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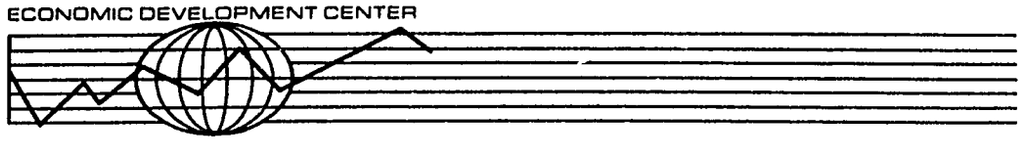

Annual Report: 1976

ECONOMIC DEVELOPMENT CENTER
Department of Economics, Minneapolis
Department of Agricultural and Applied Economics, St. Paul

UNIVERSITY OF MINNESOTA

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.

ANNUAL REPORT: 1976

CONTENTS

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: 1976* contains short reports on research completed in 1976 or currently underway.

The *Annual Report: 1976* describes in the second section several "Related Projects and Programs" in which members of the Departments of Economics and Agricultural and Applied Ecomonics 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

THE STRUCTURE OF EARNINGS IN THE KOREAN LABOR MARKET

FUNKOO PARK

This study is focused mainly on estimating the earnings functions for the workers in the Korean labor market using the 1973 Occupational Wage Survey. The primary objective of this study is to verify to what extent human capital variables are responsible for the observed earnings differentials among the workers in the Korean labor force. The earnings function investigated in this study differs from the earlier types in that it includes the segmentation of the working life of the individual into three portions: (1) the years prior to employment in the current type of occupation; (2) the years of employment in the current type of occupation outside the current employer; and (3) the years of employment in the current type of occupation with the current employer. The advantages in specifying the earnings equation in this manner over earlier ones are that the three-way segmentation of working life permits one to distinguish between changes in earnings due to the "aging process" and changes in earnings due to distinguishable types of work experiences. It also enables one to verify in part how job mobility affects earnings profiles over the life cycle.

Estimated earnings functions are used to verify some of the characteristics of the structure of earnings believed to be true in the Korean labor market. One of the features of the wage structure often observed in developing countries is the earnings differential between blue-collar and white-collar workers. Some of the labor market disequilibrium found in those countries — a glut of clerks coexisting with a scarcity of skilled tradesmen — can be attributed to this type of inappropriate pay differentials. Estimation of separate earnings functions for these groups of workers enables us to verify the true earnings differentials between these groups — adjusted by the human capital factors and the weights of different human capital variables in determining the level of earnings.

Hypotheses concerning the earnings differentials by firm size in the Korean labor market are tested using the earnings function framework. Estimation of earnings functions for the workers in small and large firms, respectively, reveals that: (1) Returns to schooling and firm specific experience are higher for the workers employed in large firms than small firms; and (2) The degree of substitution between the years of firm specific experience and outside experience is greater for workers employed in small firms than in large firms. From the estimated earnings functions for large and small firms, one can also verify the true earnings

differentials adjusted by the human capital factors.

The rates of returns, social and private, to investment in education in Korea are also inferred from the estimates of the earnings function. The estimated earnings function is used to generate age-earnings profiles for different levels of schooling which are adjusted for the post-school experience. Social rate of returns to education for the elementary school is found to be 15.5%; 14.4% for the junior-high school; 11.2% for the high school; and 8.8% for college. Private rate of returns to education for the elementary school is estimated as 22.8%; 15.3% for the junior-high school; 12.4% for the high school; and 9.9% for college.

The research on 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
GEORGE NORTON

The research on regional agricultural development in India was completed in 1976. Agricultural productivity was measured in the wheat and eastern rice regions of India using a three-stage procedure. The first stage involved estimating production functions from a 10-year time-series of cross-sectional data at the district level using an error components model. This model enables one to calculate regional effects for each district which represent systematic variations in productivity levels among districts not accounted for by conventional inputs. In the second stage variations in regional effects are explained by a variety of inputs, such as tubewells, soil type, rainfall, and roads, not included in our original production functions. Finally, the original production functions are respecified to include these additional inputs and then re-estimated for two time periods, 1959/60-1961/62 and 1967/68-1968/69, when data for all the relevant variables are available.

The results show that factors other than traditional inputs unadjusted for quality differences are important in explaining agricultural productivity differences within and among regions of India. In the case of the wheat region, the introduction of new varieties, the expansion of irrigated area and improvement in the quality of irrigation through the use of tubewells, and increased supplies of fertilizer led to substantial increases in production. Crop area, tractors, and labor were also important in explaining production.

In the eastern rice region somewhat different inputs were important in explaining productivity differences. The development and adoption of improved varieties of rice were not widespread. In addition, a good measure of irrigation quality could not be devised even though in a separate analysis very high social and private returns were found for improving the quality of canal irrigation systems. Thus, crop area, fertilizer, rainfall, and surfaced roads were the important variables in explaining agricultural production.

In our approach we tried to disaggregate our analysis of agricultural productivity growth using the district as the basic unit of observation. As in earlier work, we combined these districts into relatively homogeneous regions although there still may exist much variation among the quality of factors within each region. Further disaggregation may be highly desirable to account for the remaining variability in productivity within regions and to better identify

constraints. (K. William Easter, Martin E. Abel, and George Norton, "Regional Differences in Agricultural Productivity in Selected Areas of India," Staff Paper P76-12, March 1976.)

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

THE STRUCTURE OF REGIONAL RICE PRODUCTION IN THE PHILIPPINES
DONATO B. ANTIPORTA

Establishment of the impact of the agroclimatic factors on rice production in the Philippines was the principal objective of this study. Using discriminant analysis, homogeneous regions were delineated. The homogeneous areas were characterized on the basis of different sets of agroclimatic variables such as land resource characteristics, agricultural infrastructures, population characteristics, soil types, and rainfall.

Farm level production relationships were estimated from rice production and input data for 2,459 irrigated farms. The functions included the usual farm inputs, a technology variable, and agroclimatic factors as regressors. The scheme of homogeneous regions was employed to generate dummy variables to represent the agroclimatic environment. By locating the farms in the homogeneous groupings, the agroclimatic characteristics could be specified for each observation.

The regression results presented a strong evidence of the significant influence of agroclimatic factors on rice production. The most dominant effect was the land input and its quality. Superior production was found for those lands with better irrigation and drainage. The land resource characteristics could explain 5.5 to 20.4 percent of the variation in regional production.

