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The University of Minnesota Economic Development Center was established in 1967 as a joint activity of the Department of Economics and the Department of Agricultural and Applied Economics. It is one of several centers and programs organized under the Office of International Programs.

The Economic Development Center was organized to facilitate the research interests of graduate students and staff in the two departments who are interested in development economics and policy. The program of the Center is closely linked to several other units of the University of Minnesota which have a strong development orientation, such as the Center for Comparative Studies in Social and Technical Change in the Office of International Agricultural Programs.

The program of the Center reflects the conviction that application of knowledge with respect to economic behavior can represent an efficient source of economic growth.

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ANNUAL REPORT: 1975

PN-AAC-911

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INTRODUCTION

The research program of the Center is focused in five areas:

- Population and Labor Markets in Development
- Trade and Development: Interregional and International
- Commodity and Factor Markets in Developing Countries
- Technical Change and Resource Use
- Public Enterprises and Development

The first section of the *Annual Report: 1975* contains short reports on research completed in 1975 or currently underway.

The *Annual Report: 1975* describes in the second section several "Related Projects and Programs" in which members of the Departments of Economics and Agricultural and Applied Economics are involved. The third section outlines "The Graduate Program in Economic Development at the University of Minnesota," including graduate course offerings, staff, and staff developments.

The final sections list "Center Publications" and "Workshops and Seminars."

CENTER RESEARCH REPORTS

POPULATION AND LABOR MARKETS IN DEVELOPMENT

INTERRELATIONSHIPS BETWEEN MORTALITY AND FERTILITY*

T. PAUL SCHULTZ

Life expectancy has probably increased by one-half since 1940 in most low income countries. This extraordinary extension of life occurred in high income countries more gradually and at a later stage in their economic development. Given the speed and magnitude of this achievement in the low income world, various disequilibria are likely to emerge in the wake of the reduced incidence of death and disease. These disequilibria arise because social institutions and individual behavior adapt, for many reasons, with a substantial lag to new and unanticipated developments. Rapid social and economic changes in response to disequilibria appear to be an essential feature of development, but the reallocation of resources required to utilize the increased length of life may not automatically take place with desired efficiency and equity. Public policy may play an important role by disseminating information and appropriate technologies to facilitate private and social adaptation to this change.

In this project I was primarily concerned with the implications of mortality for desired and actual levels of fertility. Ignoring migration, my objective was to appraise how the decline in mortality in the low income world is likely to affect population growth rates, and whether the underlying relationships suggest opportunities for policy to hasten the decline in fertility.

Parents seem to respond to the decline in child mortality by having fewer births, perhaps to some extent because the biological effect of an infant's death interrupts lactation and shortens a mother's sterile period following a birth. But this association also appears to reflect behavioral preferences of parents to replace an infant that dies. This replacement motivation has not been derived from a simple economic model, although many related economic effects of a child's death on family wealth, prices, risks, and returns to human capital might contribute to a positive behavioral relationship between fertility and mortality. Mortality declines increase the real value of income streams, and in particular they raise the relative value of human versus physical capital goods for accomplishing intertemporal

*Summarized paper prepared for a conference on *Policy Interventions to Affect Fertility*, Resources for the Future, Inc., Washington, D.C., February 28 – March 1, 1975 to be published as a book in 1976. This paper is based on research on fertility determinants and economic development facilitated by a training grant from the Rockefeller Foundation and a 211(d) grant from AID to the Economic Development Center of the University of Minnesota.

life cycle transfers. Since these human assets are more equally distributed among persons than are physical assets, such as land and reproducible physical capital, the decline in mortality also has an equalizing effect on the personal distribution of wealth, at least in the short run.

Existing empirical evidence does not permit a precise attribution of the response of fertility to mortality between biological and behavioral factors, yet the noticeable pattern of reproductive response coefficients obtained for women of different ages and according to the sex of the deceased child indicate that behavioral aspects of this relationship should not be underrated. Future investigations of pregnancy histories in conjunction with economic data should permit the separate estimation of the biological and behavioral effects.

Fortunately, the sum of the biological and behavioral effects is of principal interest for policy or the *total* reproductive response to child mortality. With all their deficiencies, about half of the investigations I have studied estimate that the reproductive response of mothers is sufficient to maintain nearly constant or even diminishing surviving family size, while adjusting to lower child mortality. In the other half of the cases, the response in the time horizon studied (often two to five years) was sufficient to compensate only partially for the observed differences in child mortality.

It would be worthwhile to estimate the coefficients of comparable fertility models from a variety of surveys to ascertain under what conditions demographic equilibrium within the family (implicit in the "demographic transition" hypothesis) reasserts itself most rapidly. What social conditions, such as perhaps a national family planning program or a universal primary education system, are associated with larger and more rapid reproductive responses? Are there threshold values below which steady declines in child mortality elicit an increasing response? Do improvements in the nutritional status of a population during the initial stages of development enhance biological reproductive capacity and consequently stimulate increased overall fertility despite the selective response of parents to the concurrent decline in child mortality? These are clearly researchable issues but ones that have not yet been studied within a common conceptual framework. The empirical evidence on these issues has, therefore, not yet added up.

Extending human life is viewed as an indisputable good, requiring no justification. But I suspect a consequence of this attitude has been a certain demotion in the claims to public resources by public health programs in low income countries. Without serious efforts to measure the effects of development policies on mortality, and an equally diligent effort to quantify the consequences of mortality on fertility,

child schooling, labor productivity, and personal welfare, policy interventions to reduce mortality are likely to continue to lose out in the competition for funds.

Research on this topic must rely mainly on nonexperimental data. It will, therefore, be very important *what* is being "held constant" in such a study and in what manner it is being "held constant" when partial associations among fertility, mortality, and policy variables are being evaluated. The most serious barrier to an experimental approach is the ethical one of administering "treatments" that are thought to influence the risks of human mortality. Also, any prospective framework will be costly because of the infrequency of mortality in most contemporary populations, and hence the very large size of samples required to obtain statistically reliable results. Selective migration, which is taking place at unprecedented rates in most low income countries, further complicates the use of prospective data even where otherwise justified.

Consequently, increased effort may be directed to improving retrospective survey instruments that would compile life histories of demographic events and temporally related socioeconomic aspects of the family's environment and behavior. With such improved data sources many of the potentially important policy questions posed, but left unanswered, in this investigation could be clarified, and possibly be settled.

This project is supported by a training grant from the Rockefeller Foundation and a grant from USAID. Mr. Schultz is Professor in the University of Minnesota Department of Economics.

THE INFLUENCE OF SCHOOLING AND SOCIOECONOMIC BACKGROUND ON EARNINGS: THE CASE OF COLOMBIAN URBAN YOUTH BERNARDO KUGLER

The purpose of this research is to analyze, for the Colombian case, the extent to which schooling and postschool investments influence labor incomes, when the characteristics of the socioeconomic background of persons are taken into account. Previous studies dealing with effects of education on earnings, in particular for Colombia, neglect to consider explicitly background effects on either schooling or earnings. These studies may be criticized for attributing too large an effect of schooling on earnings than is actually caused by the omitted background variables.

In order to have an overview of the entire (urban) labor force, a representative sample is first being analyzed which does not contain information on socioeconomic background variables. This sample of 17,123 households is the National (urban) Household Survey conducted by the Colombian Department of Statistics in 1970. Earnings functions and profiles were estimated in which differences on earnings are explained by differences in schooling and age (or years of experience) stratified by sex and urban-rural birthplace. Earnings differences by age, experience, and schooling groups are being explored at different levels of aggregation and compared with other studies. The dispersion of the earnings distribution is also being estimated and partially explained in terms of schooling differentials.

Since parental background information is available for children living in their parental household only, a sample of these persons between the ages of 6 and 25 has been constructed from the original survey to study relationships in which socioeconomic background is expected to be of importance. School attendance and labor force participation are analyzed in conjunction with parental income, schooling, and occupation. Prospective returns to further schooling are also examined by age cohorts, controlling by sex, and birthplace.

For analyzing the joint influence of schooling and socioeconomic background on earnings, a sample of children living in the parental household and participating in the labor force is generated from the previous restricted sample. Positive earnings are reported by 608 children, ages 6 to 25, living with their parents. To obtain unbiased estimates of the effects of schooling and other variables on earnings, a simultaneous equation model for the amount of schooling and earnings is being developed and estimated. Potential biases arising from the way in which the sample is selected are examined, using information supplied by the more comprehensive samples. The possibility of extending the results based on the young working sample to the entire labor force will be discussed. Distributional implications are considered as well.

The results of this research should provide an indication of which public programs that attempt to influence how much schooling people get could improve the distribution of economic opportunities in Colombia and reduce inequalities in the distribution of labor income.

Preliminary results show quite large effects of schooling on earnings, even when socioeconomic background variables are included among the explanatory variables in the earnings function. A substantial fraction of personal income inequality is explained by the above framework.

This project is supported by a grant from the Rockefeller Foundation. Mr. Kugler is a Research Assistant in the University of Minnesota Department of Economics.

AN ANALYSIS OF THE STRUCTURE OF EARNINGS IN KOREA FUNKOO PARK

The objective of this study is to explain the earnings structure of the labor force in Korea by examining individual differences in the resources used to create and improve skills and augment the knowledge of workers. The basic operational concept is the human capital earnings function by which the level of earnings and investment in human capital are related. Estimations of earnings functions on the basis of human capital theory have been carried out on U.S. data, but such investigations are rudimentary for the developing countries.

The basic source of the data used in this study is the 1973 Occupational Wage Survey by the Office of Labor Affairs. Information on earnings, the level of education, type of occupation, years of experience within the current occupation and within the current employing firm were collected from a sample of workers with more than 18 workdays during the survey month of April 1973. This information on years and composition of labor market experience permits the following segmentation of working life from the completion of formal schooling up to the survey date: (1) years of general experience prior to working in the current type of occupation; (2) years of experience within the current type of occupation but outside the current employing firm; and (3) years of current occupational experience within the current employing firm.

The four main variables representing human capital investments in this context are the years of schooling and the three different types of job experience. Individual earnings are to be explained with these four variables in log-linear and quadratic forms. The following hypotheses with respect to these human capital investment variables are to be tested with the estimated earnings function: (1) there are diminishing returns to each experience variable and years of schooling; (2) returns to each experience variable are increasing functions of years of schooling; and (3) substitution possibilities between firm specific experience and outside occupational experience is inversely related to the years of schooling.

The advantage in specifying the earnings function in this manner rather than according to the conventional method* is that the three-way segmentation of working life permits one to distinguish between changes in earnings due to "aging process" and changes in earnings due to distinguishable work experiences.

This model of human capital investment will also be used to explore the "dual labor market hypothesis." The belief that the structure of earnings and employment differs significantly between large

*See J. Mincer, *Schooling, Experience and Earnings*. New York: Columbia University Press, 1974.

and small firms in Korea will be tested. Earnings functions will be estimated for workers employed in large and small firms to characterize earnings differential by firm size. Some tentative findings are: (1) outside occupational experience is not significant in determining the level of earnings in large firms; (2) the degree of substitution between the two current occupational experience variables are different; and (3) the degree of substitution between years of schooling and years of firm-specific occupational experience is much higher in large firms than in small firms. Also, it appears that even after allowing for the effect of human capital variables on earnings, earnings differentials by firm size remain. Institutional factors are being studied that might explain these residual earnings differentials.

