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**"Comparative Studies of Resource Allocation
and
Development Policy"**

HARVARD UNIVERSITY

Report through January 31, 1970

INTRODUCTION

This report describes work completed under AID Contract CSD 1543 through January 31, 1970. It is not a complete summary of all research done to date; rather it supplements and updates two previous progress reports as well as the June 1969 contract-extension proposal. In addition to a substantive review and a description of future research plans, the report also contains summary statements on expenditures and personnel.

PAST RESEARCH

The rapid progress cited in earlier reports has been maintained. Two books have been published (Richard Bird, Taxation and Development: Lessons from Colombian Experience, and Samuel S. Bowles, Planning Educational Systems for Economic Growth). Five other volumes are in press (Hollis B. Chenery, ed., Studies in Development Planning, Dorris Brown, Agricultural Development in India's Districts, David Cole and Princeton Lyman, Korean Development: The Interplay of Economics and Politics, Robert Repetto, Time in Indian Development Programs, and Arthur MacEwan, Development Alternatives in Pakistan). Other volumes are in the final stages of editing (Hollis B. Chenery, The Developing Economy, Gustav F. Papanek, Daniel M. Schydrowsky, and Joseph J. Stern, Decision Making for Economic Development, Walter P. Falcon and Gustav F. Papanek, eds., Development Policy II - The Pakistan Experience, and S. Malcolm Gillis, Fiscal Reform for Colombia: The Final Report and Staff Papers of the Colombian Commission for Tax Reform). In addition, more than 50 journal articles have been published and a considerable amount of other work is available in mimeographed form.*

* The most recent published and unpublished work discussed in this report is shown on the listing that follows. Earlier work, as well as other research of the DAS and PQRED which was not AID financed, is included on a checklist which can be obtained by writing: Mrs. Pamela Rowley, Economic Development Library, 1737 Cambridge Street, Cambridge, Massachusetts 02138.

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GENERAL STUDIES

With the support of Contract CSD-1543, the efforts of the Development Advisory Service and the Project for Quantitative Research in Economic Development have been addressed to both theoretical and empirical aspects of development processes. Such processes clearly differ in many important respects from country to country. This diversity results not only from different goals, but also because the formulation and implementation of plans are conditioned by a country's political, social, and economic values and institutions as well as by its stage of development.

From this very large and diverse set of potential studies, we have focused on two broad themes: structural change and development policy. The work has also had a strong comparative emphasis, and has concentrated on a half dozen countries where Harvard has continuing contacts.

Typical of this research are three volumes now near completion. The first of these has drawn heavily on the experiences of DAS advisors in the field, many of whom returned to Cambridge to write up their experiences. It has been directed primarily toward the actual application of economic theory and analytical techniques to specific government policy issues. Development Policy II - The Pakistan Experience (12),* edited by Walter P. Falcon and Gustav F. Papanek, draws generalizations about the development process

* Numbers in parentheses refer to the bibliography found on the preceding pages.

from the experience of a single country in which Harvard advisors have played an active role over the past 15 years. It is not a comprehensive treatment of Pakistan's development, but rather concentrates on specific policy issues of particular interest.

Another significant portion of the research undertaken is represented by the volume, Studies in Development Planning (10), being edited by Hollis B. Chenery. This book will consist of several studies done by the more theoretically oriented members of the Harvard group. Most of these will involve analytical and econometric methods underlying the formulation of planning models for different countries. (A number of the essays in this and the preceding volume are discussed individually below.)

Chenery is also in the process of writing The Developing Economy, which will bring out the implications of his earlier and more detailed econometric studies on the process of industrialization and typical growth patterns. In this volume, Chenery first establishes the "stylized facts" of development by measuring patterns of change in a number of variables related to the growth of per capita income. Where possible, he makes a comparison between cross-country and time series estimates to test for evidence of systematic change in structural relations. He then develops an interindustry model linking the several elements of internal and external demand and supply for each sector of the economy. The effects of income growth on these variables provide a set of relations that show how an economy would develop with specified changes in certain parameters. Variables other than incomes are introduced in subsequent versions.

The testing of such historically based models of development provides a crucial link between empirical analysis and policy recommendations. Without an explicit formulation of the underlying structural relations, the many statistical uniformities that have been observed are of relatively little use for policy decisions. Simulation of observed development patterns -- either over time or among countries -- serves to narrow the range of possible explanations and also helps in designing planning models.

In addition to these broader works, individual research projects have continued in several specific areas: sectoral studies, country studies of development strategy, and studies of development policy.

SECTORAL STUDIES

Agriculture

Since agriculture is by far the predominant activity of most of peoples in the less developed countries, structural change in the economy almost inevitably involves the relative reallocation of resources from the agriculture sector to the manufacturing sector. Whether it is a question of "squeezing" a surplus out of the agriculture sector or one of allocating more efficiently the available resources, there are clearly social and political ramifications to any agricultural policies effected by governments.

A major study has been completed by Dorris Brown on Agricultural Development in India's Districts (The Intensive Agricultural Districts Programme) (5). The IADP was set up in 1961 to promote rapid increases in foodgrain crop yields and to show how these could be achieved through work in one selected district in each of India's states. Brown's study makes use of recent, district-level data to make comparative evaluations of district agricultural development programs of both the Community Development Programme and the IADP, to identify major factors and constraints in agricultural growth. His conclusions are relevant to policy makers interested in stimulating growth, and to understanding the general processes of agricultural development. Results of the study indicate that during the Third Plan, growth in output and yield for foodgrain crops in IADP districts as a group was not significantly different from that of the previous five years in the same districts, or from adjoining non-IADP districts.

The analysis demonstrated that most Indian cultivators operate with economic rationale; it identified many production restraints; and it also tested some of the ways of minimizing the inhibiting effects of these constraints.

Willem Bussink has written two brief notes on wheat production in West Pakistan as part of a larger scale policy model on which he is working. In one paper ("An Estimate of the Price Elasticity for Wheat in West Pakistan and Some Implications for Policy" 7), the price elasticity of wheat was found to be quite small. This implies that the internal market offers very little scope for absorbing additional quantities and that the choice is thus between producing additional wheat for export or not producing it at all. Under these circumstances, assuming sensible incentives for the private sector to export, Bussink suggests that the government's role should be limited to export assistance and quality control. In another note, "Alternative Projections for Wheat Production and Consumption at the End of the Fourth Plan and the Value of Rabi Water" (6), Bussink describes two alternative production policies for wheat, one for minimum feasible production (self-sufficiency), the other for maximum feasible production to include an exportable surplus of 3.3 million tons by the end of the Fourth Plan. By comparing two alternative ways of arriving at the maximum level -- a fertilizer-intensive and an irrigation-intensive way -- Bussink determines the trade-off between fertilizer and water inputs.

Fluctuation in demand and its effect on farms is the subject also of a short study by Moises Syrquin and S. Eckstein, "A Note on Fluctuations in Demand and Farmers' Income" (54). The authors show that, given demand curves as commonly drawn by economists, supply fluctuations will cause a decline in farmers' average incomes whether the price elasticity is greater or less than one.