Labor productivity varied proportionately with the degree of urbanization, literacy rate, and alternative employment opportunities. The estimated partial elasticity of household labor in rice farming was lower in the rural areas. Up to 17.4 percent of the regional production difference could be attributed solely to differences in labor resource characteristics.

Soil types, monthly rainfall patterns, and agricultural infrastructures were associated with regional differentials in rice production. For irrigated farms, a lighter soil composition appeared favorable to rice production. For the same class of farms, regions with a lower average

monthly rainfall have a higher technical efficiency. Regional differentials in farm output up to 23.8 percent, 16.9 percent, and 20.6 percent were found to be associated separately with soil type, rainfall, and agricultural infrastructures, respectively.

Some factors affecting technical efficiency in rice production are not region specific. The modern varieties have undoubtedly improved production regardless of input levels and traditional practices. The statistical evidence suggests a 26.3 percent greater production of modern than traditional varieties on irrigated farms, holding other things constant. However, the realized benefits fell below the potential because of the negative effects of pests, *tungro* virus, and other diseases. Production losses were estimated at 11.9 percent for pest and disease problems, and 22.4 percent for *tungro* virus. Together, such losses would completely negate the advantage of modern over traditional rice varieties.

The analysis indicates that land and labor resources, as well as agricultural infrastructures, would be the key variables in developing the capacities in the agricultural sector. They represent the significant agroclimatic variables amenable to government policies. The results demonstrate the immediate payoffs from pest and disease control in rice. It is necessary to reduce the production risks and losses from pests and diseases to maximize the gains from modern varieties and to stimulate the adoption of inputs, as well as other practices, which fully exploit the available biological technology.

Based on agroclimatic characteristics there is a weak congruence between the administrative regions and the homogeneous areas. In view of significant regional differences and their implications on rice production, it would be useful to differentiate agricultural programs for dissimilar areas. The results reported here could be utilized to define subregions with homogeneous composite agroclimatic environments in each administrative jurisdiction. Then, programs may be conceived based on specific needs in the subregions. In this way, there would be a correspondence between the problems and the programs to relieve them.

For details see Donato B. Antiporta, "Agroclimatic Regions in the Philippines," Department of Agricultural and Applied Economics, Staff Paper P75-29, December 1975 and *The Structure of Regional Rice Production in the Philippines,* Ph.D thesis, June 1976.

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

EFFECT OF TECHNOLOGICAL CHANGE ON OUTPUT, EMPLOYMENT, AND FUNCTIONAL INCOME DISTRIBUTION IN INDIAN AGRICULTURE: A CASE STUDY OF THE PUNJAB WHEAT ECONOMY

SIDDANAIK BISALIAH

Considerable growth in output per acre has resulted from the introduction of new wheat and rice varieties in developing economies. Questions are raised with respect to the sources of this growth in output and the impact of the new technology on employment and income distribution. The main objective of this study was to assess quantitively some of these issues using farm level data from the Indian Punjab for the years 1967/68 to 1970/71. The specific objectives were (1) to decompose the total difference in per acre output between farms employing new technology (Mexican wheat) and those employing old technology (local wheat) into some constituent forces, (2) to decompose the total difference in per acre employment into some relevant components, and (3) to determine the direction and magnitude of changes in functional income distribution.

Sources of output growth were measured using Cobb-Douglas production functions. Of the 40 percent measured growth in per acre wheat output, 15 percent was attributable to technical change and 25 percent to increased use of complementary inputs, the major contribution (15 percent) being made by fertilizer.

Two models, based on the neoclassical theory of production, were used for decomposing total change in per acre employment. With the employment decomposition model based on the Constrained Cost Minimization framework, total change in employment was decomposable into technical change, change in output, and difference in input prices as between farms employing new and those employing old technology. Technical change alone decreased employment by 17.4 percent through a gain in efficiency to produce a given level of output. But this negative employment effect was more than offset by a 49.5 percent positive employment effect of output change and the 4.5 percent positive employment effects of input price differences.

With the employment decomposition model based on the UOP Profit Function, total change in employment was decomposed into the changes due to technical change, the difference in normalized wage rate, and differences in quantities of complementary inputs. In this framework, by shifting the profit function technical change alone increased employment by 20.2 percent. A difference in normalized wage rate lead to a negative employment effect of the magnitude of 14.5 percent. Differences in quantities of fertilizer and capital alone increased employment by 49.3 percent through increasing the marginal product of labor.

The neoclassical theory of distribution, based on the Cobb-Douglas production function was used in determining the direction of change in functional income distribution. Even though the effect of technical change on functional income distribution may be concluded as approximately neutral, some degree of bias in favor of capital is in evidence.

For details see Siddanaik Bisaliah, *Effects of Technological Change on Output, Employment and Functional Income Distribution in Indian Agriculture: A Case Study of the Punjab Wheat Economy,* Ph.D. thesis, Department of Agricultural and Applied Economics, November 1975.

The research on this project was supported by the Agricultural Development Council, Inc. and a grant from USAID. Mr. Bisaliah was an ADC Fellow in the University of Minnesota Department of Agricultural and Applied Economics and is currently a member of the faculty of the University of Agricultural Sciences, Bangalore, Karnataka State, India.

SECTOR ANALYSIS DESIGN AND INSTITUTIONALIZATION INTO A PLANNING PROCESS

TERRY L. ROE
HAROLD KLEIN

Quantitative approaches to agricultural policy planning have been and are being developed in over a dozen LDC's. This approach is frequently referred to as agricultural sector analysis. The analytical methodology employed in these approaches might be classified as applied general equilibrium analysis where computer algorithms are used to determine the values of variables endogenous to the model. These models are generally specified over micro-agricultural economic aggregates and designed to reflect the causal relationships between policy instruments and economic activity.

The rather obvious objective of these analytical tools is to save scarce planning resources and to improve policy formulation, monitoring, and control activities. In other words, to make more efficient the accomplishment of policy maker objectives. However, the accomplishment of this objective implies that (at least to a certain degree) these approaches be institutionalized within the planning machinery of the LDC. That is, that the analytical tools be designed not only to model economic activity but that a plan is effected for their use in the planning process itself. This implementing activity amounts to a constraint on the design and formulation of an economic model whose sole objective is to model economic activity to some given degree of reliability.

It may also be possible to use these quantitative planning tools to change or alter the current planning process in an LDC. While there is a variety of strategies on how this might be accomplished, few have ever been documented. Furthermore, it is unknown whether or

not a strategy that is successful in an LDC is applicable to some other LDC having a different bureau structure and planning process.