A by-product of this research will be estimates of the rates of returns, both social and private, to education in Korea. Expected earnings profiles are estimated, adjusted for labor market experiences, for groups with five different levels of education — no schooling, 6 years of elementary school, 3 years of junior-high school, 3 years of high school, and 4 years of college. Earnings differentials due to different amounts of labor market experiences are neglected in the first set of estimates in Table 1 and held constant in the adjusted second set of estimates. The internal marginal rates of returns by level of schooling are reported on the basis of private costs and private gains in market earnings, and again including social costs. The results indicate that the adjusted social rates of returns to successive levels of schooling diminish from 15 percent for the elementary school to 9 percent for college.

Table 1. Estimated Cross-Sectional Rates of Returns to Education in Korea, 1973.

Internal Marginal Rates of Returns from *Unadjusted Earnings Profile*

| | Social | Private |
|------------------------------------|--------|---------|
| Junior-High over Elementary | 9.7% | 10.3% |
| High School over Junior-High | 16.1% | 17.3% |
| College over High School | 10.6% | 11.9% |

Internal Marginal Rates of Returns from *Earnings Profile* adjusted for experience

| | Social | Private |
|------------------------------------|---------------|----------------|
| Elementary over No School | 15.5% | 22.8% |
| Junior-High over Elementary | 14.4% | 15.3% |
| High School over Junior-High | 11.2% | 12.4% |
| College over High School | 8.8% | 9.9% |

Internal rates are calculated from the University of Minnesota, computer package, BAS/GIRRVF.

This project is supported by a grant from the Rockefeller Foundation. Mr. Park is a Research Assistant in the University of Minnesota Department of Economics.

TRADE AND DEVELOPMENT

REGIONAL AGRICULTURAL DEVELOPMENT PLANNING IN INDIA

MARTIN E. ABEL

K. WILLIAM EASTER

The research to identify regional restraints has concentrated on the wheat region and eastern rice region of India. Several different econometric models have been used to measure differences in production and productivity in the wheat region. Estimation of production functions using cross-section-time-series data indicates that a substantial portion of the variation among 72 districts comprising the wheat region was due to factors other than the quantity of traditional inputs — land, labor, irrigation, fertilizer, and tractors. Almost half the regional variation not explained by traditional inputs can be explained by measuring the quality of irrigation.

Production functions were also estimated for both 1961 and 1968. Irrigation quality was introduced into the model, first through a tubewell variable and second with an irrigation index. The irrigation index gave a heavier weight to land irrigated by tubewells. Both the tubewell variable and the irrigation variable were significant. Again the analysis points out the importance of quality of irrigation in explaining production differences.

The importance of other variables such as work animals, research, soil type, and rainfall are being investigated.

The most important conclusion drawn from the study to date is that the quality of irrigation, rather than just irrigation, is highly significant in explaining productivity variations. The study also brought out the strength of analysis focused on a single cropping region. (George W. Norton, "Analysis of the Variation in Agricultural Productivity Between the Wheat Regions of India," Plan B Paper, May 1975, 52 pp.)

The analysis of investments to improve the quality of irrigation systems in eastern India was completed. The results from a regression model for both the wet and dry seasons supported the earlier conclusions of high investment returns. Net benefits were derived directly from the production function. The annual dry season benefits were \$13.50 per acre, while the wet season benefits were \$6.50 per acre. All benefit estimates are based only on the cultivators' rice production and do not include project costs of \$4.50 per acre.

The production function analysis shows that the reasons for the increased input use and higher production are quite different in the two seasons. An upward shift in the production function, due to the improved irrigation, accounts for about 40 percent of the actual rice yield difference in the dry season. Farmers used more high-yielding

varieties of rice and larger amounts of fertilizer with improved irrigation in the dry season. Reduced uncertainty concerning water supply and fertilizer loss has allowed farmers to operate closer to an optimum level of fertilizer application. In the wet season, the most important reasons for increased production are reduced flooding and better field drainage provided by the improvements in the irrigation systems. (K. William Easter, "Returns from Investments in Improving Village Irrigation Systems: An Example from India," Staff Paper P74-13, July 1974, 24 pp.; K. William Easter, "Field Channels: A Key to Better Indian Irrigation," *Water Resources Research*, Vol. 11, No. 3, June 1975, pp. 389-392.

The research on this project is supported by a grant from USAID. Messrs. Abel and Easter are Professors in the University of Minnesota Department of Agricultural and Applied Economics.

ECONOMIES OF SCALE AND PRODUCTION FUNCTIONS IN SOUTH KOREA'S MANUFACTURING SECTOR CHONG NAM

One of the most notable features in the recent economic growth of South Korea is the extremely fast growth in the manufacturing sector. Real value added in manufacturing grew at an average annual rate of 17.8 percent during 1961-1973, far exceeding the growth rate of real GNP of 9.25 percent. Thus the share of manufacturing in GNP rose from 10.6 percent in 1961 to 28.4 percent in 1973, contrasting sharply with the rapid decline of the share of agriculture, forestry, and fishing in GNP from 44.1 percent to 22.6 percent, despite a real rate of growth of that sector of 3.8 percent. Further, growth in manufacturing employment was also quite rapid. This experience stands in sharp contrast with that in many other developing countries where growth in manufacturing has not contributed significantly to easing problems of underemployment in the rest of the economy.

This study examined South Korea's manufacturing sector, with particular focus upon the underlying production technologies of the two-digit level industry. Various forms of production functions and alternative estimation methods were employed to estimate key parameters in the production functions. It is worthwhile to note that this study was based on the per-establishment averages of the cross-section data classified by both region and firm size, which is, therefore, a more relevant measure of microunits than regional totals or simple regional averages.

From the estimation of the production functions, several major conclusions were drawn:

(1) Indications of economies of scale were predominant, with the estimates of the elasticity of scale being significantly greater than unity in 13 out of the 18 two-digit manufacturing industries. The actual importance of the economies of scale in output growth was also quite evident in the industries where economies of scale exist. For total manufacturing the elasticity of scale was 1.152 and the economies of scale explained about 11 percent of the growth of total manufacturing output during 1966-1968.

(2) The approximation of factor-output elasticities by income shares of relevant factors, quite a common practice in the literature, tended to seriously overestimate the true output elasticity of capital and underestimate that of labor in South Korea's manufacturing sector.

(3) The data were not informative enough to draw any substantive conclusions about the elasticity of substitution. Different methods of estimation gave different results. But one conclusion emerged with reasonable certainty: the elasticity of substitution was not significantly different from unity in the majority of the 18 industries while it differed significantly from zero in all the 18 industries.

(4) There were only 2 out of the 18 industries where the assumption of homotheticity in production technology seemed to be violated with statistical significance. Thus, the knowledge about the elasticity of substitution and homotheticity found in this study should be helpful to other research workers who may want to continue exploring the underlying production technologies in order to explain the paradox that the growth of manufacturing employment has been extremely slow in some developing countries despite the rapid growth in output and capital.

(5) The data did not seem to support the classic dualism hypothesis. Only in one industry was there evidence that the production functions differ with statistical significance between small and large-scale firms.

(6) The production function results indicated that the efficient firm size tends to be larger in import-substitution and home-goods industries than in export industries in South Korea's manufacturing sector.

It appears that the outward-looking development strategy adopted in early 1960's in South Korea has resulted in a relatively efficient pattern of trade development by exporting labor-intensive manufactured goods and importing capital-intensive products. Thus the rapid expansion of exports seems to have importantly contributed to the fairly rapid growth in employment in the manufacturing sector, and hence reduced the pressure of underemployment or unemploy-

ment in the agricultural sector. Our production function results further indicate that economic size of firm in general tends to be smaller in export industries than import-substitution and home-goods industries. This suggests that the products which can be produced efficiently on a relatively small scale may be more easily developed into exports at the early stage of manufacturing development. This also suggests that the government's protective measures on some import-substitution industries may help introduce inefficient operation of firms and market structure by permitting non-economic size firms to be profitable, whereas the absence of appropriate government policy in some home-goods industries may allow monopolistic market structure because of the economies of scale.

The research on this project was supported by a grant from USAID. Mr. Nam was a Research Assistant in the University of Minnesota Department of Economics and is currently on the faculty of the Economics Department of Southern Illinois University, Carbondale, Illinois.

THE AGRICULTURAL POLICY PROCESS IN TUNISIA

MALCOLM J. PURVIS
RICHARD M. FRAENKEL

The subject of this research has been the process of making and implementing agricultural policy in Tunisia since the country's independence of 1956. The research is divided into four parts.

The first part is concerned with the process of choosing an overall agricultural policy. Agricultural policy since independence has alternated between market and administrative allocation as follows:

- 1956-1963 – market allocation
- 1963-1969 – administrative allocation
- 1969- – market allocation

These alternations in policy choice reflect the conflict between the "radical" and the "conservative" coalitions in Tunisian national politics. The conservative coalition seeks to preserve the rights of private property and the freedom of market exchange. The radical coalition believes that agricultural development is possible only if decision-making is taken out of the hands of private farmers in the rural localities and centralized in the public administration.

The changes, from market to administrative allocation and back again, have taken place under the continuous leadership of the president, Habib Bourguiba. It is the continuity of control exercised by the presidency at the local level through the prefectural system of field administration of the Ministry of Interior which explains the observed flexibility of agricultural policy choice. The Ministry of

Interior controls, in one way or another, virtually all transactions between private parties and between citizens and the functional bureaus of the administration in the rural localities.

Taken together, parts two and three of our research constitute an empirical and theoretical comparison of market and administrative allocation as systems of power. The focus is on the behavior of intermediary elites in these two systems of allocation. Intermediary elites mediate between the policy and operational levels by performing crucial command and informational functions in the organization of any political system. In the market system, mediation is "cooptative." Programs are implemented in such a way that they reinforce or, at the very least, do not disturb socioeconomic dependency relations in the rural localities between large farmer "patrons" and their small farmer "clients." In the administrative system, on the other hand, mediation is authoritarian and, as a result, little information concerning local knowledge and preferences flows upwards to policy-makers in the organization of the political system. Consequently, policy-makers are largely ignorant of the consequences of their decisions, and have little feedback information by which they might correct them.

The fourth and final part concerns the political consequences of the diffusion of innovations in production activities in the market system of allocation. It is shown that the diffusion of innovation, especially since 1969, has had the consequence of breaking down the control of the Ministry of Interior and the socioeconomic dependency relations between patrons and clients in the rural localities. The diffusion of innovation has led, in other words, to the dispersion of power in ways unforeseen by policy-makers.

The research on this project was supported by a grant from USAID. Mr. Purvis is Associate Professor in the University of Minnesota Department of Agricultural and Applied Economics. Mr. Fraenkel was Research Specialist in the University of Minnesota Department of Agricultural and Applied Economics.

POSSIBLE INTERNATIONAL COMMODITY AGREEMENTS JOHN M. UNDERWOOD

Less-developed countries have been interested in international commodity agreements for many years. But there has been no real consensus pertaining to the specific purpose of these agreements and the form they should take. Since the success of O.P.E.C., interest has centered on agreements that would result in producer cartels designed to benefit producer countries.

The purpose of this study is to develop a method for testing in advance the possible success of such a commodity agreement assuming that the agreement will take the form of a producer cartel, and

the instrument of the agreement will be an export tax. It was decided to put the issue in a dynamic programming framework. Export earnings over the period of the agreement would be the welfare measure, given a linear stochastic commodity market model. Using this quadratic-linear stochastic model it is possible to calculate the optimal export tax and the expected gain in export earnings.