In a more analytical vein, Carl Gotsch has developed in some detail "A Programming Approach to Some Agricultural Policy Problems in West Pakistan" (17). The usefulness of economic models in analyzing policy issues lies more often in the systematic exploration of alternative parameter assumptions than in the results obtained with a particular set of parameters. Gotsch has carried out several experiments with his model, in one case comparing the effect on the supply of sugarcane of traditional water supplies as opposed to supplementary water from underground sources. He also experimented with the prospects for creating additional employment through water resource development. Comparison of cases with and without tubewells indicated that the addition of a highly flexible source of supplementary water to the farm enterprise meant close to a 55 percent increase in labor utilized. Nearly 35 percent of this increase could be identified as incremental hired labor. It is clear from these exercises that the programming approach can incorporate a variety of complicated relationships between water, animal power, land and output -- relationships that would be difficult to analyze using ordinary budgeting techniques.

Walter P. Falcon and Carl H. Gotsch also continued work on their volume dealing with rural development in West Pakistan. In addition they spent considerable time (for the Pakistan Mission) on an analysis of agricultural pricing policy. Many of the techniques and broad conclusions* will form the basis of the last half of the book which will deal with the implementation and consequences of the Green Revolution in West Pakistan.

Industry

The process of industrialization is a crucial one to the development process, and hence it has been the subject of considerable scrutiny, both empirical and theoretical in nature. Hollis B. Chenery has completed his study of "The Process of Industrialization" (9) in which he attempts to synthesize the two principal empirical approaches to the study of development. Time series studies of a single country indicate the inter-relationships among structural changes in particular cases. Cross-country comparisons indicate the range of variation of individual structural features, such as demand, trade, or factor use. By combining these approaches, Chenery improves the methods for determining the nature of industrialization. He develops a model of structural change based on the Japanese industrialization experience, then substitutes general structural relationships for

* Financed separately and presented to the A.I.D. Pakistan Mission in the form of 13 working papers and a final report.

some that are specific to Japan. The variation in demand and trade that accompanied rising incomes in Japan are replaced by estimates of typical intercountry relations. Similarly, a general production function relating capital and labor used in each sector to the wage rate is substituted for the specific variation in factor inputs. The cross-section model thus estimated is then used to test the generality for the development processes that have been described for Japan and other countries. It also helps to explain the sources of the patterns of structural change.

More specific features of the industrialization process have been examined by Gustav F. Papanek. His earlier study on "The Location of Industry" (35) in Pakistan has been revised, although his main conclusion remains that the most influential factor in the location decision was the proximity of government. This was then reinforced by other factors, including especially personal preference, and the tendency to invest where others had been successful and where the government felt sufficient pressure to provide overhead facilities. Interestingly, Papanek found no evidence to suggest that external economies played the role so often assigned to them in explaining concentration in a single city. In fact, the very rapidity of growth in Karachi probably contributed to higher costs of labor, power and other facilities.

In a complementary study of Pakistan industrialization, Papanek has examined the backgrounds of entrepreneurs, "The Industrial Entrepreneurs --Education, Occupational Background and Finance" (34). The Pakistan experience presents an interesting example in that, although there existed no

experienced industrial class, no well educated population, nor trained technicians, still there was rapid development of an entrepreneurial group. This was made possible through the development of a broad based profit-incentive system which was sufficient to move a number of individuals out of their usual occupations into industry. Of particular interest was the lack of correlation between education and industrial entrepreneurship. Traders with higher education were among the less successful of the industrialists, while those with little or no education did not seem to be handicapped in any way.

From an analysis of county data from Mexico's Industrial Census of 1965, Moises Syrquin has estimated Cobb-Douglas and CES type production functions for the country, major regions, and states. This analysis is not yet complete, and the results are preliminary, but certain conclusions are emerging. In only a few cases were returns to scale increasing and statistically significant. A very small dispersion was found for the marginal product of capital across regions. The marginal product of labor, in contrast, varied considerably. It was found to be closely associated with the level of development of the region and not very different from the region's wage level.

In many countries, an attempt is made to prime the pump of industrial development by the establishment of a semi-autonomous body such as an industrial development corporation. These often absorb a significant percentage of the development budget and are usually meant to pioneer the unexplored but essential industrial frontiers out of reach of private investors. Frequently, however, they invest across the board, grow absolutely, and in the process use their resources less efficiently.

J. Tomas Hexner has investigated the experience of the East Pakistan Industrial Development Corporation (EPIDC) as a means toward understanding the process of divestiture and its potential benefits ("EPIDC: A Conglomerate in Pakistan, The Spin-off Process" 19). There are many obstacles to divestiture, in East Pakistan as elsewhere. These include the reluctance of management to reduce its empire, public fear of private sector irresponsibility, immature capital markets, and a mediocre return from public investment. The benefits are also potentially great. Divestiture removes the enterprise from public sector management, provides real investment opportunities for the private sector, and allows the private sector to respond to profit incentives. It also brings the enterprise to the point where the perceived risk for the private sector might become tolerable.

Hexner suggests that certain preparations for divestiture could facilitate the process, and he recommends that wherever possible the public sector might attract the private sector as a joint venture partner. Where there are no potential partners, possible later transfer might be facilitated by minimizing the difference in public and private sector outlook and by providing the public sector management with adequate incentive to maximize the firm's profits. Spin-offs thus represent a potential means for overcoming the lethargy often associated with public sector corporations as well as of supplying the private sector with additional -- and often less risky -- investment opportunities.

Industry studies are often based on inter-industry analysis, which presupposes a substantial investment in empirical research. This technique also assumes the existence of a considerable body of statistical data about the economy, consistently established and of "satisfactory" quality. In "An Evaluation of Inter-Industry Research in Pakistan" (49), Joseph Stern concluded that these conditions are not completely met in the Pakistan context. In particular the use of fixed input coefficient production functions in a developing country, marked by a relatively small and often technologically backward industrial sector, appears open to criticism. Stern indicates that further areas for improvement can be indicated by focusing on those coefficients which are most likely to introduce large errors into the analysis, and that the number of such important coefficients, is likely to be relatively small.

Education

The precise contribution of education to the process of growth and development seems a very elusive concept, but that the contribution is significant is now beyond dispute. For political and social as well as economic reasons, many of the less developed countries have devoted considerable portions of their resources to the improved quality and increased quantity of education. It is therefore important that these resources be allocated as efficiently as possible with respect not only to the amount and type of resources allocated to the education sector but also to the allocation within the education sector.

Samuel Bowles has completed his book, mentioned in an earlier report, Planning Educational Systems for Economic Growth (2). Here he develops a formal quantitative description of two basic characteristics of the educational system: its internal productive relationships, and the nature of the demand for its output in the economy as a whole. Choosing varying assumptions about the demand for educated labor determines the formulation of several models with differing policy prescriptions. Bowles applies these methods to the Greek and Nigerian systems to illustrate these differences.

