year in the 1970s is associated with a substantial decline in the percentage of the population below the poverty line, employment in the Indonesian rice economy is said to have increased by only one percent annually during the same period.[2] In India, at the aggregate level, the percentage of Indian population below the poverty line seems to be inversely related to the agricultural performance measured in terms of agricultural NDP (Net Domestic Product) per rural person, according to Ahluwalia.[3] Yet, at the disaggregate level, the picture seems to be mixed. While some states showed a trend decline in poverty, others showed a trend increase during the period of 1956/57 to 1973/74. In Punjab and Haryana, despite the visible success of the green revolution in increasing output, the incidence of poverty has increased during the same period, according to Ahluwalia.[4] Further, Mellor has observed that the proportion of

Table 1. Average Annual Growth Rate of Production, Agriculture, and Merchandise Trade, Selected Countries in Africa and Asia.

Country	GDP		Agriculture		Merchandise Trade			
					Exports		Imports	
	1960-70	1970-80	1960-70	1970-80	1960-70	1970-80	1960-70	1970-80
AFRICA								
Zaire	3.4	0.1	n.a.	1.2	-1.8	2.2	5.4	-12.0
Malawi	4.9	6.3	n.a.	4.1	11.6	5.7	7.6	3.5
Tanzania	6.0	4.9	n.a.	4.9	3.4	-7.3	6.0	-0.3
Sudan	1.3	4.4	n.a.	2.6	0.1	-5.7	1.2	3.5
Ghana	2.1	-0.1	n.a.	-1.2	0.2	-8.4	-1.5	-3.3
Kenya	6.0	6.5	n.a.	5.4	7.2	-1.0	6.6	-1.0
Senegal	2.5	2.5	2.9	3.7	1.2	1.2	2.3	4.1
Zimbabwe	4.3	1.6	n.a.	-0.5	n.a.	n.a.	n.a.	n.a.
Cameroon	3.7	5.6	n.a.	3.8	7.1	2.5	9.2	7.2
Nigeria	3.1	6.5	-0.4	0.8	6.6	2.6	1.6	20.0
Ivory Coast	8.0	6.7	4.2	3.4	8.8	4.6	9.7	8.1
ASIA								
Bangladesh	3.7	3.9	2.7	2.2	6.5	-1.9	7.0	3.5
Sri Lanka	4.6	4.1	3.0	2.8	4.7	-2.4	-0.2	1.1
Pakistan	6.7	4.7	4.9	2.3	8.2	1.2	5.3	4.3
Indonesia	3.9	7.6	2.7	3.8	4.0	8.7	2.0	11.9
Thailand	8.4	7.2	5.6	4.7	5.2	11.8	11.2	5.4
India	3.4	3.6	1.9	1.9	3.0	3.7	-0.9	2.8
Philippines	5.1	6.3	4.3	4.9	2.2	7.0	7.1	3.4

Source: World Bank World Development Report 1982.

Table 2. Agricultural Output and Food Output Growth Rates, 1960-80, by Regions Africa and Asia (percent).

	Agricultural Output				Food Output			
	Total		Per Capita		Total		Per Capita	
	1960-70	1970-80	1960-70	1970-80	1960-70	1970-80	1960-70	1970-80
Africa	2.7	1.3	0.2	-1.4	2.6	1.6	0.1	-1.1
Southeast Asia	2.9	3.8	0.3	1.4	2.8	3.8	0.3	1.4
South Asia	2.5	2.2	0.1	0.0	2.6	2.2	0.1	0.0

Note: Data applied to developing countries only.

Source: World Bank, World Development Report, 1982, p. 41.

the total increased income from the new high-yield varieties paid to labor is often small relative to other inputs, while much of this increased income is a residual return to the landowners.[5]

The concern of the 1970s about rural development in Asia has therefore shifted from the production problem to ascertaining the extent of the incidence of poverty and its causes. In particular, the question which has interested analysts working on Asia is how agricultural production and prices affect employment and income earning opportunities and thus the percentage of population below the poverty line. This interest has not only been the result of the widespread incidence of landlessness and rural employment, but also because of the small share of the rural poor in the marketed surplus of agricultural production; their related monetization of rural wages and wage rigidities.

The relationship of the size of food production to poverty alleviation in Asia is important because frequently the very process of increasing food production through technological change has been alleged to have led to increasing the incidence of rural poverty by eviction of tenants, growing share of owners in share-cropping, and increased mechanization or land consolidation to exploit the economies of scale in production.[6] Landlessness raises the importance of agricultural production in two ways. First, the size of production frequently is positively related not just to the size of marketed surplus but also to employment. Production in turn would have an inverse relationship to the prices of food crops.[7] Second, the lower prices of food crops combined with the higher purchasing power made possible by increased employment would have a stronger direct and indirect effect on reducing poverty than increased employment associated with increased production alone.

Because food expenditures constitute a high percentage of the total per capita monthly expenditures for all income classes in Asia — as high as 70 percent for the bottom two deciles in Asia -- a change in food prices has a substantial adverse effect on the income of the poor.[8] Therefore even if a production increase does not directly lead to increased employment, it can have a substantially positive and indirect effect on the incomes of the rural poor through its effects on marketed surpluses and prices.[9] Increased production can also generate nonagricultural employment by creating increased effective demand for goods and services produced in the small scale sectors. Such a line of enquiry is however not yet very relevant in rural Africa. In contrast to Asia, the rural development problem in Africa is still largely a production problem due both the poor performance of the agricultural production as well as to the largely peasant-oriented agricultural sector in Sub-Saharan Africa.

The paper first illustrates that the problems of rural development are acute in Africa although their nature is different than in Asia. It then focuses on some of the implications of the African record, unless actions are taken to correct the pattern soon.

Generalizations are not easy in Sub-Saharan Africa which contains a population of nearly 400 million in 40-odd countries.[10] Africa's wide spectrum of political ideologies ranges from the highly interventionist socialistic approach followed in Tanzania to

the relatively more free wheeling market-oriented policies of Kenya and Nigeria. Despite the vast differences, however, the performance of the agricultural sectors among countries has been similar, with slow or sluggish growth in the 1970s associated with a surprising degree of universality in their agricultural policies.[11] This commonality originates from an inadequate recognition of the steps needed to develop traditional agriculture combined with a desire for large public sector control and quick modernization and industrialization. Both these wishes have been implemented mainly at the cost of traditional agricultural sectors.[12] There has been little if any increase in agricultural production on a per capita basis, and with a few exceptions, incidence of rural poverty has in all likelihood increased. The causal relationships for this phenomenon are however less direct than those frequently envisaged by Asian scholars in relating the size of the agricultural production level with incidence of poverty, although the ultimate effect may be the same.

Unlike Asia, poverty per se has received relatively little attention in African analysis. This is because, unlike most parts of densely populated Asia, where there is surplus labor and land shortages, African agriculture is characterized by land surplus and labor shortages. As population has increased, it has generally been possible to bring marginal land under cultivation so as to provide subsistence production for the incremental population, albeit at declining levels of productivity. Therefore, on the whole, the African poverty problem has not been a result of acute landlessness and growing dependence on wage employment arising out of a "push factor". Wage employment has usually been the result of a dualistic economy and the "pull" of the modern sector. It has on the whole improved prosperity of rural households.

Despite the overall abundance of cultivable land, the rural poverty problem is growing in Africa. It is the result of a combination of rapidly rising population, poor and inequitably distributed agricultural resources, poor policies towards the agricultural sector which have deferred positive technological and managerial changes, and inadequate manpower and institutional capacity to develop agriculture, all leading to shrinking marketed surpluses. Over time the growing population pressure and the virtual absence of a positive technological change reinforce the problem of poor resource exploitation and their growing inequitable distribution. The poor agricultural performance in turn has had far reaching adverse effects on overall economic performance leading to growing incidence of poverty. What is important to stress in Africa is that forces of institutional change and modernization are leading to a growing incidence of poverty, frequently without the technological change in the agricultural sector to which a number of inequitous consequences have been normally attributed in Asia.

The Structure of Africa's Agricultural Production

The vast cultivable areas in Sub-Saharan Africa in relation to the size of the population have meant very low population densities. Even though Africa's agriculturally suitable soils amount to only about 40 percent of Asia's,[13] the per capita cultivable land in Africa is more than twice that of Asia and about one and one

half times that of India since Africa has only about 15 percent of Asia's population (Table 3). Thus, there are substantial labor shortages in agriculture especially in peak periods of cultivation despite the much lower overall labor use in agriculture on a per hectare basis in Africa.[14] Too often the labor constraint is an important factor limiting the amount of additional land which can be brought under cultivation, especially given the low and frequently regressing level of current technology.[15]

The vast areas of cultivable land also mean that the sizes of subsistence holdings are larger in Africa than in Asia. For instance, in Zambia, in relatively fertile areas, the typical size of a subsistence farm is up to 5 ha.[16] The average farm size for African smallholders in Zimbabwe is 23 ha, albeit of rather poor quality land, of which only about 4.5 ha is actually cultivated, partly due to the extreme shortage of oxen.[17] While large scale private estates are the predominant source of marketed production in Zimbabwe, and to a lesser extent in Malawi,[18] it is less important elsewhere in Sub-Saharan Africa. In several countries, mechanized state farms play an important role in providing urban consumption needs.[19] Despite these differences, however, on the whole, peasant agriculture is the most important source of marketed surplus in Africa.

The overall abundance of land, of course, masks the immense difference in population densities, and especially their relation to soils and rainfalls, which in turn influence agricultural production and the causes of rural poverty.

(i) The Areas of High Population Density:

Pockets of high population concentration exist in many African countries. In the Kisii district of Kenya, the population density is over 700 persons per sq. km.[20] It had reached 900 persons per sq. km. in the eastern part of Nigeria in the 1970s, compared with about 700 persons for Bangladesh.[21] High population concentrations are also present in Western Highlands of Cameroon, the Mossi Plateau of Upper Volta, and Northern Groundnut Bassin of Senegal.[22] The density reflects the high initial carrying capacity of the soils. The far more rapid rate of population growth in Africa (typically 3 to 4 percent per year in many countries in the late 1970s compared to 2 to 3 percent in Asia[23]) has led to a further pressure on the land in the already densely populated areas mentioned above. The conditions of these heavily populated regions may already be similar to those assumed by scholars in South Asia. Here dependence on rural employment both within and outside agriculture for monetary wages has increased.[24]

(ii) Dualism and Non-Agricultural Employment:

Migration and non-agricultural employment in Africa are frequently the result of a higher degree of dualism between the modern and the traditional sectors than that encountered in Asia, with far greater disparities in urban wages and the average productivity of labor in agriculture. Thus, while the extremely poor soils and low rainfall in Lesotho and Botswana explain partly the desire to migrate, migration from rural areas is also encouraged by the more highly paid employment possibilities in the mining and industrial

Table 3. Population, Land Area, Cultivable Lands and Density: Sub-Saharan Africa and South and Southeast Asia.

Region	Population 1981 (million)	Land Area (1,000 sq. km)	Cultivable Lands[a]	Ratio of Cultivable Lands to Land Area (percent)	Man/Land Ratio over Land Area (persons/sq. km)	Man/Land Ratio over Cultivable Land
West Africa	164.2	10,289.0	748.4	7%	16	219
East Africa	194.9	11,323.8	671.8	6	17	290
Sub-Saharan Africa[b]	359.1	21,612.8	1,420.2	7	17	251
South Asia[c]	945.3	4,792.4	2,131.9	44	197	443
of which India	698.0	2,973.2	1,691.3	57	235	413
Southeast Asia[d]	332.6	3,702.6	617.8	17	90	538
Asia[e]	2,466.3	18,390.6	3,926.4	22	134	628

Note: [a]Cultivable land includes arable land and permanent crops land.

[b]Includes all countries South of the Sahara, except South Africa and Namibia.

[c]Includes India, Bangladesh, Bhutan, Burma, Nepal, Pakistan, Sri Lanka.

[d]Includes Brunei, East Timor, Indonesia, Kampuchea, Laos, Malaysia, Philippines, Singapore, Thailand, and Vietnam.

[e]South Asia and East Asia and Pacific, according to World Bank's classificaton.

Source: FAO, FAO Production Yearbook, 1981.

sectors of the Republic of South Africa.[25]

Almost all such migration is composed of male members of the family. Outmigration of males has been marked and sustained, for instance in many provinces of Zambia and also among the rural households of Kenya, where female-headed households account for a large proportion.[26] In view of the importance of male migration to rural family income, the poor usually are not those with increased dependence on wage employment, but households without able-bodied men.[27] The poverty problem of the households headed by women is all the greater as the departure of the male population has perhaps further reinforced the neglect of investment in the agricultural sector by many African governments.[28] Also to the extent that remittances to some households drive up incomes and prices of commodities (food and clothing, etc...), and services (tractor hire services, etc...) sold in the rural areas, at least in the short run this outside income increases the incidence of poverty among those without such sources. In the long run, some of this effect may be offset by increased investment in goods and services in the rural areas, as has been noted in parts of rural Malawi.[29]

Such off-farm growth linkages have, however, generally been far more limited in Africa than in Asia due to the governments' attraction to modern technologies, their discouragement of private entrepreneurial activity and limited efforts in developing physical infrastructure and financial institutions needed to foster those growth linkages. On the other hand, the modern sector, to which agriculture has contributed through various means, has been able to create very little growth of productive employment. In South Africa and in Zambia, for instance, even existing absolute levels of employment in the mining sectors are threatened. In Lesotho, the source of growth of migrant labor may end in the near future as South Africa attempts to reduce its dependence on foreign migrant labor to make way for domestic black labor. In countries such as Tanzania, public sector employment has been growing at the rate of 10 to 20 percent per year in the 1970s, largely due to the rapid increase in the number of monopoly parastatals from just under 70 in 1967 to about 400 in 1981.[30] However, much of this employment has been unproductive, as both levels of agricultural and industrial production have declined. Both in the market and nonmarket economies, therefore, the inability of the modern sectors to create adequate productive employment and the consequent growing pressure on land have emphasized the need to increase agricultural productivity as dependence on wage employment within rural Africa is growing.

(iii) Resource Endowment:

The subsistence nature of African agriculture is however also frequently directly related to the poor soils and the low and unreliable rainfall, leading to extensive shifting cultivation or nomadism such as that noted in the Sahelian region. In many parts of Africa, the practice of shifting cultivation necessitated by poor soils and uncertain rainfall has meant that perhaps one is operating on lower production functions regarding the relationship of output to units of labor than is typically observed in high population density and fertile soil agriculture of Asia. Even the

practice of shifting cultivation has had to be modified with the growing population pressure. There is both lesser possibility of letting the land fallow, and poorer scope for following appropriate crop rotations, given the need to meet rural families' own growing food needs. Where population pressure has increased the need for intensification of land use, evidence of declining soil fertility and poorer crop yields is accumulating, meaning lower marginal productivity of labor than previously.[31] Whether market dependence is occasional or more permanent due to the declining marginal productivity of labor resulting from poorer land being brought into cultivation, the price of food has in all likelihood increased in terms of labor. In these situations, the marketed surplus of food per rural household would be expected to decline.

The increased food import dependence of many African countries supports this hypothesis, although of course some of the increased imports are also the result of urban population growth and the consequent changing patterns of income and consumption tastes. Whether declining agricultural marketed surpluses of rural households would necessarily have an adverse effect on the consumption of purchased commodities is a moot point however. In Africa, the decline in agricultural marketed surpluses has usually been associated with a decline in export earnings implying poorer ability of the countries to import nonagricultural goods, especially after paying for the essential imports of capital goods, oil and food. The domestic industrial performance has also been poor, leading to overall shortages of nonagricultural goods. This is especially the case in rural areas where the purchasing ability is poorer in relation to the modern sectors due to the high degree of dualism referred to earlier.

There are other problems resulting from government policies in Africa which explain the decline in agricultural production and the incidence of poverty.

(iv) Agricultural Marketing and Pricing Policies:

Foremost among these are the marketing and pricing policies followed in most African countries, and the associated declines in the real official producer prices of agricultural commodities experienced in the last decade.[32] The political need to keep urban consumer prices low, and the consequent desire to contain the food subsidy expenditures[33] implicit in raising producer prices explain some of this tendency for declining real producer prices. Low producer prices are however also the result of the high cost monopoly agricultural marketing systems operated through the public sectors in most African countries. Their rapidly expanding but inexperienced staff, bureaucratized and centralized management, and politically prompted decisions, combined with the frequent lack of financial accountability have resulted in growing domestic marketing costs of agricultural production. The policy of uniform official pricing which does not reflect transport costs followed in most African countries further distorts producer prices, as it frequently leads to unnecessary haulage of small produce from distant high transport cost regions. This leads to increased operating costs for parastatal agencies and leaving smaller share of the final revenue for the producers. While the uniform pricing

policy helps equalize return among regions, which is its main justification, it dampens the incentive to increase production in the regions of clear comparative advantage. The low prices are themselves frequently combined with the inability of the public sector's marketing agencies to ensure timely payment, or timely pick up the of produce, thus further dampening the incentive to sell to those agencies. The over-valued exchange rates, which in most cases do not adequately reflect the differing rates of domestic and international inflation experienced in the last decade, are an additional important reason for the frequently observed low producer prices.[34]

The result of low producer prices is extensive marketing of the produce in the unofficial market, in cases where such disposals are easy. Extensive trading also takes place across national boundaries through barter exchanges of consumer goods. This is a more serious problem for African countries than those in Asia because of the latter's vast borders. The incidence of rural poverty would be greater without access to such markets, given the constraints posed by the policy framework. But the high risk and uncertainty of illegal markets, the poor information, and the inability of these markets to handle large volumes clandestinely pose clear limits to the incentive signals from these markets. Together, the adverse effect of these various marketing and pricing policies is substantial on the efficiency of resources allocated to agriculture and even more important on the mobilization of additional resources to agriculture.[35]

(v) The Role of Technology:

With the exception of hybrid maize, there has been relatively little technological change in African agriculture. Little of what technological change has occurred has been productivity augmenting — rather sometimes being a source of increased inefficiency. There is considerable evidence that productivity of tractorized cooperatives or state farms is frequently far lower than the hoe and bullock technology.[36] Bio-technological change in a situation of poor marketing and pricing policies may aggravate rather than reduce rural poverty. The shift in food production from sorghum, millets, and cassava to the preferred maize noted since the introduction of hybrid maize in many parts of Africa has increased the risk of crops failures, thereby increasing the dependence of rural population on marketed food.[37] Collinson has documented as early as the 1960s the effects of introduction of cotton in Central Tanzania on increased market dependence for food.[38] At that time however, the return to labor and land in growing cotton was considerably higher than that for millets and cassava traditionally grown, with higher producer prices for cotton than those of substitute food crops. The food supplies in the informal market were also more reliable, with greater per capita food production in the country, a more reliable transport network, and the tolerance by the government of a private food marketing sytem which operated reasonably efficiently.[39] The increased market dependence thus did not imply increased poverty. Since the introduction of the monopoly public sector marketing in Tanzania in the mid-1970s however, both the market prices of goods traditionally purchased by farmers

and their physical availability have worsened, apart from difficulties in the marketing of cotton output.[40]

(vi) Land Policies:

As referred to earlier, Africa has abundant cultivable land compared to Asia. For instance, Tanzania currently cultivates only a quarter to a third of the land classified as cultivable — land with adequate to good soils and rainfall of 750mm or more. In Nigeria, available study shows that only about 40 percent of the total arable land available is presently being cultivated.[41] The percentage of land under cultivation in Ghana ranges from an estimate of 27 to 36 percent of total potentially arable land.[42]

The most pervasive land holding pattern in Africa is the customary or communal system whereby land is held collectively in clan or tribal units and allocated without rights of disposition to households. But this allocation system is becoming a problem where population pressure is increasing. This leads to a number of landless in Lesotho or land fragmentation in the Kigezi district of Uganda or among the Ibo of Nigeria.[43]

The customary land tenure system which prohibits land transaction has itself been changing in Africa. In Nigeria, there has been a growing land market, involving selling, renting, and pledging in areas of population pressure. All these activities are being done illegally.[44]

The trend toward land consolidation has been increasing as recorded in Ghana and Kenya.[45] This results in increasing inequity in land distribution.

Tanzania is one of the few countries in Africa where concern for likely disparities in access to land has resulted in government restricting individual access to land[46] with the nationalization of many European and Asian estates during the early post-independence period. This was followed by the policies of ujamaa and villagization with limits on the amount of land which could be cultivated by individuals. However, such equity-oriented land policies have not been accompanied by other effective agricultural policies; the production performance of both smallholder farmers and the large nationalized estates has been extremely disappointing in Tanzania.[47]

Achieving growth in peasant agricultural production while ensuring an equitable access to the vast amount of untapped agricultural resources still available in most countries will be crucial in the coming decade for most African countries to deal with the problem of growing poverty.

(vii) Implications of Manpower, Administrative and Policy Constraints for Augmenting Resource Endowment:

Africa suffers from a tremendous shortage of trained manpower and administrative capacity. Both are needed to open up new areas for production and to improve the quality of services required to facilitate successful intensification of land use in the existing settled areas. Because Africa started with a far lower base of education at independence compared to Asia, it will take some time to bridge this gap. Although primary education has expanded greatly, the manpower shortage is considerable because of the

inadequate training at middle and high levels. The imbalance has been partly reinforced by the policies followed by national governments and donors since independence. There is no adequate emphasis on developing the necessary manpower capacity.[48] The cost and time required to arrest the decline in peasant agricultural productivity would therefore be considerable in Africa.

There would however also need to be greater pragmatism in policymaking than now exists. For instance, many governments have exacerbated demand for formally trained manpower and administrative capacity by preempting many functions in the private sector on grounds of ideology. This has increased apparent bureaucratic control, but frequently greatly reduced the quality of governmental services and "officially traded" volumes, frequently leading to the decline in effective control over the economy. The limited formal administrative and trained manpower capacity could instead be used judiciously in areas where other private and cooperative resources or institutions are unlikely to be forthcoming.

The lack of understanding as to what is required to develop peasant agriculture is at the root of some of the government intervention. The concern that economic power will continue to be concentrated in the hands of alien European and Asian groups is the other. The tendency to this concentration is greatly aided by the ideological attraction of the public sector and the need to distribute patronage to the bureaucratic and military interests has increased the desire for public control. The problem of rural poverty alleviation is however even more serious in Africa because of weak political will in many governments. The vested interests have helped direct investment and policy away from the agricultural sector in favor of the growing salaried urban class. All too often there is no effective rural political lobby to turn policies around or to question the legitimacy of governments whose policies only support a fragment of the population.[49]

To summarize, landlessness per se while potentially very serious is far less an explanation of rural poverty in Africa. Rather, in contrast to Asia, the problem lies with the failure of the African governments to date to use the available resources effectively to bring about increases in production and productivity in the small-holder sector. This has in turn added to the serious macro-economic problems faced by the fragile African economies since the beginning of the 1970s, leading to declining standard of living for most low-income groups, including the rural population.

Conclusion

We have documented above that the growing incidence of rural poverty in Africa is a result of a combination of factors. These include the high population densities in some areas but on the whole, population pressure on land is relatively unimportant at this stage in Africa in comparison with other forces of modernization, poor policies, and institutional changes which seem to operate without the positive technological change in agriculture with which growing poverty has been attributed by many scholars in Asia. These include the dualistic nature of most African economies associated with highly distorted factor pricing and inefficient resource allocation largely away from agriculture; the poor quality of some

of the agricultural resources; policies toward pricing and marketing agricultural output which further encourage a move toward subsistence by reducing incentives to producers for the market; the lack of technological breakthrough which limit the supply of low risk, high return technologies; land policies which are rapidly leading to unequal access to this resource; and manpower, administrative and policy constraints which come in the way of exploiting the substantial latent agriculture potential. However, the effects of wage employment and prices on rural poverty are more complex. Poor agricultural performance has affected rural poverty indirectly through the implications for the overall macro-economic performance of these economies. As population pressure on land increases, however, many of the effects of landlessness which concern scholars in Asia, including those through wage employment and market dependence for food, are beginning to be evident in Sub-Saharan Africa. They reinforce the centrality of improved agricultural performance to the alleviation of poverty.

Notes

*The views expressed in this paper are those of the author and do not necessarily represent the views of the World Bank.

1. For example, the U.S. State Department Assistant Secretary for African Affairs, Chester A. Crocker, stated that "for a few countries, mostly in East Asia and Southeast Asia, the issue [of underdevelopment] is now subject for historical research". (Our Development Dialogue with Africa, address before a seminar on the African Economic Crisis at Georgetown University Center for Strategic and International Studies, March 3, 1983). He also said that "the Indians have virtually achieved food grain self-sufficiency and are increasingly capable of financing development needs by borrowing from private capital markets," while, "only a few years ago, speech writers in my own bureau of African Affairs habitually illustrated Africa's food problems by drawing gloomy parallel with India" (Development in Africa, Speech delivered before the National Business League, Dallas, Texas, September 17, 1982.)

2. World Bank data for Indonesia.

3. Montek S. Ahluwalia, "Rural Poverty in India: 1956/57 to 1973/74," in India: Occasional Papers, World Bank Staff Working Paper #279, pp. 1-42.

4. Ibid.

5. John W. Mellor, The New Economic Growth: A Strategy for India and the Developing World (Ithaca: Cornell University Press, 1976) pp. 79-90.

6. See for example Keith Griffin, The Political Economy of Agrarian Change: An Essay on the Green Revolution (Cambridge, Mass. Harvard University Press, 1974).

7. See Uma Lele and John Mellor, "Technological Change, Distributive Bias and Labor Transfer in a Two Section Economy," Oxford Economic Papers, November 1981, pp. 426-441.

8. John W. Mellor, "Food Price Policy and Income Distribution in Low-income Countries," Economic Development and Cultural Change, October 1975, p. 5.

9. See Lele and Mellor, op. cit. While not spelled out, these relationships are at the heart of the Lele - Mellor model of growth. See also T. N. Srinivasan, "Agricultural Production, Relative Prices, Entitlements and Poverty," (Forthcoming).

10. Sub-Saharan Africa according to the World Bank includes the following countries: Angola, Benin, Botswana, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Djibouti, Equatorial Guinea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Senegal, Saychelles, Sierra Leone, Somalia, Sudan, Swaziland, Tanzania, Togo, Uganda, Upper Volta, Zaire, Zambia, and Zimbabwe. In this paper, Africa refers to Sub-Saharan Africa unless noted otherwise. Asia refers to the World Bank's regional classification which includes the countries in South Asia, East Asia and Pacific, including China, Japan, and the two Koreas.

11. World Bank, Accelerated Development in Sub-Saharan Africa: An Agenda for Action (Washington, D.C.: IBRD, 1981) Chapters 4-5.

12. Uma Lele, "Rural Africa-Modernization, Equity and Long-Term Development," Science, February 1981, p. 548.

13. Cultivable land consists of Arable Land and Land under Permanent Crops as defined by the FAO, FAO Production Yearbook 1980, p. 3. Scientists in the Department of Tropical Soil Science at the Agricultural University of Wageningen in the Netherlands estimate that there are approximtely 550 million hectares of "uncultivated but potentially arable land" in Africa, well over two and a half times the available amount of uncultivated but potentially arable land in Asia. See Bruce Johnston, "Agricultural Production Potentials and Small Farmer Strategies in Sub-Saharan Africa," in Two Studies of Development in Sub-Saharan Africa, World Bank Staff Working Paper No. 300, October 1978, p. 75.

14. See John H. Cleave, African Farmers: Labor Use in the Development of Smallholder Agriculture (N.Y.: Praeger, 1974).

15. See Uma Lele, The Design of Rural Development: Lessons From Africa (Baltimore: John Hopkins University Press for the World Bank, 1979), Chapter II.

16. Robert Chambers and Hans Singer, "Poverty, Malnutrition, and Food Security in Zambia," November 1980, (unpublished) p. 6.

17. World Bank data.

18. In Zimbabwe, 76 percent of the value of agricultural output comes from commercial farms run by white farmers estimated to be about 4,500. They also account for the bulk of agricultural exports. World Bank data (see part 17). In Malawi, the estate sector provides about two-thirds of agricultural exports in 1978. World Bank, Malawi: The Development of the Agricultural Sector, May 8, 1981, p. 8. Large scale private estates are much less important in most West African countries.

19. In Tanzania, state farms now produce 95 percent of the officially marketed wheat and 50 percent of rice, whereas previously all marketed production came from either large commercial estates as in the case of wheat or from small and medium farmers as in the case of rice. World Bank sources.

20. Kenneth R. M. Anthony, Bruce F. Johnston, William O.

Jones and Victor C. Uchendu, Agricultural Change in Tropical Africa (Ithaca: Cornell University Press, 1979), p. 135. In some locations of Kisii, Kenya, density has reached 1,000 persons per square mile.

21. World Bank, Nigeria Basic Economic Report, August 17, 1981, p. 46. The figure for Bangladesh was calculated from FAO, FAO Production Yearbook, 1981.

22. Accelerated Development in Sub-Saharan Africa, op. cit., p. 13

23. During the late 1970s for Africa the rate reaches 3.9 percent for Kenya, 3.8 percent for Zambia, 3.6 percent for Zimbabwe. (World Bank data.) Asian population growth rate ranges from the low of 1.2 percent in Singapore and 1.7 percent in Sri Lanka to 3 percent for Bangladesh and Pakistan for the same period. Asian Development Bank, Key Indicators of Developing Member Countries of ADB, October 1980, p. 1.

24. See for example, "Kenyan Women and Smallholders Agricultural Productivity," World Bank Case Study, 1982.

25. For instance, in a 1977 survey, the average annual per capita income from cropping and livestock in Lesotho was estimated to be R. 150 compared to R. 1,050 a year per miner; in addition board, accommodation, and medical care were provided in the South African mines. See A.C.A. Van Der Wiel, Migratory Wage Labour: Its Role in the Economy of Lesotho (Lesotho: Mazenod Book Centre, 1977), p. 69 and p. 84.

26. Chambers and Singer, op. cit., p. 4; "Kenyan Women and Smallholders Agricultural Productivity," World Bank Case Study 1982, pp. 16-18.

27. Van der Wiel, op. cit., p. 33.

28. Uma Lele, "Rural Africa: Modernization, Equity, and Long Term Development," op. cit.

29. World Bank, Malawi: The Development of Agricultural Sector, May 8, 1981.

30. World Bank data. See also Accelerated Development in Sub-Saharan Africa, op. cit., pp. 40-44.

31. World Bank sources. For further discussion, see also Bruce Johnston, "Agricultural Production Potentials and Small Farm Strategies in Sub-Saharan Africa," in Two Studies of Development in Sub-Saharan Africa, World Bank Staff Working Paper No. 300 October 1978, pp. 65-127.

32. In Tanzania, the official producer price of tea has not changed since 1977/78; Cardamon price also stays at the same level since 1978/79. (World Bank Data.) In Malawi, official prices do not change often. Groundnut price paid by the marketing authority is such a case. From 1968-73, it stayed at 2.50 tambala per pound, raising to 3.00 for 1974-75, then 3.50 in 1976-77 and 4.00 in 1978-79. Malawi: Growth and Structural Change: A Basic Economic Report; Statistical Appendix, February 8, 1982, p. 26.

33. At official exchange rates, annual food subsidies amounted to about US $70 million in Tanzania, and $120 million in Zambia in the first years of 1980's.

34. Accelerated Development in Sub-Saharan Africa, op. cit., pp. 24-25, 55-58.

35. See Uma Lele, "Terms of Trade and Rural Poverty," (Forthcoming.)

36. Anthony, et. al., op. cit., pp. 141-143.

37. Johnston, op. cit., p. 85.

38. See M. P. Collinson, "Farm Management Survey No. 3, Luguru Ginnery Zone, Maswa District," (unpublished). 1963.

39. Andrew Coulson, Tanzania: A Political Economy (Oxford, Oxford University Press, 1981).

40. See Uma Lele, "Tanzania: Phoenix or Icarus?" Paper presented at the Conference on World Economic Growth Problems, 1983.

41. Nigeria Basic Economic Report, August 17, 1981.

42. Felix I. Nweke, "Food grain production Growth Rates in Ghana," IFPRI, 1977-78, p. 8: FAO "Country Review Paper of Ghana," No. 16, p. 13, 1978.

43. World Bank, Economic Memorandum on Lesotho, op. cit., p. 17; and Anthony, op. cit., pp. 134-135, pp. 214-215.

44. See C. W. Mitchie, "Notes on Land Tenure in the Northern District of Zaria Emirate," in Report on Land Tenure, Zaria Province, ed., C.W. Cole (Kaduna, Government Printer, 1952); David Norman, An Economic Study of Three Villages in Zaria Province: Land and Labour Relationships (Samru: Institute for Agricultural Research, 1974); Lawrence Ega, "The Changing Land-Tenure Pattern in Zaria Province, Nigeria: An Analysis of Its Implication for Agricultural Development," M.S. thesis, Cornell University, 1977); all cited in John M. Cohen, "Land Tenure and Rural Development in Africa," in Agricultural Development in Africa: Issues of Public Policy ed. Robert H. Bates and Michael F. Lofchie, (New York: Praeger, 1980) pp. 349-400.
Ega, op. cit., pp. 65-67. Ega reported that from a sample of farmers who were asked in 1975 how they acquired the field, 16 percent of the total number of fields had been gained by purchase. Ibid. p. 60.

45. Felix I. Nweke and Vishva Bindlish, "Government Agricultural Production Policy Tools and Emerging Land Tenure System in Ghana: The Implications for Equity," IFPRI, 1977-11, pp. 6-7. Aaron Segal, "The Politics of Land in East Africa," Africa Report 12 (April 1967), pp. 49-50, as cited in Cohen, op. cit. p. 365 and p. 391.

46. World Bank data.

47. World Bank data.

48. Lele, "Rural Africa: Modernization, Equity, and Long-Term Development," op. cit. See also Accelerated Development pp. 9-10, Chapter 6.

49. See Robert H. Bates, Markets and States in Tropical Africa (Berkeley: University of California Press, 1981) Chapter 6-7.

11
The Design of Rural Development: A Policy Perspective

Bruce F. Johnston

I. INTRODUCTION

In my younger years, if I ever thought about it at all, I would no doubt have assumed that a man of 63 would feel pretty old. Well, I don't. Nor am I only two years away from retirement as would have been the case under Stanford policies that were in effect until a couple of years ago. However, I am going to indulge in one of the weaknesses of advancing age by reminiscing for a minute or two.

Just 31 years ago I published an article in the Journal of Political Economy (Johnston, 1951) examining the role that increased agricultural productivity had played in the economic development of Japan between 1880 and 1920, the critical early period of agricultural development and industrial growth in that country. In 1951 economists were at the beginning of the explosion of research on problems of economic development that took place during the 1950s and 1960s. My analysis and interpretation of the role of agriculture in Japan's economic development had accordingly been influenced strongly by an interest in advancing our understanding of development problems in the contemporary less developed countries, most of which were still as predominantly agricultural in their economic structure in 1951 as Japan had been in 1880. A good deal of my work during the past three decades has been directed at expanding and reevaluating that original analysis and interpretation of Japan's experience.

In a joint paper with Professor Ohkawa (Ohkawa and Johnston, 1969, pp. 277-78), we noted that a consensus had emerged with respect to three significant characteristics of the Japanese "model" of agricultural development.

> First, agricultural output (was) increased within the unchanged organizational framework of the existing small-scale farming system. This was possible because of increases in the productivity of the existing on-farm resources of land and labor, and was associated with remarkably small demands on the critically scarce resources of capital and foreign exchange, at least during the long prewar period. Second, the bulk of the nation's

> farmers (were) involved in increases in agricultural productivity associated with the use of improved varieties, fertilizers, and other current inputs; and technological progress of this type (was) the driving force in increasing agricultural productivity.... Third, agricultural and industrial development went forward together in a process of 'concurrent' growth.

My 1951 article had stressed the significance of the first two of those three characteristics. The concept of "total factor productivity" had not yet been invented, but in this later article we presented empirical estimates demonstrating that a substantial increase in factor productivity was a major "source" of increases in agricultural output in the decades prior to 1920. Specifically, for the period 1885-1919 the index of output increased at an annual rate of about 2.0 percent whereas the index of conventional inputs of land, labor, and capital increased at only about 0.5 percent annually (Ohkawa and Johnston, 1969, p. 282).

It is an interesting story, for me at least, how I came to write that first article about agricltural productivity and economic development in Japan. I can almost say that my early introduction to problems of food and agriculture was "a baptism of fire". I arrived in Japan in October 1945, just two months after General MacArthur and Admiral Nimitz signed the documents accepting Japan's surrender at the end of World War II. Shortly after my arrival in Tokyo as a young army lieutenant and civil affairs officer, I received orders to report to the Chief of the Price Control and Rationing Division in MacArthur's headquarters as Supreme Commander for the Allied Powers (SCAP). The Division Chief was a young captain who had obviously selected me out of the batch of civl affairs officers that had just arrived because I was even younger than he was--and incidentally had a pretty good academic and military record summarized in the set of resumes that he shuffled in making a selection. To make a short story shorter, I fairly soon found myself in the job of Chief of the Food Branch of that Division, with nominal responsibility for food rationing, food price controls, and food import programs for Japan.

You probably know the old saying that there is nothing like having a hangman's noose around your neck to focus a man's attention. Well, being saddled with those responsibilities at that tender age led to an intense interest in the acute food problems that Japan faced during the first year of the allied occupation. One of my headier experiences was being ordered by General MacArthur's Chief of Staff to team up with the late Wolf Ladejinsky in drafting a cable that was to be a secret and "personal" communication from MacArthur to President Truman about Japan's critical need for grain imports to prevent a breakdown of the food rationing system. By that time I had become fairly adept at writing in MacArthur's purple prose. He made just one change in our draft by adding a final sentence: "Send me food or send me troops--but whichever it is, make haste"--or words to that effect.

The Army had a clever inducement mechanism for persuading civil affairs officers to continue their work in Japan as civilians. I was "induced" and continued my work as Chief of the SCAP

Food Branch until January 1949 when I began what turned out to be three and one-half years of graduate study at Stanford. I had attended a six-month civil affairs training school at Stanford studying the Japanese language and things Japanese before I was sent to Japan. The Director of the Food Research Institute, Merrill Bennett, had lectured to our class, drawing upon an excellent 1941 book by Bennett and Wickizer on The Rice Economy of Monsoon Asia. Fortuitously, I bought a copy at the Stanford Bookstore--and it became my "bible" as I found myself struggling to acquire some understanding of the Japanese food economy. I have often said that my decision to return to Stanford for graduate work was motivated by a desire to learn what I should have known to do what I had been doing during my three years in Japan. My original intention was to stay just enough to do an M.A. in the Stanford Economics Department and to finish a book, Japan's Food Management During World War II, which I had started working on during my last year in Japan in collaboration with two officials in Japan's Ministry of Agriculture and Forestry.

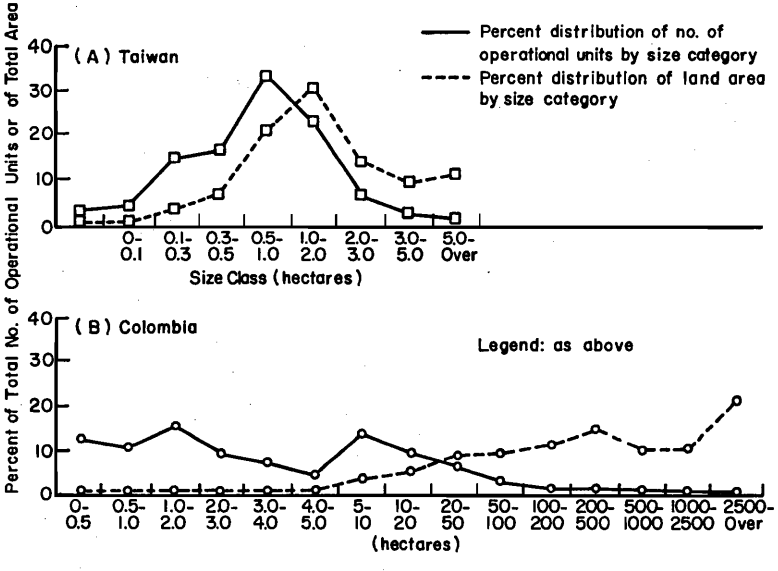
My attempts to understand the food and agricultural situation in Japan during and immediately after World War II naturally led to an interest in the historical development of Japanese agriculture. One of my first term papers at Stanford was a comparative analysis of long-term trends in rice and wheat yields in Japan and the U.S. About ten drafts later, that paper became the JPE article that I mentioned earlier--and eventually a chapter in my Ph.D. thesis on the role of agriculture in the economic development of Japan.

When I returned to Stanford in 1954, following an assignment with the Marshall Plan in Europe, it was to join a new FRI project to undertake research on the food and agricultural problems in tropical Africa. Although my research focused mainly on sub-Saharan Africa for the next 25 years, I periodically returned to my old interest in Japan and a growing interest in the pattern of agricultural development in Taiwan.

II. ALTERNATIVE PATTERNS OF AGRICULTURAL DEVELOPMENT

A considerable consensus has now emerged that a "unimodal" pattern of agricultural development as epitomized by Japan, Taiwan, and also South Korea has important economic as well as social advantages. Because of their demographic and structural characteristics, contemporary developing countries confront a choice between an agricultural strategy aimed at the "progressive modernization" of the great majority of the existing small farm units versus the "crash modernization" of a subsector of large, relatively capital-intensive, highly commercialized farm enterprises. Whereas the former strategy leads to a unimodal pattern of agricultural development the latter inevitably means a dual-size structure of bimodal pattern of agricultural development. The two alternatives are well illustrated by the size distributions for the number of farm operational units and the area cultivated in Taiwan and Colombia as summarized in Figure 1. In Taiwan, there is little difference between the size distribution of farm units and of land area by size category. Four-fifths of the Taiwanese farms are

Figure 1. Farm size distribution by number of operational units and by area cultivated, Taiwan and Colombia.



Source: Johnston and Kilby (1975), p. 15.

within one acre of the average size farm and even the top one percent are but 11.6 times the mean farm size of about three acres (1.2 hectares). But in Colombia, the two size distributions are drastically different. Only one-tenth of the farm units are within five acres of the average, and the top one percent of farms are 46 times the mean farm size of 56 acres. Especially for the lower income, late-developing countries, where the bulk of the population and labor force still depend on agriculture for employment and income, it is clearly the unimodal alternative that permits widespread participation of the farm population in increases in productivity and income.

A short paper on "Growth and Equity: Is There a Tradeoff" that Yujiro Hayami (1982) presented to the recent International Conference of Agricultural Economists is a remarkably concise, well-argued statement of the reasons why it is so important for the pattern of technological change in developing countries to be employment-oriented. More specifically, he stresses the need for an appropriate sequence of labor-using and land- and capital-saving technological innovations because they are efficient in furthering the growth and equity goals of development. If you have not already read that eight-page paper, let me urge me to do so.

For present purposes let me briefly illustrate the importance of an "appropriate" choice of technology by a comparison between Kenya and the United Kingdom. In Kenya the total labor force is growing at an annual rate of at least 3.3 percent compared with 0.4 percent in the U.K. Therefore, Kenya must find, per million population, eight times as many additional productive jobs each year as the U.K. However, Kenya has available for that purpose only one-fifteenth of the resources per million population. That means that if Kenya tried to provide the additional jobs in such a way that the new employment opportunities created would be of the same kind as in the U.K., less than one percent of the annual additions to the labor force would find jobs.

An inevitable consequence of the combination of the rapid rate of growth of a country's total labor force, together with an economic structure in which the agricultural sector still accounts for 60, 70, or even 80 percent of the total labor force, is that the agricultural sector must absorb a large fraction of the annual additions to the work force. That, in brief, is why it is so important to foster a pattern of technological change in agriculture that emphasizes labor-using, capital-saving innovations. At the same time, it is critically important to be concerned with the rate as well as the pattern of technological progress. Especially in situations where the scope for expanding a country's cultivated area has been exhausted, a technologically stagnant agriculture means that the marginal productivity of labor will decline because of the diminishing returns associated with the application of increasing amounts of labor to a fixed land area. Under those conditions, labor productivity and returns to labor will not only fail to increase, there will be a deterioration in the already low levels of income that currently prevail.

It is often useful to classify agricultural technologies into biological (or biological and chemical) technologies and mechanical technologies. The former tend to be divisible and yield-increasing,

improved seed-fertilizer combinations being an especially important example. In contrast, the mechanical technologies involve lumpy investments in farm machinery which has a labor-saving effect and is biased toward large farm units because of economies of scale in the use of a tractor or, as a more extreme example, a combine harvester.

Because of this general difference, it is interesting to partition the increase in agricultural labor productivity into two components--acreage cultivated per worker and yield or output per acre. At one point in time this is merely an identity. What is useful is to break down increases over time in labor productivity (Y/L) into these two components. This is because the annual rate of increase in (Y/L) will, to a close approximation, be equal to the sum of the rates of increase in acreage cultivated per worker (A/L) plus the rate of increase in output or yield per acre (Y/A). Table 1 summarizes such estimates for various time periods in three countries.

Note particularly that in Japan and Taiwan the increase in Y/A has accounted for most of the increase in Y/L. The 1952-67 period for Japan is an exception that I will return to in a moment. But note also that in the 1952-66 period in Taiwan a 3.3 percent rate of increase in Y/L was achieved in spite of a decline in A/L (minus 0.8 percent) because the rate of increase in Y/A was so high during that period. In the U.S. the situation was the opposite. It was only in the 1920-40 and 1940-60 periods that increases in Y/A became at all significant.

Finally, it is worth noting that the really high rates of increase in Y/L for Japan and the U.S. in the last time periods shown were related to rapid decline in the size of their farm labor force. The U.S. reached a "structural transformation turning point", i.e., when there was the beginning of a significant decline in the absolute size of the farm work force, in about 1916, although the rate of decline accelerated greatly following the Depression of the 1930s. In Japan the farm labor force reached a peak during the period of economic dislocation following World War II, but then began to decline sharply in the mid-1950s.

The principal factors that can influence changes in farm productivity and output can be considered in terms of this same partitioning between innovations that affect A/L and those that influence Y/A. Figure 2 presents a schematic summary of the farm-level factors and socially determined factors that have a significant influence on changes in farm labor productivity. The diagram also directs attention to the importance of certain general factors in addition to the more specific policies, investments, innovations, and programs that mainly influence either A/L or Y/A. At the farm level this includes the important influence on cost minimization of technical and managerial efficiency. Similarly, the rate of structural transformation as reflected in the decline in agriculture's share in a country's total labor force is an extremely important socially determined factor which influences the <u>potential</u> for increasing output per worker. It does this first of all through its effect on the growth of commercial demand, especially <u>domestic</u> commercial demand that influences the rate of increase in farm cash income accruing to the agricultural sector.

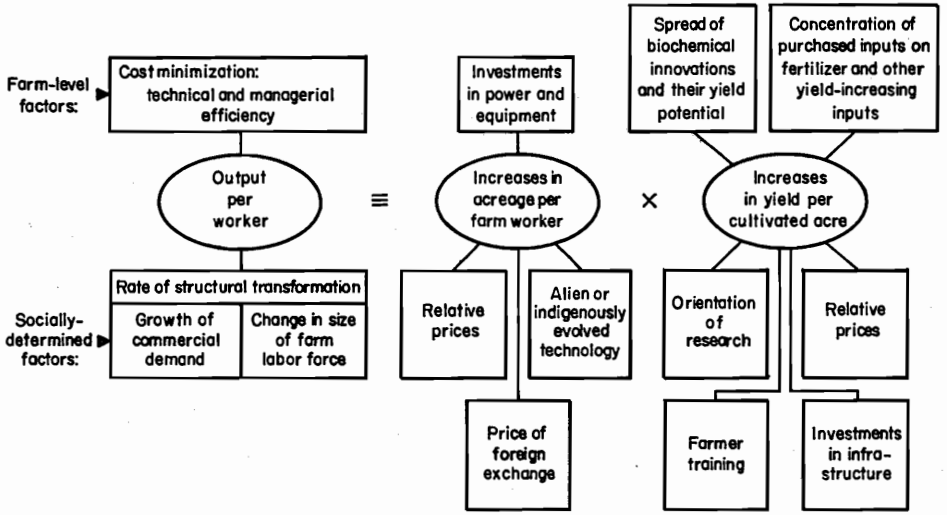
Table 1. Rates of change in output per worker, acreage per worker, and yield per acre in Japan, Taiwan, and the U.S., selected periods between 1876-1968

(Percent)

Period	Y/L	A/L	Y/A
Japan			
1876-1920	1.82	0.72	1.10
1920-40	0.71	0.19	0.52
1952-67	5.80	2.90	2.90
Taiwan			
1901-50	1.2	0.4	0.8
1952-66	3.3	-0.8	4.1
United States			
1880-1900	1.1	1.2	-0.1
1900-20	.6	.5	.1
1920-40	2.2	1.5	.7
1940-60	5.8	4.2	1.6

Source: Johnston and Kilby (1975, p. 143).

Figure 2. Schematic summary of the principal factors influencing changes in farm productivity.



Source: Johnston and Kilby (1975), p. 391.

The special significance of agricultural exports in countries that are still predominantly agricultural is not confined to their role in earning foreign exchange. It also derives from the fact that expansion of agricultural exports may provide an opportunity to rapidly increase farm cash incomes that is independent of the rate of structural transformation. The rate and direction of change in the size of the farm labor force is another powerful influence on the "scope" for increasing Y/L. As noted a moment ago, the really rapid rates of increase in Y/L in Japan and in the U.S. occurred when the farm labor force, the denominator Y/L, began to decline at a substantial rate.

A broad-based, employment-oriented strategy leading to unimodal agricultural development also leads to widespread increases in farm cash income which fosters relatively rapid growth of employment opportunities in manufacturing and other nonfarm sectors. In addition, an agricultural strategy that minimizes the capital requirements for expanding farm output by relying mainly on expanded use of divisible off-farm inputs that complement the farm-supplied resources of labor and land permits a more rapid rate of capital formation in the nonfarm sectors of the economy (Johnston and Kilby, 1975, chapters 4 and 8). Facilitating large increases in total factor productivity, as was done in Japan and Taiwan, also makes it possible to expand agricultural production rapidly with only moderate demands on the particularly scarce resources of loanable funds and foreign exchange. This means that a significant net outflow of resources from agriculture can meet a part of the investment requirements for industrial expansion and for infrastructure without stifling the growth of farm output.

Given these advantages of achieving a unimodal pattern of agricultural output, why have so few of the contemporary developing countries pursued broad-based, employment-oriented agricultural strategies? In other words, how do we account for the fact that most developing countries appear to be adopting economic policies and pursuing agricultural strategies that lead to a dual-size structure, i.e., a bimodal pattern of agricultural development in which increases in productivity and output are concentrated in a subsector of atypically large and capital-intensive farm units?

In a paper that I presented at the Seventh Rehovot Conference in Israel, I advanced a half dozen reasons which seemed to be important in accounting for the failure to design and implement agricultural strategies leading to a unimodal pattern of agricultural development (Johnston, 1975, pp. 188-89).

- Perhaps most basic is the neglect until recently of the measures required to generate an appropriate research base for a strategy aimed at promoting widespread agricultural progress. Even now, the Green Revolution is merely a beginning. In addition to the requirements for adaptive research...there is need to develop varieties of rice and wheat that will perform well under a wide variety of local conditions and without controlled water supplies.

- In many countries there has been inadequate investment in infrastructure, especially facilities for water control and roads. As a result, the areas able to benefit from the new varieties now availabe are much too limited.

- There is a great deal of skepticism concerning the feasibility of significantly increasing the productivity of millions of small and medium farms. This feeling is reinforced by a gross exaggeration of the significance of economies of scale in agriculture and a tendency to pursue modernity as an independent goal.

- Particular groups that wield a great deal of political power recognize that they have much to gain from policies that concentrate resources with a favoured subsector of large farms.