First a specific solution to the problem of calculating the optimal rule for any given simultaneous-equation world market model was developed. This included writing and testing a computer program to do the actual calculations. Next a search for specific world commodity market models was made. It was decided to work with three previously developed models: a tea market model by V.N. Murti; a copper market model by F.M. Fisher, P.H. Cootner, and M.N. Bailey; and a tungsten model by J.C. Burrows.

Presently, the Murti tea model (based on observations from 1946 to 1961 only) is being updated. It is also being changed from a recursive to a simultaneous system since there is no finite solution to the optimality problem using the recursive version. Also, the copper and tungsten models are being revised to fit into the quadratic-linear framework. (Not all the equations in these models were linear.)

It is hoped that the size of the expected gain from the agreements will give some idea of their possible success. In other words, the discovery of a large expected gain from an agreement is a necessary but not sufficient condition for its success since we are ignoring very important problems such as allocation of the gains and possible consumer retaliation. It is also hoped that the question of additional gain from a buffer stock scheme can be explored.

This project is supported by a grant from USAID. Mr. Underwood is Research Assistant in the University of Minnesota Department of Economics.

CONSTRAINTS TO RICE PRODUCTIVITY IN THE PHILIPPINES DONATO ANTIPOORTA

A thorough understanding of constraints to productivity is fundamental to any capacity building in the agricultural sector. The limited success of efforts to modernize agriculture of poor countries during the past decades emphasizes the crucial importance of the environment-specific character of agricultural technology. For the most part, the biological technologies evolved in the developed countries remained unsuitable to the resource endowments and climatic conditions of the LDC's. In the Philippines, the diffusion of the new rice technology has been relatively slow. Adoption of new rice varieties and

packages of practices have not been as rapid as the development of the biological technology at experiment stations. The situation suggests the existence of constraints to the adoption of new rice varieties and the use of supporting inputs. Adoption of the new varieties has been confined to certain areas. It appears that dissimilarities in the physical and economic environment contribute to the uneven distribution of new technology. And even in areas well suited to new varieties, the yield level has been well below its potential. It seems that some economic, social, or institutional factors inhibit the adoption of supporting inputs.

The research proposal hypothesizes that productivity differences among areas are reflections of broad sets of influences. One is the group of factors exogenous to the farm units such as topography, climate, soil type, and agricultural infrastructures. This group of factors is thought to affect both the technical coefficients of the farm inputs and their level of use. Another group consists of the socioeconomic and other behavioral characteristics of individual farm units. As these factors are not related to the technical aspect of production, they are presumed to influence productivity via input levels.

The research is primarily directed at regional analysis dealing with constraints affecting a wide geographic area and the generation of information for building a foundation for disaggregated planning. At the regional level, the study focuses on the agro-climatic variables and agricultural infrastructures as they relate to regional gaps in productivity. The specific objectives of the study are:

(1) To define agricultural regions. A "region" is conceived in this study as a unit which consists of provinces not necessarily contiguous but internally homogenous with respect to a given set of variables. The homogenous grouping enhances the utility of micro-economic analysis in terms of identifying development areas and maximizing the correspondence between development programs and constraints which such programs are designed to ease or eliminate.

(2) To analyze the comparative productivity of homogenous regions. This constitutes a series of tests of hypotheses about the relation between interregional differences in agro-climatic and infrastructural factors, and agricultural productivity. Essentially this is an attempt to isolate the reproducible factors which are important in explaining productivity gaps among the different regions. It is hoped that the results from this analysis shall be useful in identifying effective policy instruments to foster a continuous and balanced agricultural growth among the regions. This phase shall include as many crops as possible, depending upon the availability of data.

(3) To estimate the relationship between productivity of farm inputs and a selected subset of external factors and socioeconomic

variables. Time and cost constraints limit the detailed coverage to rice, a principal agricultural crop.

Present status of the work: The modeling phase of the research has been done and the data required have been collected. Analysis of the data is in progress.

The research on this project has been supported by the Agricultural Development Council, Inc., the International Rice Research Institute, and by a grant from USAID. Mr. Antiporta is an ADC Fellow in the University of Minnesota Department of Agricultural and Applied Economics.

EMPLOYMENT AND FUNCTION INCOME DISTRIBUTION EFFECTS OF AGRICULTURAL DEVELOPMENT IN INDIA: A CASE STUDY OF THE PUNJAB WHEAT ECONOMY SIDDANAİK BISALIAH

I. The Problem

The introduction of new production technology into the wheat farming sector of Indian agriculture has brought about perceptible growth in output. For example, in Punjab, during the year 1967-68, sample mean output per acre on farms employing new production technology was 13.0 quintals, whereas on farms employing old production technology it was only 8.5 quintals. This growth in output has brought to the fore certain interesting issues relating to both growth and equity. What is the source of this newfound growth? How much of it is attributable to technological change, and how much to changes in input levels not attributable to technological change? What is the impact of this growth on employment and functional income distribution? An attempt is being made in this study to examine some aspects of these questions.

II. Objectives

(1) Decompose the total change in output as between farms employing new production technology and farms employing old production technology into three forces:

- a) the change in inputs;
- b) neutral technological change; and
- c) non-neutral technological change.

(2) Decompose the total change in employment as between farms employing new production technology and farms employing old production technology into:

- a) change in output;
- b) change in the relative factor prices;
- c) neutral technological change; and
- d) non-neutral technological change.

(3) Determine the nature and magnitude of change in functional income distribution as between farms employing new production technology and old production technology.

III. Economic and Empirical Framework

The first step is to identify whether the structures underlying two production technologies are different. The economic framework used for this purpose is the aggregate production function. Our empirical framework is stability analysis. This involves the use of analysis of variance as discussed by Chow (1960) and Fisher (1970).

To decompose the total change in output and employment into their respective components, our economic framework is the aggregate production function, and our empirical framework is finite differencing method. This is a numerical method of approximating a total differential (see Brown Appendix C).

We will employ parameters governing production functions to examine the nature and magnitude of change in functional income distribution.

At present the stability test on structural break in production has been completed. We are working on decomposing the total change in output.

References:

Murray Brown, *On the Theory and Measurement of Technological Change* (Cambridge: Cambridge University Press, 1968).

G.C. Chow, "Tests of Equality Between Sets of Coefficients in Two Linear Regressions," *Econometrica*, Vol. 28 (July 1960), pp. 591-605.

F.M. Fisher, "Tests of Equality Between Sets of Coefficients in Two Linear Regressions: An Expository Note," *Econometrica*, Vol. 38 (March 1970), pp. 301-366.

The research on this project is supported by the Agricultural Development Council, Inc. Mr. Bisaliah is an ADC Fellow in the University of Minnesota Department of Agricultural and Applied Economics.

AN ECONOMIC ANALYSIS OF MILK PRODUCTION IN SOUTHERN CHILE CRISTIAN ZEGERS

Milk production has been one of the most dynamic activities in Southern Chile agriculture in the recent past. Output has been growing at a rate of 6 to 8 percent per year. The core of this growth is found in the provinces of Valdivia and Osorno, which have been adjusting their productive structure towards milk and bovine production.

The expansion in milk production has been accompanied by rapid increases in the volume and percentage of total milk processed by the dairy industry. Most of the processed milk is sold in cities located in the Central Zone of Chile as cheese, milk powder, and butter.

The average productive efficiency of dairy farms, however, is low. Increasing the productive efficiency of dairying is important to the farmer, to the region, and to the country. The direct beneficiary of increased output is the farmer generating it, assuming that the net income also increases with output. The region also benefits from the higher levels of economic activity. In the context of Valdivia and Osorno, this is especially important because the dairy activity generates about 1/3 of the regional agricultural product, which corresponds to approximately 1/8 of the regional geographic product.

From a national viewpoint, an expansion in milk production should decrease the imports of milk products that Chile must have in order to satisfy its population needs. If imports are reduced, foreign exchange devoted to milk can be used for other activities. Also, additional production of milk increases the possibilities for achieving higher nutritional levels (quantity and quality) in the population.

All of the above establishes the general setting surrounding the milk activity in Chile and provides the reason for studying this activity in its most important dairy center.

Productivity of dairying in Southern Chile will be examined with respect to economic, environmental, technological, and demographic and social factors. It is hypothesized that these four factor categories adequately explain the production process. Some of the above factors can be regarded as fixed, and man cannot act upon them; but since other factors can be manipulated, it becomes important to determine the relative importance of each factor. Once this determination is made, decisions associated with production changes become easier to make. Some of these variables can be directly controlled by farmers, while others cannot. Also, government can act on certain variables through appropriate policies and programs.

Data on a large sample of farms is currently being collected and analyzed.

The research on the project is supported by the Ford Foundation, the Universidad de Austral and by a grant from USAID. Mr. Zegers is on the faculty of the Universidad de Austral.

SHADOW PRICING FOR PUBLIC ENTERPRISES

PETER G. WARR

Market prices are often thought to be potentially misleading guides for public sector production decisions, especially in less-developed economies. In fact, the belief that production decisions based on market prices are socially non-optimal is commonly the initial reason for locating an enterprise in the public sector. This project investigates the economic issues involved in finding an alternative set of prices (shadow prices) for guiding public production. The study has so far included: (1) a theoretical study of the analytical issues involved in finding welfare-increasing shadow prices, and (2) an empirical study of the implications of shadow pricing for choice of technique in Indonesian rice milling.

The results of the theoretical study so far are that international prices are the correct shadow prices for the valuation of traded commodities irrespective of any tariffs on those or other commodities, price controls on non-traded commodities, the government's income distributional objectives, and the production possibilities available in the public sector. In the case of non-traded commodities, however, no such simple result emerges. The frequently recommended "foreign exchange equivalent" rule has been shown to be false, and the correct shadow pricing rule is much more complex. The important analytical issues being studied are: (1) the informational requirements of finding the correct shadow prices, (2) the convergence of iterative procedures for finding them, and (3) the best rule of thumb to employ if these iterative methods cannot be adopted.

The empirical study has shown that choice of technique in Indonesian rice milling is highly sensitive to alternative assumptions about the social rate of discount. The lower the social rate of discount is assumed to be, relative to the market rate of return on capital, the more labor-intensive is the optimal technique. However, there is *no* discount rate at which the most capital-intensive techniques (recommended by visiting engineering consultants) are optimal. Although these techniques are more efficient in extracting milled rice from paddy, they are overly extravagant in their use of scarce capital.

The research on this project is supported by a grant from USAID. Mr. Warr is a Post-Doctoral Fellow in the University of Minnesota Department of Economics and Department of Agricultural and Applied Economics.

**THE EFFECT OF NONAGRICULTURAL POLICIES ON
ARGENTINE AGRICULTURE
JORGE MARQUEZ-RUARTE**

This project intends to study the effect on agricultural output and exports of policies designed to achieve targets of income distribution, external balance, and growth. The Argentine agricultural sector acts as a moving force of cycles in the balance of payments and nonagricultural income. Furthermore, it is the main target of policies designed to cheapen the cost of living for the workers and to transfer the gains from foreign trade to the process of industrialization.