As part of a larger study of manpower and education in Malaysia, O. D. Hoerr treats some of these same questions. In "The Economic Demand for Education in Malaysia," (20), Hoerr synthesizes the main findings of two recent surveys: a manpower survey and a households survey (which permits benefit-cost analysis). The manpower survey found evidence of shortages of technical personnel from upper secondary graduates onward. The household survey suggested that the highest returns accrued to a lower, essentially unspecified, level of schooling, while technical graduates at the sub-professional and professional levels were seen to be investments of lesser attractiveness. Hoerr makes specific policy recommendations for each level of schooling, but stresses the importance to the economy of

increasing the degree of substitutability among the various outputs of the educational system. In practical terms this means relatively late specialization among students, the possibility of relatively easy transfer among specialized streams at the higher levels of education, etc.

Samuel Bowles has completed an additional paper -- primarily methodological and exploratory in purpose -- to investigate some of the conceptual and econometric problems involved in the empirical estimation of an educational production function ("Towards an Educational Production Function" 3). He focused on the relationship between school and student inputs and some measure of school output, based for the purpose of his examination on achievement scores. In considering the measurement of school outputs for instance, he deals with the relationship between school inputs and net output, or value added.

In another methodological study, Bowles analyzes the relationship between education and economic growth. He presents estimates of the elasticities of substitution among labor with different levels of schooling and uses these estimates to construct a two-level, constant elasticity of substitution function for the aggregation of labor inputs ("The Aggregation of Labor Inputs in the Study of Growth and Planning: Experiments with a Two-Level CES Function" 1). He then compares the measure of total labor services based on this estimated aggregation function with a number of other measures based on assumed values of the

elasticity of substitution -- ranging from infinity to unity. His analysis is based on twelve economies for which there are data on mean earnings and quantities of male labor classified by years of schooling.

The results of Bowles' analysis provide some support for the view of labor as a composite factor of production. They cast doubt on the concept of an educational bottleneck as the barrier to economic growth in poor countries, since only with a low elasticity of substitution among labor inputs could such a bottleneck arise. Finally, the results suggest that, given data constraints and the limits of computational feasibility, the assumption of constant relative earnings of labor in the study of both planning and growth is an adequate working assumption.

Transport

For the desired functioning of the agricultural and industrial sectors of any economy, the need for an efficiently operating transportation system is self-evident.

Recent research undertaken by the Transport Research Program under the contract has had three principal aims. The first was to report on the practical implications of the use of the Harvard Economic and Transport Simulator. The second was to develop and document project analysis techniques useful for situations in which a full simulation model is inappropriate. And the third was to focus on several topics of policy research in transportation relevant for developing countries.

In "A Grouped Project Analyzer for Use in Project Analysis" (44) Paul O. Roberts and J. Royce Ginn explain and elaborate the project analyzer capability. The paper represents a major advance in the mechanics of project analysis and it includes the documentation and description of computer programs for performing this type of analysis. A method for dealing with interdependencies of traffic flow over networks is explained in Roberts' paper, "Programming Additions to a Transportation System." (43).

In the sectoral policy and planning area there were also a number of contributions. "The Use of Simulation Models for Economic Development" (23) by Harold Luft attempts to develop a general framework for the use of these types of models. A paper by Roberts on "Multiviewpoint Evaluation Of Transport Projects and Systems" (42) attempts to deal directly with the problem of incorporating the views of several actors. Finally, Clell G. Harral has completed a major study of "The Social Costs of Highway Transport and the Coordination of Transport Development in Eastern India" (18). The examination is carried out in a social cost framework suitable for comparative analyses involving choice of mode in transport planning. The author attempts to include shadow values and to incorporate other technical details into a public welfare function.

COUNTRY STUDIES ON DEVELOPMENT STRATEGY

Policy formulation must take into consideration, as much as possible, both the direct and indirect effects of development projects and plans. Studies of planning on a national level are therefore intended to develop an understanding of both the economic and social consequences of structural change.

Pakistan

The experience of few countries illustrates the benefits and costs of structural change as well as that of Pakistan, the history of which is the subject of Growth and Development in Pakistan: 1955-69 (11). Originally submitted to the Pearson Commission, this study has now been revised as an occasional paper for the Center for International Affairs. Stern and Falcon discuss various phases of Pakistan's development and conclude that substantial growth in both the agricultural and industrial sectors has been the result of specific government policies. In agriculture, beginning in 1959, wide use was made of market incentives. Prices were raised and, especially for foodgrains, stabilized under price guarantee schemes. The new policy also provided some incentives for the production of export commodities. In industry as well, the government played a crucial initial role in providing the necessary incentives and infrastructure.

Development in the social sectors and progress in achieving economic equity have shown, in contrast, serious weaknesses. Real industrial wages have been at best stagnant. The failure

to reduce regional inequities and to improve the quality of life has not only contributed to the recent unrest in Pakistan, but it may also have begun to affect economic growth.

Stern and Falcon conclude that Pakistan's long-term development goals may be optimistic in light of the country's past performance. They suggest that the success in achieving the goals, however, will require a number of revisions in past policies and patterns of resource allocation. The relative price structure of domestic agricultural products must be revised to bring it in line with world market prices and to reflect the comparative advantage of some of Pakistan's agricultural commodities. The tariff structure, which has in the past provided a disproportionate incentive to consumer goods production, must be revised to provide incentives for the domestic production of capital and intermediate goods. The longterm industrial growth target will call for an increased pool of skilled workers. Educational investment must be increased and education restructured. In addition, considerably more attention will have to be given to the problem of increasing equity within the economy. Finally, while Pakistan's export performance and success in promoting import substitution can make it possible to foresee a time when aid inflows can be terminated, Stern and Falcon indicate that the country will require an increasing inflow of foreign resources over the next decade.

As has been mentioned above, the disparate rates of growth in the two provinces of Pakistan represent a problem that is as crucial politically as it is economically. Joseph J. Stern, in "Growth, Development, and Regional Equity" (50), has analyzed the regional relationships by means of a dynamic linear programming model. In this study he explores the changes in differential shares of the agriculture and manufacturing sectors within each region which would result from alternative growth paths based on varying assumptions about regional relations and the flow of external aid. The opportunity cost involved in the process of achieving equal per capita incomes by 1985 is the sacrifice of a considerable amount of growth and a sharp reduction of the growth rate of West Pakistan. This leads Stern to suggest a compromise between the two extremes of maximum growth and regional equality: a policy designed to equate regional growth rates over the Perspective Plan period (1965-1985). This would maintain the initial 30% difference in regional product per capita, but Stern suggests a redistribution policy to reduce the income per capita differences to one-third the 1965 level.

In terms of policy objectives, Stern emphasizes that all the alternatives explored point up the critical role of the absorptive capacity limit on investment in East Pakistan. Hence he concludes that any policy designed to increase this level will serve to ameliorate the regional growth problem. Unless it is possible to step up the rate of investment in East Pakistan to a level considerably above that in West Pakistan, a solution to the regional equity problem is likely to involve a reduction in the national growth rate.