- Various external influences strengthen the position of local groups that have a vested interest in agricultural development based on a dual-size structure. Specifically, the transfer of inappropriate technologies is often encouraged by foreign aid programs. Aid programs have a tendency to emphasize large, identifiable projects; finance foreign exchange but not local costs; tie aid to equipment purchased in the aid-giving country; and use technical experts whose judgment is influenced by an implicit model of efficient agriculture represented by the American Midwest, southern England, or northern France. Those tendencies are reinforced by large international corporations that desire to promote sales in less developed countries. (This desire is perhaps especially strong for manufacturers of tractors who have excess capacity now that demand in Europe and North America is largely confined to replacement demand.)

- Finally, much too little attention has been given to the formidable administrative and organizational problems involved in the successful implementation of a strategy of progressive modernization. For example, there appears to be a need for more imaginative techniques of training, capable of reaching large numbers of illiterate farmers at a cost that does not overstrain government budget resources. In many areas there appears to be a particular need to develop effective ways to achieve more efficient management of water supplies at the farm level and better coordination between the managers of public irrigation systems and individual users. This points to the need to establish or strengthen organizations that bring farmers together. But many attempts to promote cooperatives proved disappointing and suggest a need to

develop additional techniques of organizing activities that require cooperative action.

During the past decade some progress has been made in overcoming these obstacles. In particular, the foreign aid programs of both multilateral and bilateral agencies have moved away from their support of projects promoting large-scale, relatively capital-intensive farm units. There is still much to be done, however, in translating official rhetoric stressing the importance of small farms into programs that are effective in fostering a unimodal pattern of agricultural development. More important, relatively few developing countries have adopted feasible and effective policies and programs to promote broad-based, employment-oriented agricultural strategies.

III. POLICY ANALYSIS AND RURAL DEVELOPMENT

It was in part because of my growing frustration over the lack of progress toward alleviating rural poverty that I was so receptive to the policy analysis perspective that Bill Clark presented at a seminar at IIASA, the International Institute for Applied Systems Analysis in Austria, in 1979. In this seminar Clark summarized the principal lessons derived from a highly successful collaborative research project carried out by IIASA and a research team at the University of British Columbia which was directed at evolving a policy analysis approach for dealing with complex problems of resource and environmental management. Those problems, like the complex problems of rural development, are "ill-structured" problems. Hence, it is not too surprising that the lessons derived from the IIASA/UBC project, in which Clark had been participating for six or seven years, were of considerable relevance to the problems of rural development that I had been studying for so many years.

Again to make a short story even shorter, I was lucky enough to be able to persuade Bill Clark to collaborate with me in writing Redesigning Rural Development. Our objective was to apply a strategic and policy analysis perspective to the complex, ill-structured problems of rural development. We aimed at a strategic perspective because we believed that there was a need to emphasize the interactions among, and long-term consequences of, individual program interventions and policy choices. To cite a particularly important example, emphasis on short-term, tactical considerations is likely to lead to a bimodal pattern of agricultural development, thereby foreclosing the option of achieving a unimodal pattern of agricultural development. This is because to a considerable extent bimodal and unimodal patterns of agricultural development represent mutually exclusive alternatives (Johnston and Clark, 1982, pp. 79-82).

But what do I mean by policy analysis? As Clark and I have used the term, and as it is used at IIASA, policy analysis is really synonymous with systems analysis. However, both terms have been used in many different ways. An able practitioner of the art and craft of policy analysis, W. Granger Morgan, used the label

"Good Policy Analysis" in describing the approach in a guest editorial in Science. He states that the object of good policy analysis "is to evaluate, order, and structure incomplete knowledge so as to allow decisions to be made with as complete an understanding as possible of the current state of knowledge, its limitations, and its implications" (Morgan, 1978, p. 971).

Inasmuch as rural development is such a complex, ill-structured problem it is necessary to take account of a host of variables and changing interrelationships among those variables. Hence, complete knowledge and understanding is impossible. Moreover, judgments and decisions about policies and programs will inevitably be influenced by opinions, preferences, values, and vested interests. Thus is it important, as Morgan emphasizes, for good policy analysis to order and structure that incomplete knowledge "in ways that are open and explicit"; and it can and should avoid drawing "hard conclusions unless they are warranted by unambiguous data or well-founded theoretical insight".

Before I briefly summarize the perspective from policy analysis that Clark and I present in our book, let me emphasize why I believe that it is important for us as agricultural economists, development economists, agricultural scientists, or whatever to learn to be skillful policy analysts if we have a serious concern that our work will have a constructive impact on government policies and programs. In our frustration over the fact that governments, international agencies, and bilateral aid programs so often fail to act upon our knowledge, wisdom, and profound insights, the temptation is strong to put the blame on somebody else. Raj Krishna, currently a colleague of mine at the Food Research Institute, encountered such frustration as a member of the Indian Planning Commission that he sometimes declares that "policymakers are knowledge proof". Other policy analysts assign the blame to the venality of vested interests or a lack of "political will" among a country's leaders. From such a "politics first" perspective, which attributes a lack of progress to the dominance of an existing power structure opposed to changes that benefit the rural poor, a revolutionary change in the power structure is likely to be viewed as a "prerequisite" for the design and implementation of development strategies that will be effective in eliminating poverty. (See, for example, Griffin, 1979; de Janvry, 1981.)

It would be simpleminded to ignore the importance of political factors. If we recall Lasswell's classic definition of politics, "who gets what, when, and how," it is apparent that in the final analysis development is a political problem. And in one sense it is certainly true that failures of development programs are "essentially" political failures. But we believe that bewailing the unequal distribution of power is not more conducive to resolving the "essentially political" problems of development than bewailing the unequal distribution of rainfall is to resolving "essentally agricultural" problems.

Some development situations are doubtless so thoroughly dominated by power-holding interests totally opposed to economic and social progress that analysis simply has no role to play. But the proper role of policy analysis is precisely "speaking truth to power" (Wildavsky, 1979)--and speaking it clearly and persuasively

enough that the resulting development efforts actually do improve the lot of the poor. If only because politicians invariably have many concerns and only limited resources, the policy environment will never be "optimal" as viewed from our perspective as policy analysts concerned with advancing the interests of the rural poor. As Hirschman (1971, pp. 19-20) has argued, the practical requirement is to "think in terms of sequences in the course of which a forward step in one direction will induce others..." Leys (1971, p. 133) brings in the political dimension explicitly when he stresses the need to assess as realistically as possible "what changes--social and political, as well as economic--are within the politicians' 'means', and what are not; and what patterns or sequences of change, among those that are practical, will carry the process of economic development farthest and fastest at the least cost in the politician's resources". Thus we must learn to understand the constraints that define feasible programs; and those constraints are related to the world of power as much as to those imposed by nature and by the scarcity of economic, budget, and manpower resources. Development is the result of numerous short-term actions at the tactical level. But if those actions are to have a cumulative impact, they must be related to a long-term, strategic perspective.

As a perspective from which to approach the problems of rural development, policy analysis must focus on people and their interactions with each other and with their environment. These interactions are mediated through various organizations and their policies and programs. To fulfill their functions, organizations rely on a variety of social techniques of calculation and control: markets and exchange systems, the hierarchical techniques of bureaucratic organizations, the voting and bargaining of politics, and the face-to-face negotiation and bargaining that characterizes local organizations. Policies and policymaking processes in the broadest sense can be viewed as social action programs through which people seek to devise and implement solutions to their problems. In fact, we argue that an important task of policy analysis as applied to ill-structured problems such as rural development is to convert a "mess" of overlapping problems into problems defined in such a way that something constructive can be done about them. Policymaking processes in this broad perspective embrace tactics of planning, of government interventions, of institutional reform, and in some instances of revolution.[2]

An essential starting point for analysis of complex, ill-structured problems of rural development is an understanding of the nature of a country's rural development problems. There is, of course, great diversity among developing countries in their physical environment, economic resources, historical circumstances, political regime, and many other dimensions. Nevertheless, the subset of low-income developing countries, on which Clark and I focus, have in common a number of characteristics that tell us a great deal about what changes are most desirable. These countries also face some similar constraints that are important in determining the kinds of change that are likely to be feasible.

Feasibility and desirability. A tendency to equate the feasible with the desirable is one of the most common pitfalls of the

debate over development. One version of this pitfall is to assume that because a certain goal is desirable, it must be feasible as well. But especially in the lower income developing countries, resources are scarce, needs are enormous, and there is never enough money, time, or trained manpower for all of the important tasks that demand attention. The pursuit of the desirable may often be infeasible, wasting the scarce resources it consumes.

The converse pitfall assumes that because a certain goal is feasible, it must be desirable as well. But the use of resources for any task in the developing world is likely to entail substantial opportunity costs. Thus a hard-nosed penchant for doing what works almost always means not doing something else. Opting for programs simply because they appear to be feasible is likely to preclude the search for other options that could have greater impact in reducing rural poverty.

A conventional view of planning emphasizes procedures in which objectives are first established and then the means required to attain those objectives are determined. The attractive logic of this approach is misleading. Instead, good policy analysis emphasizes the need for mutual adjustment of ends and means: the definition of objectives must be shaped by the availability of resources--and vice versa to the extent that available resources can be enlarged or deployed more effectively. In particular, it emphasizes the importance of a broadly based, employment-oriented strategy for agricultural development which can be effective in furthering the multiple objectives of expanding farm output, in generating employment opportunities (both within and outside agriculture) for a growing labor force, in reducing poverty, and in creating an environment favorable for the spread of family planning. The design and implementation of agricultural strategies capable of achieving those four objectives is not easy. But there is persuasive evidence that it is a feasible goal. On the other hand, because of the severity of the resource constraints that characterize the lower-income developing countries, achieving a significant reduction of the poverty that is so widespread in these countries by relief and welfare programs is, we believe, simply not feasible (Johnston and Clark, 1982, pp. 68-69).

Ineffectiveness and lack of consensus. Another pitfall that has compromised development efforts has been the ineffectiveness of development advisors in creating the consensus necessary for effective action. Instead of cumulative progress in advancing understanding, we have seen a tendency to jump from controversy to controversy and to flit from fad to fad.

Development specialists have not given enough attention to arriving at an agreed understanding of the fundamental conditions and constraints that characterize different types of development situations. Too often our objective has been to demolish an opponent's theory and to establish the superiority of some alternative version of the "truth". Such an emphasis on claims and counterclaims is singularly inefficient in identifying the really important issues on which there is inadequate understanding or faulty or insufficient evidence and thereby gradually broadening the areas of consensus. In the absence of a workable consensus on what needs doing and how it is to be done, it is difficult to overcome the

inertia of a government bureaucracy and undertake new initiatives. At the same time, in the absence of patient and persistent efforts to advance understanding and to build consensus for well-considered programs, there will be a tendency for governments to undertake hasty and sporadic action to respond quickly (and ineffectively) to the latest crisis.

Cogitation and interaction. A third pitfall concerns the tendency to exaggerate the role of "intellectual cogitation" as an approach to social problem-solving. The terms "intellectual cogitation" and "social interaction" have been introduced to describe two alternative approaches to social problem-solving (Wildavsky, 1979; see also Lindblom, 1977, chapters 19, 23). The approach of intellectual cogitation assumes that we are equal to the task of thinking through solutions to our problems. The social interaction approach takes a more skeptical view of our capacity for calculation and analysis and relies on acting out solutions through social processes of politics, markets, bargaining, and other interactive techniques. Comprehensive economic planning is a form of intellectual cogitation that is arguably desirable but wholly infeasible. The approach is infeasible not only because it exceeds man's cognitive capacities but in addition it presumes the existence of agreed upon criteria of goodness or value on which alternative solutions can be judged (Lindblom, 1977, p. 322). As Herbert Simon (1971, p. 47) has argued, "the dream of thinking everything out before we act, of making certain we have all the facts and know all the consequences, is a sick Hamlet's dream".

The interactive approach of acting out solutions also has its limitations. We have just noted that the feasible is not always desirable; and a predilection for "getting on with it" may have a high opportunity cost and entail undesirable long-term consequences. Policies that promote a dualistic pattern of agricultural development based on the "crash modernization" of a subsector of atypically large and capital-intensive farm enterprises tend to foreclose the option of achieving a broadly based, employment-oriented pattern of agricultural development involving the progressive modernization of a large and increasing fraction of a country's small-scale farm units. Furthermore, interaction learns only randomly from its own experience, and it is incapable of learning from the experience of others.

Policy analysis seeks an integration of cogitation or thinking-through approaches and interactive, acting-out approaches which recognizes explicitly the strengths and limitations of each. Clearly, there is a need for systematic reflection on the key problems and issues, the major constraints; and the feasible opportunities for advancing development. Such reflection on and analysis of past experience provide valuable guidance for the design of program interventions. The challenge is to make the best choices knowledge can buy, but at the same time to be prepared to learn from our inevitable mistakes in a continuing, interactive process of policy design, implementation, and redesign.

IV. A THREE-PRONGED STRATEGY FOR RURAL DEVELOPMENT

Two conclusions suggested by our policy analysis approach to the problems of rural development relate to the feasibility of a reformist approach and the need to give high priority to three major components of a rural development strategy. First, the possibility of a reformist approach based on incremental improvements should not be rejected without careful examination of deficiencies in the way that we have fulfilled our role as policy analysts and of the possibility of being more effective in the future. Clark and I suggest that the poor have been known to suffer as much from ill-conceived programs designed to help them as from well-conceived programs designed to exploit them. Faulty analysis or self-delusion may in fact be more serious problems than self-interest and venality. Clearly, those are failings that we, as policy analysts, should be able to do something about.

Another general conclusion suggested by a policy analysis perspective is that we should focus on the more serious failings of rural development programs and on the most feasible and desirable opportunities for mitigating those failures. Clark and I conclude from our analysis of the constraints and opportunities relevant to today's low-income countries that three areas of historical failure merit priority attention. The first relates to the failure to design and implement effective strategies for fostering a unimodal pattern of agricultural development along the lines discussed in the preceding section. A second failure, in our opinion, is related to errors of omission and commission in the design and implementation of consumption-oriented programs--i.e., programs that affect consumption of goods and services directly rather than indirectly through generating increased income and purchasing power. We stress particularly the failure to take advantage of highly cost-effective techniques for reducing mortality and morbidity among infants and small children together with the interrelated failure to slow the rapid growth of population and labor force. The principal errors of commission, in our judgment, relate to the priority that frequently has been given to relief-and-welfare programs such as free of subsidized distribution of food. Such programs are certainly "desirable", but because of their high opportunity cost in terms of scarce resources of money, manpower, and the attention of policymakers, they tend to be undertaken at the expense of neglecting more fundamental programs such as social service programs to promote the health of a country's rural population, especially the very vulnerable groups of infants and small children, and the spread of family planning.

Finally, there have been ubiquitous failures of implementation of both production- and consumption-oriented programs. In our judgment, those shortcomings in implementation are to a considerable extent a consequence of the common failure to induce the creation of effective problem-solving organizations at the local level and to improve the performance of "facilitator organizations" such as those responsible for agricultural research and extension and rural health and family planning programs.

This diagnosis is the basis for our advocacy of a three-pronged strategy for rural development. I have already said a

great deal about the first prong related to the need for a broadly based, employment-oriented pattern of agricultural development. Clearly, the expansion of opportunities for productive employment, both inside and outside agriculture, is of central importance. Fuller and more efficient utilization of the relatively abundant resource of human labor can facilitate the expansion of output while at the same time generating the incomes that enable the poor to raise their levels of consumption. Widespread increases in food consumption, resulting from increases in per capita income or enlarged home production, are of special significance in reducing the malnutrition that is so pervasive in poor households. Furthermore, empirical evidence as well as theoretical analysis emphasize the importance of tightening the labor supply/demand situation if increases in returns to labor are to be achieved.

The second prong is related to the need to strengthen a very limited set of social services. The importance of education is now generally recognized. It is because of their importance and past neglect, that we stress particularly the need for interventions directed at the interrelated problems of malnutrition and chronic ill-health among infants and small children.[3] In addition to the high human and economic costs associated with impaired child development and the excessive mortality rates among those vulnerable groups, the risk that small children will not survive to maturity is also a major obstacle to the spread of family planning. In the past few years there has been a considerable decline in fertility in the developing world. A number of middle-income countries, including Taiwan and South Korea; and two low-income countries--China and Sri Lanka--have also achieved remarkably rapid declines in fertility. But except for those two countries, and a partial exception in the case of Indonesia, the low-income countries continue to have high rates of fertility. We argue that is is highly significant that virtually all of the countries that have realized substantial declines in fertility since 1960 have also sharply reduced infant and child mortality rates (Johnston and Clark, 1982, pp. 145-147).

Our third prong concerns organization programs designed to strengthen the institutional infrastructure and managerial skills needed for rural development. The neglect of these problems is in part a consequence of the tendency of economists to focus on what to do while neglecting the "details" of how to do it. More than a decade and a half ago Hsieh and Lee (1966, pp. 103, 105) asserted that "the main secret of Taiwan's development" was "her ability to meet the organizational requirements". That lesson has been largely ignored in spite of the accumulating evidence that organizational requirements are not easily fulfilled and require serious and sustained attention. After all, success in implementing the first and second "prongs" of an effective strategy for rural development is unlikely unless the organizatonal requirements are met.

The great danger is that the very comprehensive scope of this three-pronged perspective will be interpreted as "a recommendation to adopt any and all programs that may be advocated in the production, consumption, or organization areas. No interpretation could be further from our actual intent. On the contrary, widespread and sustained progress towards improving rural well-being requires that

only a few of the highest priority, most mutually reinforcing programs should be undertaken at all. Strategic choice means choosing not to do a vast number of tactically attractive things" (Johnston and Clark, 1982, pp. 266-67).

To my knowledge, there is no really satisfactory way to determine priorities among the components of a rural development strategy.[4] For lack of anything better, we approach this problem by systematically examining the interrelated determinants of rural well-being, stressing both the competitive trade-offs and the complementarities between various production and consumption activities.

In Figure 3 I have tried to identify the most important competitive trade-offs and the principal complementary relationships between production-oriented and consumption-oriented components of a strategy for rural development. The central role of organization "is portrayed here not so much as a leading actor but rather as the stage that supports and constrains the continuing play of development" (Johnston and Clark, 1982, p. 244).

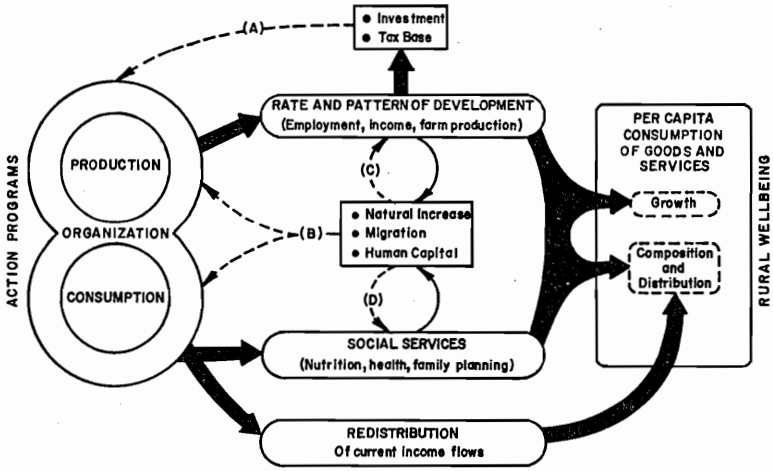
The main purpose for directing attention to these interrelationships in Figure 3 is to assist in the unavoidably difficult task of determining priorities by emphasizing the causal linkages and feedbacks that are most important in determining the well-being of a country's rural population. To a large extent the well-being of the rural population is a function of the growth, distribution, and composition of per capita consumption of goods and services. Rural well-being can be enhanced directly by effectively implemented production- and consumption-oriented activities and indirectly by the interactive effects of those activities on the rate of natural increase of the rural population, on rural-urban migration flows, and on human capital formation.

This diagram is a highly simplified portrayal. The influence of price policies, for example, is not depicted here, although obviously the prices of farm products and inputs exert a major influence on the rate and pattern of a country' agricultural development. In particular, "cheap food policies" have been one of the most common deterrents to increases in farm productivity and output.

Clark and I discuss these interrelationships in considerable detail in the final chapter of our book, but for present purposes I simply want to stress two points. First, there is inevitably competition between production and consumption programs in the allocation of scarce resources; but in the case of social service programs the complementary interrelationships are also highly significant. For example, a well-designed rural health program that emphasizes cost-effective preventive and promotional activities, such as immunization programs, hygiene and nutrition education, and family planning, can directly improve rural well-being by influencing the growth, distribution, and especially the composition of the goods and services available for consumption. In addition, such activities can facilitate agricultural development by slowing the rate of growth of the farm population and by improving the quality of human resources.

The second point that I want to stress is that there is also a competitive trade-off in the allocation of scarce resources within

Figure 3. The Determinants of Rural Well-Being.



NOTE: Heavy solid arrows denote direct effects; light solid arrows, indirect effects; and dotted arrows, major feedbacks.

Source: Johnston and Clark (1982), p. 244.

the category of consumption-oriented activities between social service programs and redistributive measures. Clark and I argue that because of the nature of the interrelationships among the determinants of rural well-being, there is a rather strong presumption that priority should be given to strengthening social service programs over programs such as a food subsidy or food stamp program for the redistribution of current income flows. However, measures to alter the distribution of capital assets, including human capital, merit special consideration. Improving the quality of the human resource represented by a country's farm population through education and health programs not only yields important benefits to individual beneficiaries but also has positive effects on the rate and pattern of development. A redistributive land reform can also have important positive effects on the rate and especially the pattern of agricultural development, subject to the large proviso that is politically feasible to not only enact but effectively implement such legislation.[6]

V. CONCLUDING COMMENTS

In closing, I want to emphasize once again the importance of a long-term, strategic perspective. Rural development is inherently a time-consuming process. Broadly based and sustainable progress will be measured in decades, not years. In part, the pace of development is limited by the demographic and structural characteristics of the lower income developing countries which make it inevitable that they will remain predominantly rural well into the twenty-first century even on the basis of optimistic assumptions with regard to the slowing of population growth and the rate of expansion of nonfarm job opportunities. Furthermore, development is essentially a learning process: the growth of organizational competence and of personal knowledge and skills is just as essential as capital formation in the conventional sense. This learning process demands a great deal of persistence and a willingness to learn from our mistakes as well as our successes.

This much-needed persistence has, however, been too often lacking. The desire to ignore the need for trial and error, to bypass the errors, to teach answers instead of facilitating learning is strong--and disastrous. It is understandable but unfortunate that relief-and-welfare approaches have so often been emphasized because of impatience for immediate results.

I must also acknowledge that those of us who have emphasized the relevance of the experience of Japan and Taiwan have been guilty of teaching answers instead of stressing the need for a learning process leading to a continually improving sequence of program designs. In particular, we have been much too slow to take account of a major limitation of technology transfer based on their experience. Because of the relatively homogeneous character of agriculture in those two countries and the dominant importance of irrigated production, there was enormous scope for expanding farm productivity and output by relying mainly on improved seed-fertilizer combinations for rice and a few other major crops. In countries with different and more heterogenous conditions,

including major reliance on rainfed production, it is necessary to confront the more difficult task of identifying a number of strategies adapted to a variety of agroclimatic conditions and crops. Experience at ICRISAT, for example, suggests that in areas where rainfall is variable and only marginally adequate, there is a need for improved methods of soil and water management in order to realize the yield potential of improved varieties and fertilizer. Little sustained and systematic attention has been given to the task of evolving equipment and tillage innovations for that purpose that meet the needs of smallholders with limited cash income and purchasing power (Johnston, 1981).

This emphasis on the time-consuming realities of development should not be interpreted as a lack of awareness or concern with the deprivations of widespread poverty in developing countries. Rather, it reflects our conviction that only a long-term, strategic approach is equal to the task of substantially reducing and eventually eliminating poverty in these countries. Unless rural development strategies are directed at correcting the root causes of poverty, it seems all too probable that the number of people in these countries suffering from malnutrition and related deprivations will continue to increase.

Perhaps we are in error in concluding that the three "prongs" that we have emphasized represent the most strategic requirements for rural development. We are all too aware of the fact that they constitute a formidable agenda. But I assure you that it is not a penchant for grandiose plans but rather our diagnosis of the nature of the problems confronting the developing countries that led us to assign simultaneous and high priority to production, consumption, and organization programs. By the same token, the need for a three-pronged approach emphasizes how important it is to be highly selective, to make hard choices, and to undertake only the highest priority and most mutually reinforcing activities within each program area.

NOTES

1. See Leibenstein (1975, p. 307). According to the most recent estimates, Kenya's rate of natural increase is 3.9 percent. There is a time lag before the rate of growth of a country's population of working age approximates the rate of natural increase; but it seems safe to assume that Kenya's labor force is already increasing at a rate appreciably higher than the 3.3 percent rate used by Leibenstein in his comparison of Kenya and the U.K.

2. The remaining paragraphs in this section are taken from a paper presented at the 18th International Conference of Agricultural Economists, Jakarta, Indonesia, August 24-September 2, 1982 (Johnston and Clark, 1982a).

3. Nutritional and health problems among infants and small children are not only especially serious and pervasive, but they are also distinctive. Because of the two-way interactions between nutritional status and diarrhea and other infectious diseases, the most cost-effective approach is to give priority to a judicious combination of inexpensive nutritional and health activities.

There is substantial evidence of the effectiveness of such an approach, provided that the organizational requirements are met (Johnston and Clark, 1982, pp. 126-34).

4. The logic of benefit-cost analysis is unassailable. In practice, however, benefit-cost calculations are applied to narrowly defined projects. Strategic decisions with regard to priorities should be based on a broader assessment of the benefits and costs associated with alternative policies and intervention programs.

5. One useful consequence of the flurry of enthusiasm for a "basic needs approach" during the late 1970s was to emphasize that some needs are indeed more "basic" than others. Thus our emphasis on nutritional status and health and on the composition of the goods and services available for consumption as a third important dimension of rural well-being.

6. In contrast, tenure reform that attempts to fix rental ceilings is likely to be counterproductive (Johnston and Clark, 1982, pp. 87-89).

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Part 3

Land and Water Resources Management

12
The Management Factor in Developing Economies

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> Perfection of means and confusion of goals
> seems in my opinion to characterize our age.
>
> - Einstein

I. Introduction

There are few concepts as important yet so difficult to understand as "management". Physical and social scientists perhaps have more difficulty with this concept than anyone else. The reason is that the concept of management is meaningless except in the context of human purpose and purpose is alien to these sciences. In the physical sciences purpose or "teleology", is ruled out of court as a matter of principle. The social sciences (imitating the natural sciences) attempt to reduce purposive action to explanation in terms of more fundamental, non-purposive terms. This objective is explicit in behaviorism and Marxian analysis; it is also a predominate force in modern economics, which tends to view humans in terms of simple instinctive machines caught up in the much greater machine of "The Market".

In general, as Arndt has correctly observed in the case of economic development theories, there is a fundamental difference between "transitive" and "intransitive" theories of human behavior (1). It is the difference, in brief, between the statements "I make the ball bounce," and "The ball is bouncing". How one thinks and acts in development or any other field largely depends on which of these metaphysical world views, the transitive or intransitive, one assumes at the beginning. Here indeed is another "Gulf-fixed" in the sciences -- which is perhaps even more important, because it is less consciously appreciated, than that between the "positive" and the "normative", the original focus of Lord Robbins' famous phrase (13).

The thesis to be advanced here is that management can and should be made into a science, both in theory and practice, but also that it is a different kind of science: a transitive science, where purpose is the fundamental datum of analysis.

Following Sir Karl R. Popper's famous demarkation between science and philosophy, a proposition is "scientific" only if it is

in principle refutable (12). Philosophic propositions are of course extremely important; there could be no science without them. But the great advantage of science is that it has two means of eliminating error in thought: first, as in philosophy, error can be eliminated by logical tests of consistency; second, in science error can be detected, even in logically consistent theories, by empirical tests. A scientifically refutable theory either excludes certain observations from being possible or insists that certain observations must exist, under specific conditions. The refutation consists in showing that the "impossibles" occur or that the "necessaries" do not.

How, then, can a transitive science of management premised on an "unobservable" like purpose, be scientific in Popper's sense of refutable? The answer to this question is contained in the idea of Management by Results (MBR), as it is called here. In brief, a managerial theory is first developed which predicts that if certain things are done in a particular way under specific conditions then certain consequences, or results, will emerge from the action. The test of the theory then consists of monitoring the results to see if what was predicted in fact occurred. Thus, the results either corroborate or refute the theory in management just as the results of a laboratory experiment do in science. The difference, and it is an important one, is that the results of a management theory are also desired states, valued outcomes, embodying both the positive and the normative aspects of purposive human behavior. The synthesis of these two aspects of human behavior and the meaning of management as a science could not be better expressed than in William James' description of pragmatism:

> The doctrine that the whole 'meaning' of a conception expresses itself in practical consequences, either in the shape of conduct to be recommended, or of experiences to be expected, if the conception be true. (8).

II. Cybernetics[1]

Cybernetics has been described by Norbert Wiener as "the study of purposive systems in man or machine" (16). All too often cybernetists forget that man is different from machine. As Kenneth Boulding somewhere observed, information theory will not be of much use in the study of people until we know how a "bit" can be turned into a "wit" (a statement which is itself an instance of the principle). Nevertheless, the conceptual framework of cybernetics, tempered by common sense, provides an important part of the foundations of management science.

Cybernetics begins with the simple concept of a "transformer", as illustrated in Figure 1. A transformer "transforms" inputs into outputs; it is an input-output relationship. A large set of individual transformers can be interlinked, as in an assembly line, and any level of aggregation of transformers can itself be considered a transformer for purposes of analysis.

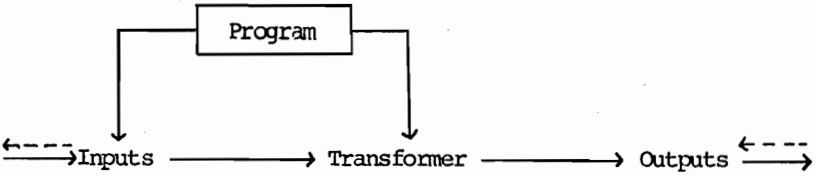

Figure 1. The Transformer Concept of Cybernetics.

Transformers are controlled in varying degrees by a program, or set of programs, which may or may not be embodied in the mechanism of the transformer. The function of the program is to control the process of transformation so that out of the set of 'n' outputs possible from a set of inputs, only one set of outputs is produced.

There are two basic kinds of transformers: "deterministic" and "cybernetic". The "deterministic transformer" has all its inputs under the endogenous control of its program and can thus operate in terms of an invarient routine. The "cybernetic transformer", on the other hand, is subject to exogenous control of some of its inputs and must therefore have a program which is able to adaptively respond to errors in the transformation caused by these exogenous forces.

The simplest examples of these two types of transformers are the clock and the thermostat. Once a clock is "wound up" it just "ticks away", fulfilling its function of keeping time through an invarient program embodied in its mechanism. Except for energy input and occasional repair and maintenance, the clock is virtually independent of its environment. The thermostat, on the other hand, works in a considerably more difficult situation. Its function is to maintain the temperature of a room within an acceptable band of error. The temperature inputs to the room are from the external environment, from heat sources in the room like human bodies, from activities like opening and closing doors and windows, as well as from variations in heat input provided by the heater. In an environment partly controlled by exogenous forces, there is no invarient routine for the heater to follow which will even approximate desired room temperature on a continuous basis. Under a clock-like routine, the room would always be either too hot or too cold.

There are three basic requirements for a cybernetic transformation: (1) It must have an explicit set of objectives; (2) it must have a source of information about the actual outputs with respect to these objectives; and (3) it must be able to control its inputs and/or its program (by a higher order program) to reduce errors which may occur in the relationship between its objectives and its outputs.

Thus, in the case of the thermostat: (1) it is set to a

desired room temperature; (2) it has a sensor, (a thermometer), which reads the actual room temperature; and (3) it controls the heater to reduce the discrepancy between the objective and the actuality. This error reducing property of negative feedback from actuality, to objective, to control, is the sine qua non of all cybernetic transformations, and of management.

III. Management by Results (MBR)

The above outlined cybernetic principles are reflected in the theory of "Management by Objectives" (MBO) as developed by Peter F. Drucker.(6) But, in practice, they have been so corrupted by authoritarian managers who wish to hold their subordinates' "feet to the fire" of performance (and thereby avoid accountability for themselves), that much of the practice of MBO has turned into a perversion of Drucker's original concept. However, in the well founded reaction against MBO there is a danger of throwing the baby out with the bathwater. The "baby", in this case, is negative feedback. Error is inevitable; therefore it is not the fact of error, of failing to satisfy the objectives, that is so important. What is important is that the error is known and that error reducing actions are taken before the error gets out of hand. In the interests of saving this important "baby of negative feedback", while joining with those who wish to eliminate "authoritarian bathwater" of MBO, the expression to be used here is, "Management by Results" (MBR).

The results (R) of a management system are the relationship between the predicted outputs (PO) and the real or actual outputs (RO) from system operation. If the results are defined in terms of the ratio of real to predicted outputs, i.e.,

$$(1) \quad R = RO/PO$$

then R = 1 means the system is functioning well (indeed, perfectly). Any deviation of RO from PO, either plus or minus, implies an inefficiency or error (e) in the system. Thus with RO defined as PO plus or minus the deviation or error (e), (1) can be expressed as:

$$(2) \quad R = \left(\frac{RO}{PO}\right) \pm e.$$

Any time $R \neq 1$ something is wrong -- either in the program or in its implementation. The system is out of control and some process is implemented to track the source of the problem, (e), and rectify it. In this heuristic process every aspect of the management system -- the program, the original management decision, the objectives themselves -- are subjected to the re-evaluation and change.[2]

In the heuristic phase of MBR, it is easy to see that the "results" of a management system perform the same basic function as the "results" of a scientific experiment. In both cases, the results provide a test of theory. If the results are favorable, the theory is considered corroborated and action/knowledge can

proceed on the basis of the received theory. If the results are unfavorable, this fact sets in motion a heuristic process of investigation and re-evaluation to find where the theory errs. The well defined "problem situation", as Popper calls it, set up by a refutation of existing theories, is maximally conducive to the development of new and improved theories for further tests. Thus, through Popper's process of Conjectures and Refutations (12) new knowledge is discovered and applied. As Martin Landau says,

> And this brings me to the point I wish to emphasize: 'scientifically managed' systems cannot be scientific unless and until they are set on the foundation of criticism. For this is the only way to make an organization accountable, effective, and reliable.(9)

IV. The Meaning of "Objective"

An "objective" acts as a kind of binding agent, a "glue", between two separate worlds of thought and action: the positive and the normative; the scientific and the metaphysical.

Positively and scientifically, the objective acts as a hypothesis in the form of a conditional proposition: "If we do this then that will occur." In this form, the objective predicts a real world event and can be scientifically tested, as explained in the above discussion of MBR. The normative and metaphysical side of an objective appears in the value judgment that the predicted event will be desirable, or "good". One may say that objectives consist in the specification of valuable future events resulting from present actions. In organizations involving many different people, with different kinds of knowledge and interest, it is essential to specify organizational objectives as clearly as possible so that they can rationally argue if they disagree. But in most organizations there is a danger of overspecifying objectives: predictions are no better than the knowledge upon which they are based and if one insists on precise objectives people will naturally limit themselves to what they know best — where the chances of error are minimal. They will cease to grow and develop through risk-taking, exploration and mistake-making, or "learning by doing". Directional objectives appear to be the solution to this problem -- objectives which say: "We will move in this direction as effectively as possible."

Most project planning efforts in the developing countries are plagued by the nearly universal problem of "fractured objectives". Technically speaking, an objective must contain both a value and an event. Yet, many so-called "objectives" are stated as values — "to help the poor" or create "peoples participation" -- without specifying the events which produce these values. With such disembodied values stated as objectives, no one but the actor can determine whether the objective was satisfied or not. That is perhaps the reason for the popularity of this form of fractured objective.

But an opposite extreme, where the objective takes the form of an event without a value, is at least as bad and perhaps even more popular. This problem occurs most frequently in the reduction of

policy objectives to operational targets. For example, in irrigation the objective is quite clearly to increase agricultural production by providing irrigation. This objective can only be satisfied by irrigating according to specified agricultural output criteria. However, the operational target of many irrigation departments is formulated in terms simply of delivering water to the outlet. Once water is delivered to the outlet, the "mission is accomplished", no matter what effect the water has on the fields and therefore on the policy objective of increased agricultural production. Thus, the system all too often succeeds in satisfying its target but fails in satisfying its objective.

Other instances of fractured objectives are afforestation policies which are reduced to targets defined in terms of the number of trees planted — with little or no attention to how many trees survive after planting (much less how well they grow) — or rural electrification programs reduced to kilometers of wiring installed regardless of the ability to deliver electricity. Obviously, in cases such as these, the operational targets are necessary to satisfy the objective but they are not sufficient. That is because they are inputs, not outputs.

In all cases of fractured objectives the fault lies with policy makers, not with operating unit personnel. In the first instance, policy makers have failed to transform values into events which the operating units can attempt to achieve as objectives. In the second instance, policy makers have failed to assure that the events used as targets by the operating units reflect policy values. This is the reason why in MBR the results are formulated in terms of outputs: the valued future events are specified by the objectives. In contrast, where only values are stated without clearly specified events, the activity is not scientifically testable; where only events are produced without values, the activity is metaphysically worthless. A result must be both an event and a value.

V. The Benevolent Dictatorship of Value

There are essential philosophic and perhaps even psychological differences between a management system and other systems of human interaction; such as an administrative system. In a management system the value one is attempting to create becomes the 'dictator' to which all process variables are subservient. In many other systems, this sequence tends to be reversed — whether because of ideological, procedural, or personal preconceptions on the "way things should be done" -- by making the value subservient to the process.

Another way of stating this difference is by saying that in the short-run a management system is closed with respect to values but open with respect to processes, while in other systems there is a strong tendency to the reverse.[3] Of course, closing a management system with respect to value not only implies fixed values with respect to objectives, but also fixed constraints of a moral and pragmatic nature on the kinds of actions that can be undertaken. But these value-constraints must be kept under continuously critical survey lest they grow into an "iron cage" of what 'we do not

do', thereby closing the options available to achieving value-objectives. Perhaps every organization begins on the basis of a simplified management system designed to achieve objective values. Many, however, degenerate into a form which only protects the internal, value-constraints of the organization itself, such as "Patronistic" organizations so commonly found in developing countries that have long established cultures. This problem is explored more fully in the following section.

VI. Differences Among Managerial, Administrative and Patronistic Organizations

The "litmus test" to determine the degree to which any particular organization is "managed" versus simply "administered", is the degree to which the organization knows the results of its behavior.

While there are a number of different organizational forms that could be discussed in this context, only three of them are germane to the subject at hand: (1) Managerial, (2) Administrative, and (3) Patronistic. When the evolution of organizational forms in developing economies are studied, it appears that they tend to arise out of a Patronistic order. Despite initial attempts at modernization, a strong Patronistic legacy remains in much of the developing world. Such economies have not truly modernized in the sense of becoming effective until they become management oriented. To illustrate this phenomena, however, each of these three forms will be discussed.

The Managerial Organization

Figure 2 provides a sketch of some of the more important structural and functional properties of a Managerial Organization (MO) which operates according to MBR. This figure reflects essentially the same structure as that of the thermostat discussed above, or of any other cybernetic transformer of whatever degree of

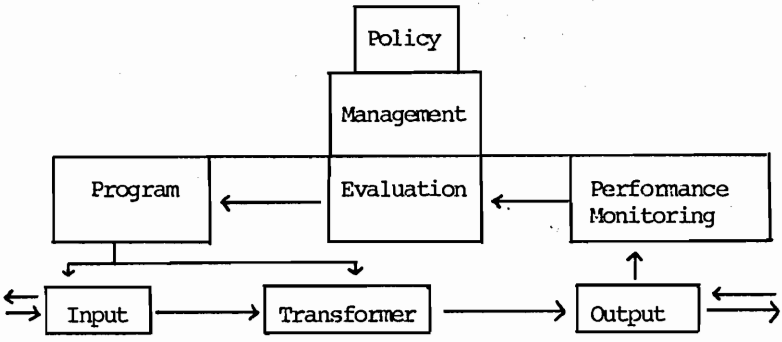

Figure 2. The Managerial Organization.

complexity. It is important to keep in mind that the basic transformers of this "machine" are people and that people are the ultimate "black boxes" of cybernetic theory. The problem is how to design organizations to maximize individual initiative and creativity, yet, stay on track of the objectives. That is the design criteria for the MO. The MO operates in terms of five essential functions:

(1) The policy function is to set the broad parameters of the organization. These parameters are of two forms: (a) The ends, values or goals of the organization; and (b) the basic operating procedures by which the action of the organization is channelized. This formulation follows the theory of "parametric management systems", as Martin Landau has called it.(9) The parameters are set at the policy level while the variables are left to the managers. In military terms, this theory is reflected by the distinction between "strategy" and "tactics".

(2) The management function of the MBR approach is, first, to transform general policy goals into specific objectives defined in terms of desired outputs at specific times, places, quantities and qualities. The transformation of policy goals into management objectives is one of the most difficult operations of the system because it requires very close interaction between the policy and management functions. The second major management function is to design programs for the organization which, it is hoped, will produce the outputs specified in the objectives. These programs necessarily take the form of conditional propositions to the effect that, given the initial conditions, if inputs are applied according to the program, then specific outputs will likely emerge from the transformation.

(3) The performance monitoring function is to estimate the results of the organization and convey this information to managers and policy makers. In other words, this function is to report the status of RO/PO.

(4) The evaluation function is shared between managers and policy makers. While evaluation is a continuous operation, its intensity fluctuates over time to a degree that it is best considered as a step-wise process periodically "triggered" by two kinds of events. As long as the results are favorable, R = 1 (and the objectives are constant) the system is simply reiterated according to the established program. This stationary situation changes, however, when: (1) due to some external perturbation in the environment, unfavorable results appear; or (b) internally, someone "gets an idea" which causes a shift in the values, objectives or program. In either case the organization as a whole is intensively re-evaluated either to rectify the error or to exploit the new opportunity. In this way the MO moves through time in a step-wise process of controlled change.

(5) The transformer function, as discussed earlier, is simply to implement the program so that the inputs are "transformed" into desired outputs within an acceptable range of error.

"Management", as Drucker says, "is not so much a technique as a culture".(6) While this is true it must be emphasized, as Drucker himself repeatedly emphasizes, that the culture of management arises from a particular kind of methodology -- the

methodology of MBR. Specifically, MBR creates an "objective culture" of management.

Administrative Organizations

The discussion of the Administrative Organizations (AO) can be much shorter than that of the MO since it is largely a study in contrast. As the MO reflects the design of a thermostat, the AO reflects that of a clock. The premise of the AO is that if a perfect program or plan is perfectly implemented, the results simply must be favorable. Therefore, it is thought to be a waste of resources to monitor outputs since outputs must follow inputs by "logical necessity".

The arch-typical AO can be depicted by mentally blotting out the performance monitoring and evaluation components of the management function (see Figure 2). Programs are formulated by policy makers and then routinely administered "according to the book". Thus, the AO is a much more simple organizational form than the MO, consisting only of a "top down" transformation of policy values into programs which are implemented by the administrative system. Inputs are of course monitored through inspection procedures, but the outputs are simply assumed. Like the clock, the AO blindly "ticks away", with no means of knowing whether its outputs are "on track" of the objectives or not — with no knowledge of its results.

In some instances AOs perform very well, but in most situations they do not. The difference between these situations may be seen by contrasting a road construction program with an irrigation program. In the case of road construction: (a) The program is perfectly known and has been tested over decades, with very little technological change causing a need to experiment with new approaches. (b) All the inputs to the construction effort, including the land, are under total control of the AO. (c) The results of the program are easy to see and evaluate by policy makers and high administrative officials — they can be monitored simply by a two or three hour drive in an automobile. Lastly, (d) a road automatically interfaces with the private, non-public, sector. Once the transformation of labor and materials into a road is complete, individual users can utilize the road by themselves, without the need for further public organization (with the exception, of course, of maintenance and traffic control).

In the case of irrigation programs, for example, conditions (a), (b) and (c) above are also reasonably well satisfied in the main storage and canal distribution system. But all of these conditions are violated, in whole or in part, below the canal outlet. Most importantly, the desired interface between the public and the private sectors (point d) breaks down at the point of the outlet because feedback of useful information about the results of the program (product output) is lost at this point.

If, for example, there were only one farmer below the outlet, then an irrigation project could work like a road project — it would basically satisfy the above four conditions. As in the case of a road, it could reasonably be assumed that management problems would take care of themselves after the public-private sector

interface. But with many dependent farmers below the outlet, the public good problem of joint-use remains in the system. Either the farmers have to form themselves into a separate organization to jointly manage irrigation water after it is delivered to the outlet, or the public-private interface must be pushed further downstream to the farmgate of the individual farmer.

The management problems of the main system can be solved by better management systems within the span of control of the organization. The problems below the outlet, however, require reorganization of the system -- involving either a new farmer organization below the outlet, or considerable revision of the interface of the existing public organization with the dependent farmers.

The problem of the canal outlet in irrigation systems is a species of the general problem of defining the organizational interface in management theory. How far upstream -- through the inputs -- and how how far downstream -- toward ultimate outputs -- should the organization attempt to extend its span of control? No organization can control everything, yet everything is ultimately related to everything else -- the dilemma of socialism, if you will.

In capitalistic private sector systems, this problem of integration of independent but interrelated activities is partially solved by the marketplace. The purchase-sales mechanism provides a feedback at the interface, or environmental terminals, of the organization. However, in the public sector AO this feedback mechanism does not naturally occur and targets may be defined short of the objectives (as in the problem of delivering water just to the outlet, or just planting trees). Without useful feedback at the interface, fractured objectives tend to prevail.

The only solution to this problem is rigorous performance monitoring operating from the policy-making level to provide feedback from events to values, from program targets to policy objectives. In the absence of such monitoring, the AO becomes a rather simple-minded machine, blindly grinding on with ambiguous objectives, to dubious results.

Like the MO, the AO creates its own distinctive culture. It is the culture of the cog in the wheel, the automaton, who cannot know if error occurs and thus cannot learn and improve. In this regard, Martin Landau (9) has noted that:

> Bureaucracies are chastised today as sluggish, unresponsive, rigid, closed, and thus resistant to change -- which means that they do not learn. Some say they cannot learn: Crozier has suggested that a bureaucratic organization is one that cannot correct its behavior by learning from its errors. I believe he offers this as a definition.

Clearly, such organizations must be shifted into the MBR mode as a precondition to successful efforts to transfer large-scale technology and capital resources for public resource development projects such as irrigation delivery systems in developing countries.

Patronistic Organizations

In Patronistic Organizations (PO), the who controls what and

how. The Patronistic Organization is an extension of the personality of the individual "boss" or "patron". In organizations under patronistic control, both objectives and operating procedures correspond to the more or less hidden agenda of the patron — the only firm rule is "ask the boss". To borrow an apt phrase from Manibhai Desai, patronistic organizations are operated in terms of "Management by Subjective".(4)

As organizations in the west have become more rationalized, (e.g. read: modernized), the role of the patron has receded to the point where it is difficult for a Westerner to understand partonism in full flower. The reference here is less to the mildly benign English "patron" and more to the vigorous Italian "patrone" -- a figure made widely familiar in the film, The Godfather. The mafia, or cosa nostra, ("our thing") is indeed the arch-typical form of patronism -- quite apart from its association with criminal activities. As in the origin of the mafia itself, patronistic organizations may be and most often are sincerely dedicated to the most noble causes, such as protection of weak and oppressed people.

The point of interest here, however, is not in the objectives of various patronistic organizations but in the modus operandi. It is the essentially familial relationship, the relationship of father to son, between the patron and what may be called, in the curious absence of a reciprocal term, the "patronist" which is the essential feature of patronism. The patrone provides security and protection to the patronist and demands in turn unquestioning loyalty, respect and honor from the patronist.

It is the culture of subservience created in patronistic organizations which provides its power in politics and war, and is the ultimate source of its weakness in the management of economic affairs in other areas. Herein lies one of the deepest dilemmas of the developing countries: in transition, of political turmoil and insecurity, the most successful political form of organization, patronism, is also the weakest form of economic organization. Thus, there is an inevitable conflict between the interests of political stability served by the patrone, or a coalition of patrones; and the management of economic development. Some of the major reasons why patronism ultimately fails in the management of economic activities are listed below.

First, and most importantly, a patronistic system cannot tolerate, much less encourage and support, the skeptical, critical spirit of science and of scientific management. Criticism implies an impersonal and equal standing between parties to the critical transaction. In a patronistic structure, neither of the critical conditions of impersonality or of equality hold. Instead, in this highly personalized world, criticism is both given and received in terms of its very opposite, as argumentum ad hominem. Simultaneously, the hierarchy of status relationships assures that criticism runs only downstream, from superior to inferior, rather than in its most useful direction — upstream, from the man on the spot to the policy maker. When, in those few instances where criticism is directed upstream, it is greeted as a form of insubordination — if not, indeed, of les majeste.

Second, patronistic societies are constantly in a state of internecine warfare between various patronistic groups. In this

competitive milieu it is essential to actively suppress information which might form the grounds of attack by one's enemies. Thus, even in those instances where a particular patrone might want to know what is happening in his organization, he hardly dare to collect the information for fear of a "leak" to his enemies.

Third, power, like a muscle, strengthens through exercise. But the power to do, the power of commission, is likely to lead to adverse results; while the power to obstruct, the power of omission, is much safer. Lost opportunities are much more difficult to demonstrate than direct mistakes. Thus, in a patronistic organization, the system of information and control focuses on the inputs rather than on the outputs of the activity. Permission must be granted for every move, or at least a reading of "no objection" humbly obtained. Plans are carefully prepared, done, and redone, while implementation awaits. In patronism: Whatever is not permitted is prohibited"; while, conversely, the requirement of an effective parametric management system is: Whatever is not prohibited is permitted.

Fourth, the effective management of any large organization requires a high degree of decentralization of authority downward to the man on the spot -- to the person who alone has the detailed information of time and place, the specific problem situation, in mind. But in a patronistic order, authority is regarded as a limited good and delegation of authority is treated as a substantial loss. With delegation of authority, the gap between patrone and patronist tends to close; and this gap, the very foundation of the system, must be preserved at all costs -- even at the expense of reduced system performance.

Fifth, and lastly, once a patronistic regime is set up and running smoothly in a delicate modus vivendi among patronistic groups, change is assiduously avoided. Adaptation to changed technological and social conditions necessarily disturbs the "territory" established by patronistic factions and promotes endless power struggles. While patrones will risk a struggle over power, they will never jeopardize themselves over a mere problem of performance.

Patronism is not only one of the earliest and most natural systems of political economy but comprises something of a sink to which all other systems eventually tend to regress in the absence of countervailing power. Thus Adam Smith's critique of mercantilism can be interpreted as a struggle against patronism, as can Miloran Dilas' work, The New Class (5). It is perhaps inevitable that in the power vacuum created in newly emerging nations patronism should appear dominant during the first stages of independence. The parallels, for example, between present day India and the United States some thirty years after its independence — a period wonderfully captured in Gore Vidal's novel, Burr (15) -- are striking.

Despite the brevity of our treatment of patronism, it is hoped that enough has been said to convey our conviction that until one understands something of patronism, one cannot truly comprehend many of the most basic problems of economic development in today's world.

VII. Transforming AO and PO Systems into MBR Systems

The problem of instilling MBR techniques in traditionally focused public service organizations has no simple or quick answer. It is not probable that MBR skills will emerge via university degree training because these students are trained first, and usually solely, to be engineers, agriculturalists, economists, and the like. Providing non-degree postgraduate training in management skills, in programs such as provided by the International School for Economic Development Studies at Colorado State University, will not make much of an impact either — particularly if only a few individuals so trained are put back into a rigid PO or AO system.