The unit of study is the cycle in the balance of payments. Preliminary hypotheses referring to this cycle are:

(1) Agricultural harvests or international prices favorable to the country typically initiate a period of surplus in the balance of trade, expansion of the money supply, and increase in employment. Credit becomes easier, restrictions on the import of machinery and raw materials are relaxed, and industries are expanded. The government fails in not recognizing the temporal or cyclical nature of the surplus and the consequent expansion. As prices, both international and domestic, rise, the real wage erodes but a pressure to raise wages becomes more and more irresistible, and a cycle of wage-push inflation, validated by expansion of the money supply, comes about. Given perfect timing, the process would end in higher prices, higher money supply, a lowering level of unemployment which would reach about the same level as before, but without going below the initial level of economic activity. But, be it because of explosive expectations, or because foreign conditions create a downward movement, eventually inflation erodes the competitive advantage in the international goods sector, output declines, the surplus in the balance of payments becomes a deficit, industries find it difficult to import raw material and machinery, and lay-offs follow. In the agricultural sector, the cycle is one of progressive increase in domestic demand triggered by economic expansion, and a reduction in the exportable supply, together with an increase in the price of agricultural inputs.

(2) Although the agricultural sector may be the driving force, the channel is mainly monetary, and the emphasis of this study is on the institutional arrangements (such as a flexible exchange rate, or tax structure) which may be used in order to preclude the worst effects of these cycles, and still take advantage of favorable export conditions.

So far this study has centered on two issues: (1) the effects of foreign price instability of welfare; (2) the working out of a framework to formalize the hypotheses of paragraph (2) above.

It is well known that for a risk-neutral economy, known fluctuation of foreign prices is better than stability on the mean, although the artificial creation of instability by domestic authorities is welfare reducing. A model to analyze these propositions in the presence of costs of adjustment has been developed. It incorporates the following characteristics:

(1) Expenditure depends on the money supply, or, put in other terms, desired hoarding and the excess stock demand for money have the same sign. This is in conflict with some recent models of dynamic behavior in which the desired surplus in balance of payments is independent of the conditions in the money market. [See, for instance, Brito and Richardson, "Some Disequilibrium Dynamics of Exchange-rate Changes," *Journal of International Economics* 5(1975): 1-13].

(2) Unemployment is possible. Monetary models of the balance of payments [those which fulfill condition (1)] are full-employment models, and thus quite ill-suited for the analysis of exchange-rate changes or changes in foreign prices in countries like Argentina.

(3) There may exist money illusion in the short run, but in the long run there must be a recognition of changes in real wages, etc.

(4) It must be possible to analyze the effects of tariffs on exports, imports, outputs, and inputs. Again, full-employment models obscure the employment effects of tariffs, and do not permit the distinction between the balance of payments effects of changes in foreign prices of imported final goods and imported inputs (the effect of the first is a surplus, that of the second a deficit).

The model has very strong implications with respect to the timing of effects of changes in economic data which seem to correspond with the hypotheses elaborated in paragraph (2). I am in the process of preparing a more careful empirical analysis of the timing of some variables, such as agricultural product and consumption, behavior of real wages over the cycle, and a more precise identification of balance of payment cycles.

The research on this project is supported by a grant from USAID. Mr. Marquez-Ruarte is a Post-Doctoral Fellow in the University of Minnesota Department of Economics.

SECTOR ANALYSIS AS AN INSTRUMENT FOR DEVELOPING A PLANNING PROCESS

**TERRY L. ROE
HAROLD KLEIN**

Comprehensive economic models incorporating a relatively large number of endogenous variables and generally focusing on more than one sector of an economy have and are being developed for several

LDC's. These efforts, referred to as sector analysis, were and are being undertaken with the objective of increasing the capacity effectiveness of planning units.

However, history and experience suggests that the effectiveness of empirical techniques in accomplishing this objective is largely dependent on the extent to which they can be institutionalized within the planning process presently in existence.

The general purpose of this study, therefore, is to assess strategies for institutionalizing analytical techniques so that they can become a more effective instrument for inducing desirable changes in the planning process and policy management in LDC's.

The general procedure is to study a single LDC and to focus on the following:

(1) Considerations which must be given to the decision-making structure of the Ministry of Agriculture. That is, the behavioral structure within which policy decisions are made and the policy-making authority exercised on agricultural policy instruments by other ministries within the government;

(2) The importance of the degree of economic control or capacity the government has to influence agricultural policy instruments;

(3) The resources available to the Ministry of Agriculture and its action oriented agencies, and the constraints these resources impose on the selection of alternative approaches to policy management.

The research on this project was supported by grants from AID-Tunisia and USAID. Mr. Roe and Mr. Klein are Associate Professors in the University of Minnesota Department of Agricultural and Applied Economics.

**THE EFFECT OF FOREIGN TRADE AND PUBLIC
INSTITUTIONS ON THE EXTENT AND DIRECTION OF
TECHNICAL CHANGE IN DEVELOPING COUNTRIES
TERRY L. ROE
DAVID F. NYGAARD**

The general problem faced here is one of inducing technical advancements in food production in developing economies through trade in technical factors of production and products. This problem has two parts. One part of the problem lies with the difficulties these economies face in developing and adopting technology which is optimal for their set of factor endowments because the imported technology is often developed in an economy whose factor endowments differ from that in the importing country. The imported technology

is felt to be less efficient to produce undesirable income distribution effects, and to bias the allocation of land and capital in directions which are not consistent with the factor endowments of the country.

The other part of the problem lies with the institutions involved in the importing-exporting activity. Institutions in importing countries appear to play an important role in influencing the terms of trade and product mix of traded items. These organizations are often created in order to control scarce foreign exchange, to collect taxes, and to otherwise influence exports or imports of inputs and outputs. Without a competitive market to guide the selection of imported and exported goods, these institutions appear to be importing technical inputs and exporting products that are inconsistent with the extent and direction of technical change that might otherwise take place.

The general objective of the study is to study what decision rules, taxes, subsidies, or other instruments LDC planners might use to encourage public institutions to import those product mixes and technologies most consistent with the countries' relative factor endowments.

The research on this project is supported by grants from AID-Tunisia and USAID. Mr. Roe is Associate Professor in the University of Minnesota Department of Agricultural and Applied Economics and Mr. Nygaard is Research Assistant in the University of Minnesota Department of Agricultural and Applied Economics.

MULTI-COUNTRY TRADE AND DEVELOPMENT: A PROGRAMMING ANALYSIS

JAMES M. HENDERSON

This project has two parts: (1) the construction of an empirically oriented prototype model of multi-country trade within a nonlinear programming framework, and (2) applications of the model to specific problems of trade and development. Progress has been made on both parts during the past year.

A revised manuscript describing the basic prototype model will be completed during the summer of 1975, and circulated prior to publication. Work to incorporate more nonlinearities into the model is currently underway. This work contains both theoretical and computational aspects. It is possible to replace the fixed-coefficient demand relations for individual countries, which implies unit income elasticities for all commodities, with relations that allow a different fixed income elasticity for each commodity. The possibility of non-zero price elasticities for demand for individual countries is also under investigation. Such demands can be incorporated into models with

small numbers of commodities and countries, but have not yet proved tractable for models with modestly large numbers.

The prospects for the incorporation of nonlinearities on the production side appear very promising. Current work covers systems in which materials inputs are governed by fixed-coefficients, and non-produced factor inputs are governed by Cobb-Douglas or Constant-Elasticity-of-Substitution relations. This work will be pushed ahead during the summer of 1975.

The applications of John Scarbrough and Tercan Baysan have been described elsewhere (see *Annual Report: 1974*, pp. 20-22). Major applications during the coming year are planned in conjunction with the National Bureau of Economic Research project on "Alternative Trade Strategies and Employment" under the direction of Professor Anne O. Krueger. Scholars working with her are performing analysis and gathering basic economic data for a substantial number of LDC's. It is planned to apply one-country versions of the programming model for a large subset of these countries. This will allow the results of the programming model to be used in conjunction with other analysis. Henderson will prepare a paper describing procedures for the one-country applications this summer.

The research on this project is supported by a grant from USAID. Mr. Henderson is Professor in the University of Minnesota Department of Economics.

COMMODITY AND FACTOR MARKETS IN DEVELOPING COUNTRIES

FERTILIZER PRODUCTION, CONSUMPTION, AND DISTRIBUTION IN KOREA: AN ECONOMIC ANALYSIS

DALE C. DAHL
YOUNG KUN SHIM
BAI YUNG SUNG
SANG-WOO PARK

This three-and-one-half-year study of the Korean fertilizer economy has been conducted in four phases: (1) estimation of the demand for fertilizer using three approaches: (a) the traditional time-series analysis, (b) calculation of the derived demand for fertilizer based upon fertilizer response functions developed from agronomic experiments conducted annually over the 1965-1971 period, and (c) per farm demand estimates based upon a sample farm survey taken in Korea; (2) a study of the distribution system for fertilizer in Korea consisting of (a) a survey of distribution outlets at national, provincial, and local levels carried on by a research consultant in Seoul National University in Suwon, Korea, and (b) development of a transshipment model for use in a short-run analysis of distribution patterns for fertilizer and a 1978 estimate of distribution system changes that might be employed under different demand, production, and trade alternatives; (3) studies of production costs for fertilizer manufacturing facilities in Korea (in comparison to engineering cost information) conducted by Young Kun Shim, Korean consultant to the study; and (4) development of a week-long research conference on Asian fertilizer demand and marketing that was held in Honolulu in cooperation with the East-West Center, the Agricultural Development Council, and the Tennessee Valley Authority.

These several dimensions of research and educational activity now serve as a basis for studying the role of fertilizer in agricultural development in other Asian countries and form the basis for future work geared to the development of an Asian fertilizer trade model to be pursued in future years.

The research on this project is supported by a grant from USAID. Mr. Dahl is Professor in the University of Minnesota Department of Agricultural and Applied Economics; Mr. Shim is Professor in Seoul National University Department of Agricultural Economics (Suwon, Korea); Mr. Sung is Assistant Professor in the Sogang University Department of Economics (Seoul, Korea); and Mr. Park was a graduate student in the University of Minnesota Department of Agricultural and Applied Economics, supported by a grant from AID-Korea. Mr. Park is currently a staff member of the Ministry of Agriculture in the government of Korea, Seoul, Korea.

**THE PRICE AND DISTRIBUTION SYSTEM FOR
FERTILIZERS IN TUNISIA
JEROME W. HAMMOND
DALE L. GOOD**

The objectives of the study were to describe the fertilizer distribution system in Tunisia, to examine the factors that influence the level of fertilizer use in Tunisia, and to analyze government policies and programs that affect fertilizer use and distribution. A report on the findings has been completed as a part of the M.S. requirement for Dale Good. Another report for the Tunisian Ministry of Agriculture and for U.S. distribution is being prepared.

The fertilizer distribution system in Tunisia is a combination of government and private enterprise. Government commodity offices and agencies, semi-governmental and private manufacturers, cooperatives, and independent retailers are involved in the distribution of fertilizer to farmers and in implementing distribution.

The fertilizer manufacturers and importers, SEPCM, STIPCE, and STEC, accounted for 21 percent of retail fertilizer sales in 1973. The state-run Office of Cereals accounted for 25.4 percent of retail sales. The remainder was in the hands of cooperatives and independent retailers.

The government has a significant impact on level of fertilizer use through its controls on farm product prices, fertilizer prices, taxes on farm products, taxes on fertilizer, and subsidization of fertilizer production and imports. The impacts of these programs on fertilizer production and use often appear to be conflicting.

A number of changes that could stimulate additional fertilizer use in Tunisia were suggested: (1) Expansion of fertilizer storage facilities in crop production areas would make fertilizer more readily available to farmers during time of need. (2) The reduction or elimination of taxes on farm products and on fertilizer should be rigorously analyzed in regard to its impact on farm production as well as its other economic consequences. (3) The use of high analysis phosphate fertilizer should be encouraged to reduce distribution costs.