The general objectives of this study are to assess strategies for institutionalizing analytical techniques under conditions of (a) a given planning process and (b) when some flexibility exists for altering the planning process.

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 is Associate Professor in the University of Minnesota Department of Agricultural and Applied Economics. Mr. Klein is currently Assistant Professor, Temple University, Philadelphia, Pennsylvania.

TECHNICAL CHANGE: THE ADOPTION OF NEW TECHNIQUES AND PRACTICES

TERRY L. ROE
DAVID NYGAARD

The general objectives of this study are (a) to obtain insights into the various factors affecting farmers' decisions to continue with a known technique or to adopt a new technique or practice, and (b) to translate these insights into the bureau-level planning machinery of the Tunisian Ministry of Agriculture.

This study essentially seeks to combine the methodology of Hiebert (1) Welch (3), and de Janvry (2) to capture farmers' response to physically induced risk associated with new techniques and practices. It departs from these studies in that an additional type of uncertainty is considered. This uncertainty may be titled subjective uncertainty and arises because of imperfect knowledge as to the parameters of efficiency of a new technique or practice. It is hypothesized that as knowledge or experience with a technique or practice increases, the expected value of the parameters converges to the true parameter values, and the level of subjective uncertainty (variance) decreases. If farmers are risk averters, this implies a decrease in costs of adopting new techniques. The impacts of spatial product and factor market price differentials, product factor market quantity constraints,

and household consumption characteristics will also be considered.

Classical econometric techniques will be employed to relate the directional and magnitudinal impacts of the causal factors mentioned above to farmers' choice of continuing with an old technique or adopting a new technique or practice. Two sources of data are currently available. These sources are the CYMMIT sponsored firm level data on 1972/73 wheat production and the 1974/75 livestock base line study data collected by the D/PAEEP. Additional firm-level data will be collected on wheat and irrigated crop production. Additional livestock data will also be collected to supplement the base line data.

It is envisioned that upon completion of the study, seminars and documents will be developed in a manner which focuses results and implications of the research to the Tunisian bureaus and planners whose responsibility lies in the domain of the study. Furthermore, the various analytical parameters obtained from the study will be incorporated into the Tunisian agricultural sector model currently being utilized by Tunisian planners.

(1) Hiebert, L. Dean, "Risk, Learning and the Adoption of Fertilizer Responsive Seed Varieties," *American Journal of Agricultural Economics,* Vol. 56, No. 4, November 1974, pp. 764-768.
(2) de Janvry, Alain, "Optimal Levels of Fertilization Under Risk: The Potential for Corn and Wheat Fertilization Under Alternative Price Policies in Argentina," *American Journal of Agricultural Economics,* Vol. 54, No. 1, February 1972, pp. 1-10.
(3) Welch, F., "Education in Production," *Journal of Political Economy,* Vol. 78, No. 1, January/February 1970, pp. 35-39.

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

SECTOR ANALYSIS METHODOLOGY

TERRY L. ROE
RICHARD TODD

Substantial progress has been made in sector modelling methodology during the last 5 years. Duloy and Norton (1) and Louis Goreux (2) are among the pioneers in this effort. The use of "matrix generators" has further decreased labor inputs and errors in data tabulation and general model management, thus making the use of these models more feasible in LDC's where technically qualified labor is already in short supply. While these models can efficiently handle nonlinear relationships, they are generally static models. The models are generally static because this type of methodology yields better estimates of economic

activity if modelled over micro-economic units such as cross-section firm level data. To expand these models to incorporate time dependent relationships increases their size to computationally unmanageable proportions. Furthermore, this methodology is not particularly suited to handle dynamic relationships or to consider, endogenously, technical change or savings and investment activities.

Analytical application of dynamic general equilibrium models, e.g., extended and modified versions of the Fei and Ranis model or the Kelley-Williamson model, however, have historically required model specific algorithms to generate values of their endogenous variables over time. Modifications of these models for purpose of simulating structural changes consistent with a possible policy dictate, often required modification of the algorithms themselves. Qualified LDC personnel are generally not available to deal with such highly technical, time consuming operations.

Thus, the general objective of this study is to explore the availability of algorithms which can be used, without modification, to efficiently solve large, square, nonlinear systems of equations. An algorithm has been found which seems to satisfy this objective. It is currently being tested and applied to the Kelley-Williamson model. A technical report on its use and flexibility in solving general equilibrium type models should be available by the fall of 1976.

(1) Duloy, John and Roger Norton: "CHAC, a Programming Model of Mexican Agriculture," in *Multi-level Planning: Case Studies in Mexico,* editors Louis Goreux and Alan S. Manne. Amsterdam: North-Holland Publishing Co., 1973.
(2) Louis Goreux has extended this methodology to "model sets" depicting multi-level planning activity. This methodology will be published shortly in book form.

The research on this project is supported by a grant from USAID. Mr. Roe is Associate Professor in the University of Minnesota Department of Agricultural and Applied Economics. Mr. Todd is a Research Assistant in the University of Minnesota Department of Agricultural and Applied Economics.

OPTIMAL RULES FOR CARTEL MANAGERS IN A STOCHASTIC MARKET SETTING; WITH SPECIFIC APPLICATION TO THE COPPER AND TEA MARKETS

JOHN M. UNDERWOOD

The recent interest in producer cartels for primary products other than oil ("OPEC imitators") has generated much discussion and con-

troversy but little research. The purpose of this study was to set up a stochastic control framework to measure, to at least a first approximation, the expected gain to the members of a primary producer cartel. Then, that framework was used to estimate the potential gain to cartelization for two primary commodities, copper and tea. Linear, stochastic world commodity market models were developed for the above two commodities. Using net discounted foreign exchange earnings as the welfare measure and a uniform export tax as the control variable, stochastic control techniques were used to calculate the optimal expected gain. A "large" expected gain (say, 5-10 percent of total member country export earnings) is looked upon as a necessary, but not sufficient, condition for overcoming the difficulties inherent in forming such a cartel. It is found that a developing country copper cartel would have little chance of success. However, the expected return to a tea cartel is found to be large enough and the number of countries involved small enough that perhaps a tea producers' cartel might succeed.

The research on this project was supported by a grant from USAID. Mr. Underwood is currently, Economist, International Bank for Reconstruction and Development, Washington, D.C.