A major revolution in such rigid systems is in order. What appears to be necessary are two factors. First, the man at the top must be sufficiently powerful and imbued with the MBR philosophy. Second, there must be organizational changes to model systems of information and control of cybernetic and scientific terms. Third, personnel throughout the whole organization must be exposed to and understand modern management principles before lasting changes can be achieved.

In sum, while Drucker is right in describing management as a "culture" not a "technique", this statement should not be interpreted in the sense of "cultural relativism" -- that, so to speak, any management system, "appropriate" to the local culture, will do. On the contrary, while management "styles" may differ from place to place in accord with local standards of inter-personal relationships, the culture of management itself is absolute and universal; it is the objective culture created by and necessary to MBR. Thus, while every organization or society always has the choice of whether it wants to manage effectively or not, once that choice is made it does not have a choice over which kind of management that culture must create. The conflict between the cultural demands of the MO and traditional cultures, as expressed in the PO and the AO, is perhaps the basic cultural conflict in the developing world today.

VIII. A Concluding Argument: The Case for The Management Factor in Economic Development

We shall begin this discussion by advancing three basic propositions, with illustrations from India.

(1) The first proposition is that differences in the economic performance of people from different cultures is determined by the kinds of organizations in which they work, rather than by culturally determined traits of their personalities. To put this proposition quite specifically: people from different cultures will perform similarly in similar organizations; and people from similar cultures will perform differently in different types of organizations. The one qualification necessary to this generalizaton is that the people must have similar technical knowledge -- an organization cannot make a clerk into an engineer, try as it might, but it can (and often does) make an engineer into a clerk.

Daily, the poor and ill-equipped Indian farmer achieves small miracles of production under conditions so harsh that they would destroy the typical American farmer. On the other hand, there are

public service organizations in India, such as Irrigation and Agriculture Departments, which presently perform at extremely low levels of efficiency. Within the same cultures one can find both the best and worst levels of economic performance, depending on different organizational modes. The opposite side of the coin is exemplified in the many cases of Indian emigrants performing in accordance with the norms of the various organizational structures in which they then find themselves elsewhere.

(2) The second proposition is that organizations persist or change as a transitive act of individual choice and will, not as the result of an intransitive system. In logic and grammer the transitive form is active, "I make the ball bounce"; while the intransitive form is, so to speak, appreciative, "The ball bounces". Most theories of economic development are of the intransitive form as H. W. Arndt has pointed out in an important article (1). In the social sciences, human behavior is explained in the same terms as, say, an astronomer would explain the motions of the planets, or a biologist the behavior of an amoeba. These intransitive theories ignore the fundamental fact that the "grand sweep of history", or the "cumulative process of cultural change", must in principle be reducible to explanation in terms of an idea or an act by somebody, at some particular point in time and place.

The importance of this second proposition is that the basic structural features of organizations are partially determined independent of cultural variables. They are created, usually piecemeal, by someone who changes organizational objectives and operating procedures. As these changes are implemented, the culture of the organization adapts (and rather quickly, we presume, if sufficient personnel have previously been trained to implement the new procedures). Thus, within the opportunities presented by the external environment, the so-called "Great Man" can make an important difference through the "leverage" provided by the ability to manipulate: first, the organizational structure; then the culture created by the organization — be it a firm, a government agency, or an entire society. If this second proposition is valid, the moral is that one need not wait, wringing one's hands, for the long-term evolution of a "development culture", however defined. This culture can be created in a much shorter time frame in organizations by manipulation of their structure. It also means that when development is not happening, there is no scapegoat for failure. As Pogo says, "We have seen the enemy and he is us."

(3) Whatever one may think of the first two propositions, the issues raised by them must be settled before any theory of economic development worthy of the name is possible. Until one understands why micro-economic organizations exhibit such enormous differences in performance even within the same society, grand macro-economic theories of development or of cultural evolution, are of very little consequence.[4] (10) The whole is not, indeed, the mere sum of the parts; it is a 'composition', as F. A. Hayek says, between the parts and the relations between the parts.(7) Until the micro-economic properties of the parts and the meso-economic relations between the parts of an economy are understood, macro-economics is restricted to stating only what might happen under vague conditions which may or may not pertain.

As evidence of the importance of this third proposition, one may note the rather astonishing findings of Dennison, Solow and others that only about one-third of the total growth of GNP in the United States since the 1920s can be attributed to increased inputs -- the remaining two-thirds somewhat miraculously having arisen from improvements in the output to input ratio.(3) This "residual" has been attributed to growth in technology and/or human capital. While both are obviously important, neither would have been possible on the massive scale required to make such large effects without the rise of sophisticated management systems capable of developing and managing technology and human capital over this period of time. While all organizations in all societies have access to sophisticated technology and training, only a few organizations in a few societies have been able to make technology work effectively on a large scale. Whatever management is, that is what it does.

In sum, economic progress is essentially an increased rate of output per unit of time. This objective can be acieved only by two means: (a) by more intensive application of inputs per unit of time; and/or (b) by increased efficiency of transformation of inputs into outputs. The latter is a rather mysterious effect: more output with the same input! However, that is what management does.

Sophisticated management systems are especially necessary to operate the large-scale, integrated processes of a modern economy. In our opinion, it is the failure to master these management systems which is the principal cause of the low economic performance of most developing nations since World War II and, indeed, virtually the definition of "underdevelopment". Without sophisticated management more output can only be increased, as it were, by brute force -- by more inputs. But also without these management instruments of information and control, increased inputs soon get out of hand, becoming unmanageable, with the result that increased intensity creates lower efficiency and output still fails to grow. Unfortunately, such is the condition of many of the developing countries today, especially in their public sectors. If these countries are to realize their economic potential, the ancient administrative orientation of the public sector must give way to the management orientation required of a modern economy, as embodied in the MBR approach.

The problem of economic development cannot be fully comprehended until one is able to explain why different organizations with basically the same stock of physical and human capital, or access to that stock, exhibit such dramatically different levels of performance. If the performance of major economic organizations in the developing countries can be improved, one by one, then a self-sustaining process of development can be created, "brick by brick", so to speak. Per contra, unless this process of organizational and managerial reform is implemented in the developing countries as a prior condition, very little can be expected from simple resource transfers -- whether of funds, technology, or training --from the developed to the underdeveloped worlds. Managerial reform is certainly a necessary condition to development and, as the few success stories in the developing nations have shown, sets in

motion a development process which makes it virtually sufficient.[5] This, then, is our case for expanding the management factor in economic development efforts.

NOTES

*The material included here is covered in greater detail in a forthcoming book, Essays on Resource Management in Developing Countries, by David Seckler, and in a recently published article by K.C. Nobe, "Irrigation Management: Delivery System and Training Needs for India," VIKALPA: The Journal for Decision Makers, Vol. 7, No. 3, July-Sept. 1982.(14) (11)

1. See Ashby for an excellent Introduction to Cybernetics.(2)
2. Most management systems have more than one objective (in addition to program constraints on "what we will not do" and budget limitations) and, therefore, the plural, "Results" is appropriate. A great deal of time is wasted, oftentimes highly counter-productively, on attempts to weigh multiple objectives so that they all collapse into one grand index of performance. This is usually an apples and oranges exercise. It is much better to state the objectives separately, and measure the separate results, so that the decision-maker can use these subjective evaluations to make relevant tradeoff decisions.
3. It is "closed with respect to values", however, only in the short-run. Values may, of course, change over the long-run through explicit, step-wise, decisions emerging from critical review.
4. See Harvey Liebenstein's article on "X-Efficiency" for a similar view.(10)
5. These success stories, not coincidentally, generally occurred in open economies who depend on foreign funds and thus under competitive pressure to perform — and reform internally. They have also encouraged the dreaded multi-nationals to enter their domestic economy and compete — with additional benefits to local organizations. The multi-nationals provide excellent management training grounds for local people who then create their own enterprises in generally successful competition with their teachers — as all good students should. A review of the World Bank's annual World Development Reports indicates a very close correlation between economic growth and the degree of openness of the economies of the developing countries.(17)

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13
Land and Water Resources: A New Perspective on Economic Development

Daniel W. Bromley

Traditional treatments of economic development pay scant attention to natural resources, except as inconvenient constraints on the process of increasing national income, or employment, or whatever indicator is taken to be a measure of "development". True, the literature on irrigation is vast, as is that concerning land reform. But the bulk of this literature does not deal with land and water in some fundamental conceptual way, rather considering land and water as mere inputs into the production process; inputs to be treated analogously to the way that labor and capital are treated.

I want to draw your attention to the critical role of natural resources in economic processes in the developing countries, and I propose to accomplish this by focusing on two extremes in natural resource use -- the labor intensive rice economy of Southeast Asia, and the land extensive livestock economy of arid Africa. The purpose of this discussion will be to lay stress on the crucial institutional and technical components of the local economy -- especially as institutions and technique influence control over -- and access to -- natural resources. Of equal importance, it will be possible to emphasize the important difference between institutional problems and their solution, and technical problems and their solution.

I will start by defining some concepts of importance for the following discussion, and I will then turn to a discussion of the rice and grazing economies. Next, I will outline the traditional "development response" to perceived problems in these two cultures. Finally, I will close with some comments about the missed opportunities arising from this traditional approach when dealing with resource problems in the developing countries.

I. SOME IMPORTANT CONCEPTS

I will refer to economic growth as a measured increase in per-capita national income for the economy under study. I will refer to economic development as the result of structural changes in an economy that bring about new input-output coefficients in a Leontief model. It should be clear that growth may occur without

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development (the value of an export crop increases through external price changes), and that development may occur without growth (structural change in the economy that somehow leaves the per-capita social dividend unchanged). Under the above definitions, economic growth is not a very interesting phenomenon to the economist — it is structural change that matters, such as, new employment opportunities, new processes being discovered, new ways of doing traditional tasks, and new tasks that were heretofore impossible. But, simply to talk of changes in productive relations without assigning some direction to such changes is incomplete. Hence, I will follow Seers and consider development to be that subset of changes in productive relations which represent increases in productivity.

Our next concept of interest is that of a resource, of which land and water are two important examples. Let us start with the idea of a "resource". The adjective "natural" is often added, though there is often confusion about how much processing is required before a resource ceases to be a "natural" resource. But the more pertinent issue for us concerns the exact meaning of a "resource". In simplest terms, a resource is something with value to man — directly or indirectly. Coal and wood are resources, but so is solar energy, though it was only recently (since the advent of solar collectors) that is has been considered to be a natural resource that we can manage. However, plants are solar collectors and we daily use solar energy embodied in plants.

The second aspect of a resource is that it can be controlled by humans. That is, man could control solar energy through its manifestation in plants, but he could not control the solar energy directly. So solar energy has always had tremendous economic value to man, but it was not a natural resource in the sense that it could be controlled (its access denied until the payment of a fee was offered). Now with marketable solar collectors it is possible to harvest and sell the sun's energy directly rather than as the embodied energy in a tree. Once this happens we begin to think of solar energy as a resource in the same category as energy from coal (former plants), or from wood. In a sense, solar energy trapped by a collector represents foregone future sources of energy in the form of wood or coal. Although it is not particularly scarce, such rays collected on my roof mean that a possible tree is without that energy.

This discussion should remind us that a resource is defined by two aspects of the particular society under study — its technology, and its institutional structure. Gravel was not a building resource for primitive peoples because the technology (knowledge and tools) for making concrete did not exist. Solar energy was not a natural resource for us in the direct sense until the technology appeared to make its capture and use on demand possible; and until the institutional arrangements for controlling it became common. These institutional arrangements are still being resolved. Zoning laws regarding the blockage of a collector by a neighbor's trees are still under development. The demand for the technology and the institutional arrangements has been stimulated by the apparent economy of solar energy vis-a-vis more conventional energy sources. This brings us to the third aspect of a resource.

Resources, because they do not exist outside of a particular technical and institutional milieu, are not defined once and for all, but rather "become" as institutional and technical conditions change. As new things become scarce and valuable, it becomes economical to change the way we do certain things. Part of the process of change is the recognition that new inputs are available. When those inputs become defined in such a way that they can be controlled, then a new resource has been created.

For completeness, we must consider those things that have not yet assumed economic value (that is, have not yet become resources), and those things that have a negative economic value (that is, are negative resources). We will call the first non-resources, and the second neg-resources. In a community of plants and animals, certain plants provide sustenance to the animals, and others are of no account to the animals. If man relies upon the animals for sustenance and materials, then not only are the animals a resource, but so are the plants that sustain those animals. Man manipulates the plant community to provide for himself directly, and for himself (indirectly) through the animals.

Those plants with economic value to man as processed by the animals are resources as much as are the plants that man uses directly. But there are some plants that are quite incidental to both man and animal; these are the non-resources. It could very well be the case that over time a non-resource could become a resource. Gravel, as mentioned previously, would be an example. Likewise, sand became a resource for making glass once that technology became known.

Let us now consider neg-resources. A neg-resource is something with negative economic value to the human enterprise -- either directly or indirectly. Malaria and schistosomiasis are neg-resources, with the intense search for cures (preventative measures) at least having neutralized the impacts of the former. Indirect neg-resources would be plant diseases, or plants that are poisonous to valuable animals.

Before proceeding, it is worth discussing, if only briefly, the delicate balance that often exists between something being a resource (having positive value) and something being a neg-resource. Water, when controlled to give it time, form, and space utility is the essence of a valuable natural resource. Yet if water is not controlled it can easily become a significant neg-resource; flooding is a case in point. Hence, we see that the same item, depending upon its location, amount, and human use, can be both a resource and a neg-resource. The distinction is seen to lie in the human effort that evolves to both benefit from it, and contend with it.

Within the class of resources, there are renewable and non-renewable resources. Coal and uranium are examples of non-renewable resources — resources the regeneration of which is too slow to be of economic significance. These resources are often referred to as exhaustible since as they are used the total amount left for the future is diminished. Renewable resources are those that have a "flow" aspect to them as opposed to mere stocks. Grass, trees, a ground water aquifer, and solar energy are renewable resources. With living resources such as grass and trees it

is possible to utilize so much of the resource in a particular time period that its ability to remain viable is jeopardized; its sustainable yield has been exceeded such that it is driven to exhaustion. An aquifer, although not a living resource, also has a use rate which if exceeded will lead to a decline in the annual yield from the aquifer. We refer to this level of use as having exceeded the "critical zone". Finally, some renewable resources continue to yield irrespective of the level of use in the current period. Examples of renewable resources without a critical zone are solar energy, and the annual flow of a river or a spring. These distinctions will become important in our subsequent discussion of the livestock economy of Africa.

We need now to turn our attention to the matter of institutions and technique — the two aspects of a social system that give meaning to the term "resource" (or non-resource and neg-resource).

Any social system requires the establishment of rules and conventions whereby individuals are able to discern acceptable from unacceptable behavior. We refer to these rules and conventions as institutions. Some institutions define social relations at a rather abstract level — who may vote, how the society will organize itself, whether the state or individuals will own and control the productive assets of the society (socialism versus capitalism), and how the rules will be changed in the face of new problems and opportunities. We refer to this level of institutions as the "constitutional" level.

But an economic system is organized around rather more basic rules — such things as who owns this piece of land, who has the right to hire labor to work on that land, what the going wage will be for a certain type of work, and what price must be paid to acquire the seeds to be planted on that land. Here we have institutions at the "operating level" of the economy. At this level institutions define the "choice sets" of the going concerns of the economy (Commons). Institutions both constrain and liberate human action; they indicate what can and cannot be done to whom — and by whom. They guide, sanction, and control individual maximizing decisions. Institutions define individual and collective choice sets.

We must be careful to draw a sharp distinction between institutions and organizations. Institutions define organizations and hence organizations are but the physical manifestation of a complex set of rules and conventions (institutions). While universities, hospitals, and other agencies are often referred to as "institutions", this is not correct [Bromley, 1982 (b)].

The final concept that we must understand is that of technique. Technique represents a combination of the physical capital of an economy and the human capital that operates that asset (as well as creates new physical and human capital). But technique in the absence of an institutional structure is nothing -- what matters is the institutional environment within which that technique operates [Bromley, 1982 (c); Cordell]. When economists talk of the "rice technology" of Asia what is meant is the combination of plants, machines, tools, land, labor, water, and the knowledge of how to combine these disparate inputs into something of economic value. But it is the institutional arrangements which permit that

combination and which guarantees an income stream from the enterprise. It is the operating rules that define land-use patterns, water control practices, marketing opportunities, labor obligations and opportunities, and the conventions that dictate access to -- and the costs of -- capital markets.

II. RESOURCE USE CONSIDERATIONS

Let us now turn to land as the dominant resource in agriculture, and concentrate on the intensity of land use. If we define intensity of land use in terms of the level of capital and labor applied to land per unit of time -- and this would be a definition consistent with that implied by Boserup -- then it is possible to depict the intensity of land in some functional relationship to the net returns per hectare of land. Consider Figure 1.

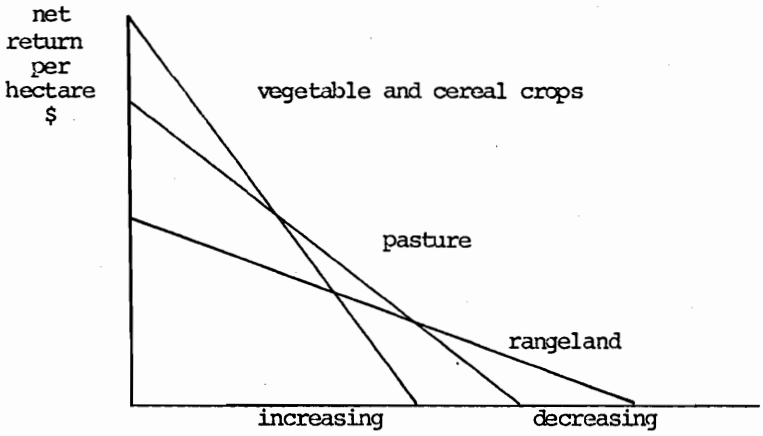

Figure 1. Intensity of Land Use

Here we see net returns per hectare as a function of the intensity of land use -- defined in terms of labor and capital applied per unit of land. We see that vegetables and cereals (especially rice) represent the extreme in intensity of use, but that they also return the greatest revenue per unit of land. Moving out to less intensive uses we find pastures. Ultimately, at the extensive margin, we encounter livestock grazing and forestry.

Another aspect of intensity is worth mentioning here; a low intensity of land use also means a low capacity to support people per unit of land. It also implies a low suitability for direct human consumption of what grows on the land. In this respect livestock -- but not people -- can utilize the ground cover, and then people utilize the livestock. That this results in a considerable loss of energy through the conversion process is now well understood. Finally, we come to the matter of institutional

arrangements as they relate to the intensity of land use. Following the work of Geertz it is now well understood that the increased intensity of land use carries with it the necessity of developing ever more complex institutional arrangements to control both the use of ever-more critical (and hence valuable) resources and techniques, but also the income streams created thereby. These relationships are summarized in Table 1.

Table 1. Attributes of the Intensive and Extensive Margins of Land Use.

	At the Intensive Margin	At the Extensive Margin
Returns per Unit of Land	HIGH	LOW
People Supported per Unit of Land	HIGH	LOW
Share of Output Directly Consumed	HIGH	LOW
Institutional Intensity	HIGH	LOW

I propose to explore natural resource use at each of these two extremes, focusing on the interplay between institutions and technique. Out of such a discussion it will become clear that agricultural development is, at its most fundamental level, a process whereby institutional and technical components of an economy are refined in response to incentives and sanctions that ultimately determine the level of "real income", broadly defined. That is, the absence of such refinement in institutions and/or in technique becomes the focus of attention for the economist interested in assisting in the development process. We will be interested in the reasons why such refinement does not occur, and how that process might be facilitated.

The Intensive Margin

Asian rice culture epitomizes economic life at the intensive margin. It also provides a convenient illustration of the role of institutions and technique as they relate to land and water use. The essential relationship in rice culture is one of physical interdependence among irrigators — if farmer A near the head of the watercourse takes water there is, by definition, less for farmer B downstream. We can think of irrigation water during a season as a stock (or non-renewable) resource W*, and the total use is then:

$$W^* = WA + WB + \ldots + Wn$$

for the n farmers along the watercourse.

The water that is available for farmer i is then:

$$Wi = W^* - WA - WB - \ldots - (Wn-1)$$

The production functions for farmer A, and another farmer on

the watercourse (say farmer D) would be:

$$YA = Y(SA, FA, PA, LA, WA, KA, TA)$$
$$YD = Y(SD, FD, PD, LD, WD, KD, TD)$$

where:

SA & SD = Seeds
FA & FD = Fertilizer
PA & PD = Pest Management
LA & LD = Labor
WA & WD = Water
KA & KD = Capital
TA & TD = Land

However, this formulation blurs the real nature of the physical interdependence between the two irrigators. It would be better to rewrite their two production functions as:

$$YA = Y(SA, FA, PA, LA, WA, KA, TA)$$
$$YD = Y[SD, FD, PD, LD, h(WA), KD, TD]$$

It should be clear from the foregoing that h(WA) is not a variable which is under the control of farmer D and hence a technological externality is seen to be present. Water use on the irrigation system is not being efficiently allocated among farmers since farmer D's access to water is a function of the quantity claimed by the upstream farmer(s). A more complete exposition of this inefficiency is given in Bromley [1982 (b)].

Water on an irrigation project -- in the absence of institutional arrangements to control its allocation among farmers -- is analogous to an open access resource; it is there for anyone to capture, much as fish on the high seas. That is, without institutional arrangements to control water use, it becomes a fugitive resource (passing by in the watercourse) that must be captured to be controlled. Each farmer along the watercourse is compelled to take as much as he thinks he can "get away with". Indeed, even when institutional arrangements exist to allocate water, compliance with the rules is not always what we might hope for (Thomson; Wade). Hence, not only is efficiency of resource use a problem, but equity among irrigators becomes a very important consideration [Bromley, Taylor and Parker).

Here we see a very basic problem in land and water use that insures that total food production in the developing countries is much less than it could be if water were allocated efficiently. Moreover, a subset of farmers (those at the head of a watercourse) will often have a considerable advantage over those less fortuitously located. The excess water use by those able to capture it early in the watercourse means that an artificial water scarcity is created on an irrgation system that not only distorts the efficiency of water use, but also affects the efficiency of the use of other purchased inputs [Bromley, 1982 (a)].

Let us now shift to the other extreme in land-use intensity.

The Extensive Margin

The African livestock economy represents the polar extreme compared to the rice economy of Southeast Asia. In the livestock economy water is no less important than in the rice economy, but its control — and the technique of its use — is sufficiently different that it merits a distinct treatment. In the livestock economy an ecosystem that is not well suited for crop production is still capable of supporting human life through the use of animals as "harvesting devices". Weather determines the availability of both water and vegetation, which then co-determine the number of livestock that can be supported. Humans enter here by recognizing that livestock can be helpful, but that they are also competitive with us; if milk is needed to nourish young animals then it is not available for human consumption.

This four-part relationship (weather/vegetation and water/ animals/ humans) depends upon a stable institutional environment which allows individual agents to act in their own private interest — as well as to act so as to contribute to the collective good. The large literature on the so-called "tragedy of the commons" addresses this problem, although from a faulty theoretical foundation. By misspecifying the cause of the problem, the "solution" is thus misplaced (Ciriacy-Wantrup and Bishop; Runge).

The natural resource problem at the extensive margin is fundamentally the same as it is at the intensive margin — a problem of faulty institutional arrangements that fail to create assurance on the part of resource users; just as irrigators have every incentive to capture as much irrigation water as possible before their neighbor does, so do livestock keepers have the same incentive to "capture" vegetation. However, among graziers it is not correct to assume that this institutional uncertainty has always been a problem. Indeed, there is impressive evidence that rather more primitive societies had managed to control excessive resource use (Netting; Runge and Bromley). What has happened to upset these indigenous institutional structures?

One prominent cause must be recognized as the breakdown of autonomous economies — that is the rise of the open economy over the past several hundred years. This opening up of economic activity has meant that existing production systems are no longer driven by local demand, but are instead also responsive to exogenous demand conditions. Under a closed economy local production is dependent upon local needs; once opened up to another economy — with its accompanying wealth and price relationships — there is another set of demand relationships to be considered.

Indeed, the essence of modernization has been to open up economies to external demand pressures in the hopes of earning foreign exchange. We have elaborate theories to show overall efficiency is enhanced when each region of the world produces those goods for which it has the greatest comparative advantage, and then engages in trade to acquire other needs. While all very elegant and compelling, such reasoning requires recognition of a set of prices that presumably reflect the "true" social scarcity of all traded goods. When we have reason to suppose that there is a divergence between values in use and values in exchange, then it is not clear that social welfare is enhanced by doing what is merely

"efficient" as defined by local costs and foreign prices.

Not only are world prices suspect as a metric of social value in a local economy, but the cost structure is open to question. In many instances these costs are an artifact of colonial legacies. In these cases relative prices for natural resources and labor are simply reflective of the political and economic power of the colonial administration vis-a-vis the local (or national) structure.

When economies are open to external trade it means that relative prices in no way can be relied upon to act as guides to resource scarcity — this is especially the case if the exporting country is one of a number of suppliers of a commodity to few buyers; here the local supply could be completely exhausted with little change in resource prices. When buyers and sellers differ greatly in terms of economic and political power then efficiency as a desirable norm loses much of its appeal (Dobb; Mishan 1971, 1974).

An interesting account of the process of "opening up" has been provided by Swift. The Somalia livestock economy was based upon clan ownership of shallow wells and tanks, and the grazing patterns were determined by custom, and what deals could be struck with well owners and other herders. In this system water in the shallow wells provided an effective upper bound on grazing pressure (on the vegetation). While such water is a stock resource during one grazing season, it is definitely a renewable resource across seasons; when a well gave out the herders would move on to another location. Because water is a resource without a critical zone, using all of the water in a shallow well or in a tank did not jeopardize that amount available for the subsequent season.

Within this closed economy demand for meat and other livestock products was simply a function of local needs. When disaster would befall one of the herders the others would combine to restore to that individual a small herd from which he might make a fresh start. While extra animals certainly bestow wealth and status in such an economy, it is equally desirable to be able to show one's magnanimity toward others; after all, you may need that gesture yourself some day. Moreover, if most others in the area also contribute then no one "loses ground" in a relative sense.

In such an economy cash did not play a very large role; it was essentially a barter economy. But with the advent of an open economy livestock began to acquire a value beyond that which arose from local conditions. By being able to sell livestock cash was introduced into the economy. The presence of cash reduced the currency of certain commodities since they were no longer used as a medium of exchange. The access to external markets opened up new opportunities for some individuals within the economy -- livestock could be sold for cash to acquire such things as fencing material, and pumps for deep wells. This external investment — far from being beneficent as we so often assume — instead created a serious problem. That is, since well water no longer gave out as soon as it did previously (since the wells were now deeper) the livestock could stay in a particular area longer than was previously possible. That this led to serious overgrazing should come as no surprise.

Now with the water lasting longer it was possible to graze the

vegetation to such a level that the critical zone was exceeded -- not just one year but in every year. An investment in a natural resource without a critical zone (water) allowed ever greater use of a resource with a critical zone (vegetation) until the latter resource was almost destroyed. Here, as is so often the case, a technical solution (investment in wells and fences) without the necessary institutional modifications has only managed to exacerbate an already serious situation.

This is, of course, not the only result of opening up the Somalian livestock economy to external forces. Social stratification increased with the rise of a merchant class, and eventually a livestock owning (capitalist) class. Herders that were once "family operations" became, instead, wage laborers for livestock owners. The transition from a subsistence economy based on domestic consumption to a commercial economy based on export was completed. When livestock died the hired herder was to blame and the owner would need a negotiated loan to restore his herds. When livestock acquired value driven by external conditions the incentive to vaccinate was increased and so led to larger livestock numbers -- and yet more pressure on the land.

The external market destroyed the former relationship between people and their animals. The funds arising from exports modified the economy's capital stock (new wells and fences) and so destroyed the former relationship between people and land. And, this too was destructive of the land-animal relationship. As indicated previously, the critical relation between water and livestock was replaced with one between plants and livestock. Now vegetation was the binding constraint on carrying capacity. But, in the absence of sufficient institutional arrangements over vegetation use the former balance could not be maintained and overgrazing resulted. Ownership of wells fell into the hands of wealthier individuals and payment for use was soon demanded in cash -- further compounding the pressure to sell livestock in external markets rather than keeping only enough for domestic needs.

We see here a familiar pattern in natural resource use in the developing countries; external demand conditions swamp the local economy and override any capacity for existing institutional arrangements to contend with the new conditions. Vested interests emerge as a few individuals capitalize on the new entrepreneurial opportunities. New institutional arrangements evolve to legitimate de facto conditions, and a new "status quo" has been defined.

III. THE DEVELOPMENT PROCESS

Because institutional arrangements define choice sets for individual and collective economic agents, natural resources have meaning to individuals (and to collectives) only with respect to a particular technical endowment and institutional structure; it is this structure that defines relative values, it is this structure that determines scarcity (and hence prices), and it is this structure that indicates which costs of resource use will be considered by those in a position to make decisions about use rates of natural resources. For instance, if the institutional arrangements over

the use of toxic agricultural chemicals are favorable for those wishing to control plant pests then costs may be imposed on others that can be ignored by the farmer applying the chemicals. On the contrary, if the institutional structure is more protective of those not wishing to have pesticides in the area then the costs to those individuals (the damages that they would incur in the presence of pesticides) cannot be so easily ignored by the farmers wishing to spray [Bromley 1979, 1982 (b); Mishan 1971, 1974].

At the local level where resource-use decisions are made on a daily basis, the institutional structure is seldom the focus of analytical attention. Yet it is this structure that creates the incentives and sanctions for a particular pattern -- and time path -- of resource use. And, of equal importance, this structure influences the appearance of feasibility of external investments in the local natural resources; the appearance of feasibility is stressed since new income streams are defined by this institutional structure.

The distinction between rates of resource use and investments in existing (or new) resources is worth elaboration. Indeed, this distinction will serve to remind us that most of our attention in development programs is focused on the investment aspect, and little has been devoted to the management problem. How might we characterize the two types of activities?

By the management problem we refer to adjusting use rates of natural resources. That is, the management problem is really a task of institutional design -- of creating a set of sanctions and incentives that will produce a pattern of resource use consistent with some social objective. At the local level one use pattern may be sought; at the national level quite another pattern. Usually, rules are promulgated at the national level in an effort to influence resource use at the local level. Unfortunately, the history of such rules shows that they arise only after serious resource depletion has occurred, and that they are developed with little consideration given to pressures created at the local level, where people must somehow survive under a new institutional structure that appears to be quite arbitrary. This is usually compounded by the absence of any substitutes for the suddenly banned resource and by the administration of the new institutional arrangements from the "top down".

Examples are found in areas where deforestation is severe, and then suddenly all cutting of timber is outlawed. When such rules are accompanied by a lax enforcement effort then we cannot expect much good to come from their creation. In irrigation projects, if the institutional structure is not in place prior to when the water becomes available, it is reasonable to anticipate that those in a position to appropriate much of the water will do so -- and then subsequent reallocation in the interest of efficiency or equity will be much more difficult than if such rules had been in place from the very beginning (Bromley, Taylor, and Parker).

On the other hand, the investment problem is one in which the physical capital stock of the local economy is augmented by the infusion of new financial and technical resources. We can relate the management problem to the investment problem by making reference to a renewable resource such as livestock forage. The

management problem is one of adjusting current grazing patterns such that the forage resource is enhanced over time. When that adjustment fails to take place, serious depletion occurs (Swift). In a technical sense we invest in renewable natural resources such as livestock forage by reducing current use rates; foregone grazing now is an investment in the future resource.

The traditional investment problem in agricultural development has tended to focus on planting trees, or building irrigation structures, or planting range forage. But, there has been a minimal concern with the institutional arrangements that control use rates of the various resources being augmented; not surprisingly, the record of success is not one to which we can point with pride.

This discussion of the distinction between investment and management was intended to highlight the extent to which we have been greatly concerned with the former and largely ignorant of the latter. It is much easier for development projects financed by external donors to concentrate on investments than on solving difficult management problems. Investments can be formulated in terms of projects and so can be seen to conform to the standard operating procedures of the development assistance agencies. Investment projects also can be defined in terms of financial commitments. Finally, the external country can appeal to its need to remain "neutral" by not interfering with indigenous institutional arrangements. Investment projects are considered safe for the external participants for precisely the reasons that investment projects fail to deal with the very institutional failures that created a natural resource problem in the first instance.

We would not wish to leave the impression that the host country is innocent in this preference for investments in natural resources over programs to improve natural resource management. Host governments and those interests represented by powerful elites like to think in terms of projects just as do the international development agencies. Secondly, host governments seem to have an affinity for the large grants and concessional loans that accompany investments. Finally, a host government would be subject to extreme political criticism if foreigners were found to be tampering with traditional institutional arrangements over natural resource use and control.

Put most simply, investments are politically safe for both the donor and the host countries, while management programs are not. Investments have the aura of Pareto safety; management programs imply a redistribution of advantage within a fixed resource base. To wait for the payoff from an adjustment in current use rates is often considered too costly. How much more appealing to install physical infrastructure -- ditches, trees, tubewells, fences, and range grasses -- and ignore the institutional arrangements that will ensure their long-run viability.

IV. IMPLICATIONS FOR NATURAL RESOURCES AND DEVELOPMENT

Natural resources have socioeconomic significance only with respect to a particular technical and institutional structure; the institutional structure defines who may control those resources,

and that structure determines relative prices. To insist that relative prices are determined in markets is to beg the logically prior question of who controls the institutional arrangements that define any particular exchange process. This means that the benefits and costs of any particular action taken with respect to those natural resources are also determined by that institutional structure.

Forests and rangeland are depleted, water is rendered unfit for human consumption, farm laborers and their families are poisoned by powerful pesticide, soil is washed away. These situations persist because of a dissonance between technique and institutions. In central India the poorest families cannot afford cows or buffalo and so graze sheep and goats for a livelihood. The institutional arrangements that may have worked for cows and buffalo (a choice of technique) will most surely not work for sheep and goats (a different technique).

The failure of governments to create needed institutional change means that as population increases, more and more people will be forced to use land (and other natural resources) of decided inferior quality. In Latin America we see large ranches in the valley bottoms, while the campesinos are confined to the steep hillsides. Survival requires intensive cropping of these hillsides even though erosion is a serious problem. When the government finally decides to act it is more likely to deal with the symptoms of the problem by forcing the hillside cultivators to move. The larger institutional structure that allows ranchers to tie up large areas of fertile land -- often to raise beef that will be exported -- is rarely questioned by those with political power.

The missed opportunities in development assistance at both the intensive and the extensive margins could be rectified by a recognition that the management problem is usually of greater importance than is the creation of new physical infrastructure. In matters of irrigation, a case could be made that economic development would be enhanced via a moratorium on the construction of new irrigation projects in favor of more careful management of the water on existing systems; indeed I would argue that until countries stop investing in new irrigation projects they are not forced to consider the full social costs of the current operation of existing projects. As long as the myth persists that yet more projects hold the answer to the development problem then existing projects will be ignored. With a moratorium on new irrigation projects, the full social costs of the gross mismanagement of existing projects would become patently clear. Then we would see national governments -- and donor agencies -- showing the proper concern for natural resource use.

At the extensive margin we must abandon our desire to create ranches in the image of the western United States. Cultural antecedents must be recognized as holding the only prospect for a sustained solution to the overgrazing problem -- and we must fashion our development assistance in light of those realities (Runge).

In summary, I submit that economic development activities concerned with natural resources are misguided in two general respects. First, we tend to deal with technical innovation -- new technique -- to solve institutional problems. Second, when

institutional change is employed, it is often for the wrong reasons, directed towards the wrong problem, and carried out at the wrong level. To a certain extent this is the result of an incorrect definition of the problem (Runge; Runge and Bromley). But it also results from an unwillingness to confront those who possess political power.

Technical change has the advantage of being apparently Pareto safe, while institutional change holds certain threats for those currently advantaged by the status quo. Economists feel comfortable dealing with technical change and quite uncomfortable with institutional change, largely because of our training where we learn that market exchange will produce economic efficiency. But it also can be traced to the belief that the structure that defines the market — here termed institutional arrangements — is not an area of legitimate scientific enquiry (Tribe).

With this view of the role of the "objective" scientist, we are circumscribed from bringing analytical skills to bear on the very structure that determines natural resource use patterns in the developing countries. I would argue that investments in agricultural projects (whether at the intensive or the extensive margins) should be drastically curtailed. This would then force the hand of those who continually hide behind the myth of Pareto safety in new investments. I would, instead, channel financial aid into urbanizing regional growth poles where infrastructure is clearly deficient. Not only would this solve the capital problem in such areas, but it would provide badly needed jobs for the squatters already there. I would be prepared to let a dualistic agricultural structure survive, and would urge institutional innovation to ensure that the small holder sector did not get abused at the hands of the commercial sector.

Most significantly, I would insist on the design of development assistance programs that created security of expectations among farmers with respect to natural resource use -- whether irrigation water, fuelwood, or forage. Such expectations would do more to solve the resource problems than all of the dams, ditches, fences, and tubewells that we might — in our more euphoric moments -- imagine.

This emphasis on institutions rather than technique would not be easy. All it has going for it is that it could be no worse than the status quo; my hypothesis is that it would be significantly better.

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14
Water Use Management in Development

Everett V. Richardson

In irrigated agriculture, water is an independent variable and a limiting element in food production. Water applied in the correct quantities and frequencies will maximize the effect of other inputs such as fertilizers, seeds, farmer practices, etc. The independent variables in crop production are listed in the following equation:

C.P. = d (Irr, Dr, Sd, SB, PP, FR, P.C., CC. Fr, En, SE.)
C.P. = Crop Production - Yield
Irr = Irrigation
Dr = Drainage
Sd = Seeds
SB = Seed Bed Preparation
PP = Plant Population
FR = Fertilizer
P.C. = Pest Control
C.C. = Cropping Pattern
Fr = Farmer Practices
En = Physical Environmental (climate, soils)
SE = Social-Economic environment

All these variables are important. They are interrelated and nonlinear in their affect on crop production.

Poor control and management of water in the delivery system and the on-farm management of the application of water has decreased the yields that are attainable from the Green Revolution. Every irrigation project in the World is not reaching it's potential. This is true in Pakistan, Sri Lanka, India, Egypt and in the United States. This fact has been well-established by Colorado State University's Pakistan Water Management Project (Clyma and Corey, 1975), Egypt Water Use and Management Project (Richardson, et. al., 1976 and Richardson and Brooks,

1979) and Water Management Synthesis Project (Clyma, et. al. 1982). Also many other investigators such as Chambers, (1977), Wade, (1980) and Wade and Chambers, (1980), have detailed the results of farm water management. The problem of poor farm water management is so well-recognized that FAO has established an International Support Program for Farm Water Management, the International Development Council has seriously considered establishing on-farm water management research centers and the U. S. Agency for International Development has given the improvement of farm water management top priority in those countries where irrigated agriculture is an important part of food production.

Improved farm water management has increased crop production from 15% to 200%; increased irrigation efficiencies 30% to 60% (from 20% to 40% efficiencies before improvement to 50% to 75% after; irrigation efficiency is defined as the ratio of the amount of water stored for use by the crop to the amount of water delivered to the individual farm); saved 20% to 50% of the water delivered to the water course; increased the amount of land area under irrigation, and in some cases increased the area of land cropped on an individual farm by 10% to 15% (Lowdermilk, et.al., 1975; Freeman, et.al., 1977; Kemper, et.al., 1980; Ewup, a,b, 1983; Hanson, et.al., 1983; Mischa and Forester, 1983). The increase in land cropped on a farm resulted from decreasing the amount of surface area taken up by oversized ditches and drains. Eckert, Dimick and Clyma (1975) reported that a farm water management program in Pakistan consisting of water course improvement, precision land leveling, and transfer of knowledge (extension) to farmers of modern irrigation techniques, plus complementary agronomic practices had a benefit-cost ratio ranging from 1.7 to 3.8. The lower increases in crop production have occured where water management or other agronomic practices have been inadequate because farmers could or would not follow the complete recommended package. Even where crop production increases were not large, water savings of 10% to 20% resulted.

The Egypt Water Use and Management Project (EWUP, 1983a) reported production increases for rice of 30%, cotton, 36% to 40%, wheat, 80%, and maize, 200%. These increases were realized with a 34% decrease in water use and a 33% decrease in time the farmer spent irrigating. Even these increases in production, decreases in water use, and increases in irrigation efficiencies are far less than the potential. For example, EWUP, (1983b) reported average wheat production increases from 1.1 tons per acre to 1.6 tons, with maximum wheat yields of 2.5 tons per

acres. It is not uncommon in irrigated agriculture to get 3 to 4 tons per acre. The reason the increases are not at potential is that it takes time for farmers to learn good on-farm water management and to overcome all the constraints.

What is farm water management? It includes the on-farm water delivery, application and management system (on-farm water management). It includes the operation (O), management (M), and maintenance (M) of the water storage and delivery system (delivery system O & M) because the delivery system, depending on how it is operated and managed and maintained, can either help or impede on-farm water management . It includes the associated agronomic practices and thus the delivery of all the other inputs necessary for optimal economic crop production. "Farm water management" is more inclusive in its definition than "farming systems" in that by necessity farm water management includes the water delivery systems. It thus, by necessity, includes the Ministries of Irrigation whereby "farming systems" appear to be delegated to Ministries of Agriculture.

The above definition of farm water management is more inclusive than that implied by Eckert, Dimick and Clyma (1975). They stated:

> An effective water management program must contain three elements:
>
> 1. Watercourse improvement.
> 2. Precision land leveling.
> 3. Irrigation and irrigated cropping extension.
>
> All deserve high priority. It should be emphasized, however, that if farmers continue their present irrigation and cropping practices, then the potential benefits from either water course improvement or precision land leveling are limited. Therefore, while extension and information transfer programs may be much more difficult to implement and their benefits harder to quantify than other components, it is essential that they receive just as much or more emphasis and full coordination within the overall program. In fact, all three components are interdependent, just as much so as nitrogen, phosphorus and water inputs to wheat. A coordinated balanced program is

> essential if Pakistan is to realize the full potential of increased food production through better water management.

This statement, in as far as it goes, is very true, but it does not include the very important factor of the delivery of water to the farmer. Farmers most often cannot effectively change their present irrigation practices without improvement in water delivery systems.

In most Lesser Developed Countries the delivery of inputs (seeds, fertilizer, water, pesticides, knowledge, etc.) is from governmental agencies. In general, there is a Ministry of Irrigation who controls, manages and operates the water delivery system down to the farm outlet (moga in Pakistan, pipe to meska in Egypt). This farm outlet generally doesn't serve an individual farmer as in the United States but serves many farmers (5 to 100). These farmers have the responsibility for the water in the watercourse downstream from the outlet. In theory, the farmers should operate, schedule and maintain the watercourse. In fact, it is laissez-faire with each farmer taking the water when and if it is available. The Ministry of Irrigation (MOI) only intrudes if the system becomes so intolerable that a large number of farmers on a watercourse complain to MOI officials. The MOI operates the delivery system as a "water disposal system" as efficiently and as effectively as they can. The system generally operated either on a rotation basis or continuous flow basis. On a rotation basis, canal gates to a system of watercourses are open for a period of days, 4 - 6, called the "on" period; and then closed for a period of days, 4-16, called the "off" period; the size of the opening to a watercourse being established by the amount of land it serves. On a continuous flow basis, water (when available), is delivered continuously in a set amount depending on the area served by a watercourse.

Farmers on a watercourse are supposed to take turns and schedule the water among themselves. There is severe maldistribution of water among the farmers on a watercourse with the tailenders suffering the most. The system typifies the statement made many years ago by a Nebraska farmer, "I'd rather be at the head of a ditch with a shovel than the tail with the best water right." The MOI, unless asked, and farmers in the LDC's have learned it doesn't pay to ask, takes no interest in the water beyond the farm outlet (scheduling, maintenance, irrigation methods, etc.). The MOI wants the system to operate with precision,

like an Army, with water at the farm outlet at the proper time in the proper amount. Unfortunately, because of the lack of resources, even this ideal is not realized. Canals, headgates, moqas, mesqa's etc. need repair. Often officials take pay to alter the schedule or amounts (Wade, 1982); thus, the statement that Ministries of Irrigation are not operating an irrigation system, but a water disposal system. The most important reason for delivering water--the irrigation of crops to maintain the correct water regime in the soil for optimal economic production--is not considered.

The Ministry of Agriculture (MOA) has the responsibility for delivery of all the other inputs for growing crops (pesticides, credit, fertilizers, farm machinery etc.). For many crops, they are also the market. They set prices for the inputs and for the output. Thus, the MOA in many countries is a tax collector because he sets a low price, purchases the major crops, and sells high on the world market or low to in country consumers.

Like the MOI, the MOA is a disposal system not a farming system. They want to dispose of seeds, fertilizers and pesticides. They try to contribute knowledge, new practices and new methods of pest control. They do contribute new seeds and fertilizer because they are the source of supply, often the only source. But the knowledge transfer of advances in seedbed preparation, application of pesticides (when, where and how), use of fertilizers, etc. is ineffective. That is, the MOA's extension service, if it exists, operates very poorly. I suspect it's because it is modelled on the U. S. system. That is, a <u>passive</u> transfer of knowledge -- field days, demonstration farms, subject matter specialist in major rural centers, demonstration farmers, pamphlets, radio station and TV commercials. Whereas, what is needed in an LDC is an <u>active</u> extension service -- transfer agents and subject matter specialists out working on the farms with the farmers, daily or weekly contact with the farmers, showing and helping. Extension workers should be actively working with the farmers to 1) identify his problems, 2) searching out solutions and 3) helping him implement solutions. What are needed in the MOA are field teams serving 5 to 10,000 acres made up of general purpose agronomists, sociologists, economists, agriculture (irrigation and farm machinery) engineers. These teams should have access to subject matter specialists such as entomologists, soil scientists, etc. who serve a larger land area. These people exist in the MOA in most LDC's, but most are in the large cities, in experiment stations or travelling abroad getting educated.

In most LDC's, neither Ministry helps the farmer to improve his irrigation practices. To contribute knowledge on how and when to irrigate, to help level the land, to help him determine when to use furrows or when to use basins, how deep to maintain water on paddy rice, how to manage his irrigation system, to organize and maintain the watercourse and to schedule irrigation turns with his neighbors.

In irrigated agriculture the application of the water on-the-farm falls through the cracks in the responsibilities of the two Ministries. In actual fact, the MOA, even if it took the responsibility to transfer knowledge on on-farm irrigation would only be partially successful because so much of proper management of on-farm irrigation depends on the MOI's operation of the delivery system.

To improve farm water management takes the resources of both Ministries. The MOI's must assume the responsibility of what happens to the water on the farm. They must establish a linkage with the farmers. They must be willing to modify the delivery schedule of water if it will improve irrigation. That is, the system should be operated for the benefit of optimal economic crop production. The MOI must establish a formal linkage to the farmer, to help them schedule water, level land, change their irrigation practices, maintain the watercourse and manage their on-farm system. This will require the MOI's to establish an irrigation advisory service and provide help in forming an irrigator's association on the watercourses and branch canals that serve several watercourses. The advisory service should link the engineer operating the canals with the farmer users and provide active professional help to the farmers to improve his on-farm water management.

At the farm level, the MOI advisory service would cooperate with the MOA extension service to provide an active program of farm water management improvement. The MOA would provide those services that involve the proper application of the other agronomic inputs. Both agencies would be charged with providing land leveling services and farm layout changes that are needed to improve irrigation.

For the MOI to carry out it's task of improving irrigated agriculture will require the formation of interdisciplinary teams. The teams should have professionals in:

Agriculture/Irrigation Engineering
Agronomy (Irrigation)
Sociology/Anthropology
Economics

These teams together with the Extension Service teams in the MOA would work an area of 5 to 10 thousand acres. They would work with farmers on a watercourse to improve the on-farm water system and it's management.

The Agriculture Irrigation engineers would develop farm irrigation plans, specifications for watercourse and branch canal improvements, supervise land leveling (a joint activity with Extension Service of MOA), supervise construction, establish irrigation frequency and amount, develop drainage plans and monitor the scheduling of water deliveries.

The irrigation agronomist would develop irrigation frequencies and quantities schedules to maintain proper soil moisture for optimal economic crop production. Together with Extension he would work with farmers to improve the use of farm machinery, agronomic practices, farm layout and on-farm research.

The sociologist/anthropology professional would help establish the irrigator's association, settle conflicts, expedite the work of the others on the team. Their objective would be to establish cooperation between and among peer groups:

Farmers to Farmers
Farmers to Professionals
Professionals to Farmers
Professionals to Professionals

They would establish an understanding of the positions between and among groups.

The economics professional would help farmers quantify their economic decision making practices by helping them keep farm enterprise records. They would continually evaluate the cost and benefits of any recommended changes.

In conclusion, poor or inappropriate farm water management is a major constraint to obtaining the optimal economic returns from the Green Revolution.

This poor farm water management results from neither the Ministry of Irrigation or the Ministry of Agriculture taking the responsibility for what happens to the water at the farm level. The MOI's are water disposal agencies. The MOA is a seed, fertilizer, and pesticide disposal agency. Often the MOA is a collector of taxes and a policeman to see to it that decreed cropping patterns are maintained. Neither serve the farmer but believe the farmers serve them.

In both a new irrigation scheme or an older established system, the farmers are made to develop their irrigation methods by trial and error. They are provided no professional help in the application of water. In time, they learn certain methodologies of irrigation taking into consideration how and when the

water arrives, where they are on the system, a certain level of production, the concept or belief of how much water is needed, etc. They do not take into consideration the available knowledge on soil-plant-fertilizer-water relations and irrigation methods. To take advantage of the Green Revolution this has got to change. New irrigation systems must be designed bottom up to serve farmers and farmers must be educated in irrigation methods and concepts.

On the old system, the Ministry of Irrigation must take responsibility for how the farmer irrigates. It must work with the farmers to improve their management and use of water. And the MOI must be willing to modify the operations and maintenance of the delivery system to provide water for the optimal economic crop production. Often this will require a National Irrigation Improvement Program.

The Ministry of Agriculture must change from a passive mode to an active mode of extension to help farmers increase production . That is, the extension service has to work on the farm with farmers to improve their cultural practices including irrigation methods.

Neither ministry actively works with farmers to improve their on-farm irrigation. Both Ministries must actively work together with farmers to improve irrigated agriculture methods. The MOI must provide help and knowledge in improved irrigation. The MOA to provide help and knowledge on improved agronomic practice. For some functions there can be a separation of responsibilities between the Ministries, i.e., MOI responsible for irrigation scheduling, MOA responsible for fertilizer application but both could be responsible for farm ditch layout and land leveling.

Farmers on a watercourse and the branch canal serving many watercourses must form irrigators associations to maintain the watercourse, schedule irrigation turns among themselves, and work collaboratively with the MOI and MOA.

The MOI must accomplish improved farm water management for increased crop production. To do this they must establish a farmer advisory service to work with farmers to help them improve their on-farm water management. This service would be the linkage between the delivery system professionals and the farmers. It should consist of interdisciplinary teams working with farmers. The needed disciplines on a team are agriculture-irrigation engineers, irrigation agronomists, sociologist-anthropologists and agriculture economists. The team would serve an irrigation district, an area of 10 to 50 thousand acres, with a single professional working with farmers on each minor branch canal, an area of 1 to 5 thousand

acres. The professional on a minor branch canal could be any discipline as long as he knows irrigated agriculture and could work with the farmers. The engineers should design and implement the on-farm watercourse and branch canal maintenance and improvement programs. The agronomist should determine needed soil-plant-water regime and methods to maintain it (i.e., water schedules). The sociologists should help maintain relations between peer groups and act as change agents, and economists should help farmers to rationally make farm decisions, and provide data analysis on the cost and benefits of changes.