The research on this project was supported by a grant from USAID. Mr. Hammond is Professor in the University of Minnesota Agricultural and Applied Economics Department and Mr. Good is currently with the Foreign Agriculture Service, USDA, in Washington, D.C.

TECHNICAL CHANGE AND RESOURCE USE

GREEN REVOLUTION: THE TUNISIAN EXPERIENCE

WILLARD W. COCHRANE

SALEM GAFSI

The broad objective of this study was to determine the forces – economic, institutional, and others – underlying the observed level of adoption of the high-yielding bread and durum wheat varieties by a sample of wheat growers in northern Tunisia. The motivating reason for undertaking this study was to provide a basis for the formulation of an effective policy aimed at encouraging the development and diffusion of new farm practices.

The specific objectives of the study were:

(1) To identify the factors associated with the observed pattern of use of the high-yielding wheats in the agricultural year 1972-73.

(2) To develop the economic rationale underlying the adoption (or non-adoption) of each type of high-yielding variety.

The study was based on a sample survey that involved 375 farms in two regions thought to be representative of the rainfall zones in Northern Tunisia. Two complementary procedures were used in conducting the analysis. First, taking the superiority of the high-yielding wheat varieties over the ordinary ones for granted, an attempt was made at rationalizing the observed pattern of adoption on the basis of a set of hypothesized behavioral relationships. Second, by relaxing the assumption of the superiority of the improved over the ordinary varieties, production theory was used to show that adoption is conditioned by the nature of the technology introduced.

The behavioral approach showed that factors related to the local production environment (mainly land topography) explained over 82 percent of the observed variation among farmers in the degrees of adoption of the improved bread wheats. The adoption equation in this case was:

$$Z = 34.58 + 69.62V - 0.405y - 0.230q_F - 12.53P - 0.024L -$$

(3.74) (2.94) (0.16) (0.04) (3.13) (0.008)

$$0.18E - 0.98q_M$$

(0.07) (0.50)

$$R^2 = 88.9\%$$

In the case of durum wheat, there is a clear excess demand for seeds. Market-related factors [mainly the price of the ordinary wheats in the tolerated (free) market relative to that in the legal (governmentally controlled) market] explained over 70 percent of the variation among farmers in the degrees of adoption of the high-yielding durum wheats. The adoption equation in this case was:

$$Z = 86.59 - 47.50P + 9.42C + 8.33V - 0.19q_F - 7.14A + 0.21D$$

$$(4.50) \quad (3.09) \quad (3.53) \quad (3.61) \quad (0.09) \quad (4.11) \quad (0.12)$$

$$R^2 = 81.0\%$$

where Z is the degree of adoption, V is the topography, y is the yield of the ordinary wheats, q_F is the family claim on the production of the ordinary wheats, P is the price in the tolerated market relative to the legal market for the ordinary varieties, L is the farm size, E is the farmer's schooling, q_M is the quantity sold in the tolerated market relative to that sold in the legal market for the ordinary wheats, A is the difficulty encountered in getting seeds, D is the distance to market, and C is the access to credit. The numbers in parentheses are the standard errors.

The production function approach demonstrated that the introduction of the high-yielding varieties caused a neutral shift in the wheat production function in the case of durum wheats and a non-neutral shift in the case of bread wheats. This implies that, in the case of durum wheats, adoption of the improved varieties requires a minimum amount of adjustments on the part of the farmer since (1) he can continue to combine his inputs the old way while achieving a higher yield, (2) he is not required to use more inputs than previously, (3) he can continue to use the same market outlets to dispose of his output.

The case of bread wheat is, however, more complicated. Farmers have to make extensive adjustments before it becomes feasible for them to exploit the potential of the high-yielding varieties. These adjustments are required (1) in their pre-adoption combination of input, (2) in the level of application of those inputs, and (3) in the marketing outlets for disposing of the output. Farmers have to learn how to combine their resources efficiently in producing the new varieties. They also have to use complementary inputs beyond a certain minimum level in order for the higher productive potential of the new varieties to start materializing. Finally, farmers have to shift their marketing outlets and adjust to a new price structure. Accordingly, adoption of the HYV seeds in the case of bread wheats requires a high learning capacity which implies a reasonable access to technical information and a reasonable aptitude to understand and apply that information. It also requires a certain capacity to finance the purchase of indispensable amounts of inputs. Finally, adoption of the new seeds requires that the increase in yield be at least large enough to compensate for the cost resulting from changes in the marketing system.

Research on this project was supported by grants for CIMMYT and USAID. Mr. Cochrane is Professor in the University of Minnesota Department of Agricultural and Applied Economics. Mr. Gafsi is currently Agricultural Economist with the World Bank in Washington, D.C.

**TECHNOLOGY, INSTITUTIONS AND DEVELOPMENT:
MINNESOTA AGRICULTURE, 1880-1970
JOSEPH C. FITZHARRIS
WILLIS L. PETERSON
VERNON W. RUTTAN**

During the past year, the final data were gathered for the project. Analysis is largely complete. A final monograph report is planned, with publication contemplated.

The introduction would provide a broad sketch of the historical context within which agricultural development in Minnesota has proceeded. The analytical framework will also be outlined. In Chapter 2, the historical record of Minnesota agriculture, with emphasis upon input and output trends and partial productivities, will be examined. The Minnesota Agricultural Experiment Station, its origins, development, work done, and related institutions in the public sector, will be detailed in Chapter 3. In Chapter 4 the private and quasi-public institutions will be treated. Studies of selected cases of technical and institutional innovation comprise Chapter 5. An accounting for the growth in output and productivity in Minnesota agriculture, with particular emphasis upon the impact of the Minnesota Agricultural Experiment Station's work, and the part played by the private and quasi-public institutions will be made in Chapter 6. Finally, the Minnesota case will be summarized in Chapter 7, and the implications of the Minnesota case for development in other countries are drawn in Chapter 8.

Several publications were completed during the year. Willis L. Peterson and Joseph Fitzharris presented a paper to the Conference on *Resource Allocation and Productivity in International Agricultural Research*, Airlie House, Virginia, 26-29 January 1975 ("Organization and Productivity of the Federal-State Research System in the United States," staff paper P74-23). Joseph Fitzharris presented a paper to the Ninth Annual Northern Great Plain History Conference, Mankato, Minnesota, 17-19 October 1974 ("The Development of Minnesota Agriculture, 1880-1970: A Case Study of Productivity Change," staff paper P74-20), wrote a short article ("Farm Management Goes Scientific") for the centennial issue of the Minnesota Agricultural Experiment Station magazine, *Minnesota Science* 31 (Spring, 1975), pp. 36-37, and provided assistance in producing another article.

This project was funded by a grant to the University of Minnesota Economic Development Center from the Rockefeller Foundation. Mr. Fitzharris is Instructor in the College of St. Thomas Department of History. Mr. Peterson is Professor in the University of Minnesota Department of Agricultural and Applied Economics. Mr. Ruttan was formerly Professor in the University of Minnesota Department of Agricultural and Applied Economics and is currently President of The Agricultural Development Council, Inc., in Singapore.

PUBLIC ENTERPRISES AND DEVELOPMENT

POLICIES AND PRINCIPLES UNDERLYING ECONOMIC DECISION-MAKING IN PUBLIC ENTERPRISES

**LEONID HURWICZ
MARTIN E. ABEL**

During the past year the work on this project focused on discerning sets of economic principles which relate to a number of key issues on the management of public enterprises. A Symposium on Economic Principles of Decision-Making in Public Enterprises was held at the University of Minnesota on May 31-June 1, 1975.* The topics covered were (1) incentive aspects of management of public enterprises, (2) pricing policies for public enterprises, (3) non-price decision systems, (4) sustainability of a multiproduct monopoly, and (5) irrigation systems in Taiwan; a decentralized public enterprise.

This project is supported by a grant from MUCIA (Midwest Universities Consortium for International Activities, Inc.) to the University of Minnesota Economic Development Center. Mr. Hurwicz is Regents Professor in the University of Minnesota Department of Economics. Mr. Abel is Professor in the University of Minnesota Department of Agricultural and Applied Economics.

*Symposium participants included from the University of Minnesota: Martin Abel, Francis Boddy, Mongi Boughzala, John Chipman, Parkash Chander, Edward Foster, Shamlall Gupta, Clifford Hildreth, Leonid Hurwicz, Michael Jerison, Anne Krueger, Herbert Mohring, Eli Ndosu, Marcel Richter, Terry Roe, N.J. Simler, Christopher Sims, Peter Warr; from the Bell Laboratory: Elizabeth Bailey; from Colorado State University: L.S. Fan; from Electricite de France: Yves Balasko; from Indian Statistical Institute: T.N. Srinivasan; from Indiana University: Grafton Trout; from International Development Research Centre, Ottawa, Canada: Larry Hannah; from Massachusetts Institute of Technology: Evsey Domar; from New York University: William Baumol; from Northwestern University: Stanley Reiter; from University of California, Berkeley: Roy Radner; from University of Michigan: Alexander Eckstein, Michael Manove; and from University of Ottawa: Thomas Giddings.

RELATED PROJECTS, PROGRAMS, AND ACTIVITIES

Willard W. Cochrane spent October-November in Rome as a consultant to the Food and Agricultural Organization of the UN on a Strategy of International Agricultural Adjustment.

Philip M. Raup participated in November in a conference in Kiel, West Germany, on New Developments in the Organization of Technology of Agriculture in East and West. He also spoke in Kiel on the subject, "The Significance of the Growth of Cooperatives and Corporations for the American Farmer."

Martin E. Abel, Willis L. Peterson, Joseph C. Fitzharris, Delane E. Welsch, and Hans P. Binswanger participated in a conference on Research Allocation and Productivity in International Agricultural Research held at Airlie House, Virginia, in January, which was sponsored by the Agricultural Development Council, Inc. and the International Bank for Research and Development.

Delane E. Welsch, who is currently stationed in Bangkok for the Rockefeller Foundation, attended a conference on development held in Washington, D.C. during February.

Anne O. Krueger was in Japan for a series of lectures sponsored by USIA; in Manila, The Philippines, to attend a conference sponsored by the Asian Development Bank and the National Bureau of Economic Research; in Bogota, Colombia, for the National Bureau of Economic Research; and Caracas, Venezuela, for USIA, in April. She spent part of June in Seoul, Korea, at the Korea Development Institute.

Martin E. Abel was in The Philippines in March to review the thesis work of Donato Antiporta and consult with the staff of the International Rice Research Institute, and in Korea to visit with economists at several universities and government agencies.

W. Burt Sundquist and Terry L. Roe spent time in Tunisia consulting with members of the University of Minnesota Tunisian Team. Robert Reeser of the Team spent January and Harold Klein spent April-June at the University of Minnesota.

Martin E. Abel, Leonid Hurwicz, Philip M. Raup, and Richard M. Fraenkel attended a conference on Group Farming held at the University of Wisconsin in June sponsored by the Agricultural Development Council, Inc. and the University of Wisconsin Land Tenure Center.

Dale C. Dahl and Martin E. Abel were in Honolulu in June to participate in a Research Conference on Asian Fertilizer Demand and Marketing.

Lee R. Martin is working with the Economic and Sector Planning Division, Technical Assistance Bureau, Agency for International Development to help the Division develop procedures for working on

natural resource subsector analyses in selected LDC's. He was stationed in Washington for 5 weeks in May and June, and will spend 3 weeks in July and August, and 8 months from September through May 1976.