AN EVALUATION OF SPAIN'S PROTECTION SYSTEM

JULIO VINUELA

In 1959 Spain embarked on a process of liberalization of foreign transactions. A system of exchange rates, tariffs, and border tax adjustments was substituted for quantitative restrictions and multiple exchange rates. However, quotas, individual licencing, and state trading still represent a relevant part of the protective structure. Simultaneously, several export promotion measures in the form of indirect tax rebates, tariff rebates on imported inputs, and exports credit at subsidized interest rates were adopted.

The object of this work is to evaluate the aggregate effect of the above protective structure. For this, the concept of an effective protective rate that takes into account the combined effects of the various protective instruments on each activity value-added is used.

In empirical studies of effective protection it has been usual to assume that tariffs and other border taxes are a good approximation of the nominal rates of protection, as measured by the percentage difference between domestic and foreign prices. There are good reasons

to suspect that this may not be the case in Spain. First, there are many exemptions and partial reductions of tariffs. Second, the existing quantitative restrictions may be generating scarcity premia. Third, many tariffs might be prohibitive, especially in those sectors in which import substitution was practically completed some time ago, revealing the existence of tariff redundancy. For these reasons independent estimates are made of both potential and actual protection.

In measuring potential effective protection, tariffs, border tax adjustments, and the premia generated by quantitative restrictions are assumed to explain the difference between domestic and CIF prices. Estimates of the relative importance in total protection of each of these policy instruments is made also. Moreover, in order to ascertain to what extent export policy instruments compensate for the bias against exports implicit in input protection, a distinction is made between an effective protection to sales in the domestic market and an effective subsidy to exports. Special attention is given to the protective effect of border tax adjustments. For each sector a comparison is made between the border tax rate actually applied and the estimated tax rate that should be applied in order for indirect taxes to be neutral from the viewpoint of protection. The difference gives an idea of the extent to which these border adjustments represent either an additional tariff on the import side or a subsidy to exports.

Actual (or realized) protection is estimated for a number of sectors. For each, a sample of commodities has been selected which gives a priority to commodities representing an important share of the sector output, exports, commodities subject to quantitative restrictions, and nonimport competing goods.

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

SHADOW PRICING FOR PUBLIC ENTERPRISES

PETER G. WARR

When market prices are distorted, due to a failure in the functioning of the market itself, or to the non-optimality of government policies, it is necessary to ask whether they provide appropriate guides for public sector production decisions. This project completes a 21-month study of this question, focusing on the properties of the optimal shadow prices for guiding public production, the problems involved

in finding them in practice, and the empirical significance of shadow pricing for public investment in Indonesia.

The theoretical study has involved the derivation of the properties of optimal shadow prices in the presence of a distortionary tax. By performing this exercise with a variety of economic models it has been possible to show: (1) that the optimal shadow prices of internationally traded commodities are always their international prices, regardless of the existence of tariffs; (2) the optimal shadow prices of non-traded commodities are more complex, and not necessarily given by their "foreign exchange equivalent." The restrictive conditions under which the "foreign exchange equivalent" rule is correct are derived in "Shadow Pricing, International Trade and the Theory of the Second-best," Discussion Paper 76-67 (March 1976), Department of Economics, University of Minnesota. This paper also examines the properites of the optimal shadow prices of non-traded commodities in those cases where the "foreign exchange equivalent" rule does not work.

A second phase of the theoretical study has been an exploration of the informational and stability problems involved in moving, by means of shadow pricing, from an initial non-optimal public production program to the welfare-maximizing program. This had led to the surprising result that even in simple well-behaved models, where the informational problems of shadow pricing are not serious, the stability problems frequently are serious. This point has been demonstrated, and is illustrated with a specific numerical example, in "Shadow Pricing, Information and Stability in a Simple Open Economy," Discussion Paper 75-62 (December 1975), Department of Economics, University of Minnesota.

The empirical phase of the study has focused on the implications of shadow pricing for choice of technique in Indonesia. This study analyzes four rice milling techniques of widely varying capital intensity and finds the optimal technique for public investment under a variety of assumptions. Neither the most capital-intensive of the techniques (recommended by visiting engineering consultants) nor the most labor-intensive (recommended by visiting economic consultants) is generally optimal. The optimal choice of technique proves to depend critically on assumptions concerning the social rate of discount, the future price of rice, and the financial constraints facing public investment. The results of the study are reported in "Shadow Pricing and Choice of Technique: An Application to Indonesian Rice Milling," Staff Paper P75-24 (September 1975), Department of Agricultural and Applied Economics, University of Minnesota.

The research on this project was supported by a grant from USAID. Mr. Warr was a Post-Doctoral Fellow in the University of Minnesota Department of Economics and Department of Agricultural and Applied Economics. He is currently Lecturer in Economics, Monash University, Melbourne, Australia.

AN ECONOMIC ANALYSIS OF MILK PRODUCTION IN SOUTHERN CHILE

CRISTIAN ZEGERS

Agriculture has traditionally been the most important economic sector in the Southern Zone of Chile. However, this position of predominance is less evident now than 10 years ago. The loss of importance of the agricultural sector in the provinces of Valdivia and Osorno can be seen not only within the regional economy, but also when compared with the total agricultural sector. This situation is partially due to a change in the production structure, with a decreased area being devoted to crops and an expansion of milk and bovine output.

The main characteristics of milk production in Chile are, firstly, that it is basically produced under grazing conditions; this together with climatic factors results in a high degree of seasonality in milk deliveries to the processing industry. Secondly, the center of production has moved from the area surrounding Santiago and Valparaiso to the southern part of the country. This regional concentration of output at long distances from the densely populated centers influences the kind of milk products that are manufactured. Thirdly, a large number of producers enter the commercial channel only during the spring and summer months, thus intensifying the seasonal production pattern. Lastly, the country has an endowment of natural resources more than adequate to produce milk beyond the present level; but despite this latent potential, Chile is an importer of milk products.

The core of the milk industry is found in the provinces of Valdivia and Osorno, where output has grown at a rate of 6 to 8 percent per year. In order to study milk production in this region, 123 farms were surveyed in January-March 1975. The data collected, for the study period 1974, was tabulated and is being analyzed.

The production of milk depends heavily on the adequate management and use of the pasture-cow system. In order to describe the bio-economic system underlying the production processes on these farms, a simultaneous model of a recursive nature is postulated. The behavioral equations are divided into five categories:

- Pasture management equations
- Animal index equations
- Animal stock equations
- Area equations
- Response equations

The model is presently being estimated.