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Improved Irrigation Water Management: A Major Agricultural Development Emphasis

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Introduction

The topic for this essay is familiar to most students of agricultural development but is increasingly becoming the concern of farmers and others as well. The issue is highlighted for popular consumption in a July, 1981 Life Magazine article entitled "Are We Running Out Of Water?". At about the same time, the Illustated Weekly of India published an article entitled "The Coming Water Crisis". The latter article argued that the world's water crisis is far more serious than the present oil crisis. Both articles stress that better management and radical changes are needed in the capture, conveyance, use and conservation of mankind's most essential resource - water. The bottom line is that fresh water can no longer be considered an infinite resource nor treated as a free good. In the United States and in other countries, the cost of "doing business the old way" in irrigation development is simply too great. (Cited in World Press Review, 1981.)

The applied science of Irrigation Water Management is hardly thirty years old and only ten or fifteen years ago, "water management specialists" were still struggling for recognition; but now such applied interdisciplinary specialists have gained worldwide respect and credibility. The day is over when strict monodisciplinary academicians and others view Irrigation Water Management as an invalid or illegitimate field of training, research, and development. The expectations of developing countries with water problems, the growing concerns of international donor agencies, and the recent decision to develop a new International Irrigation Management Institute provide evidence of the growing legitimacy of Irrigation Water Management as a field of specialization in its own right.

The ideas in this paper have been developed from our own research, from development work in irrigation in Asia done by many of our colleagues, and from the knowledge gained from our best teachers - farmer clients. Much of the content of this paper comes from a host of university colleagues, and from the growing fraternity of professionals committed to improved irrigation water management for accelerated agricultural development around the

world.

Our objectives in this paper are: (1) to indicate the magnitude of the challenge facing irrigated agriculture in the developing world, (2) to describe some of the problems confronting irrigation development, and (3) to describe some of the key criteria and concepts for planning and implementing public irrigation water mangement programs.

The Need for Improved Irrigation Water Management in Developing Nations

There are a number of compelling reasons for placing major emphasis on irrigation water management. The more important of these are discussed below.

First, it is fortunate that about three-fourths of all irrigated land and the major potential for new systems is located in current diet deficient or low income nations. In terms of the use of water for irrigation on a worldwide basis, 74 percent of irrigated agriculture is in Asia, 12 percent in North America, 6 percent in the USSR, 3 percent each in Africa and South America, and 1 percent or less in Europe and Australia. Asia alone, including mainland China, has 74 percent of world irrigated area and 90 percent of all irrigated area in low income nations. Sixty-three percent of the world's undeveloped irrigation capacity is in South Asia alone (The President's White House Report on World Food Supply, 1967 and Svendsen et al., 1983.)

Second, irrigation plays a critical role in food production, providing agricultural products for local industry, generating foreign exchange earnings, and in promoting rural development. Where there is adequate water control and the use of complementary inputs, irrigated agriculture is far more productive and more sophisticated than rainfed agriculture, which faces great climatic variability. Irrigation of only 13 to 15 percent of total world cultivated area produces about 34 percent of the total value of crop production. Biswas (1982) states that

> If the total agricultural production in developing countries is to be doubled between 1980 and 2000, the total (world) irrigated area has to be expanded by more than 40 percent...by 2000. Even then the irrigated lands will be only 16 percent of all available area but will provide 41 percent of total crop production.

Third, irrigation is a proven means for increasing crop yields and farm income. Potential crop yields and farm income are usually three to four times higher in irrigated agriculture as compared with rainfed agriculture because much of the world's irrigated land is in former desert areas where there is excellent solar energy for year-round cropping (FAO, 1980). Well managed irrigated agriculture also contributes to economic growth, provides higher levels of income for farm families, generates employment, and is considered a primary engine for rural development in many low income nations. In many low income nations such as Pakistan, India, Sri Lanka, and

Thailand, it is obvious that the high yielding varieties, centers of small and medium industrial growth, and economic progress are located in those regions where irrigation is well established. In Pakistan, the major irrigated area of the Punjab Province produces over 65 percent of total agricultural production and 90 percent of all food production while the largely rainfed Northwest Frontier produces only about 14 percent. In India it is estimated that almost half the 2.5 percent annual growth in agriculture production is due to irrigation, though current yields of irrigated grain are still only 1.7 tons as compared to rainfed yields of 0.7 tons per hectare (Oram et al., 1979).

Fourth, irrigation development is highly correlated with population growth and is a primary means of providing additional food for population increases. Not only were the first great civilizations seated along rivers, but irrigation development historically has run parallel to population growth. World population was at about two billion in 1930, reached about three billion by 1960 and increased to about four billion in 1976. Expected increases to the year 2000 differ but an estimate of six billion appears reasonable.

Irrigation development has been both a response to and a stimulation for population growth. For example, in 1800 there were, on a worldwide basis, only 10 million hectares of irrigated land. By 1900 this total had reached 40 million and by 1950, 160 million hectares, and will likely grow to 273 million by 1990. Due to rapid population growth and growth in the related demand for food and food security, the 1974 World Food Conference targeted a 25 percent increase that will be needed between 1975 and 1985. Of an estimated 3.4 billion hectares of potential agricultural land in the world, up to 470 or 500 million hectares could be irrigated.

Fifth, irrigation development, if conducted properly, can promote rural development. For example, irrigation development activities are viewed as an integral element of rural development. Utilizing the inputs of farmers in development, operation and maintenance, the effects can go far beyond the direct beneficiaries. However, few projects designed to benefit the small farmer have been completely successful. Governments still persist in their efforts to build large projects, rather than medium and small projects, and are doing little to improve existing ones with farmer involvement. Wiener (1976) strikes at the core of the problem when he states that:

> ...engineering is not the fundamental problem underlying irrigation development in the LDCs. Engineering principles are known and can be adapted but the major problem, however, is to discover ways to utilize farmer clients more efficiently in operation and maintenance and develop programs which will create rural transformation. Rural transformation essentially requires changes in farmers' behaviors, motivations, and expectations which is hardly possible until institutions exist to provide them with improved production possibilities and incentives.

As to the future, Wiener (1976) suggests that:

> ...policy makers concerned with irrigation will have to ask questions about location of projects where small farmers will benefit; divising small scale farmer operated systems, providing means for small farmers to participate in planning, implementation and evaluation of projects intended to benefit them, and making sure that along with technical feasibility studies careful attention is given to economic, social and environmental assessments.

Finally, the present investment patterns in irrigation development indicate the perceived need of many countries for more irrigation works. The role of irrigated agriculture is so important to meeting current food demands from rising population and incomes, that the 1974 World Food Conference estimated that $85 billion should be invested in new systems and the rehabilitation of existing systems over a decade (FAO, 1980, p. 1). The World Bank, Asian Development Bank, USAID, and other international donors are probably presently investing between $3.5 and $4.5 billion a year in irrigated agriculture. From 46-50 percent of all spending for agriculture in Asia by the World Bank is for the irrigation subsector. In South Asia alone, the World Bank invested more than four billion dollars in the first three years of 1980. By the end of the 1980s this will probably reach $13 to $15 billion, much of which will be in India (Svendsen et al., 1983). Most low income nations with potential for irrigation improvement now realize that a key to their total economic development lies with improved irrigation.

Some Major Problems of Irrigation Development

The Predominate Focus on the Capture and Conveyance of Water

Until recently irrigation development was strictly a civil engineering concern of capturing cheap water from rivers by dams and reservoirs and conveying it to agricultural lands by major and minor canals. Many great dams such as Tarbella in Pakistan, Aswan in Egypt, and Hoover Dam and the TVA works in the United States are monuments to the skill of design and construction engineers. There was, however, little concern with externalities, cost overruns, or the on-farm problems created. This is not to say that large dams and conveyance systems are not needed, but rather to stress that the planning is often overly concerned with water delivery per se.

Large irrigation projects are costly and typically require 20 to 30 years before they reach fruition. Project after project in the developing world falls short of the expected productivity and benefits projected by optimistic planners. Often, these systems operate at efficiencies as low as 30 to 40 percent. It is likely that few future projects will receive unquestioned approval anywhere if they use only conventional engineering and cost-benefit criteria. Design factors have usually been unrealistic because they have ignored indirect costs, social and environmental impact assessments, careful assessment of technologies, and an analysis of the possible direct and indirect externalities involved. Future irrigation projects for agriculture likely will be justified only

in terms of increased and more stable agricultural production, increased labor and income generation, more equitable distribution of benefits and the participation of farmer clients in planning and implementation, operation and maintenance of farm systems. New systems will certainly be planned with more concern for the environment (Lowdermilk, 1981).

Externality Impacts of Irrigation Projects

The "second phase" in irrigation development begins when the external effects of these man-made systems become evident as physical problems such as waterlogging, salinity, and other negative impacts on the environment and society. According to B.B. Vohra, chairman of India's National Committee on Environmental Planning, 15 million acres of land worth $21 billion have been ruined in India because of water-logging and salinity as a result of poorly planned and managed irrigation projects. Another 25 million of the total of 100 million acres under irrigation are said to be threatened with such damage. In some areas of India, farmers with waterlogged lands have refused to pay taxes and have initiated protest movements (Washington Post, March 16, 1983).

Historically, these problems have been so acute that great cities and civilizations have fallen into decay or disappeared along the great river valleys of the Middle East and in the Indus Valley. Without strong and persistent interventions and skilled operation and maintenance, reservoirs and dams clog up, water tables rise, and soil salinity spreads, destroying the eastblished agricultural base. A case can be made that irrigation management is an important variable in the rise and fall of societies. Wittfogel, a Yale University historian, in his book Oriental Despotism developed a hypothesis that only central governments can effectively manage large irrigation systems. He found that history continues to record serious problems with large-scale irrigation systems. When governments weakened, ancient irrigation systems collapsed (Wittfogel, 1957). And, in Pakistan, India and Egypt alone there are presently an estimated 10 million hectares of agricultural land seriously threatened by water-logging and salinity.

Another externality concern is comprised of a long list of health hazards. In some irrigated regions where water is not managed adequately, there is high incidence of a number of water borne diseases which include schistosomiasis, diarrheal diseases, malaria, and other maladies such as polio, typhoid, sleeping sickness, and encephalitis. In Egypt alone it is estimated that 30 million people are infected with the debilitating disease schistosomiasis, and on a global basis perhaps 200 million are infected. The resulting economic loss in Africa alone is estimated to be about $520 million.

Environmental problems that endanger animal species, fish and bird life also exist. Mismanaged irrigation systems often create return flow problems which pollute groundwater with insecticides, nitrates, and toxic levels of degraded saline or sodic water. Due to poor management of water in the lower Colorado Basin, for example, the U.S. Government, under pressure from Mexico, will have to spend an estimated $4 billion to construct a desalinization plant to clean up river water which flows to Mexico. From 25 to 35

percent of the West's irrigated lands have serious salinity problems, and the annual damage therefrom to agricultural, recreational, urban, and industrial users is estimated at $100 million (Frederick, 1981). This trend will increase without improved management. It is no wonder then that International agencies increasingly require positive environmental determinations for new water projects in developing countries.

Problems of Irrigation Water Control and Allocation

Another major problem in most irrigation systems is the loss of valuable water for irrigation due to poor management. In many countries, 40 to 60 percent of the water conveyed from a canal turnout is lost in conveyance to farms due to poorly designed and unmaintained farm ditches. Over-irrigation is also a problem because whenever and wherever surplus water is available, farmers tend to over-irrigate. The surplus goes to groundwater and is one of the reasons waterlogging and salinity problems are created. Studies in Pakistan found that through improved management at the farm level about 27 million acre feet could be saved each year - which is about three times the annual storage capacity of Pakistan's billion dollar Tarbella Dam (Lowdermilk, Early, Freemon, 1978). Conversely, some countries are much more efficient in irrigated agriculture. For example, in Japan rice production uses .045 hectares to produce 2,500 calories per day for one person. The USA uses twice as much and Pakistan and India seven times that amount of land to produce the same level of calories in rice production (Ambroggi, 1980).

Presently at least 30 countries face a severe water shortage. In the next 20 years there will likely be many serious international conflicts over water rights because so many rivers flow through more than one nation or state. Egypt, for example, has long been gravely concerned over the waters of the Nile which it shares with its neighbors to the south. There are presently problems between seven countries of the Sahel region in Africa over water. Pakistan and India barely averted one war by signing the Indus Basin Treaty to divide the waters of the Indus Rivers. India is now involved in a complex dispute with Bangladesh over the Ganga River water rights. There are also increasing political conflicts among and within states and provinces of many countries in the competition for scarce water resources between urban and rural uses and among industrial, recreational, and municipal uses.

Inequitable Distribution of Water to Users

Irrigation systems are generally highly inequitable in supplying water to users. Farmers at the heads of canals or conveyance systems often receive too much water while those downstream or "tailenders", receive far less water. Some systems supply water year round to some users and only during one season to others. Some farmers can make use of good groundwater while others cannot. Usually the larger and more elite farmers use their influence to capture a disproportionate share of scarce water supplies. Studies in Pakistan have shown that farmers with private tubewells and canal head farmers earn much more per acre than tail farmers and non-tubewell farmers (Lowdermilk et al., 1978).

The focus of public irrigation development is now shifting from the capture and conveyance of new water sources to improving the operation and maintenance of existing systems. In terms of average costs per hectare, the cost of such improvements is about $500 to $700 versus $2,500 to $3,000 or more for new system construction (Oram et al., 1979, pp. 47-62). At the same time what is learned about improving existing systems can provide valuable lessons to improve the planning and design of new systems as well. Some of the major problems with new system design too often stem from a failure to consider adequately the operations and maintenance practices which will be employed in the completed system.

Strategy and Key Planning Concepts for Improved Irrigation Development

Given the demand for irrigation development and the urgent need to improve irrigation management, there now appears to be a growing concensus among irrigation management professionals which supports the strategy described below.

Strategy is defined as a frame of reference to provide guidance in developing programs, projects, and activities for the achievement of specific objectives. A strategy provides the means for selecting elements or factors on which to concentrate or to prioritize. A good strategy must also ensure that scarce resources are combined in the proper mix to achieve specified objectives. Strategic issues, for example, that might be considered in a given country at a given time, include: concentration of resources vs. dispersion of resources; long term vs. short term involvement; primary focus on software components vs. focus on large infrastructure hardware; main system management vs. on farm-level management; small to medium systems vs. large systems; and lift vs. gravity systems. Increasingly, tradeoffs are considered when choosing among these elements in design, implementation and management of irrigation systems.

Each country or state has its own set of goals and objectives as well as special conditions and constraints which have to be accommodated. These may include such things as economic equity, welfare objectives, levels of natural and human resource endowments, stage or level of economic development, organizational and institutional differences and the like. For example, some countries will continue to develop new irrigation projects while others will focus on rehabilitation of existing ones. Some countries will have to do both.

A focused strategy for irrigation will help us move away from the old project-by-project approach to development, which results in fragmented efforts. With a strategy to guide national planning efforts, projects become mutually reinforcing and knowedge generated in one can be used to improve others.

Objectives to Guide the Strategy

Today's leaders in irrigation management seem to agree on six basic interrelated objectives that will be needed to guide future irrigation development, both in the design of new projects and in

improving existing systems. These are:

1. increased water control and greater reliability of supplies through the main system to the farm level, relative to the amount and timing of the water required by the crop/ soil sub-system;
2. improved equity of water allocation and distribution among different classes and groups of farmers;
3. increased productivity of water and increased net farm income per unit of land and water;
4. increased participation of farmers in the planning, development, operation and maintenance of tertiary-level systems and in rehabilitation and improvement programs;
5. improved maintenance and stability of the soil-water resource base over time; and,
6. increased cost effectiveness of investments in the system.

These objectives are closely interrelated. For example, where water is not used productively, the cost effectiveness of projects suffer. Where farmers do not have reliable supplies, it is unlikely that they will utilize other essential inputs or be motivated to organize for regular maintenance of the system.

Water control and reliability of supplies are the basis of good water management. Due to a host of physical, social, organizational, and legal factors, farmers served by public sector gravity irrigation systems throughout most Asian and Middle Eastern countries suffer from too much water on some lands and during some time periods as well as from periods of critical water shortages. Too many of these systems still operate like rainfed regimes. Water comes unpredictably and in arbitrary volumes without the end users being able to anticipate supplies so that they can make crucial farm management decisions.

Key Planning Concepts for a Flexible Strategy

Some of the key planning concepts which should be considered in developing an effective public irrigation strategy, are as follows:

1. encourage realism in evaluating the availability of the water resource and the present and future demands on it. Construct or reconstruct with flexibility;
2. make irrigation management the focus of irrigation development;
3. use a diagnostic analysis process and an interdisciplinary team approach for developing new projects;
4. circumvent the long period from research to implementation by using a "development-of-solutions" experimental project mode and utilize existing projects for needed studies where possible in order to shorten and improve the design process;
5. design into all projects a strong internal monitoring and evaluation mechanism and train personnel to utilize it;
6. focus heavily on human resource development by front-

loading appropriate training into all large project plans (with a focus on short-term, hands-on training in live irrigation systems in contrast to lecture oriented classroom training);

7. design basic institutional development components into projects, which include:

   a. professional training
   b. institution strengthening
   c. local farmer participation and organization
   d. extension services for farmers
   e. private incentives for improved production possibilities
   f. knowledge transfer mechanisms
   g. appropriate policy analysis based on field studies;

8. close collaboration among international donors where feasible; and
9. long-term donor agency commitment to programs of irrigation water management improvement.

Each of the above listed key planning concepts are discussed below in greater detail.

(1) Encourage realism in evaluating water availability and the demand. Construct or reconstruct with flexibility.

Newly constructed irrigation systems are often burdened with inflated expectations. It is not unusual for major projects to irrigate adequately only one-half to two-thirds of their design command area. On the one hand, reservoir or aquifer supply estimates are often overly optimistic. On the other, crop water requirements may be understated, especially for critical periods of maximum transporational demand. In rice-growing systems, the basic seepage and percolation rate of the puddled rice soils also must be included as a component of basic demand, since it is largely fixed.

The most serious design fault, however, is probably the boundless optimism with which assumptions about the distribution system's effectiveness and efficiencies are made. The efficiency of the distributional system is a function of both technical factors, such as canal seepage rates, and managerial ones, such as whether system control structures are monitored and operated after sunset, and how long breached bunds are allowed to flow unchecked. History has shown that these losses are apt to be several times those assumed in design.

Where existing systems are being considered for rehabilitation or a program of managerial upgrading, determination of the actual values of water supply, demand, irrigated area, and various measures of water losses and efficiencies for the system as a whole and its major subcomponents should be an integral part of the project development and implementation process. These estimates can often be made utilizing existing data collected by the operating agency, supplemented by a brief program of field measurement. This exercise can provide a relatively quick means of assessing baseline system performance and locating the areas of greatest structural and managerial weaknesses.

In new systems, planners must insure that:

a. the water supply estimate is reliably based on adequate hydrological or hydrogeological information and operations analysis;
b. that crop/soil water requirements are accurately predicted using current estimation procedures for evapotranspiration (and seepage and percolation) and locally derived climatological and hydrogeological data; and
c. that foreseeable distribution facilities have the physical capability to meet crop/soil demands at any place in the system in a given fraction of years (e.g., three of five or one of 10). For these studies, annual averages are not adequate. Bi-weekly operation studies covering at least 20 years are recommended for this purpose (Peterson, April 1982).

Much of the infrastructure detail, particularly of the intensive parts of the distribution system, will evolve from the more comprehensive local-level analysis as project development proceeds. This is an important concept. Post hoc experience from a number of countries, ranging from the Philippines to Sri Lanka, has demonstrated the virtual impossibility of designing an effective tertiary distribution network working solely from traditional 50-centimeter or one-meter interval contour maps.

The most effective way to meet the informational needs of the tertiary-level design process is to involve farmers and others with intimate local topographic and social information in the process. In new construction, maximum flexibility must be provided so that resources are not completely committed until sufficient local-level experience has accumulated. Once physical structures are in place, change is difficult and expensive, no matter how inappropriate the structure or its location may be.

Some large and significant professional training requirements are implied in this concept. Not only must those involved in the design process be trained to apply the principles outlined above, they need to have multi-disciplinary experience, such as that outlined in (3) below, if they are to be effective.

(2) Make irrigation management the focus of irrigation development.

The rationale for an irrigation management focus rather than a focus on the civil works of a new system is based on several considerations. First, rapid and substantial returns on investments can be obtained by improving existing projects. This is an area of high priority where costs per hectare and per farm are much less than for new projects. With new projects, a focus on management will yield much greater returns earlier (Oram, et al., 1979). Second, the irrigation management component of some projects is still ignored or treated as marginal. Third, there are many who use the terms "water management" or "irrigation management", but do not have a comprehensive systems understanding of the concept. The use of the term "irrigation management" might be more appropriate than "water management" to promote the idea that much more is

managed in an irrigation system than water. People are managed. Information is managed. Other agricultural inputs are managed in interaction with water (Chambers, 1980).

We define irrigation management as the dynamic process by which water together with other inputs is manipulated and used in the production of food and fiber. The concept focuses on catalytic or performance management and is not bound by a narrow disciplinary or professional bias (see Seckler and Nobe, 1983).

Unfortunately, this irrigation management approach has not yet been utilized in many donor assisted projects. In a recent analysis of 63 irrigation project documents from lesser developed countries, it was found that in only two projects was operation and maintenance (O&M) a major focus of project design (WASP II Report, 1981). Operation and maintenance was a significant factor in only one of the Middle Eastern projects and in only one of the Southeast Asian projects (see Tables 1 and 2 for the relative emphasis on various components of irrigation projects). Some developing countries are now taking the lead in this matter. Several states in India, for example, are considering establishing a professional personnel cadre of O&M, separated from design and construction, in order to provide incentives for professionals along O&M career paths. Serious questions need to be asked in most other countries as well about the relative importance of improving regular operation and maintenance of these complex man-made systems which will decay without constant care.

(3) Use diagnostic analysis.

The rationale for the diagnostic analysis (DA) mode being built into new projects and utilized for the improvement of existing projects is based upon long observation and experience which indicates that many, if not most, irrigation and agricultural personnel do not fully understand how irrigation system works in practice at the farm level. This is because such personnel often have not viewed the system from the farmer's perspective. Until recently, problems related to water management in the lower portions of the system have been almost a "no man's land". This situation results both from tradition as well as the lack of exposure to new water management perspectives and skills. Few developing countries today can field an experienced interdisciplinary team of social, biological, and physical scientists and professionals in order to make a careful diagnosis of system operational characteristics relative to system design standards (Clyma, Lowdermilk, Corey, 1978 and Lowdermilk et al., 1982).

The farm management focus of the DA process at the farm level does not, however, ignore the importance of the main irrigation system in providing water supplies. Specifically, it views the total system in terms of both the farmer decision makers and the local irrigation authorities who are involved with day-to-day system delivery operations. The productive end of the system (on-farm water use) is used as a barometer of how well the total system is operating in terms of providing predictable supplies of water. Problems are diagnosed at the farm level first and the causes are investigated at each control point up the entire system. In the design of new projects, the same principle holds. The

Table 1. Selected "Software" Components in 63 Irrigation Projects*

Software Components		Total Projects with Component	Percentage of 63 Projects
1.	Training	3	5.7
2.	Farm Water Management or on Farm Development	19	30.2
3.	Water User Association or Water Use Allocation	8	12.7
4.	Extension	3	5.7
5.	System Rehabilitation	11	17.5
6.	Soil Conservation	1	1.6
7.	Resettlement	9	14.3
8.	Land Consolidation	2	3.2
9.	Credit	10	15.9
10.	Research	7	11.1
11.	Operation and Maintenance	2	3.2

*These 63 projects include 32 from the World Bank and 31 from AID. Ten percent were begun prior to 1970; 79 percent between 1970 and 1979; and the remainder in 1981 and 1982.

Source: Water Management Synthesis Project (WMSP), Report No. 1, Irrigation Projects Document Review, Utah State University, Agricultural and Irrigation Engineering Department, Logan, Utah, February 1981.

Table 2. Relative Costs for Hardware and Software Components of 40 Irrigation Projects Funded by The World Bank and AID with Asia Projects Separated Out.

Components	Total Cost of all projects and percentages		Total Cost of all WB projects		Total Cost of all AID projects		Total Cost Asian World Bank		Total Cost Asian AID	
	$2200(m)	% (100)	$1806(m)	% (100)	$401(m)	% (100)	$1635mil.	% (100)	$302mil.	% (100)
A. Hardware	$ Mil		$ Mil		$ Mil					
1. Dams	131	(5.9)	131	(7.3)	-0-	(0.0)	115	(7.0)	-0-	(0.0)
2. Canals	754	(34.2)	654	(36.4)	100	(25.0)	571	(34.9)	94	(31.1)
3. Flood Control	25	(1.1)	12	(0.7)	13	(3.2)	12	(0.7)	13	(4.3)
4. Machinery and Vehicles	138	(6.3)	84	(4.7)	54	(13.5)	81	(4.9)	44	(14.6)
5. Roads and other Infrastructure	166	(7.5)	119	(6.6)	47	(11.7)	94	(5.7)	18	(6.0)
6. Tubewells	25	(1.1)	23	(1.3)	2	(0.5)	23	(1.4)	-0-	(0.0)
7. Low Lift pumps	38	(1.7)	6	(0.3)	32	(8.0)	6	(0.4)	7	(2.3)
8. Drainage	105	(4.8)	103	(5.7)	2	(0.5)	94	(5.7)	2	(0.7)
B. Software										
1. On-farm Water Management	368	(16.7)	311	(17.2)	57	(14.2)	310	(19.0)	50	(16.6)
2. Training	30	(1.4)	15	(0.8)	15	(3.7)	15	(0.9)	14	(4.6)

Table 2. (Continued)

Components	Total Cost of all projects and percentages $2200(m)	% (100)	Total Cost of all WB projects $1806(m)	% (100)	Total Cost of all AID projects $401(m)	% (100)	Total Cost Asian World Bank $1635mil.	% (100)	Total Cost Asian AID $302mil.	% (100)
B. Software (continued)	$ Mil		$ Mil		$ Mil					
3. Credit	27	(1.2)	-0-	(0.0)	27	(6.7)	-0-	(0.0)	24	(7.9)
4. Admin. & Management	400	(18.1)	348	(19.3)	52	(13.0)	314	(19.2)	36	(11.9)

NOTE: Respectively, World Bank and AID Asian project costs are 90.5 and 75.3% of total project costs. Ten percent of the total projects were begun between 1963 and 1969, 79% between 1970 and 1979, and the remainder in 1980 and 1981.

Source: Water Management Synthesis Project (WMSP) Report No. 1, Irrigation Projects Document Review, Utah State University, Agricultural and Irrigation Engineering Department, Logan, Utah, February 1981.

distribution system must fully respond to realistic projections of water needs on farmers' fields.

(4) Utilize a development of solutions approach.

Along with D.A., a mode known as "development of solutions" (D.S.) has been developed and tested. This is a means of circumventing the typically long period of research prior to the commencement of improvement or development activities. Needless to say, there are often complex soil, water and other problems which require conventional research to find the right solution. There are, however, many things which cannot be learned in irrigation development without becoming involved early in a "live" system so as to identify problems and search for solutions under field level conditions. Therefore, we recommend an approach of testing and adapting known technologies to the project environment at the earliest stages of project implementation. In existing systems, this may take the form of a pilot program of action research within the bounds of the project area involving local farmers, irrigation officials and a multidisciplinary team of irrigation water management specialists. Such an effort is allowed a limited time to test, introduce, or adapt one or more promising new methodologies. If the project is a new one, an adjacent experimental area in an existing system could serve as the testing ground.

Although the basic infrastructure for water delivery systems utilizes established technologies, when employed in different settings they must be custom tailored to local custom, organizational modes, authority roles, patterns of interaction with irrigation authorities, agricultural practices, rainfall patterns, and the like. The experimental mode means learning from small-scale experience before major mistakes are made and all funds are committed. Most projects need this built-in flexibility to learn, adapt, and refine procedures. These smaller pilot areas also provide an excellent opportunity for a visible demonstration of what "works", both for farmers and officials. Experiments and applied special studies might be used to identify the most useful mode of water allocation, water distribution, appropriate types of small structures, water rates, and farmer organization. Such an approach can prove useful in a relatively short period of time.

Where an experimental project within the project area is not feasible, special studies (in adjacent systems) need to be designed into larger projects. Usually one need not wait for water to be supplied on the new project since similar projects exist in most countries. As soon as possible, studies cum trials must be initiated and carried out on the new project lands, involving local farmers to the fullest possible extent. There is also a significant role for the use of farm-oriented systems modeling in the development of solutions, a methodology which has already had success in some countries. If properly utilized, cropping systems models can detect many flaws in potential designs quickly, thus saving valuable time in field testing.

The use of small computers in the design of field channels and small structures is little used to date in developing countries. If routine and repetitive design functions can be computer-assisted, we can move away from the traditional uniformity in

tertiary system design and layout designs which are customized to fit local situations. Such a move will also enhance the possibilities for farmer involvement in the design process.

Increasingly, there is a need to discover how irrigation management decision making can be more effective. Computers can also be used advantageously in irrigation system management. In the American West, small computers are commonly used for irrigation scheduling. Pioneering work in main system management involving data collection, evaluation, feedback and control and utilizing computer processing of data has been carried out in the Philippines and Taiwan has been using this technology for a number of years.

(5) Build in strong monitoring and evaluation components.

Monitoring and evaluation of the D.A. process, the D.S., and project implementation is essential for the improvement of these processes and the documentation of lessons learned. This monitoring and evaluation must form an integral part of the project design.

Monitoring and Evaluation (M&E) is also important in the ongoing management of the irrigation system. In fact, M&E is fundamental to a successful systems operations strategy. Since operation consists of adjusting flows and allocating supplies to best meet local irrigation demands, a continual two-directional flow of information is essential. Many weaknesses in irrigation system operation and maintenance (O&M) can be traced to the lack of an effective system of M&E.

At a higher administrative level, M&E is an important tool in assessing the functioning of the entire structure of an irrigation system. The costs of an ongoing program of M&E to the irrigation authority are generally low in comparison with the potential benefits associated with more efficient system operation. Training costs to transfer M&E methodologies are not large, yet little has been done in this area. Monitoring and evaluation initiated at the D.S. stage can be continued or expanded to provide this function on a regular basis. In India, for example, some large projects now conduct on-going internal M&E and the central government of India and the states are considering the development of external, interdisciplinary project evaluation teams.

(6) Focus heavily on human resource development.

No technology is transferred effectively unless people are adequately trained and institutions are developed for its implementation. There can be little change in technology without a commensurate change in human resource capability. Especially in irrigation development, projects designers need to plan for appropriate training. Needs for upgraded skills and changes in attitudes and perceptions extend from the farm to the policy-making level. Few countries have professionals who are trained in working together in interdisciplinary teams, and for many this is an uncomfortable mode but the process can be taught. Training needs to be field-oriented and must occur early in the life of the project so that it is effective in implementing the current project and not some future one. Finally, this type of training needs to be institutionalized through revision of the formal training programs of

engineers, agronomists, economists and others to provide a focus on comprehensive water resources development and water management. And, of course, this process can be taught via post-graduate non-degree training.

Of sixty-three worldwide irrigation projects which were funded by AID and the World Bank in the 1960s and 1970s, it was found that training was a major factor in only five of them. Of 40 projects which had adequate cost data, 19 had from "very little" to "some" training, but training still represented only three percent of the funds budgeted for these 19 projects. Of 63 projects reviewed worldwide, training received only one percent of the funding (CWMSP II, Report No. 1, 1981).

We must make more careful, country-specific assessments of professional development training needs and utilize those data in assuring that the necessary training for required staff is done. There is no "magic" percentage of total funds needed for training, but recent experience and studies indicate the need to sharply increase the amounts currently being allocated in this area. An FAO workshop in Rome was held in September, 1982 to examine the training needs for irrigation water-management, and concluded that throughout the 1980s, there will likely be a larger emphasis on professional manpower development in irrigation and water management projects (FAO Report, 1982).

(7) Stress building institutional capacity in host countries.

The rationale for a focus on institutional and related human resources development is that effective "software" is an essential complement to all hardware components of irrigation systems. In the past, attention was often focused on hardware investments at the expense of the software components such as professional development, management, training, water code and policy reform, and water user organizations. More attention to software components is essential to make the investments in hardware components effective.

Evidence indicates that the major needs under institutional development are:

a. Training-professionals: Only a few countries have irrigation personnel who have received water management training. Two recent studies indicate the critical need for such training in Asia. The study by IFPRI (Oram, 1979) estimates that for new projects alone, about 6,000 professional staff, 27,000 technicians and 22,000 Extension personnel will need to be trained in eight Asian countries alone before 1990. These figures do not include the growing demand for retraining existing staff in water management for the improvement of old systems — a critical consideration for the entire developing world. Estimates of the numbers of existing irrigation and agricultural staff needing short and longer term training in irrigation water management (IWM) range from wild estimates of "everyone" to fifty percent of the staff working on all systems. For India, Venkatesan estimated recently that about 150,000 professionals will need IWM training before the year 2000 (Venkatesan, 1981). With-

out an objective assessment, "guesstimates" will continue to be haphazard.

Both formal and informal training is required for engineers, agronomists, economists, extension personnel, rural sociologists, public administrators and others involved in public irrigation programs. Special short-term training is also needed in diagnostic analysis and problem solving techniques. Managers of projects and irrigation systems need special training in systems operations and in methods for monitoring and evaluation of systems on a regular basis. Extension workers and others need training in water management practices, agronomic practices under irrigation, and in implementing farmer organizations for the improved use of water for crop production. Planners and policy makers also need greater awareness and understanding of advances in water management and in systems design and operation. Farmers also require training in water management and in irrigation agronomy; this emphasis still remains marginal in far too many projects. We are just now learning in irrigation development that perhaps our most important potentially available resource consists of the acquired abilities of people who manage and use the system.

b. Strengthen institutions: In addition to outside training of individual professionals and the short-term in-country training of individuals and teams outlined above, host country institutions must be strengthened through longer-term support and collaboration. Just as irrigation development in the USA has proceeded through the efforts of a mix of government agencies (e.g., the Bureau of Reclamation and several agencies in the U.S. Department of Agriculture), educational institutions such as land grant universities and the private sector (irrigation ditch companies and private firms), a mix of institutions is also important for irrigation development in other countries. Collaborative programs involving host country research, training, and extension institutions and counterpart institutions in more developed countries can play a very useful role in this regard. This type of support also reduces the probability of retrenchment following project completion and helps create a local capacity for self-renewal within the host country.

c. Farmer participation and organization: This option is an untapped potential, yet is a key to attaining many of the objectives needed in irrigation improvement. Farmer involvement doesn't just happen. It takes place when farmers are reasonably convinced that they will receive visible benefits in the form of greater supplies of water and better water contro,l thus providing a firm basis for improving production possibilities. There is a need for a policy and a legal framework in many countries which provides a strong government commitment and visible incentives for farmers to organize effectively (Carruthers, 1982).

Farmers usually want more predictability in irrigation systems than is presently provided. More data is needed, however, to ascertain what levels of control are needed and desired by both irrigation authorities and farmers. In some countries, such as Sri Lanka, the Philippines, Indonesia and Pakistan, such work is underway. Farmer participation must be built into appropriate project activities from the start. Projects should never attempt to do for farmers what they can do best themselves. Project implementors should not wait until all decisions are made and then provide farmers only a token role in planning and implementing projects. Farmer participation is not only cost effective but also helps farmers learn skills, gain confidence and develop a willingness to share in the operation and management of these projects.

Farmer organizational issues are many and complex. Often, therefore, planners and program implementors ignore this area and search for ways around the "problem of involving farmers". In the recent review of 63 projects cited earlier, it was found that organization of water users into cooperative associations was a significant feature in only eight projects (WMSP Report No. 1, 1981). In the 1980s, far greater emphasis must be placed on this critical issue which in the past has often been the "Achilles heel" of irrigation projects. Efforts must be made in all projects to learn everything possible about the most successful modes of farmer involvement for improved water management and regular maintenance of systems. This new focus will require a strong input from applied rural sociologists, social anthropologists and public administration experts to identify problems, develop and test experimental modes, and to play a continuing role in monitoring and evaluation efforts (see Lowdermilk, 1981).

d. Extension vehicles to transfer the technology to farmers: Few projects include any Extension component. Public Extension programs are generally weak and ineffective in the developing countries. Farmer water management is an appropriate functional area for agricultural departments. However, there are almost no subject matter specialists in the field. One study has indicated that where rehabilitation of systems costs close to $700 per hectare, the total amount budgeted for all Extension agents, farmers and project staff training was only $25 per hectare (WMSP Report 1, 1981). The widespread myth still prevails that if water is provided, farmers will automatically organize and learn to utilize water efficiently for higher yields. This simply does not happen in practice. Conversely, unless reliable and timely water supplies are provided, which happens all too rarely now, organizational attempts will meet with limited success. Concurrent efforts in both areas are needed.

e. Private sector incentives: In public irrigation pro-

jects, there should be the strongest focus possible on private sector incentives. Wherever there are private tubewells, lift pumps or private tanks, they are usually managed efficiently in contrast to public systems. However, while private tubewell development is needed, uncontrolled private development can lead to problems of externalities and long run social and economic costs (Corruthers and Stohel, 1982). Private land leveling operations to date have been far superior to public land leveling programs in most countries. On many public irrigation systems, the field channels are private property and improvements such as lining, structures, and other improvements are all private goods. The potential role of the private sector and private incentives to producers in large as well as small systems is much greater than is often appreciated. Much policy-oriented research is required in this area.

f. Policy analysis: Institutional development, which results in innovative policies creating improved production possibilities for farmers and incentives to those who work with farmers, are needed for systems improvement. In the area of irrigation development, institutional changes are taking place primarily because governments are discovering that old approaches result in excessive costs and limited returns. Along with demands for increased food supplies, social and political pressures are forcing governments to find ways to make irrigation investments more profitable to both farmers and society. Experience to date suggests that from diagnostic analysis of a system to project completion, a steady stream of applied field research findings reported in simple, clear language can have great impact on policy makers and planners. Systematic efforts are needed to reach those who are influential in policy decisions with creative and viable options that can be implemented.

g. Knowledge transfer: A recent international symposium on arid land irrigation in developing countries has declared that the most glaring need for improving irrigation systems is the application of the scientific knowledge already available. Experience in this area is slow, erratic, and incomplete. Seldom do irrigation specialists in one country know what works under what conditions and at what costs in a neighboring country. The approach of developing each new project from scratch is far too costly. There is need for a method of transferring what is known. If this is done systematically, projects will be better designed and yield better economic and social returns. There should be built into each project a low-cost mechanism to identify and document what works under what conditions and at what cost (Worthington, 1976).

(8) Encourage greater collaboration among international donor agencies.

There is a need for more collaboration among various international development organizations. This is especially important in irrigation endeavors where, in terms of large investments, the international banks are taking the lead. These are areas in which they function well. In other areas, however, such as project implementation, training, institution building, and project monitoring and evaluation, they often have serious limitations. Agencies such as AID have technical field staff and a great deal of experience in farm-level and local institutional development supported by the technical expertise of the U.S. Department of Agriculture and the American land grant university system. Given these complementary comparative advantages, it makes sense to allow the larger donors to handle the more costly hardware elements of major irrigation systems and to collaborate with other appropriate agencies on software components, such as training, institution building and O&M.

(9) Encourage long term donor agency commitment.

Donor agencies must make a serious long term commitment to irrigation for increased crop production in the lesser developed countries. Any such involvement should be planned over a period of not less than 10 to 15 years. To date in irrigation development there still is far too much thinking and planning on a short term basis. When this situation is combined with a lack of trained professional staff, and high staff turnover rates, it becomes difficult to evolve a long-term stable program which has maximum impact. If such a program is desired, however, the burden is on donor agencies to provide and train the technical and management professionals required. The strategy laid out in this paper, focusing heavily on human and institutional development and knowledge transfer, depends on high-level, long term commitment of donor agencies for its successful implementation.

Conclusion

In conclusion, the basic planning concepts of improved irrigation management that we have presented are based on the premise that until water is "managed" more effectively at every level in public irrigation systems, millions of farmers around the world will be unable to substantially increase production and the levels of living of their families. It is a gigantic and complex task to implement these concepts and it will take time and much more technical assistance for low income nations. It will also require much longer time commitments by donor agencies and host countries to bring about the many structural and organizational changes needed to accomplish the task.

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16
Irrigation and Economic Development: Some Lessons from India

Peter Rogers

Prologue

Irrigation has been practiced throughout the world from prehistoric times. In almost all cases the goal was to improve the economic well-being of the owners of agricultural assets. It should seem strange to juxtapose irrigation and economic development as the title of this paper suggests. Irrigation water is, however, a joint input to agriculture and in many cases it does not always follow that development of irrigation and economic development go hand in hand. This paper considers the example of India, with the second largest irrigated area in the world, and which continues to invest substantial amounts each year in expanding the irrigated acreage.

V. M. Rao (1978) perfectly described the issues of irrigation and development in India when he wrote:

> Rural development and prosperity through irrigation has been a dominant theme in Indian planning since the beginning of the era of Five-Year Plans. It would indeed be hard to find an Indian planner or economist who is not apt to day-draem, during his idle moments and, even more, when at work, about the time when the tyrannies of the monsoon would be more than a bad memory relegated to a chapter in history books. The first quarter century of Independent India has witnessed a near doubling of the area under irrigation and, if the Irrigation Commission targets are realised, irrigation would cross the 100 million hectare mark by the end of the twentieth century. While this concern with the extension of irrigation is both important and legitimate, it is doubtful whether, outside the circle of technical experts on irrigation and agriculture, there is adequate appreciation of the fact that assimilation of irrigation by the farming communities is a slow process and that the developmental thrust imparted to the rural economy by irrigation could vary over a wide range depending on the mode and quality of irrigation made available to a region.

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1. History of Irrigation Development in India

There is considerable evidence for the existence of large scale irrigation systems to the Indian subcontinent in prehistoric times. The Harappa and Mohen-jo-daro civilizations of 2500 B.C. relied upon irrigation. These civilizations are serious competitors with the "fertile crescent" of Babylon and the Nile as cradles of neolithic civilization. Documented irrigation developments as early as 300 B.C. have been observed in India. An excellent short summary of the ancient history of irrigation in India is given by the Central Board of Irrigation and Power (1953). A history of tank irrigation is also given in von Oppen and Subba Rao (1980). Most of the early works were tanks. It was not until the fourteenth century that extensive diversion canals were constructed. The more recent history is given in Ganguli (1938), Chaturvedi (1976) and the Irrigation Commission (1972).

Ferozshah Tughlaq (1351-1388) built the Western Yamuna Canal near Delhi in 1355. Akbar (1556-1605) renovated the canal in 1568 to irrigate lands in the Hissar district. Later, Shahjahan (1592-1666) the builder of the Taj Mahal, improved it taking a branch canal to supply water to Delhi. Shahjahan also built a canal 180 km long from the Ravi river to the Shalimar Garden in Lahore (Pakistan). The Eastern Yamuna Canal was constructed by Mohammed Shah (1719-1748) and was repaired and remodeled by the British in the 19th century (1830) with a command area of 860,000 acres and 350,000 acres being irrigated.

During the 19th century there was a tremendous growth in irrigation works in India by the British. These works are best described, in many cases, by the engineers who built them. For example, Cautley (1854) gives an excellent description of the Ganges Canal, Baird-Smith (1856) describes the works in the South of India and Norton (1853) describes both North and South. Sir Arthur Cotton and Sir Proby Cautley were among the leading irrigation engineers of that period. In 1834 Cotton commenced the Cauvry Delta system and later the Godavari system in 1846, both in the South of India. Cotton also suggested and planned the Krishna system which was started by Captain Orr in 1852. In the north, Cautley began construction of the Upper Ganges Canal in 1836 and completed it in 1854. This was the largest irrigation canal in the world at the time of its construction and it was designed to carry 191 cumecs (and irrigated 1,500,000 acres) and has now been remodelled to carry 268 cumecs. (Baird-Smith smugly pointed out that it costs less than one half of the Rs. 31,748,026 cost of the Taj Mahal.)

The scale of these developments and the subsequent development in the second half of the 19th century did not escape the notice of the rest of the world. In 1890-91 Herbert M. Wilson of the U.S. Geological Survey was sent to India by the U.S. Department of Interior to see how the Indian experience could be translated to the U.S. where large scale western irrigation was just beginning. The report, (Wilson, 1903), is a fascinating document. Wilson's first report, published in Part II of the Twelfth Annual Report of the Directors of the United States Geological Survey, for 1890-91, was immediately out of print because of the demand for news of these technologies in the U.S. It is interesting that the report

was finally published in its own right as Water Supply and Irrigation Paper of the U.S.G.S. shortly after the Reclamation Service (later the U.S. Bureau of Reclamation) was established. The scope of the engineering, as well as the economic and administrative developments were clearly shown in Wilson's report.

Wilson remarked on the economic profitability of the irrigation systems of the 35 major "productive" works. The capital expended by the year 1900 was $100,000,000 and these projects were expected to cover more than 10 million acres. Of the 6,000 miles of main canals over 2,300 miles were used for navigation (the current figure is close to zero) and there were 18,000 miles of principal distributaries. By 1900 only 12 of these 35 projects were returning more than 4% profit -- but the profits from these 12 were sufficient to cover the losses of the other 23. For the first 20 years the works were not profitable but for the next 10 years the works as a whole averaged more than 4% return on the gross capital outlay.

As opposed to these "productive" works there were five major "protective" works costing $6,866,000 and designed to irrigate 723,720 acres. These major protective works had 400 miles of canals and 800 miles of main distributaries. There were also 80 "minor" works in operation in 1900 costing $15,040,000. These works comprised of 6,500 miles of canals and 2,650 miles of distributaries and irrigated an area of about 7,201,000 acres. These works averaged 5% net return on the total capital outlay. Even 80 years ago these minor irrigation works were more economically attractive than the larger ones!

The gross area irrigated by the productive, the protective and the minor works amounted in 1900 to 18,611,106 acres. The total area irrigated, including that watered by wells and double cropping amounted to 33 million acres. The gross value of crops irrigated was $155,000,000. Wilson claims that 50% of this value is due to irrigation — a very handsome return indeed! The average water rate charged was less than $1.40 per acre and ran between 3.3% and 8.25% of the gross value of the crops. (These water rates look like some current U.S. water rates in 1980 dollars, not 1900 dollars!) Despite some ambiguity with regard to discounting, the discussions in Wilson's and in the Indian engineers' writing show a great concern with the economics of projects and the need to assess correctly the attributable costs and benefits. The discussion has a very modern sound to it.

The sequence of irrigation development in India was that first kings and philanthropists carried out the works in ancient times, these were succeeded by the Mohguls who carried on the tradition of public provision of water. In the 19th century, however, until 1868 the irrigation development was in private (and for profit) hands — mainly the East India Company. For example, in 1858 the Government of India granted the Madras Irrigation Company and the East India Irrigation Company 5% return on the capital invested and the government supervised the plans and sanctioned their expenditures. By 1867 both of these companies had proved to be costly failures and the government purchased the works of the East India Irrigation Company when it was practically bankrupt. In 1867 the Government decided to construct its own irrigation works and this

marked the rapid expanion of the Indian irrigation system.

During the last 25 years of the 19th century there was a great interest in the economics, financing, and management of irrigation systems. For example, in 1879 a British Parliament Committee laid down that

> ...simple interest in capital cost of works at the beginning of a year plus working expenses for the year should be less than the direct and indirect receipts for the year.

Despite its modern cost/benefit sound it is not clear that the discounting (or amortization) of the start-up years when the costs greatly exceed the benefits (i.e., in this case receipts) were adequately taken into account.

About this time the British also introduced the concepts of 'productive', 'unproductive' and 'protective' works. A 'productive' work is one that the net revenue derived from the project within 10 years after the date of completion is more than a definite percentage of total capital outlay. This percentage was fixed by the central government from time to time as follows:

For work sanctioned	Percentage Rate
Before April 1, 1919	4%
Between April 1, 1919 and Aug. 1, 1920	5%
Between August 1, 1921 and March 31, 1937	6%
After April 1, 1937, Provinces set rates	4-6%
From April 1, 1949 to March 31, 1954 (Central Govt.)	3.75%
From April 1, 1954 to February 1960	4-5%
From March 1960	5%

(Cited in Mamoria [1973])

An 'unproductive' work was one that did not meet these criteria. After the great famine of 1877-78 the concept of 'protective' works was introduced. The protective works were essentially introduced as famine relief works. Since they were not evaluated according to the above economic criteria many observers believed that the existence of these projects has led Indian irrigation engineers, economists and planners to be very causal in the evaluation of all irrigation projects. Certainly, the projects that were taken up in the 20th century did not match the economic performance of some of the earlier canals. For example Baird-Smith (1856) claimed a 35% return on invested capital for the Western Yamuna Canal. For the canal which cost Rs. 3,536,629 by 1847, (or US$1,768,315 in 1950 dollars), the value of agricultural production in the year of 1837-38 alone was estimated at Rs.14,628,000.

The intellectual and administrative background for the "protective" works and its integration into all Indian canal irrigation

projects was laid out as early as 1867 by Colonel Richard Strachey when he was Inspector-General of Irrigation.

> ...the Government now having adopted the policy of extending irrigation generally, and so far as it is possible in a manner that shall to the utmost guard against the worst effects of severe drought ... The first limitation of the supply of water would be with reference to the proportion of the cultivable area within the reach of each canal, for the irrigation of which a provision should be made. This proportion might either be fixed at one uniform rate for the whole canal, say one-third or one-fourth of the cultivable area..." (Gustafsson and Reidinger [1971]).

The government became primarily concerned with equity and averting the risk of famine. These concerns have spilled over to modern irrigation planning in India where projects such as the Bhakara system has a planned irrigation intensity of 62% or about one third of the canal service area for each season.

In Table 1 (Appendix I) we show the historical growth of irrigation in India by the source of irrigation. In Figure 1 (Appendix II) we have attempted to make a graphical correlation of all the factors in the population-food-rainfall-irrigation relationships from 1901 until the present. We make no apologies for the different bases for some of these data series — there are few countries in the world where one would even attempt to analyze consistent data series over 80 years in length. Detailed statistical analysis are given later, but some broad trends can be identified from these figures. These are as follows:

1. From 1901 until about 1951 food-grain production remained more or less constant in the face of a slowly rising population and an increasing amount of irrigation.
2. The foodgrain per capita declined from the beginning of the century until the mid-1950s when it started to increase again.
3. The variance in foodgrain production appears to be increasing as the level of production rose sharply after 1951.
4. The fluctuations in the rainfall index appear to correlate well with the food grain production.

2. Irrigation in the Five Year Plans

The myopia of the Indian Planning Commission with regard to irrigation can be best demonstrated by the strategies for development in the irrigation sector in the Sixth Plan Document (1980-85), (Planning Commission, 1981). Not one of the thirteen strategies they outline in the preamble to the chapter on Irrigation deals with groundwater development (although later in the chapter they do mention the importance of conjunctive use). This is made all the more strange considering the fact that 50% of the proposed targets for increased acreage in the Plan is supposed to come from groundwater. (See Table 2 for a comparison of the proposed physical

irrigation targets of the 6th Plan compared to the 5th Plan and the two annual plans.)

Table 3 shows the expenditure on major and medium irrigation in the recent plans and Table 4 shows the public financing for minor irrigation over the same period. The Plan document also notes the disparity between the tremendous expenditure on irrigation (between 11% and 14% of total public sector expenditures in recent FYPs and 12.4% in the 6th FYP) and the rate of agricultural production. The Plan notes that irrigated land should yield 4 to 5 tons of grains per hectare compared with the average of 1.7 tons per hectare achieved. Partly because of these poor yields the irrigation projects are unable to recover even working expenses and the Planning Commission estimates an annual deficit of Rs.4270 million per year. The blame for these deficits, they claim, is mainly due to delays in completing many of the projects -- in some cases projects are still not completed after more than 15 or 20 years. Another reason given is the delay in utilization of the actual irrigation potential created.