The National Bureau of Economic Research signed a three-year contract with AID, effective July 1, 1974, under which the relationship between trade strategy and employment will be investigated. Professor Anne O. Krueger of the University of Minnesota Department of Economics and the NBER is Project Director. The contract stipulates that the major part of the first year be devoted to the detailed formulation of a research plan, the identification of project participants, and other preparatory research and organizational work.

The work is now in progress, and not all aspects of the project are fully worked out at this time. Indeed, one important feature of the research is that the project participants will play a central role in the formulation of the final research design. It is therefore inevitable that, at this stage, the details of the project are in many regards tentative.

The basic purpose of the project is to answer the following questions: What are the differences, if any, between the amount and pattern of employment associated with exporting and that associated with import-substitution activities in developing countries? Why do these differences arise?

With respect to the first of these questions, a major empirical effort will have to be devoted to the measurement, on a reasonably comparable basis across countries, of the labor and capital coefficients in import substituting and export industries. Interest will center upon differences in the coefficients at a point in time, and in changes in them over time. Of course, employment is multi-dimensional (urban-rural, skilled-unskilled, private, and public), and attention will have to be given, not simply to the coefficients pertaining to numbers of workers per unit of export and import-substituting production, but also the skill requirements and other dimensions of employment associated with different activities.

The "why" has two parts: both analytical work and empirical work is necessary. At an analytical level, the hypotheses as to determinants of comparative advantage in well-functioning markets need to be considered, especially in light of what happens in the presence of deviations from optimal allocations. At an empirical level, data on the various determinants of comparative advantage and on various factors that lead to nonoptimality (tariffs and quotas, factor market distortions, and so on) will have to be gathered and analyzed.

Hypotheses with regard to the determinants of comparative advantage are well known. The factor proportions model of trade would presumably predict that LDC exports are intensive in the use of unskilled labor relative to LDC import substitution industries *if* com-

parative advantage is followed. There are, of course, competing hypotheses, and the simple predictions of the Heckscher-Ohlin model have not stood up well in tests for developed countries. Those alternative hypotheses include focus upon raw materials (which can be regarded as a third factor of production as, for example, in the work of Vanek), technology (as in the work of Keasing and Vernon), and the role of skills (another potential "three-factor" model). These hypotheses, which are fairly well spelled out in the literature, provide the analytical basis for the empirical measurement of inputs, especially of labor, into various industries.

Measurement of what labor coefficients are, however, will not provide a test of alternative hypotheses with regard to the determinants of comparative advantage until account is taken of the effects of nonoptimalities. What is needed is a systematic theory of the manner in which various phenomena intertwine with comparative advantage to determine the actual pattern of exports and import-substitutes. Export subsidies and protection accorded to import-substituting industries can affect the commodity composition of trade in a variety of ways and result in very different employment generation than that which would be observed under free trade. Factor market interventions (including the overvaluation of foreign exchange and implicit subsidization of capital goods) can affect the choice of technique within industries, and can also affect the actual pattern of trade. Thus, interventions and imperfections can affect the commodity composition of trade and the employment coefficients of each commodity, thereby affecting the relationship of import substitution and exporting industries to employment in two separate, but interacting, ways.

As the discussion above suggests, the empirical work on the "why" side will entail analysis of the various incentives and distortions that affect the commodity composition of trade. Data will have to be gathered on deviations of domestic from international prices, on factor market distortions, and on the pattern of export incentives. The impact of those phenomena on the commodity terms of trade will then have to be analyzed.

Jean-Claude Koeune is Managing Editor and Anne O. Krueger Consulting Editor of *Portfolio*, a publication circulated by the U.S. Information Agency to a select foreign audience of economic policy makers, including Central Bank officials, top civil servants in economic ministries, journalists, and so on. The editorship was assumed last Fall under a contract with U.S.I.A.

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The main section of a typical issue is composed of five to nine recent articles written by prominent U.S. economists, and also includes a brief synopsis of each article and a general overview by the editors. Most of the articles are selected from a wide variety of economic, financial, and commercial sources, including professional economic journals, conference proceedings, and also less well-known sources, such as, for instance, the *Middle East Information Series* (from which an article by Kenneth Arrow was selected), and Richard Cooper's 1973 Wicksell Lectures in Stockholm. In addition a few articles are written expressly for *Portfolio*. Four articles have been commissioned so far: Jacob Mincer on "Population and Labor Force in Economic Growth"; Charles Kindleberger on "The Merchant and Technology Transfer: Quality Control and Delivery Dates in the 18th Century"; Harry Johnson on "Equity, Economic Theory and Economic Development"; and W. Lee Hansen on "Financing Higher Education."

In the selection process on a given theme an attempt is made to strike a balance between articles that reflect the state of the theoretical debate, articles that illustrate the use of various techniques of empirical analysis and yield empirical evidence, and articles that deal more directly with policy issues. Quality of the material, however, remains the primary criterion for inclusion. In writing the overview the editors aim at more than simply presenting the articles. The overview is seen as a self-contained piece of analysis which should guide the reader through a given problem by separating the issues that are still controversial from those over which there is substantial agreement in the U.S. economic profession, and by indicating the

type of research and empirical evidence that would clarify or resolve the debate.

Each *Portfolio* contains, in addition, a section of Reports and Documents emanating from International or U.S. public and private institutions, as well as annotated listings of new books and articles culled from (and reproduced with permission of) the *Journal of Economic Literature*.

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STAFF DEVELOPMENTS

Terry L. Roe has returned to the Department of Agricultural and Applied Economics having served two years as a member of the Tunisian Team in Tunisia.

Surjit S. Sidhu spent two months in the Department of Agricultural and Applied Economics and will return to the Department of Economics, University of Dar-es-Salaam, Dar-es-Salaam, Tanzania, for two additional years.

Vernon R. Eidman joined the staff of the Department of Agricultural and Applied Economics as Professor. He will be teaching and conducting research in the areas of farm management, production economics, and related areas. He comes from Oklahoma State University.

A.A. Walters, Cassel Professor of Economics, London School of Economics and Political Science, spent the month of April in the Department of Economics.

T.N. Srinivasan, Indian Statistical Institute, New Delhi, gave a series of lectures in the Department of Economics during May and June.

Uri Ben-Zion, Senior Lecturer, Technion, Israel Institute of Technology, Haifa, is a Visiting Professor in the Department of Economics.

Jerry Kelly, Syracuse University, will spend the academic year 1975-76 as a Visiting Professor in the Department of Economics.

Abraham Subotnik, Professor in the Faculty of Industrial and Management Engineering, Technion, Israel Institute of Technology, Haifa, will be a Visiting Associate Professor in the Department of Agricultural and Applied Economics during the coming year.

David Schmeidler, University of Illinois, will be a Visiting Professor in the Department of Economics during winter and spring quarters 1976.

CENTER PUBLICATIONS

CENTER BOOKS AND MONOGRAPHS

Yujiro Hayami (with Barbara B. Miller, William W. Wade, and Sachiko Yamashita), *An International Comparison of Agricultural Production and Productivities*. St. Paul: University of Minnesota Agricultural Experiment Station Technical Bulletin 277, 1971 (paper).

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Peter Gregory, *Industrialization and Wages in Japan*. Geneva: International Labour Office, Second Impression, 1973.

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- 70-1 Lawrence B. Morse, "The 1967 Peruvian Exchange Crisis: A Note," *The American Economic Review*, Vol. 60, No. 1, March 1970, pp. 189-194.
- 70-2 Yujiro Hayami and Vernon W. Ruttan, "Factor Prices and Technical Change in Agricultural Development: The United States and Japan, 1880-1960," *The Journal of Political Economy*, Vol. 78, No. 5, September/October 1970, pp. 1115-1141.
- 70-3 Yujiro Hayami and Vernon W. Ruttan, "Korean Rice, Taiwan Rice, and Japanese Agricultural Stagnation: An Economic Consequence of Colonialism," *The Quarterly Journal of Economics*, Vol. 84, November 1970, pp. 563-589.
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- 71-1 Yujiro Hayami, "Elements of Induced Innovation: A Historical Perspective for the Green Revolution," *Explorations in Economic History*, Vol. 8, No. 4, Summer/1971, pp. 445-472.

*Single copies of UM EDC reprints may be obtained from the Center offices at the University of Minnesota.

- 71-2 V. Somasundara Rao, "Tariffs and Welfare of Factor Owners: A Normative Extension of the Stolper-Samuelson Theorem," *Journal of International Economics*, Vol. 1, No. 4, November 1971, pp. 401-415.
- 71-3 Vernon W. Ruttan, "Technology and the Environment," *American Journal of Agricultural Economics*, Vol. 53, No. 5, December 1971, pp. 707-717.
- 71-4 Aida Recto Librero, "The International Demand for Philippine Coconut Products: An Aggregate Analysis," *The Philippine Economic Journal*, Vol. 10, No. 1, First Semester 1971, pp. 1-22.
- 72-1 Yujiro Hayami, "Rice Policy in Japan's Economic Development," *American Journal of Agricultural Economics*, Vol. 54, No. 1, February 1972, pp. 19-31.
- 72-2 Yujiro Hayami and Willis Peterson, "Social Returns to Public Information Services: Statistical Reporting of U.S. Farm Commodities," *The American Economic Review*, Vol. 62, No. 1, March 1972, pp. 119-130.
- 72-3 Vernon W. Ruttan and Yujiro Hayami, "Strategies for Agricultural Development," *Food Research Institute Studies*, Vol. XI, No. 2, 1972, pp. 129-148 (with "Comment" by George L. Beckford, pp. 149-154).
- 73-1 T. Paul Schultz, "Explanation of Birth Rate Changes over Space and Time," *The Journal of Political Economy*, Vol. 81, No. 2, Part II, March/April 1973, pp. S238-S274.
- 73-2 Vernon W. Ruttan and Yujiro Hayami, "Technology Transfer and Agricultural Development," *Technology and Culture*, Vol. 14, No. 2, Part 1, April 1973, pp. 119-151.
- 73-3 T. Paul Schultz, "A Preliminary Survey of Economic Analyses of Fertility," *The American Economic Review*, Vol. 63, No. 2, May 1973, pp. 71-78.
- 74-1 Joseph C. Fitzharris, "Science for the Farmer: The Development of the Minnesota Agricultural Experiment Station, 1868-1910," *Agricultural History*, Vol. 48, No. 1, January 1974, pp. 202-214 (with "Comment" by Roy V. Scott, pp. 215-220).
- 74-2 Yujiro Hayami, "Conditions for the Diffusion of Agricultural Technology: An Asian Perspective," *The Journal of Economic History*, Vol. XXXIV, No. 1, March 1974, pp. 131-148.

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73-1 K. William Easter and Martin E. Abel, *Cropping Regions in India*, June 1973.

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Mitoshi Yamaguchi and Hans P. Binswanger, "The Role of Sectoral Technical Change in Development: Japan 1880-1965," *American Journal of Agricultural Economics*, Vol. 57, No. 2, May 1975, pp. 269-278.

K. William Easter, "Field Channels: A Key to Better Indian Irrigation," *Water Resources Research*, Vol. 11, No. 3, June 1975, pp. 389-392.

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1968

Morris Teubal, "Optimum Patterns of Agricultural and Industrial Development for a Small Economy." Instituto Torcuato Di Tella, Centro de Investigaciones Economicas, Buenos Aires (26), Argentina (AO).