The research on this project is supported by the Ford Foundation, the Universidad de Austral, and by a grant from USAID. Mr. Zegers is a Research Assistant in the University of Minnesota Department of Agricultural and Applied Economics. He is on leave from the faculty of the Universidad de Austral, Chile.

COMMODITY AND FACTOR MARKETS IN DEVELOPING COUNTRIES

DEMAND, SUPPLY, AND DISTRIBUITON OF FERTILIZER IN DEVELOPING COUNTRIES

DALE C. DAHL

Dale C. Dahl is participating in a joint activity with the International Fertilizer Development Center to develop a manual for fertilizer sector analysis in developing countries. The general objective of the proposed publication is to foster orderly fertilizer sector growth and development in developing countries by encouraging and facilitating a scientific approach to fertilizer sector analysis. The publication aims to (1) create an awareness among development administrators of the potential contribution of fertilizer to development; (2) promote an understanding among development personnel of the interdependencies of the fertilizer sector and other sectors of developing economies; (3) demonstrate the need for sectorial planning to facilitate orderly fertilizer sector growth and development; (4) present and demonstrate acceptable sectorial analysis techniques and planning methodologies.

The diversity of the target audience presents basic format problems. On one hand it is necessary to appeal to and communicate with the development administrator on the desirability and utility of fertilizer sector analysis in planning for orderly fertilizer sector growth and development; but it is also imperative to furnish the analyst with the appropriate analytical framework and methodology. In view of the alternatives, it is believed that a two-part, single-volume publication will be most effective.

The first part will be directed toward the general audience. To facilitate subsequent presentations, this section will first briefly review the concept of chemical fertilizers and the importance of fertilizers in crop production. With this base, the role of fertilizer in the intensification of rural development efforts, the role and function of the fertilizer sector and industry in developing economies, and the necessity of adequate planning in order to permit fertilizer to more nearly reach its potential as a production and developmental tool will be discussed. It is intended that this section will be oriented toward surfacing the relevant policy issues and will develop the case for sector analysis as the basis for fostering orderly fertilizer sector growth and development.

The second part of the manual or handbook is directed toward the analyst. The intent and design is to systematically present, with the aid of case studies, the appropriate analytical framework and methodology for the conduct of fertilizer sector analysis. This entails

separating into logical steps the procedure that one should follow in conducting sector analyses and presenting each as a separate unit (or chapter), each successive chapter thus becoming a building block in the conduct of a comprehensive fertilizer sector analysis.

The research on this project is supported by a grant from the International Fertilizer Development Center to the University of Minnesota Economic Development Center.
Mr. Dahl is Professor in the University of Minnesota Department of Agricultural and Applied Economics.

TECHNICAL CHANGE AND RESOURCE USE

WATER RESOURCE USE
K. WILLIAM EASTER
FREDERICK THOMAS III

This project is concerned with reviewing the available literature on the shape of the water response functions for wheat and rice, and discerning what role water prices can play in determining levels of water use by farmers.

The quantity of water applied and its timing are both critical for the optimum use of irrigation water. The importance of quantity and timing increases as water becomes scarce. Both the quantity of water and its timing are manipulatable by the irrigation system manager and the farm operator. The degree of manipulation is partly dependent on the physical and managerial controls in a system. To achieve optimum water use, detailed information on the water-yield relationship is fundamental.

However, in most less developed countries (LDC's) these basic water-yield relationships are unknown for most crops. For any particular crop, the yield response to irrigation will vary depending on soil, climate, etc. In addition, the water-yield response will vary according to the growth stage of the plant. If there is limited water, research reports indicate that stress in the early stages of growth is less damaging than in the fruiting stages for both wheat and rice. But water stress for rice will lengthen the growing season and may increase the absolute irrigation requirement.

From the limited amount of information available for LDC's, it appears that the response of rice to water use is more inelastic than for wheat. If this is the general case, the price of water should influence water use on wheat more than on rice.

The research on this project is supported by a grant from USAID.
Mr. Easter is Professor in the University of Minnesota Department of Agricultural and Applied Economics. Mr. Thomas is a Research Assistant in the University of Minnesota Department of Agricultural and Applied Economics.

TECHNOLOGY, INSTITUTIONS AND DEVELOPMENT: MINNESOTA AGRICULTURE, 1880-1970

JOSEPH C. FITZHARRIS
WILLIS L. PETERSON
VERNON W. RUTTAN

During the past year, 3 chapters of a proposed monograph were drafted. One was published in staff paper form. The completion of the operative chapters is contemplated within the next few months, followed by completion of the introductory and summary chapters. Publication of the final monograph report is planned.

The final report will consist of 8 chapters. The introduction will 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, is examined. The Minnesota Agricultural Experiment Station, its origins, development, work accomplished, and related institutions in the quasi-public institutions are treated. Studies of selected cases of technical and institutional innovation will 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 will be drawn in chapter 8.

Chapter 2, "Minnesota Agricultural Growth, 1880-1970," and an appendix of supporting data and explanations, were published as staff papers by the Agricultural and Applied Economics Department (P76-4 and P76-4A). Chapters 3 and 4 were completed in draft. Several working bibliographies on "National and Minnesota Agricultural Research Systems" were also produced on a limited distribution basis. Integration and indexing of these bibliographies, with publication in some form, is planned.

This project was funded by a grant to the University of Minnesota Economic Development Center from the Rockefeller Foundation. Mr. Fitzharris is Assistant Professor 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

IRRIGATION SYSTEMS IN TAIWAN: MANAGEMENT OF A DECENTRALIZED PUBLIC ENTERPRISE

MARTIN E. ABEL

Despite the long history of irrigation, only a few countries have evolved design and management principles for irrigation systems that result in efficient water use. Taiwan is one of them. An examination of management of irrigation systems in Taiwan reveals four factors that seem to contribute strongly to efficient management of the systems. These factors, which are different from what one finds in most other countries of Asia, seem to be highly interrelated, making it difficult to evaluate the contribution of one in isolation from the contributions of the others.