The Plan allocated Rs.121.6 billion to the irrigation, command area development, and flood control items in the plan. Of this 69% was to go to major and medium projects and only 14% to minor irrigation (typically groundwater projects). The proportion going to minor irrigation is lower than the 18% allocated to it in the Fifth Five Year Plan. In the Sixth Plan, however, an additional Rs.17 billions are assigned to institutional investment which will be available for financing loans in the private sector. No precise assessment of private investment in minor irrigation during the Fifth Plan and the annual plans of 78-79 and 79-80 is available. The Plan urges measures for faster mobilization of private resources in this area. Rural electrification for lift irrigation purposes is urged and lifting of power restrictions for irrigation use are to be avoided in the future. A total of Rs.15.76 billion is expected to be expended for rural electrification in the Plan.

3. Instability in Indian Agriculture and the Growth of Irrigation

A conventional view of the introduction of irrigation to agriculture would be that the variance in the production would decrease and that the mean level of production would increase. What has apparently happened in India, however, is that since independence the mean levels of foodgrain production has increased considerably and the production variability also appears to have increased. Mehra (1981) compared the period 1967/68 - 1977/78 with the earlier period of 1949/50 - 1964/65. She found that for crop aggregates as a whole, and for all the food grain crops, the standard deviation of yield increased. The increase in yield variability appears to be quite extensive and not in proportion to increases in the mean yields. The wheat and rice crops - crops where the new technology has been widespread and typically crops that are irrigated wherever irrigation is available — show a smaller increase in absolute yield variability (as reflected by the coefficient of variation). Sugarcane and potatoes were found to be important exceptions because the relative and the absolute yield variability of sugarcane and the relative yield variability of potatoes declined. It is important to note that of all crops

sugarcane has the largest percentage of its area irrigated.

Mehra (1981) also reports that in the Punjab, where the use of tubewells has grown rapidly, the yield variability of all the major crops has declined or remained constant. Indeed, within the Punjab, those areas with higher concentration of tubewells had declining variability in yield compared with those with lower concentrations of tubewells where the yield variability increased over time.

Mehra also raised the question as to whether there is a causal link between growth and variability in agricultural output. Several plausible arguments advanced for this causal relationship can be summarized as follows:

1. variability increased as cultivation was extended to marginal lands where production was more susceptible to the fluctuations of weather (due to S.R.Sen).
2. while irrigation may potentially reduce moisture stress, it is frequently associated with an intensification of crop production and input use which is destabilizing (due to Barker, Gabler, and Winkelmann).

Analyzing the impact of the percentage change in the mean yield, proportion of area under irrigation, and percentage change in the standard deviation of the yield of a crop, Mehra found that the percent of area under irrigation was the most significant variable, accounting for 29% of the total variation. When she looked at individual states the findings about irrigation impacts are much stronger -- and with a strong preference for groundwater development. Table 5 shows the standard deviation, mean yields, and coefficients of variation for selected Punjab districts. These data indicate that Ludhiana district, with 87% of the area irrigated of which 93.8% was from tubewell developments, significantly out-performs the other districts with lesser areas irrigated by tubewells.

When the yield variability is analyzed by state and by season, Mehra arrives at the situation, shown in Table 6, where there is a strong association with the percent of the area irrigated and high mean and low coefficient of variation. The situation is even more pronounced in the rabi season.

It is hard to reconcile Mehra's (1981) work with Hazell's (1982) work from the same research institute which claims that for India,

> More generally, though, there does not appear to be any relationship between the yield variance effects ... and the extent of irrigation in each state. A linear regression of the yield variance effects ... regressed against data on the average proportion of the total cereal area irrigated in each state between 1971/72 and 1975/76 is statistically significant only at the 25 percent confidence level. (p. 32).

Having stated this, Hazell essentially ignores irrigation as a parameter in the stability of Indian foodgrain production. He

claims that the bulk of the increases of variance in total cereal production of 342 percent from 1954-55 - 1964/65 and 1967/68 - 1977/78 are attributed to increases in the covariances of production between crops grown in the same and different states. Without detailed explanation he states,

> It is difficult to see how the improved technologies can be blamed for these increased yield correlations; at most they are accountable for increases in yield variances. More likely causes are changes in weather patterns and the more widespread use of irrigation and fertilizers at a time when the supplies of fertilizers and electric power for irrigation pumps became less reliable. (p. 9.)

By avoiding actual technical variables such as irrigation, fertilizer, etc., and not testing an underlying causal model Hazell ends up explaining the variance in terms of some other covariances — an empty statistical exercise.

The study by Sanderson and Roy (1979) on food trends and prospects in India found that rainfall and fertilizer use were the important factors which affect yield of all cereals. Using their estimated equation for cereal yield they are able to create a weather-adjusted yield curve for all cereals (shown in Figure 2). Figure 3 from Mehra (1981) shows the variation of the monsoon rainfall over India from 1947 until 1978.

From Figure 2 we see that severe weather impacts on cereal production were noticed in 1965-66 and 66-67 and smaller impacts were noted in 68-69, 72-73, 74-75 and 76-77. In Figure 3, however, we note that the 72-73 was a relatively mild drought and that the 74-75 drought was closer to the 65-66 drought. While the actual timing and duration of the rains influences the yields one would not expect this magnitude of discrepancy between the total production deviations. The increment of six million hectares of irrigation potential between 1965 and 1974 must have played a significant role in mitigating the impact of the 74-75 drought.

The Sanderson and Roy study would tend to question the importance of irrigation in the food production sector. One factor that is particularly troublesome in assessing irrigation impacts is that of the quality of irrigation. In a study of multiple cropping in India, Narain and Roy (1980) found that three factors alone account for 80 percent of the interstate variations in cropping intensity. These factors are, the availability of labor per unit of sown area, and the extent and quality of irrigation.[1] They found that, while only 8 percent of the variation in multiple cropping among states can be attributed to the extent of irrigation fully 43 percent can be explained by the quality of irrigation. In their study they claim that tubewell irrigation has double the effect of that of well and canal irrigation.

In analyzing inter-regional variations in agricultural growth from 1952/53 to 1964/65 S. K. Rao (1971) argued that the most important explanation in the growth of crop output is the difference in growth in irrigation. He also argued that since rich farmers are concentrated in the better-off areas they have been able to induce greater public investment in irrigation in their

regions. Therefore, with the growth of irrigation inter-regional disparities as well as the gap between the rich and the poor have widened.

Sagar (1978) carried out a study on the contribution of individual technological factors in agricultural growth in Rajasthan using the Minhas and Viadynathan (1972) method. He found that the contribution of irrigation to the increase in crop yield over the period 1961-1974 was 22% for the yield of wheat, 34% for yield increase of Bajra, 41% of yield increase of rice and 32% of increase in oilseed yields. He claims that irrigation accounted for 18% of the total increase of agricultural output over that period compared to 30% for fertilizer and 15% for HYVs.

Using a variety of data sources from 1901 to 1972, the author correlated the average foodgrain yield with some of the other variables and obtained the results shown in Table 7. As expected the food grain yield correlates well with net irrigated area, expenditure on irrigation, canal irrigation, tanks and tubewells. It has, however, a negative correlation with the monsoon rainfall index.

The above discussion of production functions does not consider the effects of the timing of the irrigation. This effect is considered in great detail in Doorenbos, et al. (1979). Doorenbos shows that the timing of the irrigation may have a significant impact upon the actual yields. Minhas, et al. (1974) have attempted to make production functions for irrigated wheat in India allowing for the timing of water applications. Unfortunately, there is little data available to estimate these equations under Indian conditions. The situation becomes even more complicated when water and fertilizer impacts are considered together. A study by Parikh and Srinivasan (1974) pulled together the available Indian data and concluded that there was little interaction between the two inputs. Singh (1979) has estimated some yield functions for irrigated and non-irrigated crops from these same data.

4. Problems in Evaluating the Economic Development Impacts of Irrigation

The evaluation of the economic development aspects of projects is quite different from benefit cost analysis. Lieberman (1977) indicates, however, that there is some confusion on this point in the literature. In each case, benefits and costs are dealt with but from entirely different perspectives. The methodology for benefit-cost analysis is well developed (see UNIDO [1978]) and considers the costs and benefits for technically feasible projects and weights and manipulates them to arrive at a single index for the value of a project. This study can be compared between projects in order to make investment decisions.

The benefit-cost methodology is recommended for public investment appraisal because it allows for the inclusion of "secondary" benefits of projects and the linkages with other projects or sectors. In actual practice, most studies ignore these secondary benefits. According to Liebermann, the analysis of the economic impact of investments is much more complex because we deal with a special kind of investment called "development projects". Hirschman (1967) said that these are generally large and specific in location, qualitatively different from each other and introduced to

initiate a sequence of additional development steps.

There are two characteristics of canal irrigation projects which make them particularly difficult to evaluate. The first is the problem of technological ignorance. Many of the details of water use are not known at the time of planning and designing the system. Secondly, irrigation projects have, in the words of Hirschman, a "system quality": components — construction of dams, distribution and drainage channels, setting up new organizational structures, altering techniques and cropping patterns, developing marketing facilities — need be in place for utilization to proceed approximately as planned. Yet the successful meshing together of parts is not assured, and is not likely to be achieved except after a long period of difficult experimentation.

In a review of Whitcombe's (1972) book, Bharadwaj (1976) summarized some of the problems faced in introducing canal irrigation in North India during the 19th century as follows:

> The introduction of canal irrigation and the subsequent adoption of flood irrigation upset the traditionally worked-out ecological balance of the area through inducing intensive overcropping, also bringing up serious problems of waterlogging and salinity in certain areas. Intensive cultivation implied that the conventional practices of fallow were given up; the rapid deforestation with extensive cultivation, now turned commercially lucrative, affected likewise the hydrological balance. Further, perennial irrigation made possible extended cultivation of commercial and high revenue-yielding crops like sugarcane, cotton and wheat in place of the crops which catered to the consumption needs of the poorer peasants. Their dependence on markets and of transport links likewise meant export of food crops and an added incentive to grow cash crops. At the same time, the cultivation of these high revenue-yielding crops did not necessarily spell prosperity evenly for the entire peasantry. The cultivation of these crops required considerable circulating capital. The cash needs were enhanced further by high irrigation rates and bribes to be paid to irrigation officials, the key to water supply being in the hands of the powerful members of the village community. The smaller peasants and tenants came to depend upon credit supplied by the bigger landlords and by moneylenders/merchants. Indebtedness was further accentuated and many were caught in a perpetual cycle, as the revenue demands were increased and had to be paid in cash and in advance. This furthered cash-crop cultivation, as the smaller peasants borrowed to pay rents in advance of harvest and were compelled to grow sugarcane or cotton either directly as a condition in the credit contract or because of the ease with which credit could be raised against the prospective crop and the ease of sale for cash. Remedial actions to check the growing indebtedness which threatened to be counter-productive and for correcting ecological imbalances were attempted by the

government through measures like introduction of the Taccavi loans and afforestation. Both were peripheral and made little dent upon the situation: Taccavi loans were soon monoplized by the landlords and moneylenders while the attempt at afforestation was considered too costly to be pursued on any meaningful scale. In short, "only that minority of the rural population already in a position of prosperity and sufficient power to maintain some independence of action had access to the benefits of innovation".

This quotation gives a less sanguine view of the "success" of irrigation projects in North India during the 19th Century than the official government reports of the time. It clearly indicates the difference between the purely benefit-cost approach of the colonial government and a broader economic (and social) evaluation of the development impacts of the canals. Implicit in the above is also some sense of the idea that time also has a large role to play in the working out of the developmental impacts. For example, Sir Proby Cautley was almost impeached for his work on the Upper Ganga Canal very shortly after it was completed because it was a supposed waste of the Canal company's money. How are we to evaluate that same investment 130 years later with the hindsight of a lush, well-developed agricultural region stretching across the Ganga-Jamuna Doab? How would the evaluation have fared only 30 years after completion? Conventional discounting in benefit-cost analysis makes the future disappear after 20 years. But we know that these projects last literally hundreds of years.

The benefits of irrigation are proverbial, but in modern terms we can take these to include double and triple cropping, diversification and improved quality in cropping patterns, higher yields, and larger incomes and greater employment for hired labor. Indirect benefits are the expansion of processing and consumer oriented industries and services. The question is, not what irrigation can provide, but why many projects run into difficulty and fall short or diverge from goals.

Irrigation failure is not a new phenomenon. The taluqdars of the Avadh opposed construction of the Sarda canal on the grounds that it would cause waterlogging, as happened in the (Upper) Ganga Canal area. In historical studies of the Ganga (U.P.) and Mahanadi (Madhya Pradesh) canals, Whitcombe (1972) and Weaver (1968) suggest that errors in design and administration were aggravated by adaptive reactions of cultivators, so that canal water was either misused or not used at all.

The problems of the post-Independence irrigation projects would surprise no one familiar with the historical studies. The difficulties of the Kosi project are well known, but by no means unique. Thus, in a review of performance of the giant Tungabhadra project (headworks completed 1958) we find complaints of (1) unauthorized cultivation of wet and perennial crops in areas not designed to receive irrigation water, (2) insufficient water quantities in other areas, (3) high alkalinity in certain lands and waterlogging due to seepage in other areas, (4) inadequate knowledge on the part of cultivators of dry-cum-wet methods of

cultivation — cultivators are also faulted for not joining cooperatives, (5) slow progress in construction and maintenance of field channels, and (6) obstruction of water flows by paddy growers (Planning Commission [1965]).

Whether such difficulties -- covering unexpected and inadequate responses of users, technical aspects of design and delivery and administrative procedures -- can be overcome by various adjustments of the project design or implementation or can be offset by other exogenous developments are open questions. A wealth of information is becoming available on irrigation projects in India, but what is lacking is an agreed upon framework within which to assess project outcomes and project viability.

As discussed earlier, under British rule project success was gauged according to the net annual return on capital outlay. Projects that were expected to pay a net return of 6% or better were designated "productive" investments, where a second class of "protective" investments were not required to meet the 6% test, but were expected to save on famine relief expenses and the like. In the last 30 years, the view that irrigation has a broad impact on agriculture, and growth in general, has won the day and financial tests have given way in evaluation for certain non-financial criteria.

One approach, highly aggregate in nature, has been adopted frequently in official and semi-official studies. This entails calculation of the supply of water which is available, called the "irrigation potential", and the overall demand for water, the number of acres actually irrigated. A crucial variable is the rate of utilization of the irrigation potential. Finally, various factors have been cited to account for differences in utilization rates, but no one has tried to study these within a common framework.

Even at the level of conventional benefit-cost analysis we have a very difficult time in evaluating irrigation projects because of a lack of precise understanding at the scientific level of the relationships between plant growth and water and other inputs. Both the timing on the inputs and their interaction with each other are not clearly understood. Coupling this lack of basic scientific understanding with a lack of adequate data on soils, water, crops, solar radiation, wind, rainfall, etc., makes the prediction of yield even under controlled conditions quite difficult. Then bear in mind that the social and economic milieu of the farmer adds, in itself, another layer of uncertainty. Singh (1979), for example, reports that there is more than a factor or two difference in yield between the average yields and the average yields of the best farmers growing the same crops in the same area and using basically the same production techniques.

An interesting approach has been given by Stewart (1980) for evaluating irrigation projects under different physical, social and economic environments. This is shown in Figure 4 as a simple decision tree which enables the planner to identify the objective environmental conditions and, hence, which goals and measures to use for evaluation. Berry, et al. (1980) recognize some of the difficulties with assessing the impact of irrigation and development and made recommendations for how to make such evaluations.

5. Experience with Canal and Other Surface Water Irrigation Systems

Most of the literature on the economics of irrigation deals with groundwater development. Why this is so is not readily apparent. It may be because the groundwater development is a fairly new development, with a fairly large private sector component, and, hence, has not yet had time or the opportunity to develop its own bureaucracy. The canal irrigation systems have certainly developed a large infrastructure over the past 100 years. In these organizations it is not in anyone's particular interest to question the desirability of irrigation. The emphasis, as in the U.S. Bureau of Reclamation and the U.S. Army Corps of Engineers, is on the minimization of costs to meet irrigation targets. By and large the irrigation managers (mostly engineers) have convinced the Planning Commission to accept their point of view. Hence, there has been little scope for economic analysis of the large surface projects. An exception to this is the work of Sinha and Bhatia (1982) and their work on the Auranga Project in Bihar.

What little research has been done does not inspire confidence in the choice of the development strategies chosen by the Government of India in the area of irrigation. As mentioned earlier, the early canal administrators were very concerned with the economics of their investments. Each project is required to have detailed benefit/cost analyses before the project can be approved. There are many studies of this type. There are very few genuine follow-up studies which monitor how the project actually turned out. Table 1 shows the extent of surface irrigation in India through 1980.

Lieberman (1977) reviewed some of this literature in an unpublished study. We have drawn freely from that study in the following paragraphs. In one illustration he referred to the Sarda (U.P.) canal system, opened originally in 1928, but expanded considerably in the last 50 years. By 1957, the system was estimated to command an area of 7.5 million acres. The maximum discharge of the canal, as designed, is 9500 cusecs, where the average discharge reported for 1953-1957 was 8234 cusecs in Kharif and 5914 cusecs in Rabi season. "Irrigation potential" is defined as the net area over which water can be supplied to field channels drawing from channel outlets. By 1957, authorities estimated the potential to be 1.95 million acres. Singh and Mishra (1965) derived a lower potential by applying discharge rates and area irrigated figures for the Upper Ganga Canal to the Sarda discharge figures.[2] They estimate that the water available could have irrigated 770,000 acres of Kharif crops and 1 million acres of Rabi crops, for a total of 1,770,000 acres.

Given such estimates of irrigation potential the data show that utilization has been nowhere near capacity. Area irrigated averaged 1.2 million acres in the 1953-1957 period, a 65% utilization rate of the 1.77 million potential, 61% of the official figure. In the Upper and Lower Ganga systems utilization in the same period was well above 86%. Other data on the project are provided in Table 8.

The question is whether a comparison of these utilization rates can help us evaluate project outcomes. Our view is that the

utilization rate approach is too aggregative in nature and does not yield insight into the several factors and processes which affect performance. First, it is clear that both the numerator and denominator of the utilization ratio depend closely on certain assumptions and estimation procedures. Thus, to calculate irrigation potential we must assume particular cropping patterns, cultivation practices, and irrigation intensities, and we must also expect that water reaches the ultimate user without difficulty, that drainage is adequate, etc. But in fact irrigation potential estimates often reflect the hope that the cropping and water utilization pattern will change and that irrigation systems will function without mishap. That is, strong assumptions are made about the way farmers, irrigation engineers and administrators perform their tasks.

Actual utilization figures must also be treated cautiously. "Utilization" generally means no more than that water has been delivered to the fields. There is no concern as to whether too much or too little water has been made available at any one time, and whether delivery intervals are in harmony with the requirements of crops. In addition, cropping patterns and irrigation intensities, which vary significantly between areas, affect amounts utilized.

As regards the explanation of differences in utilization rates most authors have limited themselves to brief and discursive remarks. Thus, Singh and Mishra (1965) speculate that relatively low utilization in the Sarda system has been due to the availability of other water sources (rainfall and wells) which are adequate for the cropping patterns and low level of technique which prevail. For the Sarda, Kosi (Bihar) and other systems additional factors have been cited to account for utilization rates: the date of project completion or the argument that lags occur necessarily before systems can be fully utilized, the length of canal network which determines transmission losses, chronic problems of waterlogging, seepage, and silting, and difficulties associated with the administration and maintenance of water delivery systems.

A recent World Bank publication by Abbie, Harrison and Wall (1982) discusses the economic return to investment in irrigation in India. They summarized the data on the anticipated and actual rates of return for private groundwater investment and public surface water projects. For the groundwater projects the actual rates were everywhere slightly lower than, but very close, to the anticipated returns. Table 9 reports these results for private groundwater. However, studies showing ex post rates of return for surface irrigation projects are quite rare in India. In part this is because of the methodological problems outlined by Lieberman (1977) above, and in part a reflection of the time taken for projects to reach mature development. Abbie, et al., report ex ante rates of return in the range of 12-30% for a variety of projects shown in Table 10. They also report that the last two projects on the list, Pochampod and Kadana, had ex post rates of return of 14% and 12% respectively, and that two completed major irrigation projects in Rajasthan had rates of return in the 12-14% range. The data, although admittedly sketchy, would indicate that the rates of return on major projects should be expected to be considerably lower than those of the groundwater developments.

A careful study was made of the Damodar Canals by Basu and Mukherjee (1963) in an attempt to evaluate the benefits and the costs of the irrigation system. Based only upon the primary irrigation benefits they claim a benefit/cost ratio of 1.36.1. It is not clear from their presentation, however, if they have allowed for the period between 1952 when the digging was started for the new canals and 1957-58 when the first water was delivered. There is no indication of allocation of the costs of storage and diversion to the canal system. Inclusion of both of these costs could easily lead to a benefit/cost ratio of less than one. They do indicate, however, some of the concern outlined by Lieberman above regarding the appropriateness of benefit/cost ratios to such large development projects.

In an unpublished study (1978) the author looked at the performance of the Kosi project in North Bihar. The Kosi Project is a large flood control and irrigation project that was initiated in 1956. The barrage at Hanumannagar (3770 feet long) together with earthen dams at either end totaling 18,700 feet in length linked to eight miles of afflux binds was started in 1956 and completed in 1963. Flood protection embankments about 70 miles in length on each side of the river were started in 1954 and completed in 1958. The Eastern Canal commanding 1.5 million acres (605,000 hectares) of cultivable land started in 1961 and was completed in 1969.

The irrigation target, based upon the original plan, called for 700,000 hectares of irrigation each year. By 1978 never more than 458,327 hectares had been irrigated and the average from 1969 onwards was only 337,537 or 48% of irrigation potential. However, both Singh (1978) and Prasad (1972) show that due to waterlogging, habitations, high land, and orchards, the actual net cultivable command area is considerably smaller; 440,485 hectares (Singh) or 339,271 hectares (Prasad). At 115% cropping intensity for the net cultivable command area (CCA), these revised estimates lead to actual irrigation potentials of 506,557 hectares (Singh) and 390,161 hectares (Prasad). Using these figures for CCA the efficiency of the irrigation water use relative to the potential rises to between 66% and 99%. Looking at the actual water deliveries by season, Singh found that the actual irrigation water use per cusec of water supplied was much higher than that estimated by the canal authorities — about 76.84 acres per cusec.

Rogers (1977) concluded that even if the irrigation water use rates were high it was still difficult to evaluate the success of the project because of the low production response to irrigation and other environmental (waterlogging, drainage), health (increase in mosquities and Kalazar), and social (marked regional differences between beneficiaries) impacts. Similar conclusions were arrived at by Biggs and Barnes (177) and Joy and Everett (1976).

In a series of articles spanning from 1975 to 1980 Wade (1975, 1976a, 1976b, 1978, 1980) and Wade and Chambers (1980) have critically reviewed the performance of the large surface canal irrigation systems in various parts of India. These papers along with one by Hart (1978) indicate how and why the canal irrigation systems are not operating at their desired level of performance. The intriguing part of these studies is why, for systems already built, substantial improvements that could be made essentially at little

or no cost -- provided the managerial performance could be improved -- were not made. These same papers indicate, however, that these "costless" improvements may not be very easy to bring about for political, cultural, and economic reasons. These studies are part of the burgeoning literature on irrigation management. See for instance Pant (1979) for a study of the Kosi, Maass and Anderson (1978) for studies of the U.S. Southwest and Spain, Coward (1980), Levine and Wickham (1977), and Early (1980) for studies in Southeast Asia. Botterall (1981) and Montgomery (1982) have summarized some cash material from a variety of projects worldwide. An interesting study on irrigation organization using 'appropriate technologies' for well irrigation is given by Ghate (1980).

In recent years the emphasis by the Government of India on Command Area Development Authorities has been to address these sets of complex social and organizational issues -- with little success to date.

6. Experience with Groundwater Irrigation Systems

There were over 4 million open wells fitted with traditional water lifting devices in 1971 and there was probably a similar number in 1951, whereas the number of power pumps in operation rose from 85,000 to over 2.75 million in the same period. The number of public tubewells rose from 3,000 to about 20,000 and the number of private tubewells rose from 21,000 to about 300,000 over the same period. (This is a 19% annual rate of growth for pumpsets and 17% for tubewells.) By 1971 it as estimated that modern water lifts raised 38 million acre-ft of groundwater and traditional lifting devices 27 million acre-ft. Table 11 summarizes the vital statistics for groundwater development in India.

Madappa, Patel and Patel (1970) documented a case study in Saurachtra, Gujarat, where there appeared to be considerable underutilization of the irrigation pumpsets because of a water scarcity. The pumps were used only for a total of 315 hours per year if there were 4 pumpsets in a well and up to 955 hours per year if there were only one pumpset in the well. This led to a very low figure of irrigated area per pumpset (average 5-6 hp) of between 3 and 12 acres.

Mellor and Moorti (1971) studied state and private tubewells in Western Uttar Pradesh. They found that the state tubewells irrigated 135 hectares and the private wells irrigated 20 hectares. The state tubewells were run for 4000 hours and the private wells run for 1500 hours per year. They showed that the costs were Rs.33 for the state tubewells, Rs.22 for the private tubewells, Rs.75 for Persian wheels, and Rs.120 for chara (indigenous lifting devices utilizing bullocks) per 1000 cubic meters. They also estimated the marginal return to water per cubic meter as Rs.0.06 for state tubewells, Rs.0.10 for private tubewells, and Rs.0.03 for chara. They also reported that the water from the state tubewells was sold at the subsidized price of Rs.18 per 1000 cubic meters (although a Rs.6 tip to the operator had to be included in the total price). Farmers could also purchase private tubewell water at Rs.30 per 1000 cubic meters. From these figures it appears that water is a cost effective input in both state and private tubewells but not with a chara. While the marginal values of water obtained by

Mellor and Moorti (1971) are similar to that estimated by Hopper (1965) -- Rs.0.1 per cubic meter -- Hopper claims a better return for the indigenous water lifting system than Mellor and Moorti.

In examining the pattern of investment in farm machinery and equipment Lockwood (1972) said:

> Such broad averages tell us little, except that many more farmers have invested in irrigation facilities than have bought tractors, tillers or threshers. However, one might be allowed a tentative conclusion from this: viz. that in the minds of the farmers, assured irrigation has a higher priority than a tractor or a thresher in the allocation of investment funds.

His data show the number of electric pumpsets per 100 farms rising from 11 in 1965 to 100 in 1970 in Ludhiana District in the Punjab. Over the same period the number rose from 1 per 100 farms to 2 per 100 farms in Gaya District in Bihar. For each of these districts there is already substantial canal irrigation available; 30% of irrigated area supplied by canal in Ludhiana and 95% in Gaya.

P. S. Appu (1974) discusses an innovation in groundwater development that could pave the way for extremely high irrigation coverage in the Districts of North Bihar. The innovation — a bamboo tubewell — was introduced in Shaarsa District in 1968. All the materials used are locally available and the only skilled technician needed is the village blacksmith. Only a few hours of labor are required to fabricate and insert the tubewell and its cost was about Rs.250 (1973). The cost of a comparable (4 inch) tubewell equipped with a brass strainer was Rs.3000-4000, and for a comparable tubewell using a coir strainer the cost could be as low as Rs.800-900. (These tubewells are called "filter points" in West Bengal where the technology was first used.) From 1968 until 1972 4,000 of these bamboo tubewells were sunk, by the farmers without government help in comparison with 1580 government-sponsored tubewells over the same period. There was a severe drought in 1972 which led the goverment to change its position on making loans available for bamboo tubewells. In the four months following October 1972 14,088 bamboo tubewells were sunk in the Districts of Purnea and Shaarsa with government assistance and a further 4,795 were sunk by the farmers without government assistance. Thus over 19,000 tubewells were sunk in two districts in four months. This brought 100,000 acres under irrigation for a government loan program of Rs.5,000,000 or about Rs.50 per acre. Over the period from 1968 until 1977 over 47,500 bamboo tubewells were sunk as compared to 5,936 conventional tubewells.

The bamboo tubewell is an extremely flexible technology and farmers who own as little as one half an acre of land have installed them. It has also been used by farmers with scattered plots who now are in a position to sink wells in each part of their fragmented holdings. Since most of the villages in North Bihar are not electrified the wells are serviced by diesel pumpsets placed on bullock carts and moved from well to well. For the smaller farmers diesels can be hired for Rs.4-8 per hour including fuel charges.

This brings the water cost to about Rs.0.02-0.04 per cubic meter, (Rs.20-40 per 1,000 cubic meters which is almost identical to the costs observed by Mellor and Moorti in Uttar Pradesh).

In a series of papers (Dhawan, 1974, 1975, 1977a, 1977b, 1979, and 1980) and a book based upon them (1982), Dhawan challenges some of the assumptions upon which other studies of groundwater development (Mellor and Moorti [1971] and Madappa, S.M. Patel and K.V. Patel [1970]) have based their conclusions of the desirability of private over government tubewells.

Dhawan considers that the earlier studies had been too preoccupied with the individual or private costs of the developments and ignored the social costs and other external effects of groundwater development. In the first paper Dhawan (1974) urges a closer look at the cost of electrification associated with private tubewells and claimed that, when all of the relevant capital used for providing capacity in the generating system and in the transmission system is accounted for the economic picture changes. Dhawan argues that there is no longer a clear economic superiority of private over public tubewells. In his second paper Dhawan (1975) argued the need for public versus private tubewells on the basis of (1) the physical externalities of increasing the depth to groundwater by extensive groundwater development (he documented that in some blocks of Mehsana District in Gujarat the water table dropped as much as 14 meters and in one year, (1968), about 100 pumps had to be either changed or lowered); (2) the high capital requirements which make it hard for small farmers to have access to the technology, and (3) the size and fragmentation of holdings makes irrigation by private tubewells almost impossible. He argues that properly designed and properly managed state tubewells are the only way of addressing these issues.

A study by Bhatia and Mehta (1975) looked at the technical alternatives for tubewell irrigation and concluded from the best available data that the optimal economic size of a tubewell should be 1 cumecs (35 cusecs) discharge capacity as opposed to the smaller wells that are currently in vogue in the private sector in India. They also concluded that if the cost of village electrification exceeded Rs.104,000 for a village with 25 wells of 1 cumec capacity then the economic choice of prime mover would indicate preference of a diesel engine over an electric pumpset. These conclusions apply to North Indian conditions.

7. Financial Performance of Public Irrigation Works

As we see from the discussion of the history of Indian irrigation there was a great concern with the financial repayment of the irrigation works. Since Independence, however, the financing of irrigation in India has progressively fallen to the Center and States' general revenue sources and has not been sustained by the irrigation projects themselves. At a superficial level one could claim that this is irrelevant to any "economic" analyses of irrigation. However, the low prices set for water, and often the non-collection of the fees, has led to serious misallocation of the water by the farmers (see the Wade references). Moreover, by allowing the farm sector to capture these financial resources there is serious shortage of revenue available to finance the continued

maintenance and development of the irrigation systems. This leads to poor maintenance and excessive delays in constructing new facilities.

Srinivasan (1976) quotes the Sixth Finance Commission:

> The era of Planning which has witnessed a phenomenal increase in investment in irrigation projects, has however been unfortunately marked by sharp and progressive deterioration in the working results of irrigation projects.

He shows that between 1955-56 and 1967-68 with a less-than-two fold increase in irrigated area the losses increased nearly eleven times. Over the same period the gross receipts had only slightly more than doubled. This is shown in Table 12. Actual physical and financial performance are way off target because of time overruns which range up to 500% and cost overruns which range up to 300%.

Srinivasan describes in detail the causes of these shortfalls in revenue but eventually settles on the reluctance of the states to raise the water rates. A Committee on Taxation of Agricultural Wealth (Ministry of Finance [1972]) suggested raising the water rate to cover costs like any other input to prevent waste due to underpricing, and bring about parity for the purposes of taxation between those who depend on public and private sources of irrigation water. The Irrigation Commission (1972) urges a rate of between 5 and 12% of the gross income be adopted. Table 13 shows the then current rates charged in the various states. Only in the case of Bihar for rice does it come within the suggested range (and this is probably due to the very poor yields of rice in that state). It is important to note that the water cess (rate) was between 9 and 10% of gross value of rice per acre in 1900 declined to 6-7% by 1942-43 and dropped to 2-3% by 1955-56. Table 14 shows the water cess for rice in Godavari Delta in Andhra Pradesh over this century.

8. Summary and Conclusions

This paper has attempted to lay out some of the evidence obtainable from India with regard to the connections between irrigation and economic development.

1. We have seen that despite massive investments in irrigation works the variance of the production in foodgrains in India is increasing over time. Even for those crops that are most intensively irrigated -- rice (over 40% irrigated) and wheat (over 60%) --the absolute yield variability (coefficient of variation) increased. In the areas intensively irrigated by tubewells the yield variability decreased markedly.
2. There is some ambiguity about the importance of irrigation as a major determinant of national agricultural production. Some sort of "ecological fallacy" may be involved in the data analysis. At the farm level irrigation appears to be an unequivocally good investment activity for most farmers in most regions of India, at

least for some season. The quality of the irrigation varies widely, however, between surface systems that are merely monsoon diversions, surface storage systems, and groundwater systems of several types. Adding all these different types of activities together and calling them "irrigation" will tend to obscure the real effects of irrigation.

3. There appear to be, also, at least two types of evaluation approaches to irrigation investments. One approach, and the one taken by the bulk of the groundwater analyses, is to apply the classical benefit-cost approach. The other approach, and the one followed or hinted at by the surface water projects, is to look for proxies of the broader development characteristics of the project (food production, employment, industrial development, environmental and health improvements). The first approach does seem well suited to small divisible projects of individuals or groups of farmers and these which are taken up in a piecemeal fashion. The second approach is very difficult to implement because of the many imponderables and uncertainties to be dealt with. Moreover, there is no universally agreed upon methodology.
4. There is a pressing need to implement better means of collecting more revenue from the users of publicly supplied irrigation to finance the irrigation sector. This is a widely discussed issue, but one that is politically very hard to motivate. Farmers have demonstrated, time and time again, token willingness to pay much higher prices for water. They show this by their installation of tubewells or the purchase of water from other farmers. Unfortunately, however, in order to collect more revenue from the surface systems their operation may need to be greatly improved until the value of their water is similar to that of the "timely" water of the wells.
5. Finally, the economic performance of the system needs to be greatly improved. India currently has an estimated 61.5 million hectares of land that is potentially irrigable. At a level of grain yields that could reasonably be expected under irrigation (4 tons per hectare) India should be producing about 170 million tons of rice and wheat alone, on the currently irrigated areas. Comparing what is possible to the actual figure of 90 million tons points to some problems in the irrigation systems of India.

India is currently spending at the rate of Rs.10,426 million ($1.39 billion) per annum (in 1970-71 constant terms on irrigation development. This is a large price tag by any standard, and this does not include the private components of groundwater investments. Seventy percent of the expenditure is devoted to major and medium projects which seem to have the worse record in terms of economic return. Given the rates of return and the remaining potential for irrigation by various technologies the possibility arises that, maybe, the planning goals should be changed from the existing

concentration on surface systems to the groundwater developments, and an improvement of the existing 37 million hectares of major, medium and minor surface irrigation systems and expanding the groundwater to its full potential of 40 million hectares looks like an attractive strategy. Such a tremendous area under irrigation could easily lead to 250 million tons of food grain production per annum within the next decade. This approach could significantly reduce the public expenditures on irrigation, perhaps by as much as 50%.

The decision to change the strategy should not be taken lightly, however. The development inducing aspects of large surface projects needs to be carefully analyzed and assessed in relation to the narrower development impacts of private (or public) tubewell projects. The final choice between the strategies may well hinge on a view of what rural India should look like in the early parts of next century rather than the short run production benefits obtainable by each of the strategies.

Epilogue

In this paper we have attempted to assess the economic development consequences of irrigation development in India. What we show is that this is no easy task because the methodology typically used is more appropriate to short term benefit-cost analyses of small projects. In many of the cases that we encounter in India it is quite difficult to decide whether a project is a success or a failure based upon conventional measures. For example, is the project described in a speech by Professor M. N. Srinivas a success or a failure?

> Mandya district, the richest agricultural district in Karnataka today, was extremely poor and disease-ridden in the thirties. The Visweswariah canal had brought with it endemic malaria with the result that irrigation facilities instead of stimulating agriculture very nearly destroyed the latter. The health of the people had been so adversely affected that pregnant women were rare to come by. An intensive campaign to eradicate malaria was started by the state government during the War years and DDT was sprayed on canals and other places where the mosquitos bred. The starting of a sugar factory in Mandya and the adoption of a bold and imaginative policy to spread the cultivation of sugarcane in the district proved to be very successful. Further, the higher prices which food and commercial crops fetched during the War years and subsequently resulted in prosperity for the peasantry. The richer peasants invested their surpluses in a variety of commercial activities and, with the dawn of independence, some of them entered politics. Mandya became a boom town bursting with every kind of activity. Several educational institutions were started, and it became universal for at least the sons of the richer peasants to go to school and college. Educated youths

> demanded huge sums as dowry, and their lifestyles were sharply different from those of their parents. Agricultural prosperity resulted in the peasants' becoming aware of their collective power. It also made them sensitive to new economic opportunities, and to the importance of education for wielding power. The life-style of the rich peasants became both more Sanskritised and Westernised than before. Old temples were renovated and new ones were built, and the annual festivals of the deities are celebrated with great gusto. Alongside, drinking, gambling and litigiousness have also increased. A young Deputy Commissioner of the District confided in me, in November 1972, that very little of the gains of economic development were being ploughed in investment but in wasteful and ostentatious living. (Quoted in V.M. Rao [1978].)

Some new methods of analysis would be necessary to unscramble all of these issues and give an unambiguous answer — but this is what economic development is all about.

The paradox is that we must decide ex ante if a particular investment choice is a good one or not without being able to predict in any coherent way how the economic development parameters of the cultural, social and economic environment are likely to change over the life of the project. At present all we can do is do the best and fullest social benefit-cost analysis and hope the Hirschman's "hiding hand" will help the project muddle through to some satisfactory future.

Notes

1. They define irrigation quality as the multiple cropped irrigated area as a percentage of the net irrigated area (p. 13).
2. It was assumed that 150 acres of rabi crops and 100 acres of kharif crops were irrigated per cusec of water discharge at canal head and the ratio of 1.25 acres of rabi irrigated per acre of kharif crop irrigated.

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Table 1. DEVELOPMENT OF IRRIGATION POTENTIAL SINCE 1951 /a

Year	Major/Medium Surface /b		Minor Surface /b		Groundwater		Total	
	Million Hectares	Annual % Change	Million Hectares	Annual % Change	Million Hectares	Annual % Change	Million Hectares	Annual % Change
1950/51	9.7	-	6.4	-	6.5	-	22.6	-
1955/56	12.2	(4.7)	6.4	(0.0)	7.6	(4.2)	26.2	(3.0)
1960/61	14.3	(3.2)	6.5	(0.3)	8.3	(1.8)	29.1	(2.1)
1965/66	16.6	(3.0)	6.5	(0.0)	10.5	(4.8)	33.6	(2.9)
1968/69	18.1	(2.9)	6.5	(0.0)	12.5	(6.0)	37.1	(3.4)
1973/74	20.7	(2.7)	7.0	(1.5)	16.5	(5.7)	44.2	(3.6)
1979/80	26.6	(4.3)	8.0	(2.3)	22.0	(4.9)	56.6	(4.2)
1984/85 (target)	32.2	(4.0)	9.0	(2.4)	29.0	(6.4)	70.3	(4.5)

/a Investment creates irrigation potential when the system can deliver water to the canal outlet. Irrigation potential is the theoretical gross cropped area that can be irrigated by the infrastructure constructed and is therefore the cultivated area to be irrigated multiplied by the cropping intensity. Potential is counted as utilized when farmers actually convey water from the outlet and apply it on their fields.

/b Minor surface irrigation projects are those with a cultural command area (CCA) up to 2,000 hectares. Medium projects are those with a CCA above 2,000 hectares up to 10,000 hectares. Major projects have a CCA greater than 10,000 hectares.

Source: Abbie, Harrison, Wall (1982).

Table 2. PROPOSED TARGETS FOR 6th PLAN (1980-85)

	5th Plan (1974-78)	Annual Plans 1978-79 & 1979-80	6th Plan (1980-85) Proposed
1. Irrigation Potential (m.ha)			
(i) Groundwater	3.3	2.2	7.0
(ii) Surface water (Minor)	0.5	0.5	1.0
(iii) Surface water (Major and medium)			5.7
(iv) Total			13.7
2. Units of Works			
(i) Dugwells (Lakh Nos.)	7.25	3.55	12.00
(ii) Private Tubewells (Lakh Nos.)	5.60	4.10	12.00
(iii) Public Tubewells (Lakh Nos.)	8,000	6,000	15,000
(iv) Electric Pumpsets (Lakh Nos.)	8.70	6.5	25.00
(v) Diesel Pumpsets (Lakh Nos.)	8.0	4.0	12.00
3. Financial (Rs. in crores)			
(i) Outlays (State Plans)	630	497	1739
" (Central Plans)	19	12	70
(ii) Institutional Investment	780	490	1700

Source: Rural Electrification Corporation (1982)

Table 3. EXPENDITURE ON MAJOR AND MEDIUM IRRIGATION PROJECTS

Period /a	Total Expenditure in Current Rs million	Average Annual Expenditure in Constant 1970/71 Rs million	Average Annual Potential created in million hectares	Expenditure per hectare of Potential created in Constant 1970/71 Rs	Expenditure as a % of Total Plan Expenditure	Expenditure as a % of GDP in Market Prices
First Plan	3,000	1,385	0.5	2,770	15.3	0.60
Second Plan	3,800	1,500	0.4	3,571	8.1	0.61
Third Plan	5,810	1,804	0.5	3,922	6.8	0.58
Annual Plans	4,340	1,687	0.5	3,374	6.6	0.47
Fourth Plan	12,370	2,276	0.5	4,377	7.8	0.54
Fifth Plan	24,420	3,483	1.0	3,483	6.1	0.78
1978/79	9,770	4,934	1.0	4,934	8.8	1.00
1979/80	10,790	4,704	0.8	5,880	8.9	0.99
Sixth Plan (target)	84,484	7,366	1.1	6,696	8.7	1.13

/a First Plan 1951/52 - 1955/56, Second Plan 1956/57 - 1960/61, Third Plan 1961/62 - 1965/66, Annual Plans 1966/67 - 1968/69, Fourth Plan 1969/70 - 1973/74, Fifth Plan 1974/75 - 1977/78, Sixth Plan 1980/81 - 1984/85

Source: Abbie, Harrison and Wall (1982)

Table 4. PUBLIC FINANCING FOR MINOR IRRIGATION SINCE 1951 (Rs million)

	Plan Expenditure		Institutional Finance /a		Total	
	Total Expenditure (Current Prices)	Average Annual Expenditure (Constant 1970/71 Prices)	Total Finance (Current Prices)	Average Annual Finance (Constant 1970/71 Prices)	Total (Current Prices)	Average Annual (Constant Prices)
First Plan	660	305	Negligible	Negligible	660	305
Second Plan	1,420	659	190	88	1,610	747
Third Plan	3,280	1,292	1,150	454	4,430	1,746
Annual Plans	3,260	1,684	2,350	1,216	5,610	2,900
Fourth Plan	5,130	923	6,610	1,185	11,740	2,108
Fifth Plan	6,310	899	7,800	1,112	14,110	2,011
Annual Plans	4,970	1,177	4,900	1,151	9,870	2,328
Sixth Plan (target)	18,100	1,578	17,000	1,482	35,100	3,060

/a Primarily loans to private farmers for tubewells development. Excludes farmers' own contribution.

Source: Abbie, Harrison and Wall (1982)

Table 5. -STANDARD DEVIATIONS, MEAN YIELDS, AND COEFFICIENTS OF VARIATION FOR SELECTED PUNJAB DISTRICTS DURING 1954/55-1964/65 and 1967/68-1977/78

Crop	District	Standard Deviation		Mean Yield		Coefficient of Variation	
		1954/55-1964/65	1967/68-1977/78	1954/55-1964/65	1967/68-1977/78	1954/55-1964/65	1967/68-1977/78
		(kilograms/hectare)				(percent)	
Wheat	Ludhiana	296.7	213.7	1,384.7	3,045.4	21.4	7.0
	Bhatinda	120.6	216.4	1,276.0	2.152.1	9.5	10.1
Maize	Ludhiana	437.6	347.2	1,506.0	1,894.6	29.1	18.3
	Bhatinda	211.4	348.2	821.0	1,345.8	25.8	25.9
Rice	Jullunder	184.5	185.4	1,071.9	2,307.4	17.2	8.0
	Ferozepur	177.5	328.3	1,083.0	2,237.0	16.4	14.7

Note: For rice the two districts compared are Jullunder and Ferozepur since rice yield data for Ludhiana and Bhatinda were not available for a number of years.

Source: Mehra (1981), p. 26

Table 6. -YIELD VARIABILITY OF KHARIF AND RABI FOODGRAINS BY STATE, 1967/68-1977/78

Country	Kharif Foodgrains /a				Rabi Foodgrains /b			
	Standard Deviation	Mean	Coefficient of Variation	Average Percentage of Area Irrigated 1967/68-1969/70	Standard Deviation	Mean	Coefficient of Variation	Average Percentage of Area Irrigated 1967/68-1969/70
	(tons/hectare)		(percent)		(tons/hectare)		(percent)	
Group I								
Gujarat	0.15	0.60	25.60	5.0	0.11	1.26	8.62	48.4
Maharashtra	0.11	0.59	18.86	4.7	0.10	0.40	27.11	12.9
Rajasthan	0.11	0.31	35.45	3.4	0.09	0.97	8.98	49.7
Haryana	0.16	0.76	21.44	22.5	0.16	1.32	12.11	49.6
Punjab	0.18	1.68	10.91	71.0	0.11	2.04	5.61	69.7
Tamil Nadu	0.12	1.31	9.35	59.3	0.10	1.05	9.69	20.1
Orissa	0.10	0.83	12.39	26.1	0.07	0.74	10.05	2.6
Madhya Pradesh	0.06	0.62	9.48	6.1	0.06	0.64	8.76	8.5
Group II								
Andhra Pradesh	0.06	0.87	6.99	49.8	0.07	0.80	9.28	36.0
Assam /c	0.04	0.98	4.45	28.4	0.16	0.76	20.44	5.7
Bihar	0.07	0.84	7.93	25.4	0.11	0.94	11.34	23.4
Karnataka /d	0.08	0.93	8.67	20.0	0.09	0.56	16.21	9.2
Kerala	0.04	1.41	2.96		0.23	1.54	14.99	
Uttar Pradesh	0.06	0.79	8.05	10.4	0.10	1.07	9.15	50.4
West Bengal	0.09	1.14	8.26	28.2	0.22	1.34	16.17	9.0
All India	0.05	0.80	6.29		0.04	0.95	4.32	

Note: For the states in Group I, Foodgrain yield fluctuates more in the kharif (monsoon) season than in the rabi (dry) season. The reverse is true for the states in Group II.

/a Kharif Foodgrains include rice (autumn and winter), jowar (kharif), bajra, maize, ragi, small millets, tur, and other kharif pulses.

/b Rabi Foodgrains include rice (summer), jowar (rabi), wheat, barley, gram, and other rabi pulses.

/c The percent of area irrigated for Assam refers to 1953/54 and for West Bengal to 1967/68.

/d The percent of area irrigated figure excludes irrigated area planted with other pulses and other cereals because the rabi and kharif breakdown is not available for them.

Source: Mehra (1981), p. 31.

Table 7. CORRELATION MATRIX 12 VARIABLES

		1	2	3	4	5	6	7	8	9	10	11	12	13
1.	Foodgrain Production	1	.51	.83	.94	.93	.72	.88	.33	.96	.65	.92	.95	.54
2.	Per Capita Foodgrain		1	.02	.53	-.11	.51	*	-.25	*	*	*	*	.53
3.	Area Sown Foodgrain			1	.98	.87	.52	.45	.76	.15	.60	.66	.51	.41
4.	Average Food Grain Yield				1	.78	.75	.89	.30	.97	.70	.95	.97	-.12
5.	Net Irrigated Area					1	.52	.87	.48	*	*	*	*	.49
6.	Expenditure on Irrigation						1	.60	.30	.37	.15	.85	.70	.33
7.	Livestock							1	-.06	.94	.86	.77	.90	.53
8.	Area Fallow								1	-.29	.09	.15	-.07	.14
9.	Irrigated by Canal									1	.31	.50	.85	-.02
10.	Irrigated by Tank										1	.38	.61	.28
11.	Irrigated by Wells											1	.87	-.03
12.	Total Area Irrigated												1	0
13.	Rainfall Index													1

Data are from the period 1901-1972 but each correlation coefficient is based upon the number of data points available for that pair of variables -- hence the number of cases and their statistical significance varies over the matrix.
* Not computed.

Table 8. COMPARISON OF MAJOR CANALS OF U. P.

Source: B. Singh and S. Mishra, Benefit-Cost Analysis of the Sarda Canal System, Asia Publishing House, N.Y., 1965.

	Sarda	Upper Ganga	Lower Ganga
Normal Rainfall (Inches)	39.68	32.86	34.06
Irrigation Channels (Miles)	7,013	4,054	3,993
Culturable Command (Million Acres)	7.288	3.716	4.993
Irrigable Area (Million Acres)	1.887	1.727	1.302
Irrigated Area (Million Acres)	1.077	1.489	1.125
Irrigable Area per mile of total channels (Acres)	189.12	281.26	248.29
Irrigated Area per mile of total channels (Acres)	107.92	242.48	214.31
Culturable Command Area per mile of total channels (Acres)	730.4	605.0	856.3
Percentage of Irrigable to culturable commanded area	25.9	46.4	26.2
Percentage of flow to total irrigable area	57.06	86.21	86.31
Percentage of flow to total irrigated area	76.35	85.41	77.25
Percentage of lift to total Irrigated Area	23.65	14.59	22.75
Percentage of Kharif to total Irrigated Area	55.63	52.57	40.80
Percentage of Rabi to total Irrigated Area	44.37	47.43	59.20
Acres Irrigated per cubic feet per second of average water discharge utilized:			
(a) Kharif	88.0	187.0	132.0
(b) Rabi with sugar-cane	182.0	441.0	217.0
Acres irrigated per cubic ft. per second of average water discharge at head			
(a) Kharif	73.0	137.0	114.0
(b) Rabi with sugar-cane	121.0	263.0	130.0
Percentage of cusecs utilized to discharge (a) Kharif	69.7	68.1	71.3
(b) Rabi	58.9	75.6	66.1
Total capital Invested (Rs. in Crores)	25.83	5.23	4.73
Percentage of Net Revenue to total capital invested	3.47	23.80	18.02

Table 9. ANTICIPATED AND ACTUAL RATES OF RETURN TO PRIVATE GROUNDWATER INVESTMENT

Shallow Tubewell with Pumpset	Anticipated Returns to the		Actual Returns to the	
	Economy	Farmer	Economy	Farmer
Bihar	50+	48	n.a.	43
Gujarat	23	30	20	30
Haryana	22-27	39-66	50+	16-129
Uttar Pradesh	16-41	17-44	50+	22-33
Dugwell with Pumpset				
Andhra Pradesh	27-30	18-26	37-50+	16-50+
Gujarat	23	26	15	12
Karnataka	12	19	26	21
Madhya Pradesh	17	35	41	37
Maharashtra	23-50	23-40	18-50+	11-50
Tamil Nadu	19-20	28-29	26	16

Source: Abbie; Harrison and Wall (1982)

Table 10. SUMMARY OF ANTICIPATED ECONOMIC RATES OF RETURN ON SURFACE IRRIGATION PROJECTS

	Ex Ante Rates of Return (%)
Rajasthan Canal	30
Madhya Pradesh (med.)	18
Karnataka Tanks	20
Haryana	32
Punjab	36
Maharashtra II	15
Pochampad	14*
Kadana	12*

Source: Abbie, Harrison and Wall (1982)

*Ex-post

Table 11. INDICATORS OF GROUNDWATER IRRIGATION DEVELOPMENT SINCE 1951

	Dugwells		Private Tubewells		Public Tubewells		Electric Pumpsets		Diesel Pumpsets	
	Thousands of Units (Cumulative)	Average Annual % change	Thousands of Units (Cumulative)	Average Annual % change	Thousands of Units (Cumulative)	Average Annual % change	Thousands of Units (Cumulative)	Average Annual % change	Thousands of Units (Cumulative)	Average Annual % change
1950/51	3,860	-	3	-	2	-	21	-	66	-
1960/61	4,540	(1.6)	22	(22.1)	9	(16.2)	200	(25.3)	230	(13.3)
1968/69	6,100	(3.8)	360	(41.8)	15	(6.6)	1,090	(23.6)	720	(15.3)
1973/74	6,700	(1.9)	1,140	(25.9)	22	(8.0)	2,430	(17.4)	1,750	(19.4)
1977/78	7,425	(2.6)	1,700	(10.5)	30	(8.1)	3,300	(8.0)	2,350	(7.7)
1979/80	7,780	(2.4)	2,110	(11.4)	36	(9.5)	3,950	(9.4)	2,650	(6.2)
1984/85 (target)	8,980	(2.8)	3,310	(9.4)	51	(7.2)	6,460	(10.3)	3,550	(6.0)

Note: The electric and diesel pumpsets are used on various types of wells, so that the total number of wells is the sum of dugwells and tubewells both public and private. The total number of power pumped wells is the sum of diesel and electric pumpsets. Pumpsets are also used for surface lifts (i.e. where no wells exist).