1969

Morris Teubal, "Developing Strategy for a Medium-Sized Economy." Instituto Torcuato Di Tella, Centro de Investigaciones Economicas, Buenos Aires (26), Argentina (AO).

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Ralph H. Hofmeister, "Growth With Unemployment in Latin America: Some Implications for Asia." Prepared for the AID, NESAP Employment Conference, Kathmandu, July 6-9, 1970 (AO).

Yujiro Hayami and Vernon W. Ruttan, "Induced Innovation and Agricultural Development." Presented at a conference on the Micro Aspects of Development, University of Illinois (Chicago Campus), November 20, 1970 (AAE SP71-1; Econ DP3).

Peter Gregory, "Wage Structure in Latin America." Presented at a seminar on Labor Issues and Planning Process at the Organization of American States, Washington, July 1970 (Econ DP4).

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Clayton Ogg, "Johnson and Johnson on Sugar Policy." Draft, University of Minnesota, Department of Agricultural and Applied Economics, January 1971 (AO).

Peter Gregory, "Wages Under Conditions of Surplus Labor in Japan." Draft, University of Minnesota, Department of Economics, 1971 (AO).

Adolf Weber, "Agricultural Modernization in Market and Planned Economies: The German Experience," August 1971 (AAE SP71-16). (See Journal Articles)

Patrick Yeung and Terry Roe, "Induced Innovation: A CES-Type Meta-Production Function," December 1971 (AAE SP71-27).

Vernon W. Ruttan, "Perspective on the 'Green Revolution' in Asia." Summary of papers presented at the Rice Policy Conference, International Rice Research Institute, Los Banos, Philippines, May 9-14, 1971, and Conference on Agricultural and Economic Development, Japan Economic Research Center, Tokyo and Hakone, September 6-10, 1971 (AAE SP71-30).

Marcelo Selowsky and Lance Taylor, "The Economics of Malnourished Children: A Study of Disinvestment in Human Capital," December 1971 (Econ DP13).

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Abdelmagid Slama, Willis Anthony, and John DeBoer, "Livestock Projections by the Technique of Flow Charts," January 1972 (AAE SP72-3).

Lee R. Martin, "Some Market Effects of Agricultural Development on Functional Income Distribution in Developed Countries," March 1972 (AAE SP72-9).

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Surjit S. Sidhu, Jitender S. Mann, and Martin E. Abel, "The Demand for Cotton in India, 1952-1968," June 1972 (AAE SP72-16).

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B.B. Batra and K. William Easter, "High Returns from Field Channels in Irrigated Indian Villages," September 1972 (AAE SP72-24).

M.A. Zaidi and S.K. Mukhopadhyay, "Economic Development, Structural Change, and Employment Potential," September 1972 (IRC4).

Martin E. Abel, "The Developing Countries and United States Agriculture," October 1972 (AAE SP72-25).

Hans P. Binswanger, "The Measurement of Biased Technical Change in the Many Factor Case: U.S. and Japanese Agriculture," December 1972 (AAE SP72-28). (Revised in AAE SP73-25, October 1973; see Journal Articles).

Hans P. Binswanger, "Induced Innovation: A Critical Review of the Theory and Conclusions from New Evidence," December 1972 (AAE SP72-29).

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Surjit S. Sidhu, "Economics of Technical Change in Wheat Production in Punjab (India)," January 1973 (AAE SP73-9). (See Journal Articles.)

Martin E. Abel, Delane E. Welsch, and Robert W. Jolly, "Technology and Agricultural Diversification," January 1973 (AAE SP73-10).

Surjit S. Sidhu, "Relative Efficiency in Wheat Production in the Indian Punjab," January 1973 (AAE SP73-11). (See Journal Articles.)

Hans P. Binswanger, "A Cost Function Approach to the Measurement of Factor Demand Elasticities and Elasticities of Substitution," January 1973 (AAE SP73-12). (Revised in December 1973, AAEA-ES paper; see Journal Articles.)

Masakatsu Akino and Yujiro Hayami, "Sources of Agricultural Growth in Japan, 1880-1965," April 1973 (AAE SP73-13). (See Journal Articles.)

T. Paul Schultz, "Economic Factors Affecting Population Growth: A Preliminary Survey of Economic Analyses of Fertility," April 1973 (Econ DP29).

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Egbert Gerken, "An Alternative Approach to the Theory of Labor Supply in LDCs," July 1973 (AAE SP73-18).

Willis Peterson and Yujiro Hayami, "Technical Change in Agriculture," July 1973 (AAE SP73-20).

Assaf Razin and Uri Ben-Zion, "An Intergenerational Model of Population Growth," July 1973 (Econ DP34).

Adolf Weber, "Productivity Growth in German Agriculture: 1850 to 1970" and "Appendix: Data on Productivity Growth in German Agriculture: 1850 to 1970," Revised August 1973 (AAE SP73-1).

Delane E. Welsch, "Resource Use in Systems of Intensive Animal Production," August 1973 (AAE SP73-22).

T. Paul Schultz, "Determinants of Fertility: A Micro Economic Model of Choice," October 1973 (AO).

Joseph C. Fitzharris, "Science for the Farmer: The Development of the Minnesota Agricultural Experiment Station, 1868-1910," August 1973 (AAE SP73-24). (See Center Reprint Series.)

Hans P. Binswanger, "The Measurement of Technical Change Biases with Many Factors of Production," October 1973 (AAE SP73-25) (replaces SP72-28). (See Journal Articles.)

Martin E. Abel and Delane E. Welsch, "Technology and the Agricultural Output Mix," October 1973 (AAE SP73-26).

Hans P. Binswanger, "A Cost Function Approach to the Measurement of Elasticities of Factor Demand and Elasticities of Substitution," Paper prepared for the joint AAAE-ES Session of the Winter Meetings, New York, New York, December 1973. (See Journal Articles.)

K. William Easter, "Improving Irrigation in India: The Neglected Opportunity," December 1973 (AAE SP73-33).

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Hans P. Binswanger, "A Microeconomic Approach to Induced Innovation," March 1974 (AAE SP74-3). (See Journal Articles.)

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Mitoshi Yamaguchi and Hans P. Binswanger, "The Role of Sectoral Technical Change in Development: Japan 1880-1965," April 1974 (AAE SP74-7). (See Journal Articles.)

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K. William Easter, "Returns from Investments in Improving Village Irrigation Systems: An Example from India," July 1974 (AAE SP74-13).

Uri Ben-Zion and Vernon W. Ruttan, "Money in the Production Function: An Interpretation of Empirical Results," July 1974 (Econ DP74-44).

Martin E. Abel and Delane E. Welsch, "Microeconomics of Technology and the Agricultural Output Mix," August 1974 (AAE SP74-16).

Martin E. Abel and Delane E. Welsch, "Environmental Constraints, Commodity Mix, and Research Resource Allocation," August 1974 (AAE SP74-19).

Joseph C. Fitzharris, "The Development of Minnesota Agriculture, 1880-1970: A Study of Productivity Change," September 1974 (AAE SP-20).

Peter G. Warr, "The Economics of Shadow Pricing: Market Distortions and Public Investment," October 1974 (AAE 74-22).

Willis L. Peterson and Joseph C. Fitzharris, "The Organization and Productivity of the Federal-State Research System in the United States," October 1974 (AAE SP74-23).

Richard Fraenkel and Mathew Shane, "Land Transfer and Technical Change in a Dualistic Agriculture: A Case Study," October 1974 (AAE SP74-24).

Lee R. Martin, "A Strategy for Agricultural Development in Thailand and Its Management Requirements," November 1974 (AAE SP74-25).

Uri Ben-Zion and Vernon W. Ruttan, "Aggregate Demand and Technological Changes: A Macro-economic Model of Induced Innovations," October 1974 (AAE SP74-26).

Assaf Razin, "Economic Growth and Education: New Evidence," November 1974, Working Paper No. 65, Tel-Aviv University (AO).

Richard Blue and Yashwant Junghare, "Political and Social Factors Associated with the Public Allocation of Agricultural Inputs in a Green Revolution Area: The Case of Rajasthan," Center for Comparative Studies in Technological Development and Social Change, Office of International Programs, University of Minnesota, 1974 (AO).

Peter G. Warr, "A Note on Shadow Pricing with Fixed Taxes," December 1974 (Econ DP74-52).

Richard N. Blue with Yashwant Junghare, "Winners, Losers, and Survivors in a Green Revolution Area: Some Lessons from the Rajasthan Experience," Center for Comparative Studies in Technological Development and Social Change, Office of International Programs, University of Minnesota, 1974 (AO).

1975

John Sanders and Frederick Bein, "Agricultural Development on the Brazilian Frontier," January 1975 (AAE SP75-1).

Patrick Yeung and Terry L. Roe, "A CES Approach to the Measurement of Induced Factor Augmentation: A Test for Japan," January 1975 (AAE SP75-4).

Center Staff Papers (SP) and Discussion Papers (DP) are available as indicated by the following:

(AO) – available from author only

(AAE) – available from Department of Agricultural and Applied Economics

(Econ) – available from Department of Economics

(IRC) – available from Industrial Relations Center

CENTER PH.D. THESES

1968

Lawrence B. Morse, *The Peruvian Experience with Fixed and Flexible Exchange Rates: An Empirical Examination*, Department of Economics, University of Minnesota, 1968.

V.S. Rao, *Disaggregated Demand and Some Aspects of the Pure Theory of International Trade*, Department of Economics, University of Minnesota, 1968.

1971

Eduardo Sarmiento, *Efficient Allocation of Resources in the Supply of Water for Domestic Consumption: Colombia*, Department of Economics, University of Minnesota, 1971.

Sung Hwan Ban, *Long-Run Productivity Growth in Korean Agricultural Development, 1910-1968*, Department of Agricultural and Applied Economics, University of Minnesota, 1971.

Aida Eguia Recto, *An Analysis of the International Demand for Philippine Coconut Products*, Department of Agricultural and Applied Economics, University of Minnesota, 1971.

1972

Edgardo E. Barandiaran, *The Control of Money and Bank Credit in Argentina*, Department of Agricultural and Applied Economics, University of Minnesota, 1972.

Alvin John DeBoer, Jr., *Technical and Economic Constraints on Bovine Production in Three Villages in Thailand*, Department of Agricultural and Applied Economics, University of Minnesota, 1972.

Peter Greenston, *The Food for Peace Program and Brazil: Valuation and Effects of the Commodity Inflow*, Department of Economics, University of Minnesota, 1972.

Terry Monson, *Migration, Experience-Generated Learning and Infant Industries: A Case Study of Turkey*, Department of Economics, University of Minnesota, 1972.

Surjit S. Sidhu, *Economics of Technical Change in Wheat Production in Punjab (India)*, Department of Agricultural and Applied Economics, University of Minnesota, 1972.

Francisco E. Thoumi, *A Theory of International Trade of Used Durable Goods with an Application to Underdeveloped Countries*, Department of Economics, University of Minnesota, 1972.

Remigio D. Torres, *Potential Benefits and Pricing of Irrigation Water: A Case Study of the Santa Cruz System*, Department of Agricultural and Applied Economics, University of Minnesota, 1972.

1973

John H. Sanders, *Mechanization and Employment in Brazilian Agriculture, 1950-1971*, Department of Economics, University of Minnesota, 1973.

Mitoshi Yamaguchi, *Technical Change and Population Growth in the Economic Development of Japan*, Department of Agricultural and Applied Economics, University of Minnesota, 1973.