First, in order to increase agricultural production Taiwan has recognized water as a scarce factor of production to be used as efficiently as possible. Second, the national government of Taiwan has evolved a basis for centralized planning of irrigation investments and, at the same time, decentralized management of the systems. Planning of new investments by the central authorities was important to ensure rational allocations of resources among all categories of development expenditures. However, the management of irrigation systems was devolved into the hands of those who directly benefited from irrigation. The mechanism used was the cooperative irrigation association. Users of water have participated in the planning and management of irrigation systems. Third, within the irrigation associations information systems were developed which permitted the exchange of agronomic and engineering information between users of the water and the managers of the system. These information systems were and still are especially important because water is administratively allocated to users based on some calculation of the scarcity value of water; prices actually charged do not play a major role in allocating water among users. The information systems also facilitated continued improvements in the physical design of irrigation systems and in the agricultural production technologies used by farmers. Fourth, the irrigation associations employ systems of incentives for both managers of irrigation systems and users of water which appear to be compatible with the efficient use of water.

The management of irrigation systems in Taiwan is often used as a model that other countries, particularly in Asia, might follow. However, it is doubtful that many other countries could, in a short period of time, achieve anything like the level of technical efficiency one finds today in Taiwan. In most other countries one or more of the four prerequisites for the successful management discussed

above is missing and could not easily be established. Creating strong and effectively implemented agricultural development policies that recognize the value of irrigation water will require (1) substantial reordering of development priorities and (2) strengthening of administrative services dealing with implementation of development policies and programs and will be fraught with all manner of political problems. The same can be said for providing legal and administrative bases for permitting centralized planning of investments in irrigation development, but decentralized management of irrigation systems.

The creation of information and incentive systems within the management structure of irrigation systems will require considerable research, training of management staff, and education of the users of water with respect to the benefits to them of improved management. These steps also require considerable time and effort.

There are also environmental, cultural, and political considerations involved in trying to transfer the Taiwan model of irrigation to other countries. The technical design of irrigation systems, as well as the development of certain management principles in Taiwan, was influenced by local environmental conditions, particularly with respect to topography, climate, soils, and crop technology. One would expect to find considerable differences in these conditions among countries as well as within certain countries. Design and management principles will have to be adjusted to specific environmental conditions.

The political institutional framework for the management of irrigation systems in Taiwan grew out of a particular political history and cultural setting. During the 50-year period of Japanese colonial rule and the subsequent 30 years of independence, strong emphasis was placed on the investments in technology and infrastructure, including irrigation, required to accomplish rapid rates of growth in agricultural output. These achievements involved a combination of incentives to farmers and an ample measure of force. Furthermore the institutions that were developed to implement agricultural development programs, such as the irrigation association, seemed to be politically and culturally acceptable in the sense that participant responses desired by the governments were elicited. It is doubtful that direct transfer of Taiwan's approach to the development and management of irrigation systems would yield beneficial results in other political and cultural settings. The Taiwan experience would have to be molded and adapted to conditions prevailing in other countries.

The relevance of the Taiwan experience to other countries lies in recognizing the importance of the economic and management principles discussed and the key interrelations among at least some of them. Beyond this, other countries should try to learn more about how policies, institutions, and technology related to irrigation evolved

in Taiwan. (Martin E. Abel, "Irrigation Systems in Taiwan: Management of a Decentralized Public Enterprise," Staff Paper P75-15, July 1975 (forthcoming in *Water Resources Research*).)

Mr. Abel is Professor in the University of Minnesota Department of Agricultural and Applied Economics.

RELATED PROJECTS, PROGRAMS, AND ACTIVITIES

Martin E. Abel and W. B. Sundquist consulted with the Central Bank of Nicaraugua on the training and research needs of that organization.

Martin E. Abel will travel to Israel and Taiwan in July 1976 to pursue work on the management of irrigation systems.

Willard W. Cochrane spent January and February 1976 as a visiting professor at Tamil Nadu Agricultural University, Coimbatore, India, under the auspices of the Ford Foundation.

Hans M. Gregersen represented the United States at an FAO sponsored Seminar on Analytical Techniques for Forest Sector Planning and Policy Analysis held in Rome on November 10-12, 1975.

Hans M. Gregersen is participating in a project sponsored through FAO by the Swedish International Development Authority (SIDA). Involved is a study of project preparation techniques in forestry of primary concern to World Bank, FAO.

Hans Gregersen was principal lecturer on Sector Analysis at a FAO and SIDA sponsored seminar in Quito, Ecuador in August 1975.

Hans M. Gregersen has coauthored with Arnold Contreras a book, *U.S. Investment in Forest Based Sector in Latin America: Problems and Potentials* (Baltimore: The Johns Hopkins University Press, Resources for the Future, 1975).

James P. Houck presented a paper entitled "Is There Enough" at the Food and Agriculture session of a MUCIA sponsored Colloquy on D. velopment held in Racine, Wisconsin, July 21-24, 1975.

Jean-Claude Koeune and Anne O. Krueger continue as Managing Editor and Consulting Editor, respectively, of *Portfolio*. The publication plans were detailed in *Annual Report: 1975*.

The National Bureau of Economic Research three-year contract with AID effective July 1, 1974 directed by Anne O. Krueger, which was discussed in detail in *Annual Report: 1975,* has progressed toward the purpose of answering the questions: What are the differences, if any, between the amount and patterns of employment associated

with exporting and that associated with import-substitution activities in developing countries? Why do these differences arise?

Anne O. Krueger is working with the Harvard Institute International Division (HIID) on a trade and aid study of South Korea which is being conducted in conjunction with the Korea Development Institute.

Lee R. Martin worked in Washington, D.C. for 10 months as Agricultural Economist with the Division of Economics and Sector Planning, Office of Agriculture, Technical Assistance Bureau, Agency for International Development to help the Division develop procedures for working on natural resource subsector analyses in selected LDC's.

Terry L. Roe participated in a seminar on Agricultural Sector Analysis in the Near East and North Africa. The seminar was sponsored by FAO/SIDA and was held in Cairo in October 1975.

Terry L. Roe and John W. Schamper spent two weeks during the month of May in Tunisia. The purpose of the trip was to develop a plan for interfacing the Tunisian agricultural sector analysis model with planning activity currently under way and to test the models on recently available Tunisian computer systems.

Terry L. Roe, Mathew Shane, and Philip Burstein of Purdue University have received a MUCIA grant to study "The Effect of International Trade on Technical Change in a Small Developing Economy: The Malaysian Case." The general objective of the study is to obtain insights into the interrelationships between foreign trade and technical change. The general procedure will be the formulation and empirical testing of a theoretical economic framework that relates technical changes to both factor and product market characteristics.

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5720 ECONOMICS OF WORLD AGRICULTURE. (3 cr)
Distribution, quality, and utilization of agricultural resources, agricultural organization and structure; location of agricultural activity; national and international agricultural policies.