Source: Abbie, Harrison and Wall (1982)

Table 12. FINANCIAL RETURN OF PUBLIC IRRIGATION WORKS (Area in million hectares, amount in million rupees)

Particulars (1)	End of First plan (1955-56) (2)	End of Second plan (1960-61) (3)	End of Third Plan (1965-66) (4)	(1966-67) (5)	(1967-68) (6)
Area irrigated	7.55	9.33	12.72*	12.87*	14.40*
Capital outlay	3,932.00	6,643.60	13,759.70*	14,388.80*	15,181.40*
Accumulated interest	814.80	1,539.70	3,833.70	4,111.50	4,555.30
Accumulated revenue	1,348.60	1,502.50	1,859.60	1,734.80	1,947.70
Sum-at-charge	4,746.80	8,183.20	17,593.40	17,397.80	17,737.30
Gross receipts	160.90	223.50	348.50	319.40	370.40
Working expenses	105.90	161.70	295.80	310.80	329.80
Revenue	56.00	61.80	52.70	8.60	40.60
Interest	103.40	206.60	588.60	577.70	606.50
Profit/Loss	(-) 48.40	(-) 144.80	(-) 536.00	(-) 569.10	(-) 565.90

*Provisional

Source: Srinivasan (1976)

Table 13. STATEWISE INFORMATION ON WATER RATES AND GROSS VALUE FOR HECTARE OF RICE AND WHEAT

Crops	Water rate per hectare (Rs.)	Yield per hectare (kg)	Harvest price at par level (Rs. per quintal)	Value of produce per hectare (Rs.)	Percentage of column 2 to column 5
(1)	(2)	(3)	(4)	(5)	(6)
1. Andhra Pradesh					
Rice	37.05	1,428	98.44	1,406	2.6
2. Bihar					
Rice	37.05	926	59.63	553	7.0
Wheat	22.5	940	87.02	818	2.7
3. Gujarat					
Rice	45 to 62.5	1,358	101.39	1,377	3.2 to 4.5
Wheat	45 to 62.5	1,529	92.69	1,417	3.1 to 4.4
4. Haryana					
Rice	24.04	1,433	53.96	773	3.1
Wheat	14.5	1,822	69.27	1,262	1.1
5. Kerala					
Rice	12.5 to 25	1,447	107.56	1,556	0.8 to 1.6
6. Madhya Pradesh					
Rice	25	1,167	93.39	1,090	2.3
Wheat	10 to 25	970	81.59	791	1.2 to 3.1
7. Maharastra					
Wheat	22.5	626	123.47	773	2.9
8. Mysore					
Rice	40	1,474	74.09	1,092	3.6
9. Orissa					
Rice	2.5 to 20	1,171	N.A.	N.A.	N.A.
10. Punjab					
Rice	24.4	1,326	53.96	716	3.4
Wheat	14.6	1,953	69.27	1,353	1.1
11. Rajasthan					
Wheat	13.1 to 25	1,140	92.54	1,055	1.2 to 2.3
12. Tamil Nadu					
Rice	40 to 50	1,517	73.79	1,120	3.52 to 4.4
13. Uttar Pradesh					
Rice	10 to 35	1,483	52.69	781	1.2 to 4.4
Wheat	10 to 30	1,323	78.72	1,041	0.9 to 2.8
14. West Bengal					
Rice	13.4 to 31.25	1,824	128.32	1,699	0.8 to 1.0

Source: Report of the Irrigation Commission (1972).

Table 14. WATER CESS AS PER CENT OF GROSS VALUE OF RICE PER ACRE

District	1900	1942-43	1968-69
East Godavari	9.01	5.4	2.5
West Godavari	9.00	5.4	2.5
Krishna	9.7	6.1	2.4
Guntur	10.4	5.5	2.2

Source: Srinivasan (1976)

Figure 1. Foodgrain, population, rainfall and irrigation in India from 1901 to 1981.

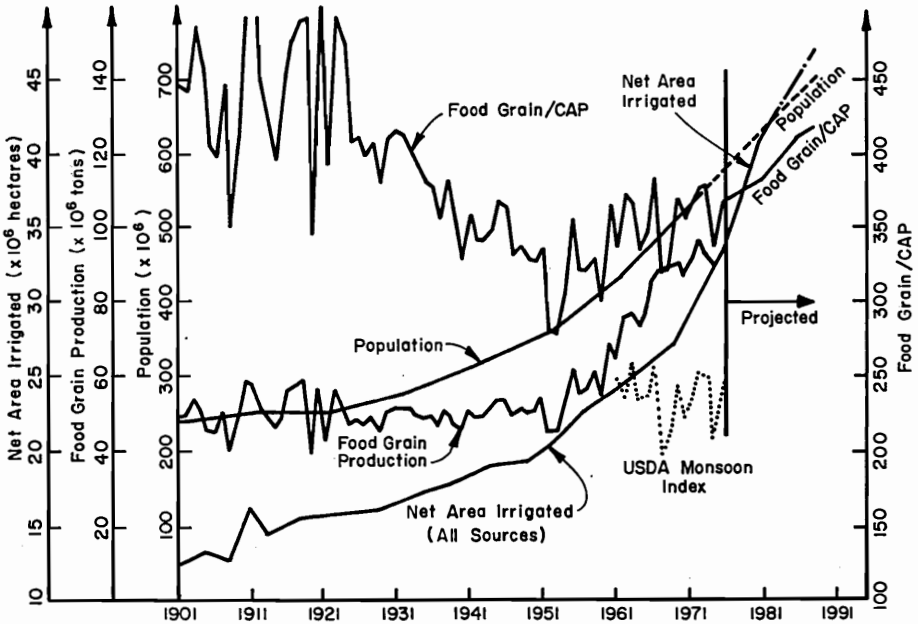
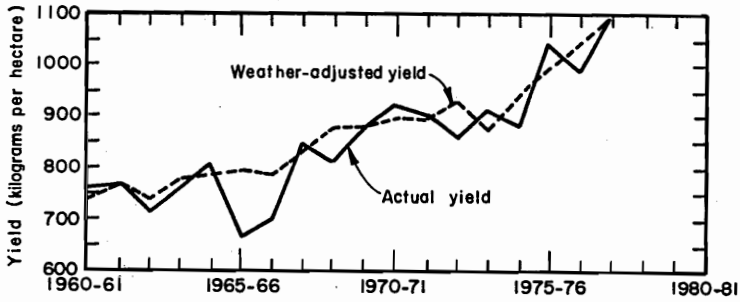
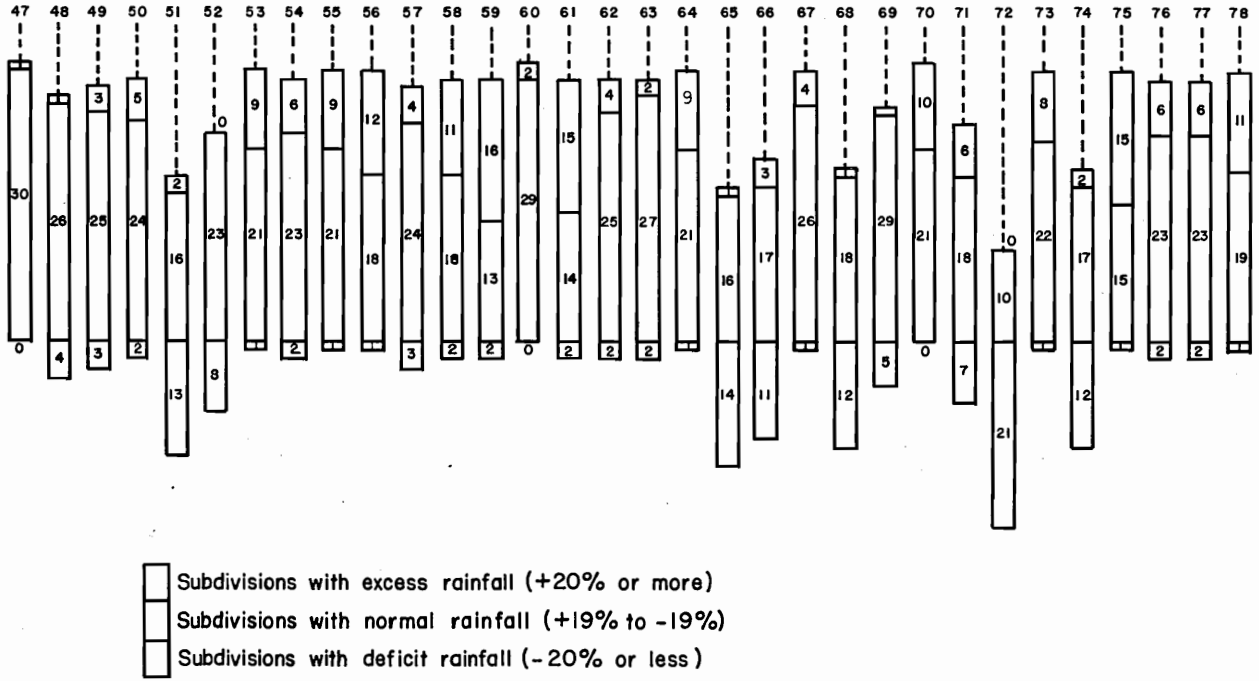


Figure 2. Actual and weather-adjusted yields, all cereals, India, 1960-61 to 1977-78.



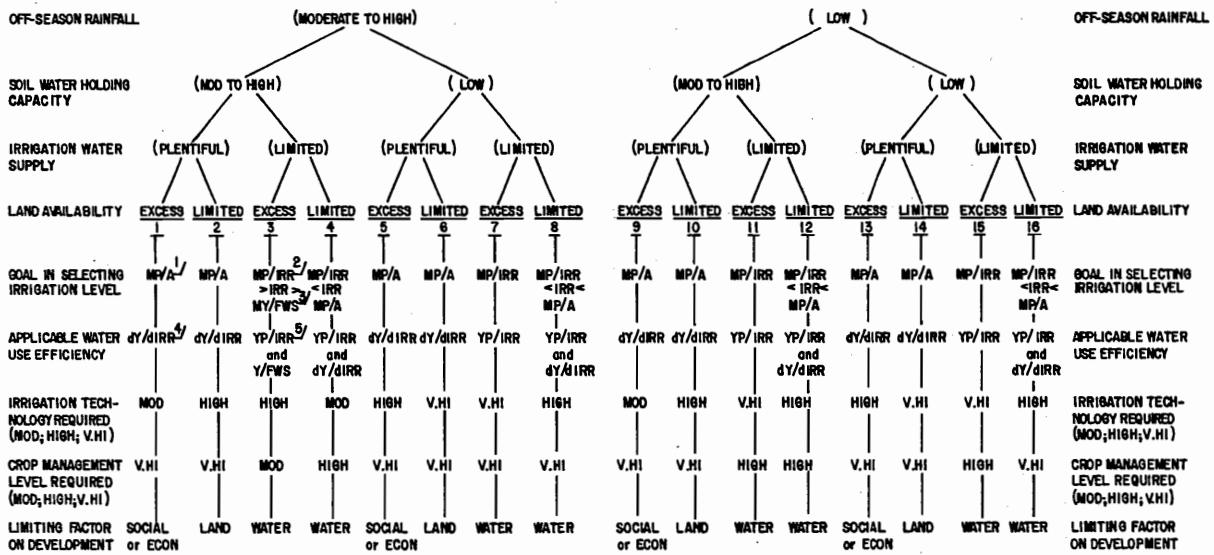
Source: Sanderson and Roy (1979), p. 23.

Figure 3. Yearly distribution of monsoon rainfall over India, 1947 to 1978.



Source: Mehra (1981), p. 15.

Figure 4. Chart showing impacts of environment and resources on irrigation project goals, applicable water use efficiency and technology requirements.



NOTIFICATIONS:
1/ Maximum profit/Unit area irrigated
2/ Maximum profit/Unit of irrigation water
3/ Maximum actual yield/Unit field water supply
4/ Change in actual yield/Unit change in irrigation applied
5/ Profitable yield/Unit of irrigation

Source: Stewart (1980), p. 149.

Part 4

Global Issues

17
The Global Food Situation and the Choice of Development Strategy

John W. Mellor

During the next few decades the world food situation will be unusually dynamic. An ever-increasing number of African, Asian and Latin American countries will pass through a development phase in which rising per capita incomes will fuel a sharp increase in the domestic demand for food. The still-fledgling agricultural sectors of many developing countries will be hard-pressed to meet such food demand increases. This will put added pressure on the export capabilities of the more mature economies.

At present the world is locked in the throes of a major recession, which has significantly reduced both the rate of food demand growth and the level of real food prices. But once this recession has run its course the interaction of long pent-up income and growth factors will very likely produce a strong increase in food demand growth throughout the developing world. Rising incomes in the developing world will necessarily raise the effective demand for food, because of the high marginal propensity of low-income people to spend increments to income on food. This may well provoke a gradual rise in the real price of food, as total Third World demand for food shifts far more rapidly than supply.

Under such circumstances it becomes economic for most African, Asian, and Latin American countries to place a far greater emphasis on agricultural production in their development strategies than they have in the past. Success in such an effort will not only help meet the rising demand for foodstuffs in the developing world, but will also help provide the wage goods needed to stimulate broad based economic growth. In this sense, the economic pressure on the food front over the next decade may well have a salutary effect on the pace and pattern of development.

Food in the Structure of Economic Growth

Despite the need for accelerated food production growth in the developing world, all too few developing countries have paid adequate attention to the complex problems of agricultural production. Why don't more of these countries choose to follow the example of Japan, for whom agriculture represented the leading sector in a pattern of development that led to highly advanced economy? The answer is simple. The leadership in most of these countries has tended to equate development with industrialization, especially

heavy industrialization, and to generally overlook the critical role that food and agriculture can play in fostering industrialization. Other than Japan, the two leading exceptions to this rule, are Taiwan and the Punjab of India.

Among many developing countries the common pattern is for agriculture to make only a residual claim on government resource. For example, in Africa, a continent where per capita food production has declined 15 percent since 1969-71, a recent study found that the median government expenditure on agriculture was only 7.6 percent of the total government budget (Table 1). Other studies have suggested that public sector allocations to agriculture are even lower in Latin America (Elias 1981).

Such low levels of government investment in agriculture have done little to foster the type of technological innovation in agriculture needed to stabilize the supply-demand imbalances created by economic growth. Between 1961-65 and 1973-78 net imports of major food staples by developing countries (excluding the People's Republic of China) increased from about five million tons to 23 million tons, an average rate of increase of 13 percent per year (Paulino forthcoming).

What is the constructive role that a technologically dynamic agricultural sector can play in economic development? First, it is important to recognize that food and employment represent two sides of the same coin. Low-income people spend the bulk of additional income on food. For example, in India the laboring class spends 60 percent of increments to income on grain and nearly 80 percent on food products as a whole (Mellor, 1978). Thus, any development strategy which stresses high employment of necessity produces a large increase in the demand for food, because of the high marginal propensity of the poor to buy food. If more food is not forthcoming, food prices will rise, the real cost of labor will increase, and investment will swing to more capital-intensive processes. Thus, we can see that a high employment policy is a high food demand policy. I will comment later on the implications of this for the global food economy.

Second, food and employment are intimately related through the multiplier effects of agricultural growth and development. Through the new seed-fertilizer inputs, technological change in agriculture greatly increases the amount of total production. Such technological change also raises the incomes of landowning farmers, who spend a significant proportion of their new income on a wide range of local goods and services. Various country studies (e.g., Hazell and Roell, forthcoming) indicate that typically 40 percent of increments to income of farmers is spent on locally produced nonagricultural goods and services. Such expenditure significantly increases employment, and thus expands the nonagricultural employment opportunities for the rural poor. Since the poor spend a high percentage of their additional income on food, greater employment opportunities for the poor serve to further stimulate agricultural growth.

We see then that an agriculture-based strategy of economic development stimulates growth in other sectors of the economy. Because that growth is employment intensive, it is also equity

Table 1. Percentage of Government Expenditure Allocated to Agriculture in Selected African Countries, 1963-1973.[a]

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	Average All Years
Kenya	—	17.9[b]	18.1[b]	14.3[b]	12.4[b]	12.5[b]	12.8[b]	11.0	9.0	10.0	12.1	13.0
Malawi	—	8.8	—	10.4	—	12.5	—	—	11.9	15.4	15.4	12.4
Tanzania	13.6[b]	11.8[b]	8.6[b]	8.3	—	—	—	10.2	11.3	9.5	9.9[c]	10.4
Uganda	—	8.1[b]	6.7[b]	8.5[b]	8.0[b]	8.2	6.6	9.5	8.7	—	—	9.1
Ivory Coast	—	—	—	—	—	—	—	8.8[c]	6.3[c]	6.8	8.4[c]	7.6
Ghana	6.4	5.4	8.8	7.5	7.4	6.5	5.3	5.1	4.9	5.6	6.5	6.3
Rwanda	—	—	—	4.6	5.9	5.1	4.9	5.1	4.6	—	—	5.0
Ethiopia	—	—	3.0	2.7	2.8	4.2	—	3.6	5.0	8.7[c]	8.4[c]	4.8
Sierra Leone	—	—	—	—	—	3.6[b]	3.1[b]	4.8[b]	4.9[b]	3.5[b]	7.8[b]	4.6
Liberia	—	—	—	—	—	1.8	1.8	1.5	2.7	3.8	3.8	2.6

Source: Nicholson, Esseks and Khan (1979)

[a]Actual recurrent and capital expenditures, unless otherwise indicated.

[b]Fiscal year.

[c]Estimated.

oriented, in the sense of providing greater incomes and job possibilities for low-income groups.

It is important to recognize that the key ingredient to an agricultural strategy of development is productivity increases in agriculture. Throughout the world, even in Africa, the rate of growth of the cropped area has declined substantially in the past decade. An ever-increasing proportion of the food needed to meet the rising demand for foodstuffs must therefore come from increased yields per unit of land.

In recent years crop yields have in fact been the main contributor to the growth in food production in the developing world. According to the data in Table 2, between 1961 and 1977 output per hectare of major food crops increased by 1.87 percent annually, and accounted for more than 70 percent of production growth. During this time period increases in the harvested area averaged only 0.71 percent a year and contributed the other 30 percent.

Productivity increases in agriculture, which are now needed in many developing countries, require prolonged and continuous technological change in agriculture. Depending on the particular situation, the components of the new agricultural technology - seeds, fertilizers, and irrigation - produce yields two to four times higher than those achieved with traditional inputs. For example, through the adoption of the new agricultural technology, average cereal yields in India increased by 29.2 percent between the period 1954-55 - 1964-65, and 1967-68 - 1977-78 (Hazell 1982). Such yield increases require the development of agricultural research systems, local extension facilities, and effective fertilizer and credit institutions. All of this distinguishes an agricultural strategy of development where food, agriculture and employment are all emphasized.

Food Demand and Production in the Developing World

It is possible to pinpoint the need for an agricultural-based strategy of development in the developing world by examining the food situation in several developing countries.

Twenty Third World countries, containing some 700 million people, averaged growth rates of 4 percent or better in per capita income during the period 1970-77. Eight of these countries, all major oil-exporters (Algeria, Indonesia, Iran, Iraq, Mexico, Nigeria, Saudi Arabia, and Venezuela), had an aggregate population of 361 million in 1977 and an average per capita income growth rate of 5.6 percent per year. Because of the large increase in oil prices, these eight oil-producing countries have experienced a large growth rate in national income relative to their stage of development. This, in turn, has sparked an extraordinary rise in the demand for food in these countries, a demand that the still-fledgling agricultural sectors of these countries has been unable to meet. Thus, in the period 1970-77 food imports by these countries grew at an unprecedented rate of 19 percent per year in real terms. Even though oil revenue growth now has slowed, food consumption will continue to increase rapidly as their foreign investment declines, domestic investments mature, and as higher proportions of income are consumed.

Perhaps more symptomatic of the future, however, are the

Table 2. Average Annual Growth Rates of Production, Area Harvested and Output per Hectare of Major Food Crops in Developing Countries, By Region, 1961-77.

Country Group	Average Annual Growth Rate, 1961-77[1]			Relative Contribution to Production Growth	
	Production	Area Harvested	Output per Hectare	Area Harvested	Output per Hectare
	(percent)			(percent)	
Developing Countries[2]	2.59	0.71	1.87	28	72
(Excluding China)	(2.63)	(1.00)	(1.62)	(38)	(62)
Asia[2]	2.64	0.34	2.29	13	87
(Excluding China)	(2.77)	(0.66)	(2.09)	(24)	(76)
North Africa/ Middle East	2.53	1.12	1.40	44	56
Sub-Saharan Africa	1.50	1.28	0.22	85	15
Latin America	3.20	1.78	1.39	56	44

Source: Developed by Leonardo Paulino, International Food Policy Research Institute from FAO data.

Note: [1]Annual growth rates of production may differ slightly from those shown in Table 1 as data exclude the output of bananas and plantains for which estimates on area harvested are not available.

[2]For the People's Republic China, trend values for 1961 and 1977 were based on 1962-77 data.

growth patterns of the twelve rapid growth Third World countries that are not major oil-exporters. These countries (Brazil, Hong Kong, the Democratic People's Republic of Korea, and Republic of Korea, Malaysia, the Philippines, Singapore, Syria, Taiwan, Thailand, Tunisia, and Turkey) had an average growth rate of per capita income of 5.6 percent for the same period and an aggregate population of 349 million people. In these twelve countries the demand for food rose by well over 5 percent a year. Of course, these countries are now experiencing a substantial reduction in their growth rates during the current global recession. But they have the institutional base for sustained economic growth, and will resume a rapid pace as soon as the current recession has run its course.

Some of these rapid growth countries may well be able to pursue the type of agricultural policies needed to satiate demand. The historical record, however, suggests that most of them will not. This point is dramatically underscored by the fact that those countries experiencing the most rapid agricultural growth have also tended to increase their net food imports.

Research at the International Food Policy Research Institute (IFPRI) shows that the sixteen developing countries with the fastest growth rates in basic food staples production over the period 1961-76 collectively more than doubled their net food imports (in tons) during the same period. From 1961-76 the average growth rate for basic food staples production in these countries was 3.9 percent, but the high growth rate in food imports meant that their self-sufficiency ratio actually declined 2 percent. These data demonstrate that while it is possible for rapid growth countries to achieve impressive increases in basic food production, it is still quite difficult for such production to keep pace with the rate of food demand growth.

The phenomenon of rapidly growing developing country food imports is captured by the data in Table 3. According to this data, the growth rate in food imports varies directly with the rate of per capita income increase. The only exception to this finding is the slowest growth countries (less than 1.0% per capita income increase), whose relatively high rate of food import growth is made possible by large-scale foreign assistance flows. The somewhat faster growth countries (3.0% to 4.9%) evince the type of food import growth that is consistent with their rate of income increase. And the very fast growth countries (over 5%) show an even more explosive increase in food imports.

Phases in Food Demand-Supply Growth

The way in which income growth causes food imports to burgeon during the development process is illustrated in Table 4. The table, depicting five stylized phases of economic growth, shows growth in food demand to a peak, and then diminution.

Row one of the table shows an early stage of economic growth in which people are very poor, desperately wishing to consume more food, yet unable to do so because of low incomes. In this stage, poverty causes high death rates and hence only modest rates of population growth. The result is a 3 percent or less growth rate in effective demand for food — a rate that can be met by more effort on a slightly expanded land base. In this stage population

Table 3. Exports, Imports and Net Trade of Major Food Crops in the Developing Countries, 1961/65 and 1973/77 Averages.

Country Group	Exports 1961/65 (million tons)	Exports 1973/77 (million tons)	Exports Change (%)	Imports 1961/65 (million tons)	Imports 1973/77 (million tons)	Imports Change (%)	Net Trade[a] 1961/65 (million tons)	Net Trade[a] 1973/77 (million tons)	Net Trade[a] 2000[c]	Annual Growth Rate 1961/65 - 1973/77 Exports (%)	Annual Growth Rate 1961/65 - 1973/77 Imports (%)
Total	21.9	28.3	+29	27.2	51.3	+88	-5.3	-23.0	-75	2.1	5.4
By GNP/capita[d] growth rate											
Less than 1.0%	2.2	1.2	-47	3.8	9.2	+143	-1.6	-8.0	-40	-5.1	7.7
1.0% - 2.9%	14.2	16.4	+24	10.4	15.3	+47	+3.8	+1.1	+48	1.8	3.3
3.0% - 4.9%	4.1	7.2	+76	5.8	11.2	+93	-1.7	-4.0	-18	4.8	5.6
5.0 and over	2.5	3.5	+41	7.2	15.6	+116	-4.7	-12.1	-65	2.9	6.6
By region Asia	7.6	10.2	+34	13.9	21.2	+52	-6.3	-10.9	+24	2.5	3.5
North Africa/ Middle East	1.4	1.1	-21	5.0	11.6	+133	-3.6	-10.6	-58	-2.0	7.3
Sub-Sahara Africa	2.9	1.7	-43	2.0	4.5	+127	+0.9	-2.9	-36	-4.6	7.1
Latin America	10.0	15.3	+53	6.3	13.9	+122	+3.7	+1.4	-6	3.6	6.9

Source: Developed by Leonardo Paulino, International Food Policy Research Institute from FAO Data.

Notes: Trade data include bran and cakes for feed use; to minimize double counting, partial adjustments were made for wheat flour based on available figures for this commodity as reported in the 1978 FAO Trade Yearbook; the People's Republic of China is not included in this table because of difficulties of developing significant trend coefficients in the face of large politically related fluctuations. Major food crops here include cereals, pulses, roots and tubers groundnuts, plantains, and bananas.

[a]Exports minus imports.

[b]Calculated between the mid-years of the indicated periods.

[c]Projections derived from production and income data for 1961-77 and UN population projections.

[d]During the period 1966-77.

Table 4. Comparison of Growth of Demand for Agricultural Commodities, at Different States of Development, Hypothetical Cases.

Levels of development	Percent of population in agriculture	Rate of population growth	Rate of per capita income growth	Income elasticity of demand	Rate of growth in demand
Vey low income	70%	2.5	.5	1.0	3.0
Low income	60%	3.0	1.0	0.9	3.9
Medium income	50%	3.0	3.0	0.7	5.1
High income	35%	2.0	4.0	0.5	4.0
Very high income	10%	1.0	3.0	0.1	1.3

Source: Adapted from Mellor (1966).

growth roughly meets its own demand for food.

As development occurs, the population growth rate increases. But, even more importantly, income begins to grow rapidly. The low base income carries a relatively high income elasticity of demand, and so rising income strongly augments the effect of population growth to increase the growth rate of demand for food by some 30 percent over the earlier phase. This exceeds all but the most rapid known rates of food production growth. To maintain food production growth rates as high as 4 percent reqiures the type of land area expansion and technological innovation in agriculture that most developing countries are unable to achieve, at least in the short run. For this reason most countries in the high growth, medium income stage find it necessary to rely upon rising levels of food imports in order to satiate demand.

Eventually, of course, population growth rates decline, income elasticities of demand for food become highly inelastic, and growth in income begins to have little effect on food consumption. Meeting demand growth then becomes more manageable, particularly since by then food production growth rates have become institutionalized at high levels. It is in this stage that food imports become unnecessary and agricultural surpluses begin to accrue.

Population Growth

The effect of population growth on demand for food requires clarification because of its interaction with supply and demand forces. Although income growth will be the dynamic factor causing food demand to rise in the coming decade, population growth will play an indirect role in magnifying the consequences of that growth.

It is no accident that during the early stages of development food production growth keeps rough pace with population growth. Population growth enlarges the rural labor force and hence the capacity to produce food. If mounting pressure on land resources reduces labor productivity, per capita income declines and per capita food consumption descreases comparably.

The decline in rural incomes caused by population growth may push more rural youth into urban areas, thereby increasing urban unemployment and depressing urban wage rates. The resulting national political pressures may then cause governments to institute transfer payments to lower income urban people through food subsidy and distribution programs. In many developing countries the resources to maintain such welfare programs will have to be provided by foreign assistance. Such foreign assistance, interacting with population growth, may well be an important source of food demand growth in the next decade for those low-income countries not yet experiencing rapid productivity and income increases. In recent years foreign assistance programs have certainly played a leading role in facilitating the rapid growth in food imports by the least developed countries of Sub-Saharan Africa (Table 3).

When a developing country begins the process of sectoral transformation and capital formation in the nonagricultural sector, rapid population growth serves to fuel that process. The supply of labor for growth of the nonagricultural sectors is in effect highly inelastic. Under these circumstances of rapid growth in capital

stock and labor force, the supply of wage goods - primarily food - will be the operable constraint to development (Lele and Mellor 1981). Unless rapid and prolonged technological innovation in agriculture takes place, the growth momentum can only be sustained by rapid growth in exports or foreign borrowings to pay for rapidly growing food imports. If such technological advances do occur in agriculture, the extent of the upward pressure on food prices becomes the product of the complex relationship between the rate and nature of technological change in agriculture, and the rate of growth in nonagricultural employment and income (Lele and Mellor 1981). In most cases the rapid application of modern high-yield agricultural technology will tend to restrain the rise in agricultural prices.

Conclusion

The closing decades of the twentieth century will see vast populations in the developing countries of the world moving into the high growth, medium income stage of development. During this period the ever-rising demand for food will place increasing pressure on these countries to increase their rate of food production growth, in order to minimize their need for food imports and to restrict the growth in real food prices.

Under these circumstances most developing countries will be well-advised to place a far greater emphasis on agricultural production in their development strategies than they have in the past. Increased food production represents an important, if not necessary, condition for continued economic growth and poverty alleviation throughout the developing world. In most countries accelerated food production growth requires the widespread dissemination of technological change in agriculture. While such technological change may not lead to greater self-sufficiency in the short-run, it does provide the expanded supply of wage goods and the income multiplier effects needed to stimulate further economic growth. Technological change in agriculture leads to increased food marketings and incomes on the part of the rural elite. These income increases in turn support the expansion of employment opportunities for the poorer classes, through the development of labor-intensive nonagricultural production. The development of a small-scale, labor-intensive industry based on agriculture helps to pave the way for the emergence of a successful export industry, as the recent examples of Japan and Taiwan clearly suggest.

It is important to recognize that the more mature economies have a critical role to play in the success of such an agriculture-led strategy of economic growth in the developing world. Food aid by the developed countries is frequently essential in stabilizing the food supply-demand imbalances caused by peak periods of food demand growth. The developed countries also possess the funds and the technical expertise to assist developing countries in undertaking the types of infrastructural improvements needed to accelerate food production. Such aid and assistance by the more mature economies not only serves to promote a more egalitarian pattern of economic growth, but also helps to relieve the very onerous problems of food production and consumption instability that are an integral part of the whole developmental process.

NOTES

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18
Reforming the Global Agricultural Research Support System

Vernon W. Ruttan

The architects of the post World War II set of global institutions included the problems of meeting world food needs and reducing poverty in rural areas as essential elements of their vision of a world community that could assure all people of freedom from want and insecurity. They sought to achieve this vision by the creation of a set of global bureaucracies -- the U.N. specialized agencies.

The establishment of a U.N. Food and Agriculture Organization (FAO), headquartered in Rome, was the major institutional response to the concern for freedom from hunger and the reduction in rural poverty (Hambridge). The explosion in the number of new nation states associated with the decolonization of the 1950s and 1960s placed new demands for assistance on the FAO system which the FAO bureaucracy was unprepared to accept and which the FAO governing council was unwilling to support. The result has been the emergence of a welter of bilateral and multilateral agricultural programs designed to support or coordinate agricultural development efforts in poor countries. The effect, by the late 1970s, was to create a "tower of babel" in which competition among and between assistance agencies and assistance recipients is more characteristic than is cooperation.

It is again time to give serious thought to the structure of international assistance for agricultural development. In this note I first describe the changing structure of international support for agricultural development. I then turn to a discussion of some specific problems in the area with which I am most familiar — financial and technical assistance for strengthening national agricultural research capacity. I then turn to an attempt to suggest some of the reforms in the support for agricultural research that should be considered.

But the perspective presented in this paper is not confined to agricultural research. Both the analysis and the suggestions for reform have implications for other development assistance activities in support of agricultural production and rural development.

The needed reforms are so substantial that, until they are made, increases in the transfer of resources to poor countries as advocated in the reports such as the Brandt Commission and the Presidential Commission on World Hunger, would be largely counter-

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productive. The reforms are imperative because development of national agricultural research capacity is one of the most effective ways to remove the most serious constraints on the ability of poor countries to meet their basic needs and to sustain other agricultural and general development activities.

Institutions to Support Agricultural Development[1]

In this section I review and assess recent trends in the capacities of the national and bilateral assistance agencies.

The National Aid Agencies

Bilateral technical assistance to agricultural development during the post war period has been dominated by three major national programs -- those of the United States, the United Kingdom and France. More recently Germany has become an actor of major significance. A number of other nations -- Canada, Australia, Sweden, Holland, Belgium, Switzerland and Japan -- occupy smaller and more specialized roles.

In recent years most bilateral programs have run into increasing problems stemming from weakened domestic support, declining professional capacity and difficulty in adapting their style of operations to the changing political and professional environments in the countries in which they work. The bilateral programs have also been weakened by their tendency to let political objectives subvert program content.

In 1973 the U.S. Congress mandated, under its new directions legislation, that U.S. development assistance be targeted at meeting the basic needs of the poorest people in the developing countries. Yet during the 1970s the USAID budget for bilateral development assistance has declined in real purchasing power. It has also declined relative to the budget for bilateral security assistance (Table 1). The result has been a decline in USAID resources allocated to countries where technical and institutional development needs are most severe and an increase in resources allocated to countries considered politically sensitive.[2] In many countries the U.S. programs of assistance for agricultural and rural development have been reduced to filling in the technical assistance, research and training gaps resulting from over-ambitious World Bank projects. On the positive side a larger share of U.S. development assistance has been allocated to the agricultural sector and within the agricultural sector a larger share has apparently been devoted to research in food crops.

The Peace Corps should also be mentioned. The Peace Corps has played a major role in educating young Americans to realities of village and urban life in developing countries. The education has come at a stage in the life of most Peace Corps volunteers when they were highly receptive to such learning experiences. Many returned Peace Corps volunteers who have gone on to acquire the graduate education necessary to help them to understand and interpret the significance of their experience are now highly skilled AID staff members, productive scholars, and citizens who have an

TABLE 1. FOREIGN AID BUDGET BY CATEGORY, FY 70-85 (outlays, millions of dollars)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982[1]	1983[1]	1984[1]	1985[1]
I. Economic and Financial Assistance																
Multilateral Assistance																
International Financial Institutions/Multilateral Development Banks	224	201	276	324	446	569	902	875	858	683	784	955	1,109	1,253	1,366	1,316
International Organizations	113	129	196	186	168	115	143	250	230	199	243	336	250	224	233	238
Subtotal: Multilateral Assistance	337	330	472	510	614	684	1,045	1,125	1,088	882	1,027	1,291	1,359	1,477	1,599	1,554
Non-Military Bilateral Assistance																
Bilateral Development Assistance																
Development Assistance (AID)	1,040	1,087	926	837	863	940	1,001	976	1,007	1,175	1,366	1,544	1,605	1,720	1,768	1,818
Public Law 480 - Food Aid	937	918	993	754	639	936	693	850	808	976	1,073	1,254	1,141	1,028	1,004	988
Peace Corps	90	89	77	74	81	86	69	87	87	94	101	99	105	98	98	98
Bilateral Strategic Assistance																
Economic Support Fund/ Security Support Assistance/Peacekeeping Operations	485	460	717	645	382	396	601	1,062	1,908	1,755	1,904	2,082	2,471	2,737	2,973	2,976
Refugee Assistance	--	--	--	--	43	76	42	--	75	166	466	384	465	455	436	395
Indochina Post-War Reconstruction Assistance	--	--	--	--	246	496	65	--	--	--	--	--	--	--	--	--
Subtotal: Non-Military Bilateral Assistance	2,552	2,554	2,713	2,310	2,254	2,930	2,471	2,975	3,885	4,166	4,910	5,363	5,787	6,038	6,279	6,275
Offsetting Receipts/Other	-14	-72	-7	-257	-128	-55	-301	-366	-345	-304	-311	-357	-398	-451	-476	-494
Subtotal, Economic and Financial Assistance	2,875	2,812	3,178	2,563	2,740	3,559	3,215	3,734	4,628	4,744	5,626	6,297	6,748	7,064	7,402	7,335
II. Military Assistance																
Grant Military Assistance	548	510	563	485	460	556	367	209	169	140	219	228	317	203	137	124
Foreign Military Training	--	--	--	--	--	--	--	25	22	28	26	22	40	50	51	53
Foreign Military Credit Sales	61	520	216	356	406	247	280	570	570	640	644	507	755	913	1,363	1,653
Military Assistance: South Vietnam	--	--	--	--	--	402	--	--	--	--	--	--	--	--	--	--
Emergency Security Assistance Relocation of Facilities: Israel	--	--	--	--	640	930	--	--	--	31	341	--	--	--	--	--
Offsetting Receipts/ Other	-16	-35	-60	24	-195	-256	454	-311	-277	-276	-355	292	-97	-67	-29	-19
Subtotal, Military Assistance	593	995	719	865	1,312	1,879	1,101	494	484	563	875	1,049	1,015	1,099	1,522	1,811
TOTAL FOREIGN AID	3,468	3,807	3,897	3,428	4,052	5,438	4,316	4,228	5,112	5,307	6,501	7,346	7,763	8,163	8,924	9,146

[1]Estimates

Source: Budget of the U.S. Government, Fiscal Year 1972-Fiscal Year 1983.

Table 1 (cont.) FOREIGN AID BUDGET BY CATEGORY, FY 70-85 (outlays, millions of dollars)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982[1]	1983[1]	1984[1]	1985[1]
Multilateral Assistance	9.7	8.7	12.1	14.9	15.2	12.6	24.2	26.6	21.3	16.6	15.8	17.6	17.5	18.1	17.9	17.0
Non-Military Bilateral Assistance																
Development Assistance	30.0	28.6	23.8	24.4	21.3	17.3	23.2	23.1	19.7	22.1	21.0	21.0	20.7	21.1	19.8	19.9
Food Aid	27.0	24.1	25.5	22.0	15.8	17.2	16.1	20.1	15.8	18.4	16.5	17.1	14.7	12.6	11.3	10.8
Economic Support Fund	14.0	12.1	18.4	18.8	9.4	7.3	13.9	25.1	37.3	33.1	29.3	28.3	31.8	33.5	33.3	32.5
Other	2.6	2.0	2.0	2.2	9.1	12.1	4.1	2.1	3.2	4.9	8.7	6.6	7.3	6.8	6.0	5.4
Military Assistance	17.1	26.1	18.5	25.2	32.4	34.6	25.5	11.7	9.5	10.6	13.5	14.3	13.1	13.5	17.1	19.8
Total[2]	100.4	101.6	100.3	107.5	103.2	101.1	107.0	108.7	106.8	105.7	104.8	104.9	105.1	105.6	105.4	105.4

[1]Estimates

[2]Totals exceed 100% because of offsetting receipts to economic and financial assistance and because of rounding.

Source: Budget of the U.S. Government, Fiscal Year 1972-Fiscal Year 1983.

acute sensitivity to international affairs. But investment in the Corps (and in the youth volunteer agencies in other countries) should be charged against the nation's education budget rather than its foreign assistance budget.

The Development Banks

The World Bank has become an increasingly important source of funding for agricultural development. During its early years support for agricultural development was largely a by-product of major multi-purpose infrastructure investments in hydroelectric, transportation and related development areas. Over time project funding for agricultural resource development achieved increased emphasis. Beginning in the mid-1960s the World Bank began making loans for the development of agricultural research and training institutions.

As lending for agricultural development has increased the World Bank has rapidly expanded its project lending and management staff capacity. As the World Bank's emphasis on agricultural research, extension and education projects has expanded, its effectiveness has declined. A concern with the transfer of resources has increasingly dominated the capacity of the recipient country to implement and manage bank-funded projects. In the area of agricultural research Bank support for facilities development has often outrun the development of capacity to manage and staff the new research facilities. The result is resource dissipation rather than resource transfer (Cardwell, Moomaw and Ruttan).

These observations also apply, but with somewhat less force, to the regional development banks for Latin America, Asia and Africa. Because of their more limited financial resources their lending is more likely to match the scale that is appropriate in the smaller countries in their region. But their staff capacity for analysis and monitoring tends to be weaker than that of the World Bank.

The International Agricultural Research System

Since the mid-1960s, a new system of international agricultural research institutes emerged as perhaps the most dynamic component of the global agricultural support system. The initial units in the system, the International Rice Research Institute (IRRI), the International Wheat and Maize Research Center (CIMMYT), the International Center for Tropical Agriculture (CIAT), and the International Institute for Tropical Agriculture (IITA) were initially funded by the privately endowed Rockefeller and Ford Foundations. The further expansion of the institute system was made possible by the major national aid agencies and the World Bank and regional banks organized as the Consultative Group on International Agricultural Research (CGIAR). The governance of the system is characterized by a highly innovative system of funding and management. While system funding and planning are centrally coordinated, research management is decentralized to the individual institute

level (Ruttan, 1982, pp. 116-146).

The new technologies developed by the institutes have contributed to significant expansion in commodity production, particularly in wheat and rice in a number of poor countries. The effectiveness of the CGIAR system is, however, constrained by the lack of capacity of most national research systems to make effective use of the new knowledge and prototype technology that the CGIAR system of institutes is capable of producing. It is also increasingly recognized that some of the dramatic contributions of the institutes was the result of the ability to exploit lags in the application of scientific and technical knowledge. There is currently a perception that the easy gains have been realized and that the institutes themselves have begun to lag in their capacity to take advantage of recent advances in biological science and technology in their crop and livestock development programs.

Foundations and Private Voluntary Agencies

From the mid-1950s to the late 1970s the two major U.S. foundations, Ford and Rockefeller, were major innovators and supporters of agricultural development. The Rockefeller Foundation provided much of the entrepreneurial and professional leadership for the new agricultural research institutes. The Ford Foundation field offices attracted some of the best intellectual capacity of American universities to their very substantial agricultural and rural development programs. By 1980, as a result of the effect of inflation on the value of endowment portfolios and conscious decisions to reorient program activities, neither Foundation was playing more than a marginal role in agricultural development.

A number of private voluntary agencies that have been active in the food aid and agricultural development field have expanded their programs in the 1970s. In the U.S. this expansion has occurred primarily with government support. Some of the PVO's have been a source of imaginative program initiatives. As their public support has risen, however, their relationship to the USAID has increasingly tended to evolve into a patron-client mode (more than 75 percent of the CARE and Catholic Relief budgets comes from public sources). In turn they have often taken on a major role in mobilizing political support for the AID programs.

Toward a Reform of Agricultural Research Support

What can be done to replace the deficiencies that characterizes support for agricultural research, extension and rural development programs in poor countries? In my judgment the basic thrust of the reform that is needed is to move away from primary reliance on the project approach. In supporting agricultural research the project system should be largely replaced by a "formula funding" or "revenue sharing" approach.

There have been many criticisms of the project approach followed by the major bilateral and multilateral development assistance agencies. The criticism most frequently heard is that the

assistance agencies exert undue influence on the content of the national development programs.[3] This criticism is partly correct. It is not too difficult to identify cases where close patron-client bonds have been established between particular officers in the aid agencies and the leadership of favored national program agencies. Such relationships have often appeared to give particular national programs a degree of stability and continuity that would be difficult to achieve in the unstable political environments that characterize many developing countries.

The criticisms that focus on selectivity in program support and bias in the direction of program activity are not, however, my major concern. My concern is that the project support approach to agricultural development assistance has rarely been effective in contributing to the development of viable national agricultural development institutions. It might be argued, in contrast to this assertion, that the project system has, in a number of countries, contributed to the rapid development of professional capacity and facilities (Judd, Boyce and Evenson). But the period of rapid development has too often been followed by the erosion or collapse of program capacity when external project support has declined (Ardila, Trigo and Pineiro).

In my judgment cycles of development and erosion are inherent in the traditional project approach. The reason for this inherent contradiction is that external assistance provides an alternative to the development of internal political support. National research system directors have frequently found that the generation of external support requires less intensive entrepreneurial effort than the cultivation of domestic political support. Domestic budget support required by donors is often achieved by creative manipulation of budget categories rather than by increments in real program support - particularly when donor representatives are under pressure from assistance agency management to "more resources". Most existing project systems thus have built in incentives for national research system leadership to direct entrepreneurial effort toward the donor community rather than toward the domestic political system.

Any effective alternative should attempt to reverse the perverse incentives that characterize existing development assistance instruments. The system should be reformed to provide incentives for national research system directors to redirect their entrepreneurial efforts toward building domestic political and economic support for agricultural development.

I am increasingly convinced that the long term viability of agricultural research systems depends on the emergence of organized producer groups who are effective in bringing their interests to bear on legislative and executive budgetary processes. The support of finance and planning ministries for agricultural research is undependable. Their support tends to fluctuate with perceived severity of food crises and foreign exchange demands. Where, for example, will the political support necessary to assure financial support for EMBRAPA (Brazil), PCARR (Philippines), and PARC (Pakistan) come from when donor resources are phased out? Such support requires a long term political development effort on the

part of national research program leaders and program beneficiaries.

A Formula Funding Model

What alternatives to the existing system do I suggest? I do not want to be interpreted as completely negative with respect to traditional development assistance instruments. Project aid is often quite appropriate for physical infrastructure development projects. Program aid can be an effective way to provide macroeconomic assistance for structural adjustment or for sector development in a country with substantial capacity for macro-economic policy analysis and program management. But neither the traditional program aid nor project aid instruments are fully effective in countries that have little financial or professional capacity for providing support for long term institution building efforts. New methods of combining the flexibility of program support, effective technical assistance, and sustained financial support for long term development efforts must be sought. One innovation that might be effectively used is for the donor community to move toward an approach in which the amount of external support is linked to growth in domestic support. This implies the development of a "formula" approach in which the size of donor contribution would be tied to the growth of domestic support. The formula should include a factor that adjusts the ratio of external to domestic support to take into account differences in domestic fiscal capacity.

An example of how such a system might work is presented in Table 2. In the model presented in the table, external donors agree to support a specific share of the national agricultural research budget. In the example the share declines from 40 percent for a country with low fiscal capacity to 10 percent for a country with high fiscal capacity. The amount of external assistance within each fiscal capacity group varies with the level of national resources that a particular country is willing to devote to agricultural research. The advantages and disadvantages of alternative models should be explored. One alternative would be a formula in which external donor support would be related to increments in national program support rather than to the absolute level of national support.

But how could such a system evolve out of the anarchy of existing bilateral and multilateral assistance programs? For such a program to be most effective it would be desirable for the donor community to put its resources in support of national agricultural research systems into a common fund to be administered by an existing international agency (World Bank, UNDP, FAO) or establish a consortium similar to the Consultative Group on International Agricultural Research to administer such a program.

Country-Level Research Support Group[4]

A second alternative might take its lead from the experience now accumulated with the CGIAR model. To form and operate a

Table 2. Illustraton of a Funding Model for Agricultural Research Support

	Program Support and Assistance Level (in millions of U.S. $)					
	Low		Medium		High	
National Fiscal Capacity	National Support	Donor Assistance	National Support	Donor Assistance	National Support	Donor Assistance
Low (40% Assistance)	20	8	50	20	100	40
Medium (20% Assistance	20	4	50	10	100	20
High (10% Assistance)	20	2	50	5	100	10

country-level Research Support Group (RSG) will require close liaison between the host country and aid agencies and improved levels of collaboration among donors. To function, the group will need to have available to it a relatively long-term program for the development and operation of the national agricultural research system. To produce and continuously update this program, the national research system may require external assistance, but in general the program should be the product of indigenous experts in agricultural science and development. Its focus, to help protect the program from vagaries of political change, would be on long-term agricultural research needs and goals and on the incremental steps required for implementation.

It is expected that the long-term program development and the priority setting would be done through an interactive process with the RSG. Once the program has been accepted, donor members of the RSG, it is hoped, would collectively agree with the host country to help provide the components essential to the execution of the program as a whole. The host country, in turn, would assume the responsibility from moving its national research program along the agreed upon development path. Initial commitments might be for three to five years subject to annual review and course corrections suggested by the analysis and feedback from actual experience.

Use of an institution such as a RSG has the potential of helping the country involved avoid many of the pitfalls of the project mode while retaining several of its desired attributes. Donor identity could be retained by relating grants to components of the agreed-upon overall program. These could even be called projects if, for administrative purposes, it were so desired. Donor-recipient negotiations, most of which would take place at the group level, would have content and quality. For the RSG, like the CGIAR, would likely involve bilateral grants developed in the framework provided by the forum of multiple donors and the host country. The impersonal process of contributing to a common fund is not envisioned. However, this would not preclude "incentive funding" of a formula type. At the same time, the danger that a single donor would dominate the priority-setting process or that essential program components would be ignored would be minimized.

The RSG also has several other potential advantages. (a) It would contribute to building a national constituency by focusing from the onset on this essential ingredient for viability. The donors, for example, might agree to increase their contributions by some fraction of the rise that occurred in the real support provided by the nation involved. Or other matching provisions might be agreed upon to provide incentives for nurturing and cultivating national constituencies. (b) It would provide reasonable continuity in support (commitments would be fairly long term; subject to review and extension well in advance of termination dates) with less risk of the excessive program fragmentation frequently associated with narrowly defined project funding. (c) It would reduce the administrative and management load on the host country through the planning and review process the RSG would follow. And (d) it would place donors in a position of genuinely complementing and supplementing one another and the national program rather than endlessly competing for "good investment opportunities".

Fundamentally, success in the use of the research support group approach would require that all parties involved be open to learning by doing. The fact that such a support mode is often discussed but little used is evidence that implementation is not a simple, trouble-free task. The method is, however, being used successfully in Bangladesh and somewhat more informally, in several other countries. An important element in its success in Bangladesh is that the Development Support Group meetings are chaired by the Director of the Bangladesh Agricultural Research Council rather than by a donor representative.