Political as well as economic considerations are the subject of a related study, "Problems of Interregional and Intersectoral Allocation: The Case of Pakistan," by Arthur MacEwan (25). In this essay a multisectoral regional linear programming model is used to investigate various aspects of Pakistan's regional "problem." First, the model serves to illustrate the dependence of the average productivity of a region upon the structure of demand in that region. Usually productivity is conceived of as a function primarily of supply conditions. When trade limitations exist, however, the composition of supply and hence the average productivity are also dependent upon the structure of demand.

The model also aids in the examination of the dependence of regional comparative advantage upon political preference regarding the regional allocation of welfare. The decision to favor the development of one region necessarily implies a shift of resources to that region and away from the other region. The change in resource availabilities in the two regions affects relative prices and hence affects comparative advantage in each region.

Finally, the model is used to isolate the economic factors which are most important in determining relative regional advantages. It can be seen that regional differences in the ability to generate resources which can be transferred between the regions do not seriously affect regional comparative advantages. However, regional comparative advantages can be affected either by changes in national resource availabilities --

e.g., the increase of capital availability relative to foreign exchange availability -- or by regional differences in the ability to generate nontransferrable resources. This suggests the range of possibilities within which decision-makers must act.

MacEwan has also completed his manuscript on Development Alternatives in Pakistan: A Multisectoral and Regional Analysis of Planning Problems (24), in which he investigates the possibility of effecting an industrial structure aimed at reducing income disparities.

India

Under separate financing (in part by AID), Morton Grossman has continued his study of overall Indian development, planning and policies, completing the sectoral analyses of agriculture, industry, domestic finance and the external sector, and preliminary drafts of macro planning and performance for the 1950-66 period. The analysis suggests -- for such a large, low-income country with limited domestic and foreign exchange resources -- that aggregate growth of income, employment, savings, government revenue and investment and balance of payments viability depends essentially upon the balanced growth and efficiency of each of the key sectors of the economy. The relationships between sectoral and macro performance, planning and policies are analyzed over the three phases (cycles) of Indian development with emphasis upon the changing constraints, agricultural production, industrial efficiency and foreign exchange, and their effects upon aggregate growth. Further study will examine

these interrelationships during the 1966-69 and Fourth Plan periods.

Robert C. Repetto's study of Time in Indian Development Programs (41) has been revised and is now in press. This work is an examination of the appropriate rates of time discount to economic decisions of all kinds. Evidence suggests that in India the appropriate rates are relatively high. This places a premium on those measures which foreshorten the time stream of returns on investment, squeeze additional output from current capacity at marginal expense, and reduce the gestation periods of development projects. Repetto applies higher rates of time discount to several issues of development economics, including investment strategy, comparative advantage, choice of techniques, and development administration. He concludes that there exist significant and practicable opportunities to economize on capital by the consistent application of a high valuation of time. The study suggests the need for reinterpretation of the conventional concepts of developing economics, recognizing that the use of resources in a developing country may not always be guided by perfect sub-optimizations based on given technological and resource constraints.

India-Pakistan

Taking advantage of the large fund of information available, Gustav F. Papanek has made an historical comparison of India and Pakistan ("Comparative Development Strategies: India and

Pakistan" 31). Similarity in their overall longterm growth rates demonstrates that given a satisfactory social and political environment, and some outside financial resources, even poor countries can achieve a noticeable increase in per capita income. Both economies, however, proved highly vulnerable to unfavorable exogenous developments. It is apparent that economies at low levels of income and of diversification, such as those of India and Pakistan, cannot readily adjust to such strains.

Papanek's comparison shows the danger of simply equating growth rates, whether of GDP or of savings, with "self-help," or commitment to development. The increase in both GDP and savings depends not only on the actions of the governments but also on natural resource endowment, the structure of the capital stock in the base period, and the extent to which new technology benefits a particular economy. A substantial proportion of the differences between India and Pakistan in both the 1950's and 1960's can be explained by factors over which neither country had any control.

This historical comparison leads, however, to some encouraging conclusions for development planners. Political, social, cultural and institutional obstacles did not prove insurmountable. For the economies as a whole, and in particular sectors, it is clear that in these two mixed economies the

desired results followed from reasonably sensible and quite conventional economic policies and programs: exports increased when returns were increased (and domestic demand weakened); a highly favorable cost-benefit ratio led to the adoption of new agricultural technologies; and so-called "soft" governments managed to quadruple investment over 20 years while at the same time improving its efficiency.

Argentina

Richard Mallon has continued his study of growth and development policies in Argentina over the past 20 years, and he has now completed the initial four chapters (26, 27, 28, 29). These include an analysis of the main directions of the economy and of policy, and of the political and economic cycles during that period. Constant interruptions in the continuity of economic policy have the dubious distinction of providing a rich variety of experience for the analysis of specific policy issues.

The focus of Mallon's concern is the balance of payments problem. 1948 saw a rapid deterioration in Argentina's balance of payments and the beginning of the kind of inflation which inevitably generates serious stabilization problems. The foreign exchange constraint and the struggle with inflation played key roles in the unsatisfactory performance of the Argentine economy during this period. The behavior of the economy clearly demonstrates the interrelationships between stabilization and growth objectives. Mallon's study should thus be useful to an understanding of the problems of managing other economies susceptible to severe inflation.

STUDIES OF DEVELOPMENT POLICY

Development policy comprises a multitude of aspects, and planners for economic development face many questions in the attempt to formulate a development strategy. The question of the use of foreign aid and investment, the frequent conflict between growth and equity, employment, problems of trade and the balance of payments, and the role of the government are all issues debated in the attempt to formulate and execute development policy.

Project Analysis

Robert Repetto has undertaken a study of two rather different government sponsored projects -- the Madras Vasectomy Programme (40) and irrigation project design in East Pakistan -- in each of which he evaluates the economic aspects of planning and of policy making.

The Madras Vasectomy Programme has generated considerable controversy, and its proven effectiveness must be weighed against a number of social costs allegedly resulting from the use of commissioned promoters outside the administration. The program has evoked several interesting features. An extensive network of informants and agents has developed, operating at a grass-roots level outside the government bureaucratic structure. The program has created a fairly stable group of self-selected, successful entrepreneurs able to earn through performance alone much more than they could in other occupations open to them. This group is much closer -- in terms of social distance -- to the target

population than the salaried government social worker, who identifies in dress, speech and aspirations with the middle class civil service. Perhaps because of this, they have been markedly successful in reaching those disadvantaged segments of the community least accessible to the regular machinery and to the mass media. The program also has enlisted the cooperation of "satisfied customers" as agents and informants of the canvassers, and it has resulted in the intensive use of clinical facilities by drawing clients to them from a wide geographical area.

In analyzing the program Repetto develops a model which counts the costs of new births as the discounted resource cost of their consumption expenditure and the social overhead capital occasioned by them in such fields as housing, water supply and sanitation, education. It counts the economic contribution of new births as the discounted marginal product of their labor, taking into account labor force participation rates and the age-sex characteristics of the population.