5750 AGRICULTURAL TRADE AND COMMERCIAL POLICY. (3 cr)
Patterns of trade in agricultural products; trade policies and practices of export and import nations; commodity agreements; agricultural trade policies of common market areas; negotiations and potential trade developments.

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8278 AGRICULTURAL AND ECONOMIC DEVELOPMENT. (3 cr)
Theories of socioeconomic growth; models of economic growth; consumption, production, and supply relations in agricultural development; agricultural development policy.

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STAFF DEVELOPMENTS

Lee R. Martin has completed his AID assignment in Washington and resumed teaching and research in the area of resource economics in the Department of Agricultural and Applied Economics.

Delane E. Welsch has resigned from the Rockefeller Foundation after 9 years in Thailand. As a full time faculty member in the Department of Agricultural and Applied Economics his area of specialization will be farm management and production economics.

Visiting staff in the Department of Agricultural and Applied Economics during the year 1976/77 include Abraham Subotnik, Professor in the Faculty of Industrial and Management Engineering, Technion, Israel Institute of Technology, Haifa, until September 30 and N.D. Deomampo, Chairman, Department of Agricultural Development and Administration, University of the Philippines, for the academic year.

Visiting staff in the Economics Department will be Tore Thonstad from the University of Oslo, Oslo, Norway, during spring quarter; James Likens, Pomona College, Claremont, California, during winter and spring quarters; and Leonard Shapiro from the University of Minnesota Mathematics Department for the academic year.

Edward Coen will be on leave to complete a book and to research and write on environmental economics.

Leonid Hurwicz will be on leave at the University of California, Berkeley, to work on the project "Decentralized Economic Mechanisms for Resource Allocation."

Thomas Sargent will be a Ford Foundation Visiting Research Professor of Economics at the University of Chicago.

Craig Swan will be a Visiting Associate Professor at the University of California, Berkeley.

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).

Yujiro Hayami and Vernon W. Ruttan, *Agricultural Development: An International Perspective.* Baltimore: The Johns Hopkins Press, 1971.

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

Anne O. Krueger, *The Benefits and Costs of Indian Import Substitution: The Automobile Ancillary Industry.* Minneapolis: The University of Minnesota Press, 1975.

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Hans P. Binswanger and Vernon W. Ruttan, eds., *Induced Innovation and Development: A Microeconomic Approach.* Baltimore: The Johns Hopkins Press, forthcoming, 1976.

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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.

70-4 Yujiro Hayami and Vernon W. Ruttan, "Agricultural Productivity Differences Among Countries," *The American Economic Review,* Vol. 60, No. 5, December 1970, pp. 895-911.

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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.

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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.

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

CENTER BULLETIN SERIES

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

Bull. 2 Dale L. Good and Jerome W. Hammond, *The Tunisian Fertilizer Distribution System -- Structural and Policy Considerations,* October 1975.

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(Articles not included in Center Reprint Series)

Martin E. Abel, "Irrigation Systems in Taiwan: Management of a Decentralized Public Enterprise," *Water Resources Research,* forthcoming May 1976 issue.

Matakatsu Akino and Yujiro Hayami, "Sources of Agricultural Growth in Japan, 1880-1965," *The Quarterly Journal of Economics,* Vol. 88, August 1974, pp. 454-479.

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K. William Easter, "Neglected Opportunities in Irrigation," *Economic and Political Weekly,* Vol. 9, April 6, 1974, pp. 557-564.

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Young K. Shim, Dale C. Dahl, and Bai Y. Sung, "Estimation of Fertilizer Consumption in Korea, 1975-85," *Seoul University Faculty Papers,* Vol. 3(E), March 1974, pp. 64-88.

Surjit S. Sidhu, "Economics of Technical Change in Wheat Production in the Punjab," *American Journal of Agricultural Economics,* Vol. 56, No. 2, May 1974, pp. 217-226.

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Adolf Weber, "Agricultural Modernization in Market and Planned Economies: The German Experience," *Studies in Comparative Communism,* Vol. VI, No. 3, Autumn 1973, pp. 280-300.

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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.

CENTER STAFF PAPERS

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

1970

Ralph H. Hofmeister, "Growth With Unemployment in Latin America: Some Implications for Asia." Prepared for the AID, NESA 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 Processes at the Organization of American States, Washington, July 1970 (Econ DP4).

1971

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).

Vernon W. Ruttan and Yujiro Hayami, "Technology Transfer and Agricultural Development." Presented at the Conference on Agriculture and Economic Development, Tokyo, September 6-10, 1971 (AAE SP71-10).

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).

1972

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).

Francisco E. Thoumi, "Industrial Capacity Utilization in Colombia: Some Empirical Findings," April 1972 (Econ DP14).

Assaf Razin, "Investment in Human Capital Under Uncertainty," July 1972 (Econ DP19).

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

Peter K. Clark, "A Competitive Market Model for 'Futures' Price Determination," August 1972 (Econ DP21).

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).

1973

Edgardo Barandiaran, "The Supply of Money and Bank Credit in Argentina," January 1973 (AAE SP73-4).

Osama A. Al-Zand, "The Economics of Olive Oil and Oilseeds in the Mediterranean Region," January 1973 (AAE SP73-5).

Osama A. Al-Zand, "Exploration and Analysis of Producer Prices of Olives in Tunisia – A Case of Pricing Imperfection," January 1973 (AAE SP73-6).

S. Bisaliah and M. Shane, "An Appraisal of the State Bank of India," January 1973 (AAE SP73-7).

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).

Vernon W. Ruttan, "Technology Transfer, Institutional Transfer, and Induced Technical Change in Agricultural Development," June 1973 (AAE SP73-16). (See Journal Articles.)

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). (See Journal Articles.)

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). (See Journal Articles.)

1974

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

Mitoshi Yamaguchi and Hans P. Binswanger, "Some Structural Changes in The United States and Japanese Economies," April 1974 (AAE SP74-6).

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.)

Mitoshi Yamaguchi, "Population Effects on the Economic Development of Japan," June 1974 (AAE SP74-11).

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 SP74-20). (See Journal Articles.)

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). (See Journal Articles.)

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). (See Journal Articles.)

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).

Martin E. Abel, "Irrigation Systems in Taiwan: Management of a Decentralized Public Enterprise," July 1975 (AAE SP75-15). (See Journal Articles.)