Other options should also be examined. A partial approach toward the principles suggested in this section is implicit in the World Bank practice of making project loans within the framework of a program development plan. Program reform or performance then becomes an important consideration in the negotiations for support beyond the initial loan period. At the USAID, internal discussion is focusing on the development of "common theme" regional approaches to the transfer of technology and the development of institutional capacity. One objective of the proposed approach is to achieve sufficient agreement on regional priorities to overcome the tendency for each new mission director or program officer to impose his/her personality on program priorities and objectives.

A dialogue on donor assistance to national agricultural research programs was initiated at a meeting called by the World Bank in 1981. The dialogue has been continued by ISNAR in a series of meetings with directors of national agricultural research systems. It is imperative that these dialogues be continued. The issue of reform of agricultural assistance should be recognized as one of the most urgent items on the agenda.

Some Qualifications

Opposition to these or other proposed reforms in the method of supporting national agricultural development support can be expected from a number of sources.

Policy level opposition can be expected from the foreign affairs ministries of the developed countries. In the case of the U.S., the State Department could be expected to be unhappy about the loss of discretion to direct agricultural development support to or from strategically important countries -- toward Egypt and Pakistan — and away from Nicaragua and India for example. This objection might be muted in the case of a formula funding experiment that included only a relatively low ticket time such as agricultural research rather than the total agricultural development support budget.

Bureaucratic objections to formula funding approach could be expected from the staff of the assistance agencies. Transfer of funds on a formula basis would be much less intensive in its demands on aid agency administrative and professional resources than the present system. The use of technical assistance personnel from DC universities and consulting firms would also decline as LDC agricultural development agencies substituted lower cost domestic personnel for "tied" technical assistance staff. Even in countries

where technical assistance personnel outnumbered local counterparts, technical assistance personnel rarely regard their presence as counter-productive. One of the advantages of the Research Support Group (RSG) approach is that it would probably be more acceptable to the development assistance bureaucracies.

Donor legislative bodies might object that the formula funding approach looks like an "open checkbook" activity with little donor control over program level of content. A partial answer to this objection is that the program would encourage more intensive internal program review as the level of national resources devoted to the program rises. A second answer is that donor representatives should focus their attention on national research strategy and policy rather than on the details of program management. A regular schedule of reviews of policy, strategy and impact such as that proposed in the Research Support Group (RSG) approach might remove some of this criticism.

One might also expect opposition from the aid constituencies in the developed countries to any reform that transfers program decisions from donors to recipients. The aid constituencies typically have their own reform agendas which they would like to see national agencies impose on recipient countries.

With this kind of opposition what does the reform proposal have going for it? My response is nothing more than the development of agricultural research institutions that develop the capacity to achieve political and economic viability within their domestic political-economic system.

Notes

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1. The perspective presented in this section draws heavily on a recent review of the literature on development assistance prepared by the U.S. Agency for International Deveopment (Krueger and Ruttan, 1983).

2. In recent years over 80 percent of the Economic Support Fund has been allocated to three countries -- Israel, Egypt and Jordan.

3. See Faaland (1982). For an example of the lack of congruence between national and donor agricultural research priorities see Salmon (1983).

4. This section draws directly from ISNAR (1983).

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19
Towards Reform of Our International Monetary and Trade Institutions

G. Edward Schuh

The focus of this paper is on the growing importance of international economic relationships and on the growing deficiencies of international economic and policy institutions. I will address these issues from the perspective of agricultural trade, but the principles and issues involved are in general much broader than agriculture.

One of the most significant developments of the post-World War II period has been the growing internationalization of the world's economy. In some respects this development has been an economist's delight. One observes the growing international division of labor and with it the potential for increases in per capita incomes due to increased specialization and the realization of comparative advantage.

Although an economist's delight, the internationalization of the world's economy presents us with many economic and political dilemmas. In the first place, the growing division of labor imposes rather large shocks on the economies of individual countries, especially those such as the United States that have had to face foreign competition in sectors basic to their economy. In addition, the economies of many countries are increasingly out of the reach of national economic policies. At the same time, the international institutions that served us so well for almost 30 years have in a rather short period of time either broken down, disappeared, or become largely irrelevant. Complicating these problems is the fact that policymakers act as if they still had the same degree of control over their national economies as they had in the past. Worse still, many of them still act as if closed economy models were relevant for managing their economies, when in fact open economy models would be more proper as a guide to policy.

From a political standpoint perhaps the most serious consequence of this state of affairs is the growing disaffection with both our political process and with our economic system. And it is little wonder that we become disaffected. The economy no longer responds in the way it once did to conventional policy measures. But politicians and policymakers continue to advocate the same policies as they did in the past. When the response is not as expected, the tendency is to look for scapegoats and conspiracy. Moreover, policies are often advocated that in the long run will be

counterproductive.

The main point of my paper is that solutions to many of the problems we face in today's world will not be found in domestic policies or in what we do with domestic institutions. Instead, solutions will be found only in the reform of our international institutions, and in some cases in the creation of new international institutions.

Clearly, bringing about some of these changes will not be easy. There has probably been no time in the post-World War II period when as a nation we have been more discouraged or frustrated with the UN, the GATT, and other international institutions. But realism also suggests that there really is no alternative to addressing the system as it is, not as we would like it to be. Economically, we obviously cannot return to Fortress America. The political and economic costs would simply be too high.

But man is both rational and intelligent. Consequently, with patience and persistence we should be able to devise the policies and institutions needed to manage the world's affairs in a sensible way. And it is to that end that my paper is directed.

What follows is divided into three main parts: (1) a brief review of some of the important chages in the structure of the international economic system these past twenty years, for it is these changes that are the root cause of some of our current problems; (2) a discussion of the breakdown and growing irrelevance of our international institutions; and (3) some suggestions for changes needed in the system.

The Changing Structure of the International Economic System

The structure of the world's economy has changed dramatically in the period since the end of World War II. Unfortunately, policymakers have not kept up with these changes and consequently have failed to devise policies consistent with the changed conditions. I would like to first discuss four changes in the structure of the international economic system that have already emerged, and then three more changes that appear to be in the offing.

Perhaps one of the most significant changes in the structure of the international economy in the post-World War II period has been the emergence of a well-integrated international capital market. At the end of World War II, international capital markets were debilitated. Such international transfers of capital as there were were from one country to another, and on concessional terms. The Marshall Plan was the outstanding example of such tranfers, and in some years involved transfers as large as 3 percent of the GNP of the U.S. But the U.S. also assisted countries other than our wartime allies, and as the Marshall Plan phased out, concessional assistance to other countries, especially the less-developed countries, increased.

Over time, government-to-government transfers of capital on concessional terms declined in relative terms. In its place arose a very effective international market for capital. This market started out as a Eurodollar market, but eventually evolved into a

Eurocurrency market. Later there arose the rudiments of an Asian dollar market and in recent years there has been talk of creating a Rio dollar market.

The amount of resources that flow through this international capital market is now huge. Countries borrow in this market to finance their development programs. Consortia of banks mobilize large quantities of funds. And very little of the credit is extended on concessional terms. In fact, today, the amount of capital transferred on concessional terms is relatively small compared to that which passes through the relatively unregulated markets.

An important aspect of the emergence of this international capital market is that the economies of the world are increasingly well-integrated and linked together. We generally tend to think that countries are linked together by means of trade. In point of fact, they are now also linked together by the international capital market. Moreover, as will be explained in more detail below, the capital market links economic policies in ways they were not linked in the past.

The second change in the structure of the international economy was the shift from a system of fixed exchange rates to a system of quasi-flexible exchange rates in 1973. The system of fixed exchange rates had reigned throughout the post-World War II period. But in 1973 the U.S. forced the international community to a system of flexible exchange rates. Although more properly described as a system of block floating, it still remains that something like 85 percent of world trade moves across flexible exchange rates.

The shift towards a system of flexible exchange rates has a number of important implications for policies designed to deal with the world food problem. First, trade and exchange rate policies have been an important means of taxing agriculture in the less-developed countries. With a system of flexible exchange rates, implementing such policies becomes a great deal more complex.

The current difficulties faced by U.S. agriculture further illustrate some of the consequences of the structural changes in the international economy identified above. The value of the dollar has risen dramatically in foreign exchange markets over the last two years, at least in part due to tight monetary policies here at home. The strong dollar has made U.S. exports less competitive in international markets, while at the same time translating prices in the international market back into the U.S. economy at a lower dollar value. Hence, a strong dollar has helped create a serious farm problem here at home.[1]

The strong dollar can be expected to have additional consequences if it persists. In the first place, the effect on agriculture will be similar in those countries that keep the value of their currency tied to the U.S. dollar. That includes a large number of less-developed countries. In effect, the agriculture of these countries will face the same adjustment problem as U.S. agriculture now faces.

In addition, the U.S.'s role in supplying foodstuffs to the rest of the world can be expected to decline if the value of the dollar remains strong, since our exports can be expected to decline, other things being equal. Similarly, agricultural output in countries whose currencies have declined vis-a-vis the dollar will

increase, and these countries can be expected to be more competitive in international markets - either importing less or exporting more, whichever the case may be.

These limited examples point out some of the important consequences of the changes in structure of the international eocnomy. These changes have made the world's economy a great deal more interdependent, and in ways that have important implications for the world food problem and for food and agricultural policies.

Still a third change in the structure of the international economy that has important implications for food and agricultural policies is the rather significant shift in trade patterns over the last decade. At one time the bulk of trade in cereals was among the advanced, industrialized countries. During the 1970s, however, this trade took on important North-South and East-West dimensions. For example, from 1971 through 1979, imports of cereals by the centrally planned economies increased over seven-fold, from 6.5 million metric tons to 54.6 million tons. Similarly, imports by the less-developed countries increased over six-fold, from 8.9 million tons to 54.5 million tons. Imports by the industrialized market economies increased only 40 percent during this same period, from 27.4 milion tons to 38.3 million tons. Most of this increase was due to growing imports by Japan, however, which increased by 131 percent, from 10.3 million tons to 23.8 million tons. Imports by the European Community actually declined by 68 percent, from 13 million tons to 4.2 million tons. In recent years the European Community, aided by large export subsidies, has actually become a net exporter of grains.

These large changes in the patterns of trade have important implications for the relevance of the international institutions created to manage and regulate that trade. Those implications will be discussed in more detail below.

A fourth change in the structure of the international economy is the increased integration of the economies of the world through the labor market. The problem of the undocumented worker in the U.S. has received a great deal of attention in the popular press. But massive migrations of labor have also become significant economic events in other parts of the world as well, such as in Asia and Africa. These migrations are important for food and agricultural policy, for they help change the comparative advantage of particular sectors in individual economies. For example, the U.S. is able to remain competitive in labor-intensive fruits and vegetables in part because of the ready supply of undocumented workers.

In addition to these changes in the structure of the international economy that have already occurred, there are at least three more changes that may be in the offing. First, the comparative advantage of individual countries is likely to undergo further dramatic shifts in the decade ahead. The bases for these shifts are already well in place. The technological base of world agriculture is likely to change significantly in the decade ahead due to the maturation of the International Agricultural Research System. The capacity of this system to produce new production technology was developed during the 1970s. The payoff from the system should begin to emerge in the 1980s. New production technologies should significantly alter the comparative advantage of

individual countries.

Investments by individual countries in their own capacity to produce and distribute new production technology have also increased greatly. The less-developed countries as a group are investing a great deal more in their domestic capability - Brazil being an outstanding example. These investments will have a positive payoff in their own right. They also enable countries making them to take greater advantage of investments made by the international community.

Similarly, industrial technology is being diffused around the world at a much faster rate and on a broader scale than in the past. The increased speed is due both to the growing recognition of technology as the basis for development and the improvements in educational attainment in the less-developed countries. This rapid diffusion of technological knowledge will probably give the less-developed countries an ever-stronger comparative advantage in the future in labor-intensive manufactured products.

It is too early to say how these various developments will balance out in the decade ahead. It seems clear, however, that they will pose serious challenges both to international trade policies and to the domestic food and agricultural policies in individual countries.

Another development likely to emerge in the decade ahead will be a growing liberalization of economic policies in the less-developed countries. The autarchic, import-substitution industrialization policies of the 1950s and 1960s are now discredited, together with the neglect they implied for agriculture. The potential of export-based development policies is being increasingly recognized. These shifts lead to rather different perspectives on the role of agriculture in the development process and in the posture individual countries take vis-a-vis trade.

There has already been a remarkable shift in the posture of groups of countries relative to trade. For example, throughout most of the post-World War II period the industrialized countries as a bloc have promoted freer trade and greater international economic intercourse. The less-developed countries, on the other hand, have been inward-looking and autarchic. Today those positions are almost exactly reversed. The less-developed countries are becoming increasingly free-trade minded while the industrialized countries are becoming increasingly protectionist.

The implications of these changes in trade perspectives are quite important for food and agricultural policies. They further illustrate the growing dependence of such policies on international trade issues.

The third development likely to emerge in the decade ahead is a shift on the part of the centrally planned economies towards increasingly decentralized, liberal and market-oriented economic systems. This judgment about the future is somewhat more speculative than the previous two. But changes in the centrally-planned system are already significant. Changes in China, for example, have gone beyond what most people thought possible only a few years ago. The Polish summer of a year ago may be a harbinger of the future, even though that important attempt at liberalization has been side-tracked, at least for the time being.

In any case, it seems likely that we will increasingly need to incorporate the centrally-planned economies into the international economic system. That will make trade and other international issues a great deal more complex than they have been in the past.

The Breakdown and Growing Irrelevance of International Institutions

The end of World War II witnessed the birth of important new international institutions. The United Nations and its operational organs such as the Food and Agriculture Organization (FAO) came into being. The World Bank was created, together with the International Monetary Fund. The Bretton-Woods conventions were established to guide international monetary relations. The General Agreement on Tariffs and Trade (GATT) was signed to guide international trade. And so on. In summary, this period witnessed a significant burst of creativity in terms of international institutions.

A number of characteristics of this period and of the institutions created at that time are worth noting. First, the technical capability to design these institutions was apparently ample and relevant. Second, there was significant political leadership to bring the institutions into being. The U.S. played a major role in the events of those days, due in no small part to its dominance of the international economy as the only clear "winner" of the war. And third, the institutions that emerged in that period were designed in large part by representatives of the industrialized West, and to serve the interests of the industrialized West. They have, in general, served those interests quite well. However, they have not, as a practical matter, served the interests of the rest of the world nearly as well.

The past decade has seen a breakdown of many of the institutions created at the end of World War II. Within those that still remain, there is a growing irrelevance to the problems of the day. And for some emerging problems, satisfactory international arrangements for dealing with them never existed.

In this section some of these important developments or lack of developments pertinent to agriculture are identified.

1. The breakdown of major provisions of the Bretton-Woods Conventions.

An important element of the Bretton-Woods convention was the agreement to operate with fixed currency exchange rates. Another element was the agreement that there would be only a limited number of reserve currencies. A third was that disequilibria in the external accounts would be corrected by changes in domestic policies rather than by changes in exchange rates.

This system served the industrialized countries of the world quite well for almost 30 years. However, when the U.S. forced the world to a system of flexible exchange rates in 1973, the main elements of this system were eliminated. Unfortunately, no formal agreed-upon rules have replaced the old system. Problems are dealt with on an ad hoc basis as they arise. And there are few generally accepted principles to serve as a guide for crisis management when

crises arise. Moreover, there were never any rules about distortions in exchange rates as a distortion to trade.

2. The shift in trade patterns makes the GATT less relevant.

The General Agreement on Tariffs and Trade has established rules which govern trade relationships among countires. It has also provided the leadership for a succession of Multilateral Trade Negotiations which have successively lowered tariffs, and to a lesser extent, other barriers to trade, while at the same time reaching agreement on a set of codes pertinent to international trade.

However, the signatories to the GATT are primarily the industrialized countries of the West. The centrally-planned and less-developed countries for the most part are not members. Hence, the provisions of the GATT do not apply to them.

At one time this was not a serious issue since most of the world's trade was among the industrialized countries. With trade patterns shifting more and more towards the centrally-planned and less-developed countries, however, the result is that a larger and larger share of international trade is not governed by any agreed-upon rules.

In the case of agriculture the situation is even more serious. The GATT in general has provided little assistance in providing a more responsible, stable trade environment. The industrialized countries, again led by the United States, have protected their domestic agricultural programs by excluding agriculture from the provisions of the GATT. Hence, agriculture has experienced little direct benefit from the general reduction of tariffs in the post-World War II period. There has also been only limited progress in establishing rules for the use of non-tariff barriers to trade, even in the most recent MTN, which gave increased attention to non-tariff barriers.

To summarize, agriculture has for the most part been left outside the provisions of the GATT. Moreover, such provisions as did have relevance have become less and less relevant with the passage of time as trade has shifted away from countries signatory to the GATT.

3. The emergence of the UNCTAD

The failure of the less-developed countries of the world to be members of the GATT, together with their inability to gain a voice in the deliberations of the GATT, gave rise to the first United Nations Conference on Trade and Development in the mid-1960s. Designed in the beginning to call attention to the importance of trade to the development of the less-developed countries, the UNCTAD rapidly coalesced into a political movement which has both challenged the trade rules established by the industrialized market economies and pressured for resource transfers from the developed countries.

A series of UNCTAD conferences has followed. An increasingly coherent political rhetoric has evolved and the political cohesiveness of the group has grown stronger. The list of demands from the UNCTAD constitute the agenda for the so-called North-South debate. Major items on the agenda have relevance for the world's food and

agricultural problems and policies, but so far the agenda has elicited little or no response from the developed countries. The expected debate has instead become a dialogue of the deaf.

The UNCTAD has persisted in its attempt to establish a serious dialogue with the North. It has given less attention, however, to focusing on its own internal problems, or to collective actions it might take as a group. Were it to do the latter it might become a politically powerful group. The potential importance to food and agricultural policies is obvious.

4. The emergence of state and quasi-state trading agencies.

Trade with the centrally-planned economies takes place on a state-to-state basis, at least on the centrally-planned economy side of the exchange. But other countries have developed state or quasi-state trading agencies as well. Among these are the Canadian Wheat Board, CONASUPO in Mexico, INESPRE in the Dominican Republic, and similar agencies in Japan, Australia, and the long list of countries with marketing boards.

These state trading agencies are typically created to provide the government with a monoploy of either the import or export of particular commodities. In some cases they are the means of taxing agriculture in implicit ways. In other cases they are the means of providing implicit subsidies to agriculture or to other groups in society.

As vehicles for food and agricultural policies these organizations have become increasingly important. In the trade context they create serious difficulties because they make it difficult to identify measures of objective costs and therefore to identify subsidies and taxes. Hence, ultimately they become important sources of distortions to trade.

Despite their growing importance, there are few agreed-upon rules for the regulation of state trading agencies. The GATT has been notably silent on them, as has the UNCTAD. Conflicts over their trade practices have to date been resolved primarily through bilateral negotiations. Yet their obvious potential as disturbances to food and agricultural policies should not be neglected.

5. The lack of international arrangements or mechanisms for dealing with international trade adjustment problems.

With trade becoming an ever larger component of national GNP, and with rapid shifts in comparative advantage emerging on the international scene, the world is faced with serious trade adjustment problems. Agriculture is likely to be in the forefront of these adjustments, especially if the potential of new technology as the basis of developing the agricultural sector is realized.

The world faces somewhat of a paradox when it addresses the trade adjustment problem. Such problems are inherently domestic issues and typically involve tradeoffs between domestic consumers and domestic producers. However, trade problems are typically perceived and articulated as conflicts between domestic producers and foreign producers. Under such circumstances it is not surprising that the foreigner tends to lose out and that protectionism prevails.

A possible way of addressing this problem is to devise an

international mechanism or means of dealing with it. In this way, international resources will be used to deal with what is perceived to be an international problem.

6. The growing use of economic sanctions to influence the behavior of countries.

The use of economic sanctions in international relations is not new. Economic blockades and other forms of economic retaliation have long been used as means to attain political objectives. But the growing reluctance to use military force in international affairs, especially by the industrialized countries, has led to increased use of economic sanctions. Moreover, they are likely to be increasingly important in the future.

Food and agriculture are likely to be in the forefront of such sanctions. Moreover, as in the case of the Soviet embargo, such measures may well represent large shocks to the world's food and agricultural sector.

If such practices do indeed become more important in the future, a set of principles to guide and discipline their use is needed. The world long ago agreed on a set of rules for military warfare. It would seem equally plausible that it agree on a set of rules for conducting economic warfare.

To conclude this section, it should be noted that there has been a number of important international institutional innovations of relevance to agriculture in the post-World War II period. Perhaps the most important of these is the Consultative Group for International Agricultural Research (CGIAR) and the system of International Agricultural Research Centers which it represents. In addition, there have been the World Food Council and the International Fund for Agricultural Development, both of which were created after the crisis in international commodity markets in the mid-1970s.

These institutional innovations have been exceptions to the general rule, however. The general rule has been a breakdown of international institutions that at one time were effective, the growing irrelevance of some major institutions such as the GATT, and a failure to devise new institutional arrangements to deal with emerging problems. Whether this situation is due to a lack of creativity on the part of social scientists, to political paralysis at the international level, or to some combination of the two is an open question. But the impasse and paralysis have occurred at the very time that the world's economy is becoming rapidly internationalized.

SOME SUGGESTED CHANGES[2]

Changes are needed in the international money order, in the arrangements governing international trade, in international labor and capital markets, in institutions to deal with trade adjustment, and in the means for redistributing income on an international scale. These issues and suggestions for change are discussed in this section.

The International Monetary Order

Under the provisions of the Bretton Woods Conventions questions of the monetary order were largely a domestic or internal issue. Countries were mandated to resolve problems in their external accounts by changing their domestic policies. In this way individual countries were to be precluded from dumping their problems abroad by pursuing beggar-thy-neighbor competitive devaluations, as some of them did during the 1930s.

As long as the supplier of the major reserve currency for the world (the U.S.) pursued monetary policies that maintained a relatively stable price level, and as long as international capital markets were either atrophied or non-existent, that system worked reasonably well. But when the U.S. began to inflate its economy because it was unwilling to raise domestic taxes to finance a war and a massive expansion of its social welfare programs[3], the game changed. The problem was further complicated by the emergence of international capital markets, and the granting to the International Monetary Fund (IMF) of the right to create international reserves in the form of Special Drawing Rights (SDRs). Much of the world inflation of the 1970s was due to the excessive pumping of dollars into the international system by the U.S., and by the creation of large amounts of additional international reserves by the mere stroke of a pen by the IMF. The large increase in the value of gold at this time exacerbated the problem by increasing the monetary value of gold reserves.

Conventional wisdom has it that individual countries can isolate themselves from inflation in the international economy by letting their exchange rates float. Two comments on that "wisdom" appear to be in order. First, when international capital markets were virtually nonexistent, there may have been some basis for that proposition. However, it is seriously weakened by the extent and efficiency of the present international capital market. Second, the consequences of exchange rate realignments are not innocuous. The purchasing power parity doctrine in which exchange rates reflect only price level differentials is valid only when international capital markets are unimportant. Once major capital flows become possible, and actually occur, exchange rate realignments can induce major shifts in the production sectors of individual countries.

This problem becomes especially serious when the world is subject to major monetary disturbances, as it has been over the last decade or so. Since about 1968 the United States has been an important source of such disturbances with its stop-and-go monetary policies. But the IMF also has contributed, especially with the significant increase in international monetary reserves in the early 1970s -- mostly in the form of newly-created SDRs.

I see little solution to these problems short of the establishment of an international central bank with a mandate to keep monetary reserves for the international system growing at a measured, steady rate. Such a system would not assure that individual countries did not pursue unstable policies. However, it would remove the onus from the U.S. of having to act like the Central Bank for the world. It would also reduce the exposure of other countries to the consequences of political pressures on the U.S.

Federal Reserve Bank and the monetary instability which results.

A more stable monetary order is a service that has to be provided by the public sector. It is a proper role of government. With such a stable order some of the pressures for protectionism will decline and an environment will be created in which barriers to trade might be reduced. Capital markets will also be able to perform more efficiently, thus setting the stage for a more efficient allocation of the world's resources.

Trade Arrangements - Reforming the GATT

The issues surrounding stock carrying and food security are important examples of where developments and actions in the international economy lead to externalities that give rise to the need for international institutions. As Gale Johnson[4] has pointed out so effectively, an important source of instability in international commodity markets is the prevalence of barriers to trade and autarchic commodity policies. The failure to let international prices be reflected to domestic producers and consumers precludes the needed adjustment to changing conditions of demand and supply. Consequently, prices respond in an exaggerated fashion to shocks to those markets.

The key to food security and to more stable commodity markets is to reduce the barriers to trade[5]. Given the variety of places in which most commodities are produced, it is seldom that bad weather will affect all of those regions at one time. Hence, in the absence of barriers to trade, weather-induced instability in international commodity markets would be fairly limited. Moreover, there would not likely be a need for buffer stocks other than what normal market forces would induce.

It is important to recognize that trade distortions which cause instability of international markets to be larger than they otherwise would be are of two quite distinct kinds. On the one side of the market are tariffs, undervalued currencies (implicit tariffs),[6] and non-tariff barriers to trade. Although not exclusively so by any means, such policies tend to be more prevalent among the advanced industrialized countries. It is these countries that tend to protect their agriculture.

On the other side of the market are distortions which shift the domestic terms of trade severely against agriculture. These policies tend to be prevalent among the less-developed countries, and include over-valued currencies (implicit export taxes), explicit export taxes, export quotas and embargoes, and high levels of protection for the industrial sector. These policies tend to reduce the production capacity in these countries, often causing them to shift from being net exporters to being net importers. They also result in extensive forms of agricultural production, with only limited dependence on purchased inputs, or inputs produced in the industrial sector. This limited use of modern inputs limits the flexibility of agriculture in these countries, and when combined with the reduced production capacity they have, cause there to be both more demands on international markets and more shocks to the system.

Reforming the international system and finding ways to deal with these problems have to be high on the agenda for reformers of

the current international system. They are collective issues and not likely to be resolved by the initiatives of individual countries. The incentives for action by particular countries are just too limited.

Participants in the most recent round of multilateral trade negotiations had little stomach for the continuation of these negotiations, nor did they believe at the termination of those negotiations that there was much to be gained from another round of negotiations. But the mutual or collective reduction of trade barriers is the only way sufficient tradeoffs can be generated to create the incentives for a reduction in barriers to trade.

The next round of multilateral negotiations should have a significantly broader negotiating agenda if much progress is to be made in lowering barriers to trade. In the first place, the less-developed countries should be brought in as full-fledged participants. This obviously complicates what has already been a complicated set of negotiations in the past. But the role of these countries in trade is now so great they can no longer be ignored. Moreover, their newly-found interest in trade makes their participation timely.

Second, the full range of trade distortions should be placed on the table. Export quotas and embargoes are as important as barriers to trade as are tariffs and non-tariff barriers. Third, distortions in foreign exchange markets should also be a part of the negotiations. Over-valued currencies may well be the most prevalent distortion to trade. As a tax on exports they have reduced the productive capacity of agriculture world-wide. As import subsidies, they have given rise to the need for high tariff barriers for the industrial sector, especially in the less-developed countires. Very little progress can be made in reducing or eliminating one form of distortion if the other sets of distortions are not addressed.

The problem of under-valued currencies also needs to be addressed. Although used primarily by Japan and to a lesser extent Germany as a general practice, some of the green currencies of the European Community's Common Agricultural policy also constitute over-valued currencies. This distortion may become increasingly important as countries become more trade oriented in response to the need to import more petroleum and other scarce raw materials.

An important innovation in the most recent round of trade negotiations was the attention given to the codes. This emphasis needs to be sustained in any renewed negotiations, with the focus expanded to include the implicit export subsidies that are often reflected in domestic policies.

An important source of pessimism about further trade negotiations is frustration with the GATT machinery for adjusting trade disputes. This machinery has become very bureaucratic and the delays in reaching judgments are long and costly. The solution to this problem is to reform that machinery as well. Change is going to be needed in any case, especially if the number of countries represented is increased and the range of negotiable topics enlarged. We need to get on with the necessary reforms.

Trade Adjustment

Trade negotiations alone are not the only policy initiatives needed in the trade sector. In the first place, if there is to be trade liberalization, some means needs to be found for dealing with trade adjustment problems. Unfortunately, trade problems are all too often articulated domestically as a conflict between foreign and domestic producers instead of the conflict between domestic consumers and domestic producers which they tend to be. One way to deal with this problem is through international means. One such means would be an International Trade Adjustment Fund, financed by a tax or "contribution" based on the value of trade for individual countries. This fund would then be used to deal with adjustment problems created by trade liberalization. It would provide an international means for dealing with what is perceived as essentially an international problem.

I must be candid and admit that so far trade adjustment policies have not been very effective. Even the instruments of the 1974 Trade Adjustment Act in the U.S. have seldom been used in true trade adjustment fashion. But our failure to devise such mechanisms so far should not preclude our making the attempt.

International Capital and Labor Markets

Distortions in international capital and labor markets are quite severe. Foreign capital is viewed with more than a little suspicion in most countries and barriers are erected to its entrance in many countries. Barriers to migration among countries are quite severe in most countries. And laws which prevent the ownership of land by foreigners are quite common.

There are a number of encouraging signs on the international scene, however. For example, a very efficient international market for capital has emerged over the last two decades. Although governments are reluctant to let foreign firms make direct investments in their economy, they have been more than willing to go into international capital markets for credit. This means of financing development programs has largely supplemented concessional foreign aid by other countries as a source of capital funds. This system has been put at risk by the failure of banks and other lending institutions to look after their own best interests. Government intervention is not the solution to this problem. More astute lending is.

International labor markets have also become more open, sometimes by forces majeur and sometimes as a rational response to market forces. The petroleum-rich Middle East countries with their sparce population are important examples of the latter. The Mexican border and the boat people of Southeast Asia are important examples of the former.

Properly specified welfare functions to assess the gains a country experiences from economic intercourse with the rest of the world include the factor markets.[7] The exchange of capital and labor can be as important to national welfare as exchange of goods and services.

Barriers to the international migration of labor and to the international owning of land are likely to continue into the near future. Perhaps the best that can be done is to keep the market

for capital open and efficient, together with a freer flow of trade. The combination of these two factors can lead to a more efficient use of the world's resources. It can also lead to a more equitable distribution of income.

The changing age pyramid for many of the industrialized countries may put substantial pressure on governments to liberalize their labor markets. The same applies to the centrally-planned economies. We may well see more international migration of labor in a few years than we ever thought possible a few years ago.

Redistributing Income on an International Scale

An important component of the demands for a New International Economic Order put forth by the less-developed countries is a series of proposals designed to transfer income from the developed to the less-developed countries. Among these are proposals whose intent is to shift the external terms of trade in favor of the low income countries, such as by commodity agreements. Other proposals call for the direct transfer of income by means of foreign aid.

I believe the most effective way to bring about direct international redistributions of income is by means of foreign aid, with that aid limited to or concentrated on investments in human capital. In many countries, the underinvestment in human capital is quite severe. Moreover, providing support for human capital programs need not imply foreigners intervening in the educational systems of other countries.

More attention has been given in recent years to increasing the international capacity for agricultural research, both bilaterally and multilaterally. These efforts should be expanded and resource transfers for physical capital reduced. The externalities from human capital are high. All countries, including the donor countries, can benefit from such investments. A reduction in the productivity differentials among countries is the key to reducing the income differentials. It may well be that more equal investments in human capital are the only effective means for narrowing the gap among countries in a reasonable time.

CONCLUDING COMMENTS

Reforming and strengthening international trade and monetary institutions as proposed herein moves us closer to what might approximate an international or world government. Some will object to that trend, on the grounds that we will be giving up our national sovereignty and sumbitting ourselves to the rule of people not elected by us and to rules established by others.

There is a certain element of validity to such concerns. At the same time, however, we should not mislead ourselves with respect to just how much national sovereignty we now have. Ours and the world's economy have already evolved in directions which greatly weaken the sovereignty we have over our respective national economies.

In addition, much of what I have proposed has been limited to setting the rules for and monitoring international trade and the international mobility of resources. If a more effective set of

rules can be established and enforced, markets will have a greater role to play on the international scene. Moreover, reductions in barriers to trade on the international scene may well lead to increased dependence on markets and a freer play of market forces within individual countries. A greater dependence on markets will lead to a more efficient use of the world's resources, and an increase in the welfare of all.

NOTES

1. For more detail, see Schuh, G. Edward, "Agriculture in Transition", testimony before the Joint Economic Committee, U.S. Congress, April 28, 1982.

2. Much of the material in this section is taken from an earlier paper, "The Role of Markets and Governments in the World Food Economy" in The Role of Markets in the World Food Economy, edited by D. Gale Johnson and G. Edward Schuh, Westview Publishing, forthcoming.

3. An important advantage the issuer of the world's reserve currently has is that it can collect a tax from the world's economy by pumping the system up with its money.

4. Johnson, D. Gale, "World Agriculture, Commodity Policy, and Price Variability", American Journal of Agricultural Economics, 57(5): 823-828 (December 1975).

5. These barriers cause the monetary disturbances discussed earlier to have an exaggerated impact on commodity markets.

6. Japan has persistently undervalued its currency since the early 1960s, Germany has also, but to a lesser extent. Certain of the Green currencies of the EC have also been undervalued.

7. Brandao, Antonio, "The Terms of Trade and the Welfare Gains from Trade: New Perspectives", unpublished Ph.D. thesis, Purdue University, 1978.

20
Some Domestic Consequences of the Expanded Role of the United States in Meeting World Food Needs

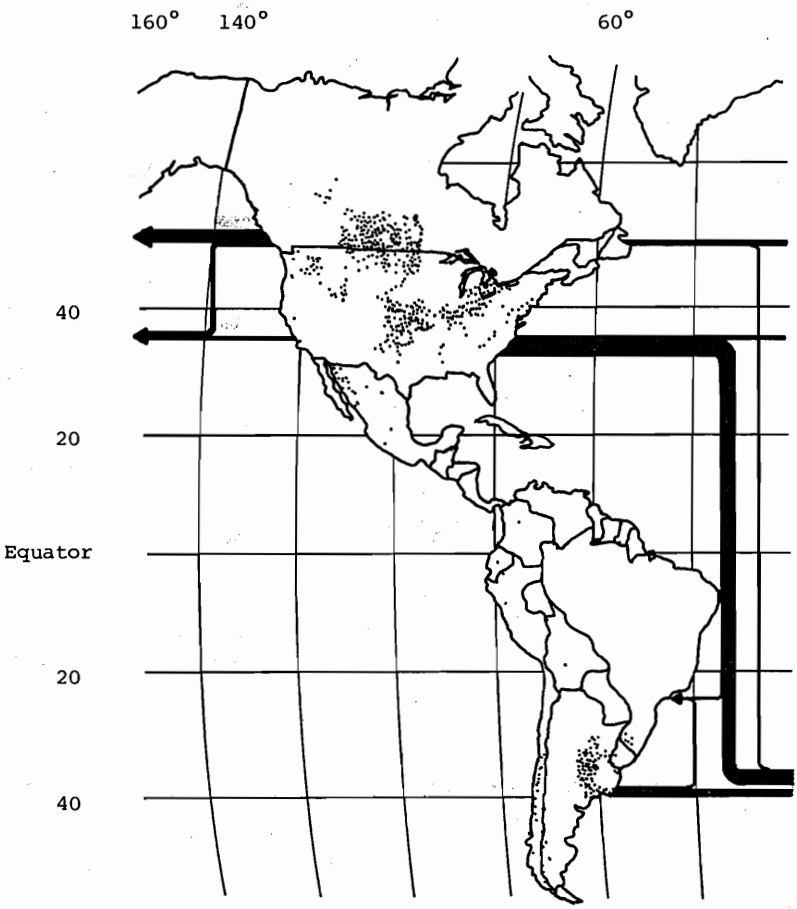
Philip M. Raup

Although the focus of this paper is on the United States, I will begin by referring to several other parts of the world in order to set a framework. Figure 1 reproduces a dot map of the major wheat belts of the Western Hemisphere. Note the essentially north/south orientation of the distribution of wheat acreage in the U.S. and Canada. In general, that contrasts with Figure 2 which shows the location of wheat acreage in the Eastern Hemisphere. Here you can spot the North African wheat areas, Spanish/French grain areas, and the concentration of wheat scattered across the mid-European continent and then structured in a huge east-west orientation in the Soviet Union, with major portions of the belt reaching deep into Siberia as far as Lake Baikal. The USSR axis follows approximately the route of the trans-Siberian railroad. This is no accident in that grain belts are very much a function of transport facilities.

Note the the distinction between those two belts. The North American belt has a rough northwest/southeast orientation, while the Eastern Hemisphere belt has a distinct east/west orientation. Given the rotation pattern of the earth and the movement of air currents in the northern hemisphere, weather systems more or less cut at right angles to the North American grain belt and parallel the axis of the European/Asiatic grainbelt. One consequence is that it is rare to have a massive crop failure in the entire North American wheat belt. We can have some high years and some low years, and we do, but a joint U.S./Canadian wheat crop failure has occurred only in the drought of the 1930s. On the other hand, the movement of weather systems makes extreme variations across the USSR/Asiatic wheat belt not only possible but probable. That does not apply quite so specifically to the east-Asiatic version, that is, to the Chinese wheat belt, but it does definitely concern the USSR wheat belt, which lies far to the north.

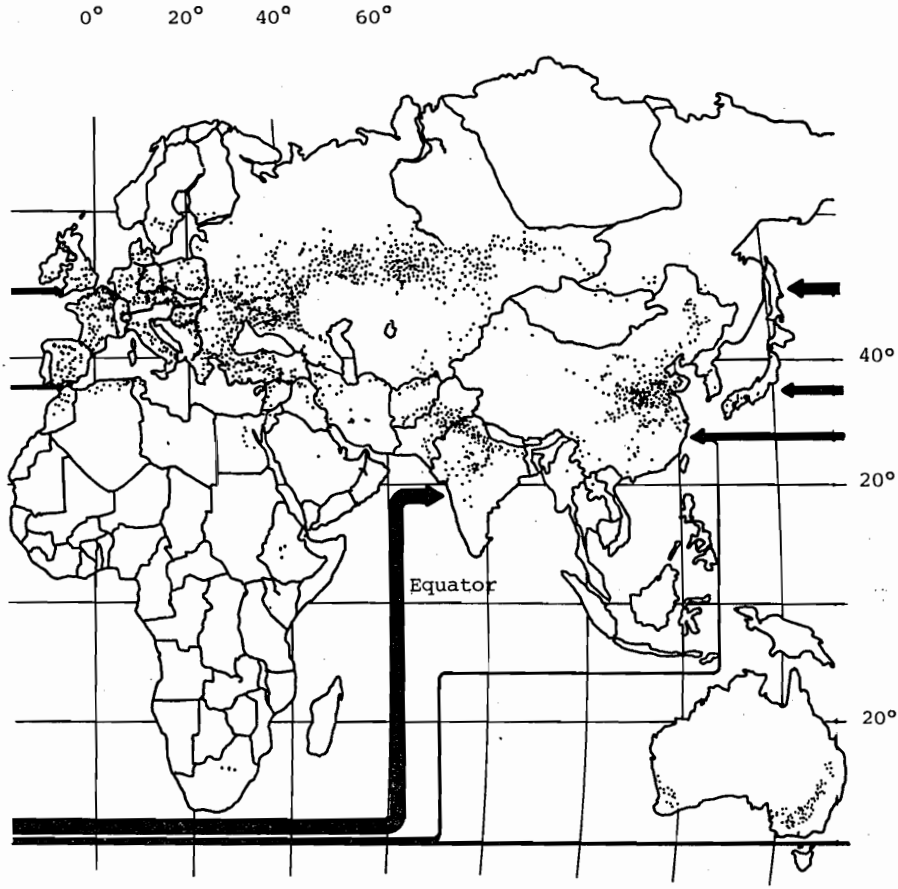
Let me ask, "On what parallel of latitude are we now, in Fort Collins?" Where are we on the globe? We are now just north of the 40th parallel. Do you recognize yourself in Sardenia? Or Naples? The 40th parallel almost completely misses the Soviet Union, passing approximately through Yerevan, Baku, and Samarkand. St. Paul, Minnesota is on the 45th parallel, as are Bordeau, France; Venice, Italy; and Yalta in the Soviet Crimea. Almost all of the grain

Figure 1. Western hemisphere wheat belts .



Source: Oxford Economic Atlas of the World, 1972 edition, London, Oxford University Press, p. 12.

Figure 2. Eastern hemisphere wheat belts.



Source: Oxford Economic Atlas of the World, 1972 edition, London, Oxford University Press, p. 12.

belt of the Soviet Union lies north of St. Paul, Minnesota. Note from Figure 2 that much of the wheat acreage of the USSR is north of the 50th parallel, or the latitute of Winnipeg, Manitoba. If we include spring barley, the major feed grain of the USSR, then the majority of the grain area of the Soviet Union lies north of Winnipeg.

Consequently, the Soviet Union's grain belt is not only east/west oriented and subject to climatic hazard to a much greater extent than is the North Aemrican grain belt, but its grain all becomes ripe within a shorter period of time. There is a critical planting season, a critical ripening season, and a critical harvest season. The combined result is that the timeliness of field operations is much more important in the USSR than is the case in North America.

The wheat harvest in the U.S. will begin in late May or early June in Central Texas and the lower Mississippi Valley. It will work north into Kansas and Colorado in July, into Nebraska, the Dakotas and Montana in August and into the prairie provinces of Canada in September. It will end in the Peace River Area in Canada where there are often harvesting from windrows of wheat into October. Note the geographic spread--Vernon, Texas is at the latitude of Casablanca; Enid, Oklahoma is Gibraltar; Dodge City, Kansas is Palermo; Yuma, Colorado, is Lisbon, Portugal; Scottsbulff, Nebraska, is Barcelona; Aberdeen, South Dakota, is Bordeau; and Minot, North Dakota, is Paris. In a latitudinal sense, I can defend that pairage. The U.S. wheat harvest, thus runs from May through June, July, and August. Continuing the comparison into Canada, there is a five-month span over which to spread the harvest, which ranges over 30 degrees of latitude. This makes possible many spatial, geographically determined economies, through the reuse of harvesting equipment, labor capacity, and by spreading the burden on the transport and marketing system over time. The North American grain system is characterized by a tremendous North-South spread over space and time.

These spreads are not available in the Soviet Union. The geographic dimension is East-West, which guarantees that the timeframe in which the harvest must be completed is usually three to four weeks and in extreme cases five. This is much less than half the time available in the U.S.-Canadian grain belt. The spatial spread of the Soviet harvest is confined within about 15 degrees of latitude, or roughly half the range available in North America. The consequence is that the grain system of the Soviet Union is not only highly dependent on rainfall and storm patterns but it is very susceptible to temperature patterns. It must operate under a double hazard--a severe moisture hazard, and a much greater temperature hazard than is experienced in any part of the North American grain belt except in some of the Northern Canadian portions. This then leads to extreme variations in output, to wastage, and to enormous pressure on storage and transport resources.

Some data will give you an idea of the magnitudes involved. In the Soviet Union the all-time record output of wheat and coarse grains (excluding the pulses and minor grains) was 226 million metric tons in 1978. The low output in the last two decades was in 1975, just three years earlier, when it was 132 million metric

tons. For the 1981/82 crop year, a year of record exports, the total export of wheat by the five leading wheat exporters (U.S., Canada, France, Australia, and Argentina) was 94.9 million metric tons. The total U.S. carryover grain stocks equaled 103 million metric tons. Let me recapitulate. The spread between the high and the low of Russian grain output within three years was greater than the total wheat exports of the five leading exporters in the year of record exports, and only slightly less than the total grain stocks in the United States as of June 1982 (USDA, 1982, A, B).

In terms of total grain output and total trade in grain, this variability has consequences for the world market that go far beyond the significance of the grain output of the Soviet Union as a fraction of total world output. In other words, in estimating risk factors or in estimating market disturbance factors, the Soviet Union exercises a much greater influence than would be indicated by the proportion of its output to the world's total. That significance was greatly expanded by the decision in 1971-72 on the part of the Soviet leadership to increase their imports of grain.

A brief review of the history of that era is essential to an understanding of what happened in world grain markets in the past ten years. Recall that the Gomulka government fell in Poland in December-January 1970-71, following riots of workers in the shipyards in Gdansk on the seacosts of north Poland because there was a shortage of meat in the shops. This was a traumatic experience in the east-European COMECON circles. The distance from the shipyards in Gdansk to the western border of the Soviet Union is approximately the same as the distance from Fort Collins to Denver, or Baltimore to Washington, D.C. The possibility that meat shortages could precipitate revolt within the Soviet Union itself must certainly have been prominent in the minds of many political leaders at that time. Whatever the reason, the Soviet Union apparently made a decision in the late Spring of 1971 to begin the import of grain, resulting in net imports of over one million tons in 1971/72. It could have been asked, although it was not seriously asked at that time, why are they importing when they have the prospect of a reasonably good crop in 1971? The answer was soon apparent with the emerging prospect of a poor crop in the spring of 1972. At that time the USSR entered the market for a truly phenomenal amount of grain. Soviet net grain imports of over 21 million tons in 1972-73 constituted the largest amount of grain ever imported by one country in any one crop year, to that date.

The economic cost of the decision to import was made easier by the large gold stocks held by the USSR and by the rapid rise in the price of gold following the U.S. decision in August 1971 to end the traditional convertibility of the dollar to gold. By the end of 1973 the gold cost of grain on world markets had fallen to approximately 40 percent of the level that had prevailed before August 1971. By the end of the 1970s it was to fall even farther, making the real cost of Soviet grain imports ridiculously low over most of the decade.

This grain purchase electrified the world. It seemed to signal a basic change in Soviet internal political thought, involving a reversal of the policy incorporated in the famous slogan

of "socialism in one country". Under Stalin, the Soviet Union had turned inward, becoming to some extent a fortress of socialism. That policy involved autarky in trade. The Soviet Union would explore if necessary to get hard currency but the goal was to remain as remote as possible from import dependency. The reversal of that policy in 1971-72 must have been a traumatic political experience within the Soviet Union. The issue has symbolic as well as economic importance in that it was evident after more than 50 years of socialism that the Soviet Union could not feed itself. This was a damaging political admission, apart from its economic cost. We must assume that it was not taken lightly. Because of the political weight attached to the decision, it certainly was not taken lightly in the western world and particularly in the United States.

Coincident with the unexpectedly large grain imports by the USSR there was a sharp increase in total world trade in grains. U.S. wheat exports increased by 69 percent from calendar 1972 to 1973, with only two-fifths of this accounted for by sales to the USSR. Corn exports in the same years increased by 48 percent, with Japan far outdistancing the USSR as a market for U.S. corn. Concern about an impending world food shortage was widespread, generating a euphoric belief in the prospect of export markets for U.S. grains limited only by production capacity.

The full realization of what had happened led to a re-energizing of the grain economy of North America. The first response in the United States was to empty our grain bins of any surplus. The second response was to expand our grain acreage, our export capacities, and our export expectations. This led to an unprecedented expansion in U.S. grain output. We can illustrate this with corn and wheat, the two major grains. Table 1 shows data for planted and harvested acreage and production for the years 1965-1981. The acreage planted and total output for corn and wheat are shown graphically in Figures 3 and 4.

Between 1971-73 and 1981 the acreage planted to corn was increased by approximately 13 million acres, or 18 percent, while production of corn for grain increased from 5,632 to 8,201 million bushels, or 46 percent. For wheat, acreage planted increased from an average of 57.7 million acres in 1971-73 to 88.9 million acres in 1981, or 54 percent. Production for the same period rose from an average of 1,625 to 2,793 million bushels, or 72 percent.

The much greater responsiveness of corn to fertilizer, irrigation, and better seeds is shown by the fact that 60 percent of the increase in corn output, 1971-73 to 1981, was due to higher yields per acre, and only 40 percent to expanded acreage. The situation was reversed for wheat, with two-thirds of the increase in output resulting from an expansion in seeded acreage, and only one-third due to higher yields.

The most significant consequence of this rapid escalation in grain production was a sharply increased dependence on export markets. Total domestic usage of wheat in 1981/82 was approximately 600 million bushels for food, 112 million for seed, and 142 million for feed, for a total domestic disappearance of 754 million bushels (USDA, Foreign Agriculture Circular, Grains, FG-13-83, May 12, 1983). The 1981/82 wheat crop of just under 2,800 million

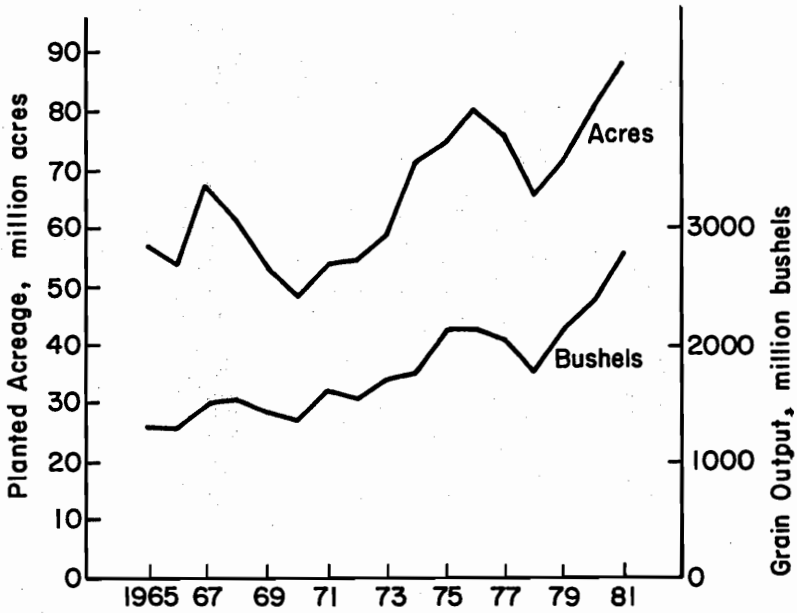
Table 1: Wheat and Corn Area, Yield, Production, United States, 1965-1981

Wheat				
Year	Area Planted	Area Harvested	Yield per Harvested acre	Production
	1,000 acres	1,000 acres	Bushels	1,000 Bushels
1965	57,361	49,560	26.5	1,315,603
1966	54,105	49,613	26.3	1,304,889
1967	67,264	58,353	25.8	1,507,598
1968	61,860	54,765	28.4	1,556,635
1969	53,450	47,156	30.6	1,442,679
1970	48,739	43,564	31.0	1,351,558
1971	53,882	47,635	33.9	1,618,636
1972	54,913	47,303	32.7	1,546,209
1973	59,254	54,148	31.6	1,710,787
1974	71,044	65,368	27.3	1,781,918
1975	74,900	69,499	30.6	2,126,927
1976	80,395	70,927	30.3	2,148,780
1977	75,410	66,686	30.7	2,045,527
1978	65,989	56,495	31.4	1,775,524
1979	71,424	62,454	34.2	2,134,060
1980	80,637	70,984	33.4	2,374,306
1981	88,864	80,948	34.5	2,793,436

Corn				
Year	Area planted, all purposes	Area harvested	Yield per harvested acre	Production
	1,000 acres	1,000 acres	Bushels	1,000 Bushels
1965	65,171	55,392	74.1	4,102,867
1966	66,347	57,002	73.1	4,167,608
1967	71,156	60,694	80.1	4,860,372
1968	65,126	55,980	79.5	4,449,542
1969	64,264	54,574	85.9	4,687,057
1970	66,863	57,358	72.4	4,152,243
1971	74,179	64,123	88.1	5,646,260
1972	67,126	57,513	97.0	5,579,832
1973	72,253	62,143	91.3	5,670,712
1974	77,935	65,405	71.9	4,701,402
1975	78,719	67,625	86.4	5,840,757
1976	84,588	71,506	88.0	6,289,169
1977	84,328	71,614	90.8	6,505,041
1978	81,675	71,930	101.0	7,267,927
1979	81,393	72,400	109.7	7,938,819
1980	84,047	73,030	91.0	6,644,841
1981	84,153	74,624	109.9	8,200,951

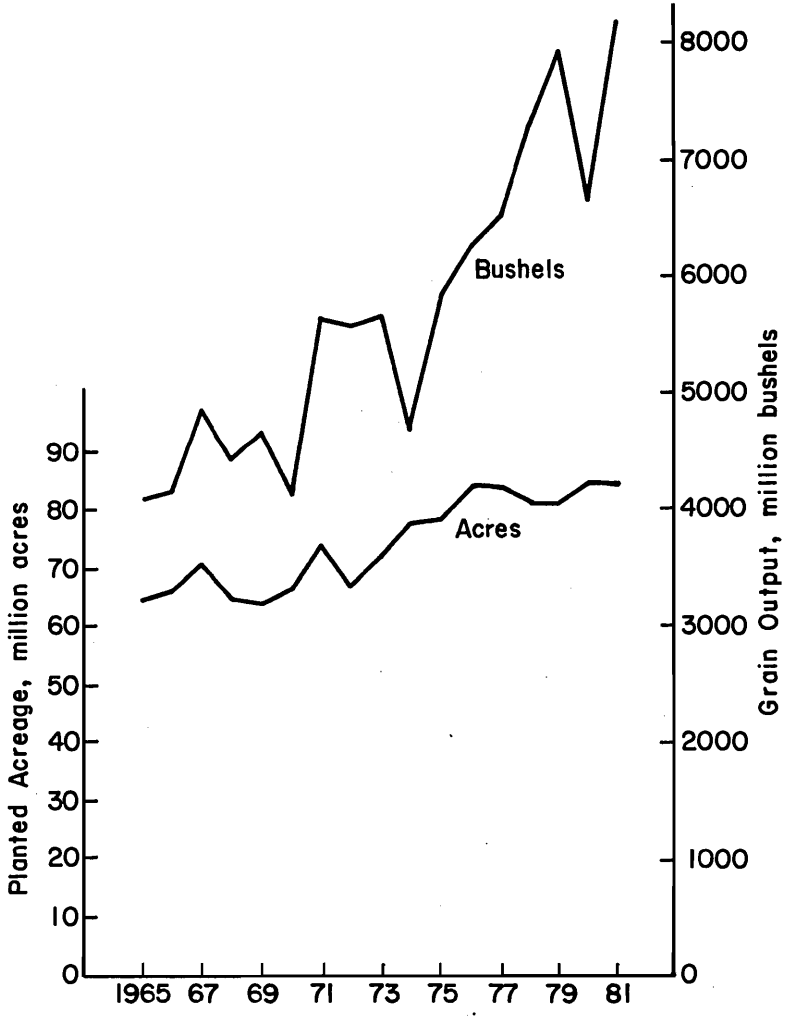
Source: U.S. Dept. of Agriculture, Agricultural Statistics, 1982, Tables 2, 39.