He concludes that the benefits from the program -- or from any program that is effective in accelerating the progress of population control -- are so high that a strong presumption is created in its favor. This appears to be the underlying rationale for the Indian government's willingness to underwrite "all that can be usefully spent."

Repetto's study of "Economic Aspects of Irrigation Project Design in East Pakistan" (39) should also be of use to policy makers. In this study he has drawn on data and analysis generated

in the course of a feasibility study for a particular irrigation project contemplated for East Pakistan. His study has relevance to many of the less developed countries who experience the need to reduce the capital intensity of development projects. He proposes two ways in which investment costs per unit of benefits can be reduced: by the acceptance of lower returns in return for much lower capital costs, and by the advancement of the time stream of benefits, with little change in capital costs.

Employment

John W. Thomas has done an exhaustive study of the Rural Public Works Programme in East Pakistan ("Rural Public Works and East Pakistan's Development" 55). This program was established in 1961 to convert idle labor into capital, to raise the level of nutrition of the landless and unemployed, to provide basic rural facilities which would promote the growth of agricultural production, and to stimulate the economy by providing new demand for domestically produced goods. The experience of the project suggests an approach to rural development rather than a model that other countries might apply to the solution of their own problems. This approach is one which begins by identifying priority needs, links these to potential sources of financing, tests the concept before undertaking it on a large scale, evaluates its efforts honestly and critically at all stages, and maintains a flexibility in the administration of the program.

Given the magnitude of the problem of rural-urban migration in many countries, a program that creates new rural employment and substantially reduces the flow into urban areas can be highly beneficial. Such a program can also create employment more cheaply than is possible in the urban-industrial sector of the economy, since it avoids heavy investment in housing and urban infrastructure. The experience of East Pakistan also suggests that, contrary to widespread assumption, labor-intensive projects can be highly productive and a spur to development.

In a later note, "Work for the Poor of East Pakistan," (56) Thomas rebuts the argument that the employment-creation and production-increase aims of the program were not achieved. He points out that approximately 750,000 were employed annually and that average rice production increased 31 percent during the period 1961-1965 over the records of the previous five year period. He also contends that the situation was not one in which the surplus farmers were using their own power and the government program to drive the small farmers and the landless to the wall and to hold them in "feudal bondage" as had been suggested.

In Malaysia, as in East Pakistan, there has been major attention to rural employment and increased agricultural output, although by a different means -- youth land settlement schemes. In his larger study of the manpower situation and economic demands for education in the country, O.D. Hoerr has made a study of these youth land settlement schemes ("Youth Land Settlement, Some Observations and Unanswered Questions" 22). The crucial

policy question here is the allocation of scarce management resources. State control over land has meant the proliferation of different types of schemes, with different aims, organization, financing, and requirements. A basic problem is to whom these schemes will cater, and whether entry should be restricted on the basis of marital status, geographic origin, race, etc. The location of the schemes is also open to question -- particularly with respect to their proximity to markets (urban areas) for their cash crops. Questions of finance, particularly the size of state subsidies, remain unsettled. Finally the organizational aspects of the relationship between the state and the schemes need to be established more firmly.

The state with the most ambitious plans for these schemes expects to settle only 4,000 youths over a 10 year period. Clearly then the schemes can hope to make only a very small dent in the group of unemployed (aged 15-24) estimated at 140,000 in 1967. Hoerr has also considered other possibilities for rapid-impact employment creation ("A Primer on Rapid-Impact Employment Creation", 21). These include expansion of the armed forces, expansion of the police force, expansion of the civil service, and various training programs. Hoerr discusses the pros and cons attendant on each of these possibilities.

Taxation and Expenditure Policy

Taxation represents a principal tool by which a government can effect certain desired goals, one which also has considerable social and political ramifications which need to

be understood. S. Malcolm Gillis has edited the final report of the Musgrave Commission: Fiscal Reform for Colombia: The Final Report and Staff Papers of the Colombian Commission for Tax Reform (15), which deals specifically with tax policy. Most of the recommendations made in this study have already been submitted to the Colombian government through the Finance Minister. In a paper which will constitute a chapter of the report, Gillis sets forth the principal objectives of tax reform ("Objectives and Means of Indirect Tax Reform", 13). These objectives include the following: 1) a more progressive pattern of burden distribution, with a minimum of adverse incentive effects; 2) greater economic efficiency and the mitigation of certain tax-induced distortions in the Colombian economy; 3) administrative simplification; 4) amelioration of the effects of the foreign exchange constraint on stable growth; 5) strengthening of the overall revenue elasticity of the tax structure. Gillis also describes the measures he proposes to achieve these aims. They include the separation of import substitution policy from the aims of luxury taxation, increased taxation of luxury expenditures, reform of automotive taxation, transferral of traditional excises to the departmental governments, and the reform of archaic, anti-economic indirect taxes such as the stamp tax, the Industry and Commerce Tax, and the national sales tax.

In another chapter of the report, written with Charles McLure, Gillis emphasizes that policy objectives must be kept in mind in the formulation of reforms for a system of import duties and internal indirect taxes ("Coordination of Tariffs and Internal Indirect Taxes", 16). Otherwise there may be unintended effects on the structure of consumption, production, and foreign trade, not all of which can be expected to be benign. The nature of the coordination of tariffs and indirect taxes in Colombia is basically that of devising measures that provide a clear separation of import substitution and balance of payments policy from the aims of luxury taxation. This implies an attempt to impose the same ad valorem rate of tax on particular luxury products without regard to national origin. It would be accomplished by imposing taxes on the consumption of luxury products rather than on their importation. More specifically, coordination requires the discontinuation of the use of the tariff structure as a means of taxing luxury consumption and the abandonment of the present use of the sales tax as a supplementary instrument of protection. Coordination policy is principally designed to achieve the aims of luxury taxation, import substitution policy and balance of payments stability while avoiding the distortion of the distribution of tax burden that now exists. The authors recommend the adoption of a uniform general ad valorem tariff, but in the event that this is politically unfeasible, they describe an alternative but decidedly less optimal means -- the elimination of all tariff rates above a certain ceiling.

Daniel M. Schydrowsky has also considered the question of social implications of government economic behavior ("Distribution, Growth, and Economic Behavior in Peru: Comment" 45), and he presents a very favorable appraisal of Peru's welfare policy. He finds that on several counts protection appears to be redistributive in favor of the poor. The incidence of higher relative taxes resulting from the implicit tax is found to be more extensively borne by the higher income groups than by the lower ones. Data on the evolution of the capital-labor ratio indicate a net benefit of protection to labor, and since tariffs foster import substituting industrialization, protection can be expected to strengthen the labor union movement. In addition, when adjustments are made to account for the fact that the relative price of government services and other components of GNP vary internationally, it is apparent that Peru has had for some years a substantially larger government sector than might otherwise have been expected. This implies that the "elite" in fact had much less power in the early 1950's than has been suggested.