Sachiko Yamashita, *An Exploration of the Economics of Taste and Demand for Food*, Department of Agricultural and Applied Economics, University of Minnesota, 1973.

William W. Wade, *Institutional Determinants of Technical Change and Agricultural Productivity Growth: Denmark, France, and Great Britain, 1870-1965*, Department of Agricultural and Applied Economics, University of Minnesota, 1973.

1974

Tercan Baysan, *Economic Implications of Turkey's Entry into the Common Market*, Department of Economics, University of Minnesota, 1974.

Michael J. Hay, *An Economic Analysis of Rural-Urban Migration in Tunisia*, Department of Agricultural and Applied Economics, University of Minnesota, 1974.

Sudhin K. Mukhopadhyay, *Sources of Variation in Agricultural Productivity: A Cross-Section Time-Series Study of India*, Department of Economics, University of Minnesota, 1974.

Clayton W. Ogg, *Sources of Agricultural Productivity Differences in North America*, Department of Agricultural and Applied Economics, University of Minnesota, 1974.

Peter K. Pollak, *Economic Analysis of Oilseed Markets in Thailand*, Department of Agricultural and Applied Economics, University of Minnesota, 1974.

Enrique O. Scala, *The Efficiency of Import Substitution in the Argentine Automotive Industry*, Department of Economics, University of Minnesota, 1974.

John E. Scarbrough, *Some Economic Effects of Customs Unions in South America*, Department of Economics, University of Minnesota, 1974.

Bai Yung Sung, *The Demand for Fertilizer in Korea*, Department of Agricultural and Applied Economics, University of Minnesota, 1974.

1975

*Salem Gafsi, *Green Revolution: The Tunisian Experience*, Department of Agricultural and Applied Economics, University of Minnesota, 1975.

*Chong Nam, *Economies of Scale and Production Functions in South Korea's Manufacturing Sector*, Department of Economics, University of Minnesota, 1975.

*Sang-Woo Park, *Fertilizer Distribution in Korea*, Department of Agricultural and Applied Economics, University of Minnesota, 1975.

Copies of Ph.D. theses completed under Center sponsorship may be obtained from University Microfilms, Ann Arbor, Michigan. Copies of these theses identified by (*) will not be available from University Microfilms until early 1976.

**WORKSHOPS AND SEMINARS
JULY 1974 – JUNE 1975**

WORKSHOPS*

AGRICULTURAL DEVELOPMENT AND TRADE WORKSHOPS

Maury Breckahl, "European Community Grain Policies and their Relation to World Trade."

Boyd Buxton, "An Analysis of Alternative Dairy Import Policies."

Yigal Danin, "Grain Reserves and Price Stabilization: Theory and Practice."

Larbi Firdawcy, Institut Hassan II, Rabat, Morocco, "Manpower Planning in Morocco."

Richard Fraenkel, "National Policy, Innovation, and the Local Political Process: Agricultural Development in a Farming Locality in Northern Tunisia."

Richard Fraenkel and Mathew Shane, "Land Transfer and Technical Change in a Dualistic Agricultural Sector."

Salem Gafsi, "Green Revolution: The Tunisian Experience."

Salem Gafsi, "Adoption of New Wheat Technology in Tunisia."

Dale Good, "Fertilizer Distribution in Tunisia."

Dale Good, "Fertilizer Marketing in Tunisia."

Hans Gregersen, "Problems of Foreign Investment in Renewable Resources in Latin America."

James P. Houck, "Food Reserves, Buffer Stocks, and Export Controls."

James P. Houck, "Grain Reserves and Export Controls."

Chaiwat Konjing, "Thailand's Maize Export Agreements: Their Effect on Price and Market for Thai Maize."

Harold Klein, "Designing and Implementing Agricultural Planning Systems: A Tunisian Case Study."

Yair Mundlak, Harvard University, "Development of Agriculture in Israel over Twenty Years."

George Norton, "Regional Variations in Agricultural Productivity in the Wheat Regions of India."

Sang-Woo Park, "Fertilizer Distribution System in Korea."

Robert Reeser, "Institution Building in Agricultural Economics in Tunisia."

Terry Roe, "Agricultural Sector Analysis in Tunisia: Part I."

*Except where otherwise indicated, speakers were faculty or students at the University of Minnesota.

Peter Warr, "Shadow Pricing and Choice of Technique In Indonesian Rice Milling."

William Wong, "The Role of Bargaining Power in the Malaysian Agricultural Sector."

HUMAN CAPITAL WORKSHOP

Alan Blinder, Princeton University, "Human Capital and Labor Supply: A Synthesis."

Bernardo Kugler, "The Influence of Schooling on Earnings for Urban Colombian Youth."

Randy Olsen, "Wives."

Funkoo Park, "Estimates of Earnings Function for the Korean Labor Market."

Jack Rodgers, "The Effect of College Quality on Earnings."

Michael Wachter, "Understanding the Employment Relation: The Analysis of Idiosyncratic Exchange."

TRADE AND DEVELOPMENT WORKSHOP

William Brock, University of Chicago and Cornell University, "Economic Theory of Politics: The Case of Tariffs."

Jacob Frenkel, University of Chicago, "Portfolio Equilibrium and the Balance of Payments: A Monetary Approach."

James P. Houck, "Export Controls and Food Reserves."

Gary Hufbauer, Treasury Department, "U.S. Tax Policy Towards Multi-national Corporations."

Helen Hughes, IBRD, "The Distribution of Gains from Foreign Direct Investment."

Leonid Hurwicz, "Principles of Resource Allocation and Public Enterprise."

David Kendrick, University of Texas, "The World Cocoa Market."

Anne O. Krueger, "Effect of Devaluation on Price Levels."

Anne O. Krueger, "Comparative Advantage and Factor Market Distortions."

Jorge Marquez-Ruarte, "Factor Market Distortions and Output Response to Price."

Jorge Marquez-Ruarte, "Effective Protection and Substitution: The Short-run View."

Michael Michaely, IBRD, "Export Policies in Developing Countries – A Research Agenda."

Terry Monson, University of Michigan, "A DRC Evaluation of Expatriate Labor Replacement in the Ivory Coast."

Yair Mundlak, Harvard University, "The Effects of Distortions in Factor Markets on Short-run Equilibrium."

Chong Nam, "Economies of Scale and Production Functions in Korean Manufacturing."

Gershom Rudish, "The Effects of Anticipated Rate Changes."

Richard Snape, Monash University, "Tariffs and Product Differentiation."

Yun-Wing Sung, "Factor Proportions in an Export-Dependent Economy: The Case of Hong Kong."

John Underwood, "Optimization Rules for Production Groups in a Stochastic Market Setting."

Julio Vinuela, "An Evaluation of Spain's Protection Policy."

Peter Warr, "The Theory of Shadow Pricing."

SEMINARS*

DEPARTMENT OF AGRICULTURAL AND APPLIED ECONOMICS

Donald Baker, "Weather Patterns and the Probability for a Good Crop Year in 1975."

Albert Chominot, Department of Social Sciences, National Institute of Agronomy, Paris, "The Land Question in French Agriculture."

William Griffith, University of New England, Armidale, New South Wales, Australia, "Combining Time Series-Cross Section Data: Alternative Models and Estimates."

John Hoyt, Jr., "New State Government Data Sources."

Grady Mann, Private Consultant, "Operations of the Saskatchewan Land Bank."

Ted Moriak, Commodity Economics Division, USDA, (discussion of current and emerging policy issues).

V. James Rhodes, University of Missouri, "The Changing Structure of the U.S. Livestock Industry."

John Rosine, Minneapolis Federal Reserve Bank, "Cattle Cycles – Past and Present."

Vernon W. Ruttan, Agricultural Development Council, "Induced Institutional Change."

Gary SeEVERS, Council of Economic Advisors, Washington, D.C., "The New Economics of Agriculture."

Abraham Subotnik, Technion, Israel Institute of Technology, Haifa, "Analysis of Some Economic Stabilization Schemes."

Tom Veblen, Cargill, Inc., Minneapolis, "The Future Role of Multinationals in Meeting World Food Needs."

RESOURCE ECONOMICS (DEPARTMENT OF AGRICULTURAL AND APPLIED ECONOMICS)

Stephen Fagerlie, "Economic Aspects of Preserving the Bald Eagle."

Donald Genadek, "Uncertainty in Project Evaluation."

John Gostovich, "Petroleum and Pricing – Theory and Practice."

Hans Gregersen, "Estimating Effectiveness and Efficiency of Subsidy Programs."

Alan Hopeman, Staff Assistant to Minnesota Legislature, "Environmental Impact Statements."

Ronald Hays, Private Consulting Engineer, "Issues in Copper-Nickel Mining in Minnesota."

Glenn Knowles, "Economics of Commercial Fishing."

Chaiwat Konjing, "Economics of Irrigation in Thailand."

David MacGillivray, "Regional Economic Planning."

William Meyers, "The Measurement of the Social Opportunity Cost of Labor in a Labor Surplus Economy."

Duvvuri Ramakrishnaiah, "Social Opportunity Cost in Upland Agriculture."

John Spriggs, "Energy Conservation vs. Economic Growth."

Audun Tvedten, "Public Lands and the Problems of Common Property Resources."

John Waelti, "DNR and Drainage."

Peter Warr, "Shadow Pricing."

DEPARTMENT OF ECONOMICS

Aloisio Araujo, University of California, Berkeley, "Aggregation of Demand Correspondences."

Peter K. Clark, "Rational Expectation and the Theory of Investment."

Jaime Demelo, Yale University, "A Multisector Trade Model Applied to Colombia."

Andrew Feltenstein, Yale University, "General Equilibrium in a Soviet Economy."

Milton Friedman, University of Chicago, "U.S.-U.K. Evidence on Price and Output Reactions to Monetary Change."

W. Lee Hansen, University of Wisconsin, "Financing Post-Secondary Education: Tuition Loans and All That."

Gary Hufbauer, Office of Secretary of the Treasury, Washington, "U.S. Tax Policy Towards Multinational Corporations."

Leonid Hurwicz, "Revelation of True Preferences in the Allocation of Public Goods" and "On Maximizing the Exploiters' Gains."

Alvin Klevorick, Yale University, "Towards a Testable Theory of Jury Deliberation."

Edwin Mansfield, University of Pennsylvania, "Social and Private Rates of Return from Industrial Innovation." (Jacob Schmookler Memorial Lecture.)

Andrew Mas-Colell, University of California, Berkeley, "A Model of Equilibrium with Differentiated Commodities."

Hukuhane Nikaido, "Monopolistic Completion and Effective Demand."

Mark Pitt, University of California, Berkeley, "Economic Policy and Agricultural Development in Indonesia."

Christopher A. Sims, "Output and Labor in Manufacturing."

T.N. Srinivasan, Indian Statistical Institute, New Delhi, "Foreign Trade Regimes and Economic Development"; "A Model of Fertilizer Requirement in India"; "A Job Ladder Model"; and "Energy-Food Choices in India."

Lester C. Thurow, Massachusetts Institute of Technology and University of Arizona, "Alternative Theories of Income Distribution."

Neil Wallace, "Can There Be a General Equilibrium Liquidity Preference Demand for Money?"

A.A. Walters, London School of Economics and Political Science, "Unemployment, Inflation and British Experience in 1950 to 1975" and "Importing Inflation and Exporting Inflation."

Thomas E. Weisskoff, University of Michigan, "A Radical Perspective on the Modern Capitalist Economy."

*Except where otherwise indicated, speakers were faculty or students at the University of Minnesota.