Figure 3. Planted Acreage and Production of Wheat, United States, 1965-1981.



Source: U.S. Department of Agriculture, Agricultural Statistics, 1982, Table 2.

Figure 4. Planted Acreage and Production of Corn, United States, 1965-1981.



Source: U.S. Department of Agriculture, Agricultural Statistics, 1982, Table 39

bushels left the United States 328 percent self-sufficient at the beginning of the 1981/83 crop year. Stating the relationship in another way, only 30 percent of the 1981/82 wheat crop was needed for domestic uses; 70 percent was available for export. Any weakening in export markets would lead to a rapid accumulation of carry-over stocks.

This has happened. Wheat exports reached a peak of 1,773 million bushels in 1981/82 and are forecast at 1,400 million bushels for 1983/84. The carry-over stock at the end of the 1982/83 crop year is estimated at 1,550 million bushels or only slightly less than total wheat production in 1971-73 (USDA, 1983 A, p. 21). With only a slight reduction in the use of wheat for livestock feed, the carry-over stocks at the beginning of the 1983/84 crop year would cover total domestic U.S. wheat requirements for two full years.

After 1972/73 corn rapidly outdistanced wheat as the leading grain export of the United States. Although the percentage increase in acreage planted to corn was much smaller than for wheat, following the unexpectedly large Soviet grain purchases in 1972/73, the output effect in total bushels was much greater. National average corn yields per acre in 1981/82 at 109.8 bushels were almost exactly three times the average wheat yield and 34.5 bushels. And although domestic uses accounted for 61 percent of the total 1981/82 corn crop in contrast to only 30 percent of the wheat crop, carry-over stocks of corn in June 1983 were projected to be 3,434 million bushels, or more than twice as large as the carry-over stocks of wheat (USDA, 1983 A, p. 21). Taking wheat and all feed grains together, the United States held 61 percent of the total world stock of these grains at the end of the crop year 1982/83.

The decade of the 1970s left the United States highly dependent on export markets for its grains and soybeans. At the beginning of the decade, less than one out of three crop acres produced for export. At the end of the decade, this ratio had increased to two out of five. The prospect of seemingly unlimited export markets led to an immediate and unprecedented increase in farmland values. From 1970 through 1981 farmland values increased four-fold nationwide, and almost five-fold in the major corn and soybean producing areas. This increase was not evenly distributed over the United States. It was much less pronounced in the East and West Coast states, where land values were already relatively high and where the prospect of rapidly expanding export markets for grains had little impact.

The increase was concentrated in the Mississippi Delta states, in the seaboard states of the Gulf Coast, and in the grain belt states of the upper Mississippi and Missouri Valleys. The greatest percentage increase was in Minnesota, at the headwaters of the Mississippi. This has some interesting connotations with reference to concentric-ring theories explaining the gradation of land values with respect to distance from major markets. It is consistent with the classic theories of J. H. von Thunen that the sudden appearance of new market potentials should have the greatest impact on land values in the producing areas most distant from the market. The grain lands of the upper Mississippi and Missouri Valleys were most

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distant from ocean export terminals, and it was there that land value increases were most pronounced.

The euphoria generated by the large Soviet grain purchases in 1972/73 was sharply augmented by two other unexpected events. Within a period of about 30 months the OPEC oil embargo and the Nixon mission to China piled surprise upon surprise. To the prospect of large new markets in the USSR and eastern Europe was added the heady possibility of a market in Mainland China. The OPEC embargo was a sharp reminder that the U.S. was the only large grain surplus producing country with a substantial if declining production capacity in petroleum fuels. In a world that was then perceived as facing catastrophic food shortages, it was reasonable to assume that the United States would have an overwhelming competitive advantage in grain export markets. The logical conclusion of this line of reasoning was to buy farm land, and the land boom was on.

While the reaction to these events was reaching its peak another trend was unfolding that gave the land market a powerful boost. In the 1950s and 1960s the real cost of land-based credit (the nominal rate of interest minus the rate of inflation) had fluctuated within a range of two to four percent, with a mean in the 1960s and to 1972 of approximately three percent. The inflation that accelerated after 1972-73 resulted in a phenomenon virtually unknown in the United States: Persistent very low and negative real rates of interest.

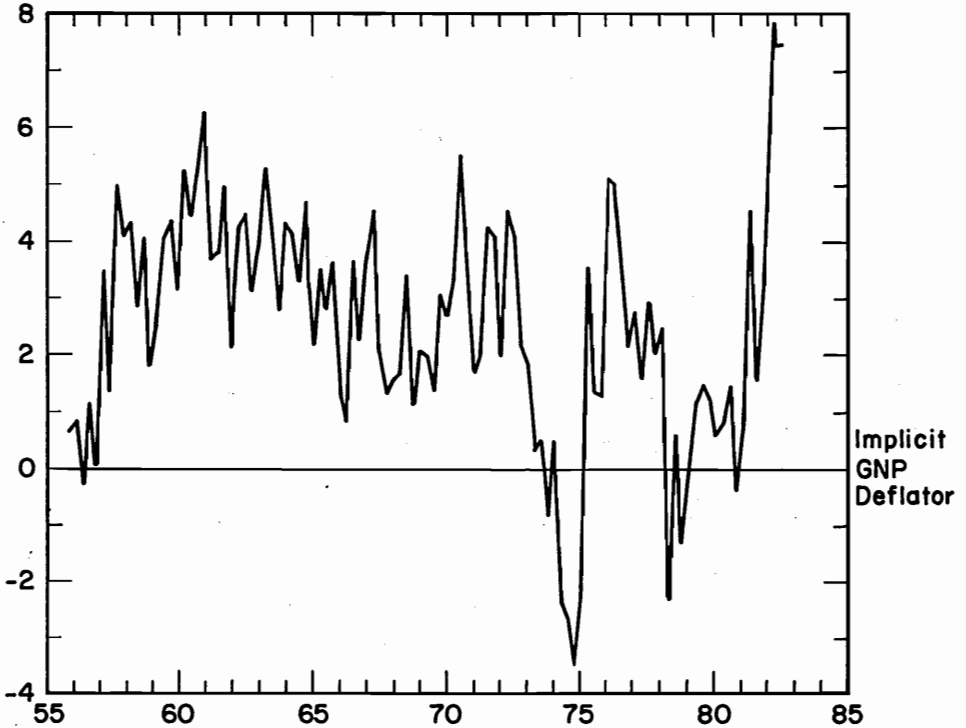
This trend is illustrated by deflation of the rates of interest charged by the Federal Land Banks on farm mortgage loans. Figures 5 and 6 exhibit these trends, by quarters, from 1956 through mid-1982. In Figure 5 deflation is accomplished with the implicit GNP deflator while in Figure 6 the consumer price index is used.

From the fourth quarter of 1972 through the first quarter of 1981 the real rate of interest on Federal Land Bank farm mortgage loans, deflated with the GNP deflator, was negative in 8 quarters and below 3 percent in all but 5 quarters. On an annual basis, the real rate of interest was below 2 percent in seven of the nine years.

Devalued with the consumer price index, the results are even more dramatic. In the eight years from 1973 through 1980 the real rate of interest on FLB farm mortgage loans was negative in 18 of the 32 quarters. Buyers of farm land who could qualify for Federal Land Bank loans could have regarded the loans as gifts, throughout most of the 1970s. They made money by borrowing money, regardless of the productivity of the land.

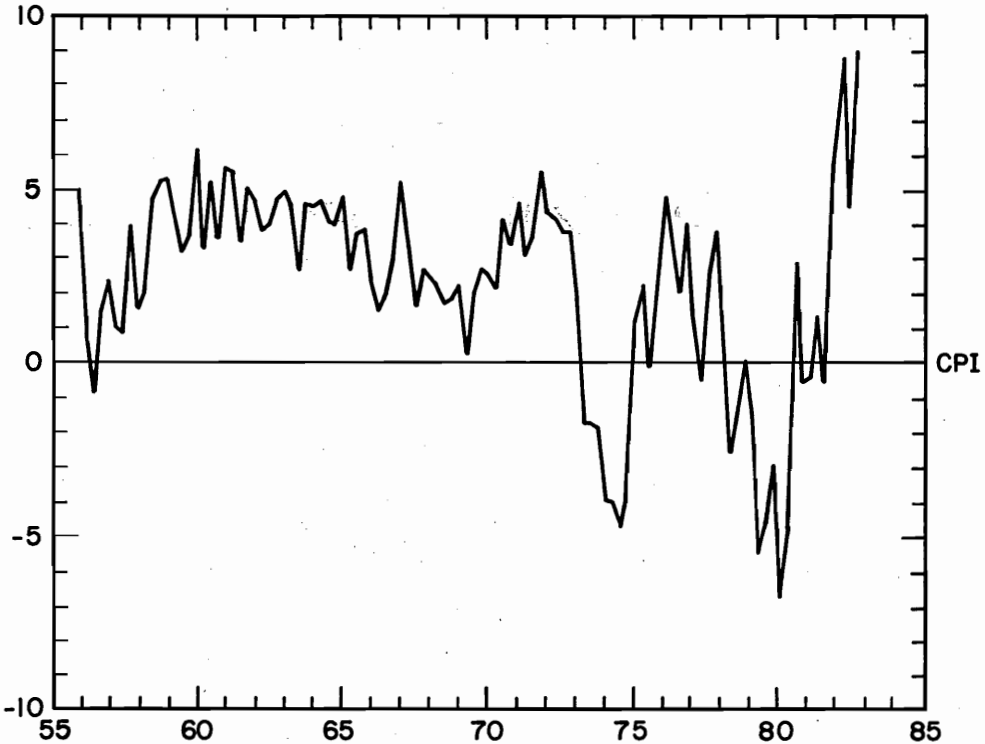
The effect of negative or very low real rates of interest was equivalent to pouring gasoline on a fire. A land price boom induced by the opening up of unexpected new markets was underway regardless of the cost of credit. To top this off, exceptionally low or negative real rates of interest simply lifted expectations of land price increases even higher. To state it more accurately, near-zero rates of interest pushed the cost of acting upon expectations of land price increases even lower. In the entire history of the Federal Land Bank System, which dates from 1916, there had never been a period in which real rates of interest were as low as

Figure 5. Average Real Interest Rate Charged by Federal Land Banks, 1955-1983.



Source: Federal Reserve Bank of Minneapolis, data series on real rates of interest and stock prices, print-out of January 12, 1983.

Figure 6. Average Real Interest Rate Charged by Federal Land Banks, 1955-1983.



Source: Federal Reserve Bank of Minneapolis, data series on real rates of interest and stock prices, print-out of January 12, 1983.

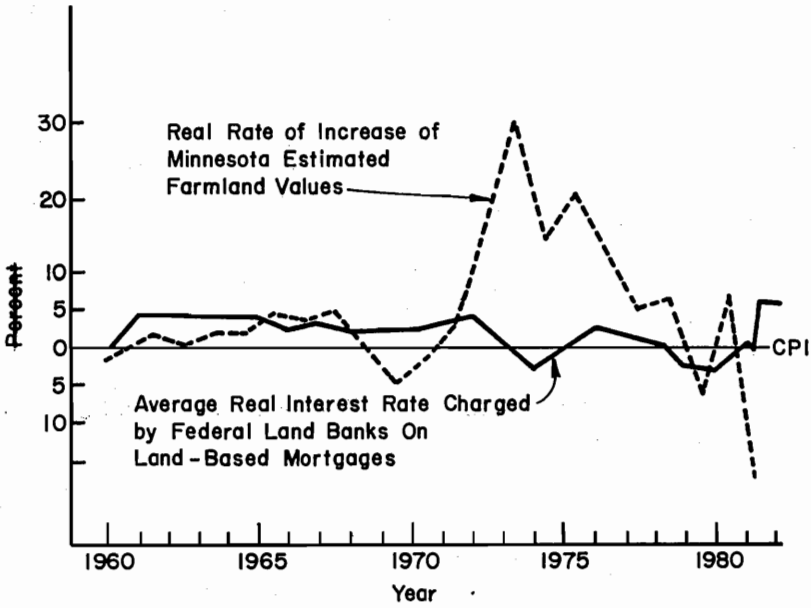
they were in the eight years from 1972 to 1981.

The reversal was sudden and painful. Beginning in the fourth quarter of 1981 real rates of interest shot back up again, leading to a positive real rate of interest on land-based mortgates averaging about 8 percent throughout 1982. A climate of expectation created by very low or negative real rates of interest at a time of inflating land values was suddenly transformed by a cost of capital for which the United States had no previous experience. There may have been some periods in our colonial past or perhaps in the few years during and for a short time after the American Civil War in which real rate of interest on mortgates reached the 8 percent range, but the nominal interest rate minus the rate of inflation has never been in the 8 percent range in the twentieth century. After having been weaned on a cost of capital that was ridiculously low, land buyers were suddenly faced with a cost of capital that was unprecedently high.

A sense of the magnitudes involved is provided by the graphic presentation in Figure 7, for Minnesota, 1960 through 1982. Recall that Minnesota in 1972-81 had the largest percentage increase in farm land values of any state. The heavy line in Figure 7 shows the average real rate of interest charged by Federal Land Banks on land-based mortgages and the dotted line shows the average annual rate of increase in Minnesota estimated farm land values. Note the dramatic decline in land values associated with the sharp increase in real rates of interest after 1981. From July 1981 to July 1982 the real value of Minnesota farm land fell 17.2 percent. This was the greatest decline recorded since 1931-33. Similar declines occurred in Indiana, Illinois, Iowa, and other areas in the Upper Mississipp Valley grain belt. Exports of wheat and coarse (feed) grains fell from 114 million metric tons in 1980/81 to an estimated 94 million tons in 1982/83. For the U.S. as a whole, the real value of farm land in April 1983 was 18 percent below 1980 levels, and had fallen for three years in a row (USDA, 1983 B). The land boom was over, punctuated by the highest cost of credit in living memory.

While the land price boom was going on, and preceding it by a few years, a rapid relocation of major grain usage was taking place in the United States. Until the mid-50s, with the exception of a few war and post-war years, the principal market for U.S. grain was the domestic market, and especially for feed grains. Beginning in the 1950s and accelerating in the 1960s, the technology of large scale confined feeding of beef cattle was rapidly improved. It might be well to recall why. The key technology was disease protection, with the veterinarians rather than the nutritionists playing the strategic role. Anitbiotics and other techniques for controlling disease in large confined animal populations permitted big poultry houses and large cattle feed lots. In 1955, less than 20 percent of U.S. beef production was associated with cattle feeding. Currently, it is estimated that one-fourth to one-third of U.S. beef production results from cattle feeding operations, an activity heavily concentrated in the southern Great Plains. Fed cattle marketed from this region were estimated to be 44 percent of total U.S. fed cattle marketings in 1977, while Corn Belt feed lots accounted for only 20 percent (Schertz, et al., 1979, pp. 89-91,

Figure 7. Real interest rate compared to real rate of increase in Minnesota land values.



100). The percentage coming from the southern Plains is believed to be even higher today.

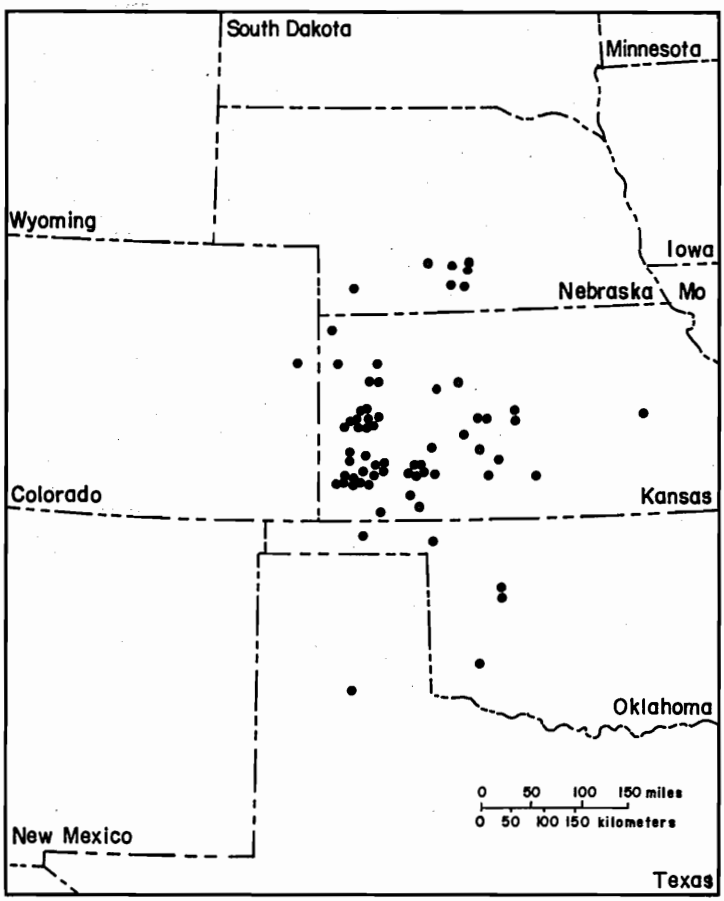
Figure 8 is a dot map showing the location of major commercial cattle feedlots in the southern Great Plains that were advertising for cattle placements in 1979. This is not a map of all the large feedlots, because some of the biggest feedlots are proprietary, or in-house operations. They are not commercialized in the sense that they do not offer their facilities for hire. The feedlots shown in Figure 8 are in effect cattle nurseries or cattle hotels, in that they accept cattle for feeding, typically at a specified price per pound of gain.

The location was dictated by several considerations, one of which was climate. It is interesting to observe that most of the commerical beef feeding capacity is north of the 35th parallel and south of the 40th, with the major part concentrated within about 5 or 6 degrees of latitude. There is good reason for this, in that they are far enough north to minimize losses from Texas fever and other hot-country cattle diseases and far enough south to minimize winter losses in outdoor lots. The majority of the lots are at or below the 20-inch rainfall line, thus minimizing mud problems and pulmonary problems arising from wet, nasty weather through the winter season. The location decision rule for large cattle feedlots has been to seek out dry country, far enough north to escape the zone of tropic diseases and far enough south to reduce winter losses. As a result, our large cattle feedlots are highly concentrated.

This concentration was accelerated by the contemporary rapid improvement in sorghum yields through the development of hybrid sorghum, a dry-country, low rainfall crop. This occurred almost simultaneously with perfection of the technology of water management through centerpivot irrigation. With high yielding corn, high yielding sorghum, and a new technology for applying water, the Southern Great Plains experienced a rapid expansion in its feed-grain producing capacity. This was made possible by the fact that the feedlots are located above the southern lobe of the Ogalalla aquifer, the largest underground supply of irrigation water at economic depths in the United States. The fed-beef industry in the United States, in short, emerged from the 1970s highly concentrated and heavily dependent on irrigated feed grains, produced with pumped water. This insured a maximum exposure to the rising costs of energy.

The migration of cattle feeding to the Southern Plains was given a powerful impetus by the sudden appearance of greatly expanded export markets for cash grain after 1972. Without the expansion in exports, the shift of cattle feeding to the Southern Plains and the associated expansion in local hybrid sorghum and irrigated corn output would have left the Corn Belt with a large feed grain surplus. It seems reasonable to assume that the resulting price-depressing effects would have reduced the feed costs of Corn Belt cattle feeding and retarded the shift. Instead export demand and relative price movements to the mid-1970s lifted feed-grain prices to levels that made Corn Belt cattle feeding unattractive, thus accelerating the shift to the large feedlots of the Southern Plains. Throughout the 1960s and well into the 1970s

Figure 8. Commercial feedlots in the Southern Plains, 1979.



Source: The High Plains Journal, Dodge City, Kansas, Aug. 13, 1979, p. 20-B (does not include proprietary logs feeding for own account).

these large lots enjoyed lower feedgrain costs and lower labor costs than prevailed in the Corn Belt. Although this cost advantage was reversed by the end of the 1970s, the initial surge of investment in large feedlot capacity carried the trend well beyond the point that was justified by the cheap water, cheap labor and cheap feed of the pre-OPEC era.

One consequence of this shift in cattle feeding was a pervasive abandonment of on-farm grain feeding of animals in the heart of the Grain Belts. The 1970s witnessed a great decline in the number of farms feeding cattle and hogs in Minnesota, Iowa, Illinois and, to a degree of lesser importance, in Ohio and Indiana. Historically, the heart of the Corn Belt had been focused on the domestic market for animal products. Expanding foreign markets for soybeans and feed grains triggered a massive reversal, leaving the Corn Belt in the 1980s one of the most export-dependent regions in American agriculture.

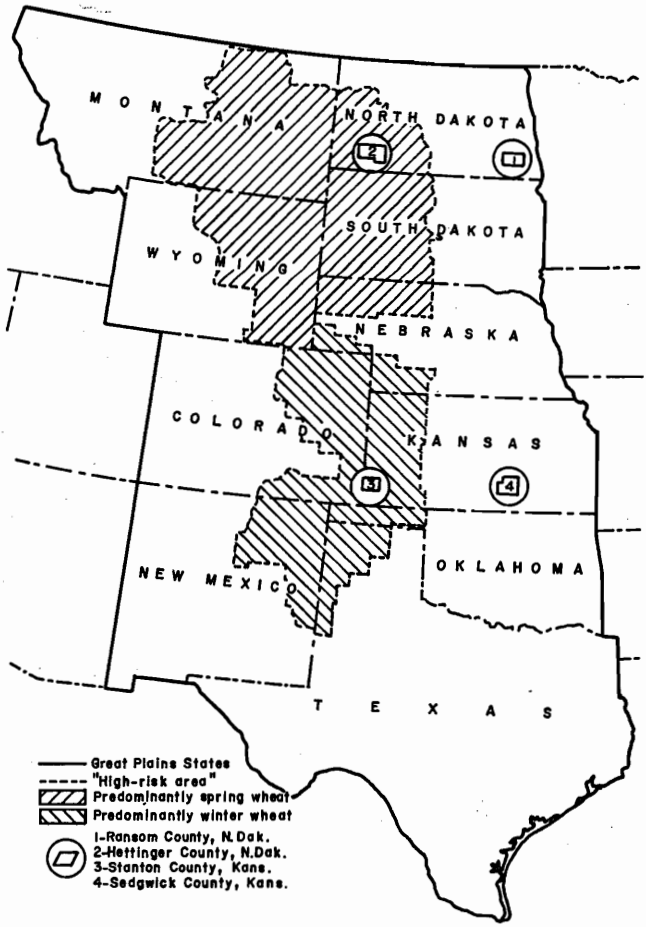
Although the Corn Belt is still the major locus of hog-feeding, and a substantial amount of cattle-feeding remains, the animals are concentrated on fewer farms. One consequence is that animal manure is sharply reduced in quantity and is much less available across the spectrum of farm sizes. The switch from widely-dispersed livestock feeding on the majority of farms to a dependence on cash grain sales and export markets for soybeans and corn has robbed the Corn Belt of fertility-maintenance capacity through the recycling of animal wastes.

This loss, which must be replaced with chemical fertilizers, is not only a loss to the Corn Belt. The majority of the largest Southern Plains feedlots are now located in semi-arid regions. Given their size and location, and the high cost of transporting manure, much if not most of its value as fertilizer is simply wasted. Even if spread on neighboring grain fields, the rainfall regime prevents full use of its fertility value. Transporting it to irrigated fields is largely precluded by distance and cost. Much has been written about the export of soil fertility represented by the heavy grain exports of recent years. A similar and much more tangible internal export of fertility out of the Corn Belt has been an unmeasured consequence of the spectacular rise of industrial-type feedlots in the southern Great Plains. This is a classic example of a negative externality that has fallen outside the decision framework of all of the parties involved. The loss is national and not simply regional in scope.

The threat of recurring drought introduces an additional element of risk. Figure 9 outlines the "high-risk areas" of the Great Plains as they were defined following the succession of droughts in the 1930s. A comparison with Figure 8 shows the heavy concentration of large cattle feedlots in the high-risk area of the southern Plains. This has been the traditional locus of the "dust bowl" in the United States, a designation that was confirmed by a subsequent severe drought in 1954.

On the basis of past weather records, we can anticipate a future feed supply crisis in southern Plains cattle feeding. Some will argue that a severe drought in the area of greatest feedlot concentration is overdue in the 1980s. In the summer of 1981 grain handlers in Dodge City, Kansas estimated that the southwest Kansas

Figure 9. Great Plains states and the "high-risk area."



Source: O. J. Scoville and James W. Gibson, The Great Plains and the Supply of Wheat, U.S. Dept. of Agriculture, BAE, F.M. 23, Washington, D. C. May 1941.

area was 50 to 70 percent deficit in feedgrain supplies, reflecting the short corn crop of 1980. In the summer of 1982 corn moved into the area from central and eastern Nebraska, and feedlot buyers eagerly sought feed wheat. The U.S. Department of Agriculture maintains a continuously updated data series on costs of production in Great Plains and in Corn Belt cattle feeding enterprises. Throughout 1972 and 1973, the price required to cover all costs of production of fed beef in southern Great Plains feedlots averaged 10 percent below the break-even price in Corn Belt feedlots. In 1979, Great Plains feedlot costs were about 3 percent above Corn Belt costs and in the first half of 1983 this cost differential had increased to 5 percent (USDA, 1983, C). A fraction approaching one-half of the national supply of fed beef is dependent on one of the most hazardous climatic zones in North America, and on rapidly rising costs of water and transportation.

In retrospect, the rapid expansion in world demand for grains and soybeans in the 1970s left the United States with major dislocations in its agricultural economy. Many of these can be traced to a set of irrational expectations, of which the most pervasive was a belief in the inevitability of world-wide food shortages. Based on statistics available in the early 1970s, world population growth was overestimated, leading to overestimates of effective import demand for grains. Substitution possibilities were inadequately explored, in particular the potential for shifts from animal to vegetable proteins.

One of the most important contributors to a belief in the permanence of large export markets for U.S. grains was the almost universal tendency to underestimate potentials for agricultural output expansion in the developed countries. The increase in U.S. output of both corn and wheat in the 1970s was the largest percentage increase in any decade since reasonably reliable statistics on national grain output were first published in 1870. France emerged in the 1970s as the third-largest grain exporter in the world. The UK had western Germany, traditionally two of the largest grain importers, ended the 1970s at levels of food self-sufficiency unmatched since the first World War.

Those whose bid prices for U.S. farm lands reflected a belief in impending world food shortages made a fundamental error in confusing need with effective demand. Before the onset of the land price boom in the early 1970s, it was axiomatic to observe that the net earnings from two acres of good Corn Belt land would be needed to finance the purchase of one acre. At the end of the 1970s, financing the purchase of one acre would have required the net earnings from four acres. With the production costs, farm produce prices and interest rates prevailing in 1981/82, it was inevitable that land prices should fall. The adjustment is still incomplete. Only the most pessimistic assessment of future world food output can give comfort to those who believe that the real value of U.S. farm land must ultimately rise.

Under current and foreseeable conditions, U.S. agriculture is struggling with an over-valued land base. Accompanying this is a potentially severe regional imbalance in its beef industry, which alone accounts for just under one-fourth of total receipts from the sale of farm products. The risks involved in adjustment to these

changes are compounded by the commanding presence of the USSR in world grain markets, with a history of massive shifts in trade policy reflecting both climate and political winds. The forces that generated these problems in U.S. agriculture are too complex to be attributed alone to an uncritical search for economic salvation in export markets, but that clearly must be included as a contributing cause.

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21
A Critique of the Economics of U.S. Foreign Aid

Theodore W. Schultz

Foreign aid has become institutionalized as is the church and the philanthropy of foundations. In high income countries it has become an established, organized activity. The management and its purposes have much in common and for this reason, it is convenient to think of aid agencies as the International Donor Community. Although budgets and staffs are large, it is difficult to get at the economic effects of foreign aid. It is fair to say that the economics of foreign aid is concealed in many different black boxes. There is a lot of talk about the design of these boxes, their dimensions, construction and whether they are big enough. Some critics fail to see that they are black boxes. Some contend that what they see is red, while other critics see them as a pale gray that is politically neutral.

The funds that are put into each of these boxes are known. These amounts are proxies of the apparent costs that are incurred. What is unknown is the true economic value of the activities that are supported by these funds. There are some general useful clues, notably in the OECD Annual Reviews by John P. Lewis on Development Co-operation.

Net official disbursements worldwide are not trivial. In 1980, 33.46 billion dollars of such aid were disbursed. The non-concessional funds were larger. These two parts came to 88.95 billion dollars in 1980.[1]

Net Disbursements	In Billions of Dollars	
Official Aid		
Bilateral	25.75	
Multilateral	7.71	
Total		33.46
Non-concessional Flows		
Bilateral	50.69	
Multilateral	4.80	
Total		55.49
		88.95

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The 1980 Net Disbursements of the United States in Millions of Dollars were:[2]

I. Official Aid:		
Bilateral		
Technical Assistance	724	
Food Aid	471	
Other Grants	1,780	
		2,975
Net Development Lending	674	
Food Aid Loans	687	
Debt Reorganization	30	
		1,391
Multilateral		
Grants		
UN Agencies	647	
Others	250	
		897
Capital Payments		
IBRD	39	
IDA	1,072	
Regional Banks	733	
Others	31	
		1,875
Other Official Aid:		
Bilateral	1,112	1,112
		8,250
II. Grants by Private Voluntary Agencies in 1980		1,301
III. Private Flows at Market Terms		4,301
Total Flows, Balance of Payment Basis		13,851

From the perspective of a struggling trainee from a low income country, these figures must seem gigantic. He receives a microscopic bit of it. What is being accomplished by all the rest, is a multi-billion dollar question. Since these are scarce resources, this question assuredly entails some economic attributes. To get at the economics of foreign aid, we have the option of speculating about the economic consequence of what takes place in these black boxes, or of prying the lids open and observing what actually occurs.

Economists, with few exceptions, have been shy when it comes to analyzing the economics of foreign aid. They are shy for various reasons. Some see aid as a moral issue, an obligation of rich countries that is beyond the economic calculus. Others view it as all too political for their professional taste, and understandably, younger economists know that doing studies in this area will not increase their chances of being promoted. For reasons of age, the promotion incentive is for me zero. Being protected and sheltered by a university, I am neither awed by nor beholden to, politics, and I know that moral values are an integral part of people's preferences.

Any discussion of the economic effects of foreign aid is influenced by what we believe the state of production and of the welfare of people in low income countries actually is. Reliable facts are exceedingly hard to come by. We have the pronouncements of aid agencies which are self serving like those of the public relations offices of universities. Worse still is our tendency to view every problem here and abroad as a crisis. The international donor community has become a comfortable club that abides by a live-and-let-live policy. Critical statements about the performance of any member of this club are deemed to be in poor taste with one exception, namely that the U.S. is allocating too small a share of her GNP to foreign aid.

During the 1970s, the stress was on the pending food crisis and on the inevitability of famines. As yet, the mounting agricultural surpluses are seen as only postponing doomsday with respect to food. "Experts" have come up with all manner of estimates to show that nutrition in low income countries has been going from bad to worse, although these stories about nutrition are incompatible with the remarkable increases in life span that have been achieved by many low income countries.

Performance of Agriculture

China aside, where one must wait and see,[3] most of the countries in Asia -- Taiwan, South Korea, India, and Indonesia are doing some of the things that need to be done to increase their agricultural production. There are contributions that U.S. AID could make, namely in the area of rural schooling, agricultural research and in some infrastructures.

Despite considerable political instability, parts of South America are currently doing fairly well; exports of some major agricultural commodities are increasing.

With respect to agriculture and food, the centrally planned

economies are in real trouble.[4] They, however, do not fall within our political domain, although we have in the past provided considerable P.L. 480 agricultural commodities to Poland and also to some of the others.

There are two groups of countries in which the agriculture and food situation has gone from bad to worse. Most of the countries in Central (tropical) Africa are doing very badly.[5] Egypt also has a poor record. We do have a real political interest in these countries. In my view, what U.S. foreign aid and the rest of the international donor community have been doing to assist these countries has been a series of failures. Who is there in our universities, or in our foundations, or in U.S. AID that has any useful ideas on what foreign aid can do to correct the sad state of agriculture and the rest of the economy in these countries? Nigeria, and a few of the others, are cashing in on oil exports. Egypt is receiving massive P.L. 480 commodities. Despite all this, the prospects are bad.

The other group consists of various countries in Central America that are being torn apart by internal conflict and warfare. What can U.S. non-military foreign aid accomplish under the circumstances that prevail in these countries?

Issues to Ponder

To set the stage for critical discussion, there are several major issues that are troublesome. My comments on these at this point will be too brief to make my case. We need to clarify the essence and the economic implications of these issues.

1. In doing foreign aid, we do not comprehend sufficiently the reasons for the successes and also for the failures pertaining to agriculture and food. We underrate the importance of health, education, and entrepreneurial ability, i.e., improvements over time in the quality of farm people from their investment in human capital. Our federal agricultural programs to improve the economic lot of our own small farmers have been failures. Despite these failures, Congress in providing funds for aid, insists that AID see to it that low income countries do what we have been unable to do within the U.S.

2. The credibility of foreign aid is being increasingly impaired by its pronouncements on the dire state and prospects, supported by heart-rending pictures, stories and bad data on hunger, malnutrition, starvation, and a future beset with famines. The international donor community has seriously overplayed these self-serving pronouncements in its quest for funds.

3. A creditable analysis of the food situation throughout the world is basic to putting U.S. AID on the right track and also to informing Congress and the electorate on where there are serious problems that fall within our political domain.

4. The relationships among the official foreign aid donors of the high income countries are all too cozy. They do not criticize one another. I know of no public documents that deal critically with the foreign aid activities of others. For example, a competent analysis of the actual harm that has been done by the aid

of the World Bank, the International Monetary Fund, and other multilateral UN agencies to the economy of Tanzania, would be exceedingly instructive.

5. Our official foreign aid agencies and our foundations have a poor record in their endeavors to improve the economic lot of women in low income countries. There has been no lack of talk and papers with stress on social reforms. Taking the long view, what is long overdue is the establishment of organized research centers that would do for household production activities what agricultural research does for the production activities of farmers. There is even a lack of simple equipment to break and remove the hard husk of sorghum that would eliminate the backbreaking work of so many women throughout Central Africa. Because much of the work in agriculture in many countries of Africa is done by women, a part of agricultural research should be oriented to this activity of women.

Fortunately, advances in knowledge pertaining to birth control oriented to the requirements of housewives in low income countries is being supported by U.S. foreign aid despite the adverse political mood that presently prevails on this issue.

6. The state of knowledge about nutrition applicable to low income countries is terribly inadequate. The use of public funds via aid to establish, in low income countries, organized nutrition research centers, staffed by competent scientists and social analysts, would over the long term produce a rate of return comparable to that derived from organized agricultural research.

7. The International Agricultural Research Centers are a first-rate investment. National agricultural research in a considerable number of low income countries, however, is as yet not viably established. U.S. AID has a spotty record in this area. I would not advise low income countries to become dependent on our aid for this purpose because of the lack of continuity of our aid.

8. During the fifties and sixties, U.S. aid made a major contribution in ideas and funds in helping India establish her agricultural universities. Our training programs were also an important contribution.

As If Economic Efficiency Matters Not

Donors of foreign aid have long been blissfully indifferent to the lack of economic efficiency in most low income countries. With some exceptions, agricultural scientists fail to see that the pervasive economic inefficiency in low income countries is the predominant barrier to the effective adoption of high yielding crop varieties and of other contributions from the advances in agricultural research. Economists who are committed to elegant growth models, are also, as a rule, silent on the important issue of economic efficiency.

The growth of an economy depends fundamentally on increases in the quantity and quality of resources and on economic efficiency. Correspondingly, the modernization of agriculture depends basically on the additional quantity and quality of agricultural inputs and on the economic efficiency of agriculture. High yielding crop

varieties, fertilizers, insecticides, tractors, combines, experiment stations, and well trained agricultural scientists and related technical personnel are all more or less necessary, but they are not sufficient. Wherever the economic organization of agriculture is inefficient, production languishes even though the quantity and quality of the inputs are at hand along with a high order of technical services. In terms of the technical requirements that I have listed, agriculture in the Soviet Union should be highly productive. But it is not. The reason it has failed is the inordinate economic inefficiency which is a consequence of the economic organization of Soviet agriculture. Most of the donors of foreign aid have not yet faced up to the critical importance of economic efficiency in agriculture.

Farmers the world over are not to blame for the officially imposed economic inefficiency that burdens agriculture. Farmers in their small private domain are calculating economic agents. In my Transforming Traditional Agriculture[6] I presented evidence that farmers in traditional agriculture are "poor but efficient" by the test of marginal costs and marginal returns. There is now much more evidence in support of this proposition. Thus, I contend that within low income countries, farmers are intelligent economic agents, poor as they are in terms of resources, and in living with the distortions of incentives that are imposed on them in the prices they receive and pay, and with their dependency on corrupt, inefficient governmental agencies as suppliers of fertilizer, insecticides and seeds and on marketing boards that have a monopoly as purchasing agents and in some cases, enforced by mandated procurements.

Most governments in low income countries seriously impair the economic efficiency of agriculture as well as other sections of their economy. To some extent, but very slowly, governments learn from their mistakes. These economic inefficiencies are presently not as pervasive as they were two and three decades ago. At the extreme, they have been reduced somewhat in China but not in the Soviet Union. The situation on this issue throughout most of the countries of tropical Africa is, indeed, serious; these are countries that fall within the domain of U.S. foreign aid.

Donors of foreign aid do not deal with farmers although they make believe that they are primarily concerned about the production and welfare of the poorest of the poor. They talk equity and forget about economic efficiency. There is no way that farmers in low income countries can convey to these donors their economic priorities. Donors deal with the governments of these farmers, and the economic distortions imposed on farmers are, more often than not, supported in part by donor funds.

Donors of foreign aid have provided an increasing share of the funds that support the International Agricultural Research Centers. The achievements during the seventies of a goodly number of these Centers are not in doubt. By my last count, there are now 13 with a current total annual budget of about $150 million. They have an international dimension that owes much to the Rockefeller Foundation and the pioneering entrepreneurship of George Harrar in Mexico. These centers are supported by 35 donors. In recent years, among others, the World Bank, the various regional banks,

and U.S. AID have contributed substantial funds to support them. These centers are a decidedly worthwhile innovation.

I have, however, four concerns pertaining to these International Agricultural Research Centers.

(1) They are not a substitute for on-going national agricultural experiment stations and laboratories.
(2) They do not do basic agricultural research and, therefore, are dependent upon research done elsewhere.
(3) The central management, i.e., the allocation of funds to each of the centers is becoming over-organized in the sense that too much of the time of the research personnel at the centers is spent on paperwork "justifying" research.
(4) The center located in Nigeria has concentrated on local food production and it has neglected the important export commodities. More generally, the emphasis that U.S. AID has placed on food production, especially so throughout central Africa, has been a serious mistake in view of the fact that economic comparative advantage was, and continues to be, in the larger gains to be had from the real growth in their exports, primarily of tree crops. Clearly, agricultural scientists have no comprehension of the economic importance of the role of comparative advantage in production and trade among nations. There is truth in the dictum, namely, "trade not aid". In fact, foreign aid for research to promote only food crops in tropical Africa is decidedly harmful to the economy.

When a sudden destruction of resources occurs, whether it is caused by the vicissitudes of nature or by war, foreign aid is as it should be, a humanitarian response. U.S. food and medical aid, when floods, earthquakes, and serious droughts occur, deserves a high mark.

The war devastated countries that received Marshall Plan aid benefited. Much physical capital had been destroyed. The stock of human capital was still first-rate. Marshall Plan aid helped rebuild and restore the structures, equipment and inventories. The pay-off that accrued to these countries was large. But the economic circumstances that prevail in low income countries do not correspond to those that existed in Europe following World War II. Low income countries, in general, have meager stocks of human capital.

But, what about sudden riches? Consider the economic distortions that are clearly evident in Nigeria, Venezuela, and Mexico that appear to be compounded by their sudden large revenue from the sales of oil. Mexico, for example, acquired $18 billion from oil during the recent peak year. Do large amounts of foreign capital and foreign grants (aid) have corresponding adverse effects on the economy of the recipient country? My view is that Tanzania and Bangladesh experienced similar economic distortions in recent years by all manner of foreign aid. In this connection, we do well to ponder the reasons for the remarkable growth of agricultural production in Malaysia. Their high yielding rubber and palm varieties

did not come from us. Nor did we provide the funds to do the necessary research. There are countries where low per capita income is not a necessary and sufficient condition to receive foreign aid to achieve real agricultural growth.

It is all too easy to forget the lesson we learned from our Point Four agricultural aid throughout Latin America. With the help of a competent staff, supported by a large grant from the Ford Foundation and sponsored by the National Planning Association, I had the opportunity during the early 1950s to assess the achievements of Point Four programs.[7] They failed mainly because Point Four was committed to building agricultural extension services and only belatedly learned that the necessary worthwhile agricultural research had not been done. In sharp contrast, the agricultural research of the Rockefeller Foundation in Mexico was on the right track. At the beginning of the fifties, the Ford Foundation joined the government of India in an expensive agricultural extension program. It, too, was premature. Neither the high yielding new wheats nor other worthwhile possibilities to increase production were as yet available.

U.S. foreign aid to India did not produce the new high yielding wheat that contributed greatly to the wheat producing capacity of India. The profitability of the new wheat variety induced the formation of a large amount of additional physical capital for the production of wheat. None of this additional capital was provided by U.S. AID or by the World Bank or by any other foreign entity, public or private.

The role that U.S. foreign aid and that of American leadership — notably that of Ralph W. Cummings, Frank Parker and others in AID in Washington and members of several U.S. Land Grant Universities — played in assisting the Indian Political and academic leaders in establishing the agricultural universities in India, stands as a major achievement of permanent value. It was not a short term undertaking. It entailed building a new institution for the long term.[8] But regretably, U.S. aid has failed to undertake any corresponding enterprises since then; to wit our dismal record throughout most of tropical Africa.

The Sad Case of Egyptian Agriculture

The United States is providing Egypt with massive amounts of aid. From information available to me, U.S. aid going to Egypt comes to about two billion dollars a year. It includes large amounts of P.L. 480 agricultural products. Egypt meanwhile is a model of economic inefficiency with respect to her own agriculture. But why should Egypt not take advantage of our P.L. 480 products? She is immune to the going international market prices of agricultural products. Under these circumstances, Egypt is pursuing a rational policy. With agricultural products at concessional prices from abroad, Egypt maintains her cheap food for consumers and very low prices for farmers. What is sad is the raw deal the the poor Egyptian farmers are dealt.

The pervasive economic distortions that dominate the Egyptian agricultural economy cannot be gotten at and solved by reorganizing

the ministry of agriculture, or by tinkering with controls and with this or that price. Nor will a first-rate biological research program designed to serve Egyptian agriculture and a well organized, competent agricultural extension program, eliminate these economic distortions.[9]

Choices Pertaining to Foreign Aid

Any foreign aid that is based on antimarket biases results in an inefficient use of resources. It is necessary to distinguish between the economic activities that are in the domain of markets and those that are not in that domain.

In large measure, worldwide experience supports the proposition that most organized agricultural research, agricultural extensions, primary schooling and some welfare activities fall within the public domain. All of these activities entail cost, none are short term undertakings; there are no quick fixes. They have long time dimensions and for that reason to be done efficiently, they must be approached as long term investments. U.S. foreign aid is seriously handicapped by short term authorizations and budgets as these are mandated by public laws. The public choice with respect to the time dimension of foreign aid is presently decidedly inefficient.

The one notable exception is that of U.S. food and medical aid when sudden emergencies occur in low income countries.

The strong and persistent anti-market bias conceals the choice between trade and aid. For most low income countries the opportunities to trade are much more important than foreign aid.

There is also the choice of providing capital for structures, equipment, and inventories on private accounts at market term or on public accounts via foreign aid. The economic efficiency of foreign aid as a source of subsidized capital for these purposes is in general unduly wasteful.[10]

Most of the capital that is required for agricultural research, extension, primary schooling and for some welfare programs is not to be had from private sources at market terms. The implication is that to the extent that foreign aid is in the business of providing capital to low income countries, its comparative advantage is precisely in the areas indicated and not in funding structures, equipment, and inventories that dominate the formulation of physical capital.

A case in point pertains to investments in primary schooling. A much higher priority than is presently given to schooling in the allocation of foreign aid funds would in all probability contribute much more to agriculture production and to the welfare of farm people in low income countries over the long term than can be had from the present priority favoring the standard forms of physical capital.

The United States has a substantial stake in the performance of the World Bank. Its 1982 World Development Report, as D. Gale Johnson has noted in his review of it,[11] reveals a new comprehensive understanding of markets and prices, trade and the requirements of economic efficiency in allocation of resources. I quote

from his review,

> Knowing something of efforts within the staff of the World Bank to obtain appropriate consideration of the role of markets and prices in determining the outcome of Bank's projects and loans, I wish to take this opportunity to salute those who made the effort. This report, and others such as Accelerated Development in Sub-Saharan Africa: An Agenda for Action (World Bank, 1981), reveals a striking shift in the dominant pattern of thought and analysis within the Bank's staff.

The World Bank is also engaged in foreign aid to the tune of 2,686 million U.S. dollars equivalent during its fiscal year 1982 through its IDA (International Development Association) window.[12] These are very soft loans; they are by any practical economic test, grants. There are two critical issues with respect to IDA: (1) For IDA to be managed by the Bank gives rise to a conflict of interest within the operations of the Bank. Its primary purpose is to make viable loans. It is all too convenient to buttress loans that get into trouble by using IDA funds to provide complementary support for such loans. (2) I have argued that a high priority is warranted in the allocation of foreign aid funds to schooling. In fiscal 1982, of the vast 2,686 million dollars allocated by IDA, only three percent of it was for schooling.

In making choices, do not be misled by the clamor that the time has come to choose between food versus feed. It is a false dichotomy.

We do well to ponder why it is that countries that acquire sudden riches from oil exports experience serious troubles. Clearly, in the case of Nigeria and Mexico, oil and agriculture do not mix.

It is doubtful that U.S. AID can succeed in resisting the political influence of agriculture groups and that of the Congress in once again using P.L. 480 to force AID to engage in dumping large quantities of agricultural commodities by this means. The administration of aid is well aware of the harm that such dumping would do to parts of agriculture in low income countries.

The cleaner economic thinking within the World Bank as it is revealed in its 1982 report, is also evident in U.S. AID. There is now an emphasis in AID on reducing the economic distortions that farmers in most low income countries face, on improving the incentives to induce farmers to modernize agriculture, on investing in people, and in doing so, lessen the exploitation of farm people in support of cheap food policies. The President of Egypt, during his recent visit to Washington, was clearly informed on these critical policy issues. It does not follow that Egypt's internal repressive agricultural pricing policy will be significantly improved, nor that the United States government is, as yet, prepared to use its massive foreign aid going to Egypt to achieve this purpose.

My basic position is that most of the poor people in the world are farm people, that farm people in low income countries have very little political influence when it comes to improving their economic lot, and that foreign aid has all too long served the recipient

governments and, in doing so, has in large measure failed farm people.[13]

Notes

1. Development Co-operation, 1981 Review OECD, Paris, November 1981, a report by John P. Lewis, Table A.1, page 172.

2. 1981 Review by John Lewis already cited, Table A. 16, pp. 194-5.

3. See D. Gale Johnson, "Progress in Economic Reform in the People's Republic of China," Agricultural Economic paper No. 82.7, February 17, 1982, University of Chicago. This paper is being published by the American Enterprise Institute and also in Chinese in China.

4. D. Gale Johnson, "Food and Agriculture of the Centrally Planned Economies: Implications for the World Food System," in Essays in Contemporary Problems: Demand, Productivity and Population, American Enterprise Institute, Washington, D.C. 1981, pp. 1/1-213.

5. Two competent studies are at hand on this part of Africa. Uma Lele, "Rural Africa: Modernization, Equity, and Long Term Development," Science, February 6, 1981, pp. 547-553; and, Robert H. Bates, Markets and the States in Tropical Africa, University of California Press, Berkeley, 1981.

6. Transforming Traditional Agriculture was first published by the Yale University Press, 1964. The Arno Press, New York, then published a hardcover edition of this book in 1976. The University of Chicago Press is now publishing a paperback edition.

7. The University of Chicago Press published most of our studies. The basic summary report, Technical Cooperation in Latin America, was published by the National Planning Association, Washington, D.C., 1956, 192 pages.

8. Theodore W. Schultz, "The Production and Distribution of Agricultural Knowledge With Special Reference to India," forthcoming in Minerva (available meanwhile as Agricultural Economics Paper No. 82:2, University of Chicago). See also, Hadley Read, Partners with India Building Agricultural Universities, University of Illinois, 1974, 159 pages.

9. It should be noted that Egypt's foreign earnings from petroleum exports increased from 300 million in U.S. dollars in 1978 to 3300 million in 1981; during the same period, receipts from remittances rose from 1,800 to 3,300 million, receipts from Suez Canal operation were up from 550 to 1000 million, and from tourists, the receipts were 700 in 1978 and 900 million dollars in 1981.

10. See Uma Lele in Science, already cited.

11. To appear in Population and Development Review, published by The Population Council, New York.

12. The World Bank Annual Report 1982, Appendix 4, pp. 192-196.

13. For an extended analysis of the "Distortions by the International Donor Community," see Chapter 7 in my Investing in People, University of California Press, Berkeley, 1981.

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