Trade

Trade and the balance of payments are also crucial problems in the formulation of development strategies, both in their purely economic aspects and in the social ramifications of various policies. Balance of payments and the availability

of foreign exchange specifically represent a primary consideration in the formulation of any development strategy. The measurement of the cost of foreign exchange is thus critical. Daniel M. Schydrowsky has estimated a shadow price for foreign exchange in "On the Choice of A Shadow Price for Foreign Exchange" (47).

In most countries the exchange rate, whether a market or an official one, does not alone maintain equilibrium in the balance of payments; some form of import restriction is used in addition. Such a situation implies a continuous disequilibrium in the foreign exchange market and causes the exchange rate to be a poor indicator of the scarcity of foreign exchange. In consequence, its use in the evaluation of investment projects will lead to misallocation of resources. Schydrowsky develops a more appropriate price for foreign exchange, equal to the marginal utility of the goods and services on which it is spent. If the consumer is in equilibrium, the marginal utility of consumption goods is measured by price.

The marginal utility of foreign exchange and hence its shadow price is reflected at any point in time by the average demand price adjusted for domestic indirect taxes on the goods, services, and financial assets on which the marginal unit of foreign exchange is spent. This average price will be the exact shadow price in a competitive economy and an underestimate in an economy with market imperfections. The shadow price of foreign exchange will vary over time with changes in the composition of foreign exchange expenditure and in import

restrictions. Schydłowsky's paper includes computations for 48 countries, based on 1965 data.

Morton Grossman designed and directed an Indian team study of Indian non-traditional manufacturing exports, to be incorporated into his larger study of Indian development. The survey, which covered 106 firms in industries contributing over 70 percent of India's newer manufacturing exports, yielded the following results: (a) these newer exports increased by nearly 100 percent during 1968/69 and may increase by 15-20 percent in 1969/70; (b) the composition of these exports changed markedly; (c) some of the new export products proved on shadow pricing analysis to be comparative advantage goods having relatively high labor content, using relatively low-cost domestic materials, being manufactured by large and efficient firms, and having low marketing costs and requirements; (d) other products, including those being pushed by the government, proved to be economically costly; (e) the total package of export incentives afforded different industries varied widely, and the Government was not employing appropriate analysis to foster or plan exports on an economic basis; (f) in some cases, even where the explicit export incentives appeared to be large, they were offset or negated by the effects of import, material and industrial controls which raised costs or lowered the quality of inputs and restricted the abilities and capacities of promising exporters.

Grossman concludes, therefore, that it is unlikely that newer, economic exports will continue to expand at optimal rates in the future unless there are significant changes in industrial, import, and export policies.

The question of the composition of foreign trade is still another aspect to be considered in the formulation of an international trade policy. Joseph J. Stern has written "A Note on the Structure of Pakistan's Foreign Trade" (51), in which he examines the effects of government policies. The economic development of Pakistan has been marked by a highly successful export-promotion policy which has achieved a rapid rate of growth of exports. This has been accompanied by a considerable change in the structure of trade, which has manifested a diversification most marked in terms of a change in the commodity structure of exports. In terms of geographic concentration, there has been no change in the measured concentration indices. In general, insofar as this diversification has helped to increase the demand for exports and reduce the risk of fluctuations in export earnings, it has benefited the economy. It has been suggested, however, that the deliberate policies instituted to diversify exports have moved Pakistan away from precisely those commodities in which its endowment of productive resources makes it best suited. If such a distortion in terms of resource allocation has indeed occurred, Stern suggests that the cost of achieving a more diversified export structure may well have been very high.

PLANNING TECHNIQUES

The formulation of plans and development strategies are obviously based on a great deal of information, and on a variety of implicit or explicit assumptions. Questions of planning methodology therefore remain of utmost importance.

David Kendrick has continued to examine mathematical and computational methods in economy-wide planning for nations, regions, and urban areas and in sectoral planning for sectors such as education, water resources, agriculture, transportation, and heavy industry. Several draft chapters of his book, "Mathematical Methods in Economic Planning" have been completed. The emphasis is on the relationships between (i) the economic assumptions embodied in the models, (ii) the mathematical methods used to solve the model, and (iii) the degree of disaggregation obtainable at reasonable computational expense. In a related project, Kendrick worked on a study of dynamic economic planning under uncertainty. This is a study of methods of economic planning over time when there is uncertainty both in the measurement process to determine the state of the economy at any point in time and in the production processes by which goods are produced over time. He began with a study of problems with linear production functions and quadratic performance criteria, and is now attempting to generate these results to nonlinear production functions and nonlinear non-quadratic performance functions.

William Raduchel has also worked to improve the use of econometrics in planning models. ("A Suggested Production Function for Use in Planning Models", 38). Econometric investigation of direct factor substitution has generally involved the use of a constant elasticity of substitution production function. Within a planning model, however, this assumption may be too strong, for the range of capital-labor variation may be considerably wider than that actually observed. The result is that such models in an optimizing context often indicate production at points involving implausibly high or low capital-labor ratios. Raduchel feels that it is probably more realistic to expect that the elasticity of substitution will decline as production becomes very intensive in one factor.

Raduchel thus suggests a simple modification of the Arrow, Chenery, Minhas, and Solow CES production function, with the property that the elasticity of substitution declines to zero as the amount of either excess capital or excess labor goes to zero. Technological change is introduced such that for any given set of factor prices, differential technological change will induce greater use of the factor receiving the greater benefit from the improved technology. In such a production function, a realistic capacity constraint is imposed when one factor is fixed, and returns to the other factor diminish as the capacity constraint is approached. There are minimal capital-output and capital-labor ratios below which production is impossible. Such a production function thus permits reasonable factor substitution while ruling out improbable productive situations.

SUPPLEMENTAL STUDIES

With the support of the contract, research projects such as these have permitted the fullest possible use of DAS advisors' field experiences. The increasing fund of academic research on the processes of development is in turn being used for the training of students of development. In this connection Gustav F. Papanek, Daniel M. Schydlofsky and Joseph J. Stern are preparing a casebook based on DAS experience (36). Using specific decision-making examples, the book will focus on major decisions facing contemporary governments in the less developed countries and will include discussion of topics such as trade and the balance of payments, investment decisions, development strategies, monetary and inflation problems, and government pricing. This book is expected to be available in mid-1970 from Houghton Mifflin.

FUTURE RESEARCH

The justification for, and description of, much of the future research to be completed was described at length in Annex A of the June proposal to extend this work. What follows, therefore, are brief summaries of intended studies for the next six months -- cross-classified by region, functional area, and major investigator. It is hoped that these will permit all interested members of AID to comment on the nature and structure of these studies while the research is still in the planning stage.

Cross country
Education

Samuel Bowles will continue his work on the extension of an educational production function, investigating the relationship between the quality of education and its effect on later income earnings. He is also working on the political economy of mass education programs in the less developed countries, with particular reference to the determination of investment in education. Cross-country econometric studies of resource allocation have been completed, and thus far Bowles' initial hypotheses concerning the importance of political influences on resource allocation in education have been borne out by the results of this work.

LA
Foreign Investment

Dwight Brothers is investigating the international transmission of technology by means of foreign investment in collaboration with Constantine Vaitzos. Particular attention will be paid to the costs to Colombia of arranging access to foreign-controlled industrial technologies by means of direct foreign investment, various licensing arrangements, and management contracts. At a more general level, the study will attempt to specify an analytical framework useful for host country policy-making which takes into account both the costs and benefits of international technology transmission by this means

NESA
Policy and Planning

Willem C.F. Bussink will continue his work on a policy model for West Pakistan. He is presently finishing work on a complete set of consumption coefficients for the model. After a two month field trip to Pakistan, he will work on the interaction between (on the one hand) the structure of consumption, prices, and incomes and (on the other) real growth. He will consider in particular the effect of a price support policy for foodgrains on growth prospects and the growth potential that might be realized through rationalization of the internal price structure.

Cross country
Structural Change

Hollis B. Chenery will continue work on "The Developing Economy," in which he will bring out the implications of some of his earlier, detailed econometric studies. He expects to complete his assessment of typical patterns of growth, including the analysis of structural change, changing patterns of production and trade, and changes in technology and labor use. He also hopes to complete a study of the balance between industry and agriculture to include the effects of natural resource endowments and comparative advantage. In addition, Chenery will work with Christopher A. Sims on a cross-section analysis using World Bank data which will incorporate a wider set of variables than did Chenery's earlier work, done in collaboration with Lance Taylor.

NESA
Agriculture

During the next six months, Walter P. Falcon expects to complete two aspects of his work on Pakistan. He will do the final editorial work on Development Policy II - The Pakistan Experience, and he expects to finish a major article (with Carl H. Gotsch) on agricultural price policy in Pakistan -- based in part on work previously done for the AID/Pakistan Mission. Any additional time will be spent on the Falcon/Gotsch volume on rural development.

LA
Taxation and Expenditure

Within the next two months, S. Malcolm Gillis will finish writing up the results of his investigation of the reform of the indirect tax structure in Colombia. He will also complete final editing of Fiscal Reform for Colombia. Gillis will then begin an examination of pricing strategies for publicly supplied goods in developing economies, with particular reference to road and highway services.

NESA
Agriculture

Carl H. Gotsch will work on three projects. The first, a model for planning farm-to-market transportation systems, utilizes earlier work with linear programming models of West Pakistan agriculture to determine the optimal grid size and transportation mode for hauling agricultural commodities to farm markets. An article on agricultural price policy in West Pakistan (with Walter Falcon) will emphasize the impact of price policy on income distribution. A third study, comparing Mississippi and West Pakistan, will examine the impact of similar macro economic structures and social patterns on the well-being of rural people.

AFR
Industry

Leslie E. Grayson will analyze the economic contribution of public sector enterprises in Ghanaian manufacturing and mining. The performance of these enterprises can be understood in terms of their longer-than-average "learning curves" to reach a break-even level of operation and the source and nature of their financing -- primarily supplier's credit. He will examine whether, assuming that the enterprise is a feasible one, supplier's credit is suitable for industrialization in developing countries, recognizing the short term nature of supplier's credit financing and the longer "learning curve" of many such enterprises.

NESA
Development Policy

Morton Grossman will complete his study of overall Indian growth, planning, and policies. He will analyze agriculture, industry, and finance during the 1966-69 recovery period, and will investigate the relationships of sectoral developments and of aggregate growth of income, savings, taxation, investment, imports, and exports for the forthcoming Fourth Plan period (1969-73). Several separate studies, based on the Indian experience, will consider (a) the role and limitations of planning in a large economy; (b) shadow pricing and controls versus market pricing and allocations; (c) second-best policies and programs for manufacturing exports in a controlled, disequilibrium economy; and (d) the state of applied economic thinking on planning, policies, and growth in the 1970's.

NESA
Industry, Finance

J. Tomas Hexner will continue his analysis of two issues in East Pakistan: (a) private and public sector joint financing, erection, and management of jute mills, and (b) the business policy and operation of quasi-governmental bodies, with special emphasis on the East Pakistan Industrial Development Corporation. Hexner's initial hypothesis is that new entrepreneurs can be attracted into the jute industry by leveraging investment in their favor (reducing the equity) and by providing them the institutional umbrella and prestige of a government corporation. Concerning the quasi-governmental bodies, analysis indicates that the extremely close interrelationship between government and corporations deters optimum performance on the part of the corporations, that the latter have contributed greatly to the development pace, and that their comparative advantage lies in the planning and development rather than the operation and maintenance of projects.

FE
Education

O.D. Hoerr will continue his analysis of the allocation of educational resources in Malaysia. Regression analysis has been employed to estimate the impact of education on incomes in urban and rural areas, and benefit-cost calculations are being made for educational expenditure. This involves the weighting in socio-political terms of the various types of educational output. Hoerr is concerned with the question of whether Malaysia can be said to be allocating educational resources in such a way as to maximize growth and/or equity.

LA
Foreign Investment

Arthur MacEwan is involved in a study of the impact of foreign investment on the social institutions necessary for domestically based development. He is interested particularly in determining the effect of foreign investment on the rise of a dynamic industrial class with the potential for taking the lead in the development process. Preliminary work which has been done on Brazil suggests that this effect may be detrimental in some respects. Specific questions which MacEwan will investigate include the effect of joint ventures, the role of foreign investors, and the contribution of the types of investment likely to be chosen by foreign corporations.

LA
Development Policy

Richard Mallon, in collaboration with Jean Sourrouille, will complete a book on Argentine economic policy within approximately nine months. The study is concerned with the policy-making process, particularly as it relates to the conflicting objectives of stabilization and growth, in a semi-industrialized country encumbered by the cumulative distortions of past policy mistakes and socio-political unrest. Several draft chapters have been completed as well as much of the regression analysis of the determinants of inflation. This analysis of policy-making under tight economic, institutional, and time constraints in Argentina should contribute to an understanding of the process in other middle-income countries.

NESA
Development Policy

Gustav F. Papanek will continue his comparison of recent Indian and Pakistani development policies and strategies, a first draft of which has just been completed. Questions that require further examination include the contribution of foreign aid and the effect of different policies and strategies on the efficiency of the economy and on the equity of income distribution. Although India's policies have been more favorable for equitable income distribution than those of Pakistan, this may have been more than compensated for by the impact of Pakistan's higher growth rate on the lower income groups.

NESA
Industry

Gustav Papanek, in association with Stephen Guisinger, will initiate a study of the relationship of firm size to industrial efficiency, using census and survey data from Pakistan. They will explore in detail the role of effective protection, capital-labor ratios, and capacity utilization in explaining productivity differentials between different size categories in two-digit industry groups.

Cross country
Planning Models

William Raduchel will continue work on substitution in development planning models. He will examine the sensitivity of optimal growth paths to changes in the objective function and in the technology. In addition to evaluating the qualitative importance of the several types of factor substitution, he hopes to gain insight into the effect upon optimal growth paths of attaching more weight to income distribution.

NESA
Industry

Robert C. Repetto is reworking the theory of optimal tax on foreign trade to encompass inter-temporal effects, and he is applying this amended theory to Pakistan's export policy on raw jute. His hypothesis is that countries may cut production in some industries when faced with short-run inelastic demand. In cases involving concentrated production and supply the long-term elasticity may in fact be high. The time discount thus becomes important and what is needed in these situations is an optimal production policy and a set of decision rules. Repetto is also studying the implications of differential uncertainty between home and export markets for the choice of industrial strategies. His hypothesis is that the lack of market knowledge of foreign sales potential biases industries toward import substitution, and that the heavy protection of import-competing industries may then arise as a response rather than the initial impetus to this allocation of investment funds.

NESA
Population Studi

Repetto is starting a new study designed to test the "Revelle hypothesis" that large completed family sizes in developing countries are the result of pronounced son preference combined with high expected infant mortality, and that households desire six or more children to ensure that one or two sons will survive to adulthood to support the parents in old age. If this hypothesis is correct, the present approach to birth reduction through distribution of contraceptive means and information would need reconsideration.

Daniel M. Schydlowsky will be working on several studies. The first is the evaluation of foreign investment proposals from the point of view of the host country. He expects that for suboptimization within one sector (raw material exploitation), the net present value method is most appropriate and that for optimization across sectors (industrial projects), a version of the domestic resource cost of foreign exchange is the appropriate method.

Schydlowsky will also work with Moises Syrquin on the estimation of production functions from international cross section data. Primary emphasis will be on the standardization of value added figures for relative price differentials among countries. Estimation will be by making use of the cost minimization assumption and by means of new non-linear estimation procedures.

With Stephen Guisinger, Schydlowsky will continue to study the effective rate of protection, exploring the effect of introducing time into the production function when effective rates of protection are estimated. Data from Pakistan will be used to assess cost differences arising from changes in the price of working capital resulting from the imposition of tariffs. A comparison of adjusted and unadjusted rates of protection will be made, and the importance of including explicitly the effect of time in tariff analysis will be derived.

Christopher A. Sims will spend a major part of his time on empirical work on the dynamics of the production process. His earlier work has suggested strong interactions between rates of capacity expansion and rates of technical change. Sims will also collaborate with Hollis Chenery on a descriptive survey of time series from a large group of both developed and less developed countries, covering a variety of statistical variables related to development.

LA
Industry

Moises Syrquin will continue work on production relations in Mexico's manufacturing sector. He will report on his estimation of Cobb-Douglas and CES type production functions across counties for total manufacturing, and will continue the analysis of industrial disaggregated data across states. This analysis will include a comparison of productivity among states within Mexico, and between Mexico and the United States.

PERSONNEL

Table 1 indicates the senior personnel whose research has been supported under the contract. During 1969, 23 senior faculty members devoted about 100 man-months to research under this contract. This was slightly lower than originally budgeted, but it is in keeping with the phase-down in total expenditure that is anticipated for the next two years. This lower rate, which was also brought about in part by extended overseas stays by several individuals before returning to Cambridge, permitted the original funding to extend two additional months through January 1970.

In addition to the senior staff noted in Table 1, five advanced graduate students were also supported on final phases of doctoral dissertations whose work was an integral part of the original proposal.

Table 1. Senior Research Personnel

Approximate Portion of Total Time Committed to AID Research During 1969

<u>Name</u>	<u>Spring Semester</u>	<u>Summer</u>	<u>Fall Semester</u>
S. Bowles	a/	25	12.5
D. Brown	100	-	-
W. Bussink	75	75	75
H. Chenery	25 ^{b/}	50	25 ^{b/}
W. Falcon	50	50	50
M. Gillis	-	-	33
L. Gordon	20	20	
C. Gotsch	75	75	75
L. Grayson	-	-	100
M. Grossman	100	100	-
J. Hexner	50	50	50
O. Hoerr	75	75	75
D. Kendrick	20	50	a/
D. Kresge	25	-	-
A. MacEwan	50	100	50
R. Mallon	25	25	25
G. Papanek	33	33	33
R. Repetto	-	-	100
P. Roberts	25	-	-
D. Schydlowsky	25	50	25
C. Sims	50	100	25
J. Stern	50	-	-
L. Taylor	a/	a/	a/
T. Weisskopf	37.5	50	-

a/ On leave.

b/ Indicates time committed on substantive work. Salary paid from funds of the Center for International Affairs.

EXPENDITURES

Preliminary expenditure data through December 31, 1969, are given in Table 2. The pattern, roughly comparable to the man-month data described above, indicates that a total of \$ 941,699 (inclusive of Harvard overhead) has thus far been spent. (These numbers are tentative, pending official tabulations to be provided by Harvard's Office for Research Contracts.) Quarterly expenditure during 1969 averaged about \$ 75,000, and it is expected that that rate, or one slightly lower, will also prevail during the first half of 1970.*

Thus, in terms of man-months committed, dollars expended, and substantitative accomplishments, the project appears to be proceeding about as scheduled.

Walter P. Falcon
Cambridge, Mass.
January 31, 1970

* The lower expenditure in the final quarter of 1969 occurs for several reasons. Because of the holidays, it is likely that a number of expenditures actually made in December were not posted. Second, because of the uncertainty during the first half of 1969 about the contract's extension, a number of offers to return to Cambridge were delayed. Third, there was a mix-up with the comptroller's office on three staff members, and inappropriate salary amounts were debited. The latter will be corrected by a ledger change in the first quarter of 1970. While there may be a few additional months of lower expenditures, we still anticipate that an annual expenditure rate of about \$ 300,000 is correct.

Table 2. Summary of Expenditures for Period Ending December 31, 1969
(AID Quarterly Reporting Form A)

(1) Dollar amount of contract	
(a) Initial funding	\$577,882
(b) Amendment - Cumulative total + \$145,000	722,882
(c) Amendment - Cumulative total + \$25,825	748,707
(d) Amendment - Cumulative total + \$292,896	1,041,603 *
(e) Amendment - Cumulative total + \$313,560	1,355,163 **
(2) Expenditures on the contract (accrued basis)	
(a) Cumulative to December 31, 1969	\$941,699
(b) Quarter ending December 31, 1969 (actual)	45,652
(c) 2nd quarter preceding (actual)	95,844 ***
(d) 3rd quarter preceding (actual)	93,244 ***
(e) 4th quarter preceding (actual)	74,398
(3) Unexpended balance at end of quarter (December 31, 1969)	\$413,464
(4) Estimated future expenditures	
(a) Quarter following this report (Jan-Mar 1970)	\$60,000
(b) 2nd quarter following this report (Apr-Jun 1970)	80,000
(c) 3rd quarter following this report (Jul-Sep 1970)	90,000
(d) 4th quarter following this report (Sept-Dec 1970)	80,000

*Original project originally scheduled to end November 30, 1969, but extended through January 31, 1970. Two-year extension in the amount of \$627,120 approved by RAC.

**Calculation assumes addition of funding for first year of extension.

***Contains revised data, Office for Research Contracts.