Young K. Shim, John T. Shields, and Dale C. Dahl, "The Fertilizer Marketing System in South Korea," Tennessee Valley Authority, Bulletin Y-97, August 1975 (TVA).

Lee R. Martin, "The Long Run Outlook for World Food Production," September 1975 (AAE SP75-21). (Published in the 1975 Proceedings of the Business and Economics Statistics Section, Annual meeting of the American Statistical Association, Atlanta, Georgia, August 25-28, 1975, pp. 61-62.)

Peter G. Warr, "Shadow Pricing and Choice of Technique: An Application to Indonesian Rice Milling," September 1975 (AAE SP75-24).

Peter G. Warr, "Shadow Pricing, Information and Stability in a Simple Open Economy," December 1975 (Econ DP75-62).

Donato B. Antiporta, "Agroclimatic Regions in the Philippines," December 1975 (AAE SP75-29).

1976

Joseph C. Fitzharris, "Minnesota Agricultural Growth, 1880-1970," January 1976 (AAE SP76-4).

Joseph C. Fitzharris, "Minnesota Agricultural Growth, 1880-1970: Appendix," January 1976 (AAE SP76-4a).

K. William Easter, Martin E. Abel, and George Norton, "Regional Differences in Agricultural Productivity in Selected Areas of India," March 1976 (AAE SP76-12).

Peter G. Warr, "Shadow Pricing, International Trade and the Theory of the Second-Best," March 1976 (Econ DP76-67).

Martin E. Abel, "World Market Conditions for Grains: Prospects and Problems with Special Reference to the Developing Countries," June 1976 (AAE SP76-20).

Joseph C. Fitzharris, "Public Institutions and Agricultural Growth: The Minnesota Experience," June 1976 (AAE SP76-22).

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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, 1920-1968,* Department of Agricultural and Applied Economics, University of Minnesota, 1971.

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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

Siddanaik Bisaliah, *Effects of Technological Change on Output, Employment and Functional Income Distribution in Indian Agriculture: A Case Study of the Punjab Wheat Economy,* Department of Agricultural and Applied Economics, University of Minnesota, 1975.

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

Robert P. Latham, *The Economics of Forestry Information: Case Studies in Central America,* College of Forestry, 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.

1976

* Donato B. Antiporta, *The Structure of Regional Rice Production in the Philippines,* Department of Agricultural and Applied Economics, University of Minnesota, 1976.

* John M. Underwood, *Optimal Rules for Cartel Managers in a Stochastic Market Setting; with Specific Application to the Copper and Tea Markets,* Department of Economics, University of Minnesota, 1976.

Copies of Ph.D. theses completed under Center sponsorhsip may be obtained from University Microfilms, Ann Arbor, Michigan. Copies of these theses identified by (*) will not be available from University Microfilms until early 1977.

WORKSHOPS AND SEMINARS
JULY 1975-JUNE 1976

WORKSHOPS*

AGRICULTURAL DEVELOPMENT AND TRADE WORKSHOPS

Martin E. Abel, "Regional Differences in Agricultural Productivity in Selected Areas of India."

Donato Antiporta, "Delineating Agro-climatic Regions in the Philippines."

Donato Antiporta, "Structure of Rice Productivity in the Philippines."

Maury Bredahl, "The Effect of Currency Adjustments on Common Market Imports."

Rodney Christianson, "Economics of Recreation Resources."

Pierre Crosson, Resources for the Future, Inc., "The Food Situation: Resources and Environmental Issues."

W. Lawrence Gates, Rand Corporation, "Current Research on Climate and Climatic Change."

John Hernesman, "Electrical Energy Pricing – Resource Implications."

William Meyers, "Long-run Income Growth and World Demand for Grain."

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

William Meyers, "Income Growth and Grain Demand: A Progress Report."

William Miller, "Economic Aspects of Non-point Sources of Pollution."

Roger Norton, World Bank, "Agricultural Sector Programming Models."

David Nygaard, "Uncertainty and Its Implication for Adapting New Technology."

Mark Pitt, "Trade Policy and Agricultural Production in Indonesia."

Surjit S. Sidhu, "Agricultural Development in Tanzania: An Outsider's Perspective."

John Spriggs, "Australian Grains Sector."

Frederick Thomas, "Pricing of Irrigation Water in LDC's."

Richard O. Wheeler, Winrock Foundation,"Livestock Production in the Navajo Nation: A Case Study of Training and Development."

Cristian Zegers, "Economics of Milk Production in Southern Chile."

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

HUMAN CAPITAL WORKSHOP

Evangelos Falaris, "The Determinants of Internal Migration in Peru: An Economic Analysis."

John C. Hause, "An Analysis of the Covariance Structure of Earnings and the On the Job Training Hypothesis."

C. Russell Hill and Frank Stafford, University of Michigan, "Family Background and Lifetime Earnings."

Jean-Claude Koeune, "Human Capital Obsolescence: Concepts and Measurements."

James Medoff, Harvard University, "Trade Unions and the Production Process."

Funkoo Park, "Returns to Education in Korea."

Jeffrey Perloff, Massachusetts Institute of Technology, "The Wage-Setting Process in the Construction Industry."

Jack Rogers, "The Effects of College Quality on the Earnings of College Graduates."

Robert A. Shakotko, "Household Labor Supply and Unobservable Variables."

TRADE AND DEVELOPMENT WORKSHOP

Martin E. Abel and K. William Easter, "Regional Differences in Agricultural Productivity in Selected Areas of India."

Edmar Bacha, Visiting Fellow, Harvard Institute for International Development, "On Some Contributions to the Brazilian Income Distribution Debate."

Robert Baldwin, University of Wisconsin, "Employment Effects of a General Tariff Reduction."

Armeane Choksi, World Bank, "A Planning Model for the Chemical Fertilizer Industry."

Kemil Dervish, Visitor, Princeton University, "Modeling the Effects of Protection and Alternative Trade Strategies in a Dynamic Framework."

Evangelos Falaris, "The Determinants of Internal Migration in Peru: An Economic Analysis."

Ana Marie Martirena Mantel, de Tella Institute, Argentina, "A Generalized Crawling Peg System for a Small Open Inflationary Economy."

Gary Maybarduk, "Some Economic Effects of Investment of Repressing Nominal Interest Rates."

Lennart Ohlsson, "Patterns of Engineering Trade Specification, 1960-1970, and Sweden's Factor Abundance."

G. Parthasarathy, Andhra University and visiting professor, Cornell University, "Lessons of Agricultural Development in Developing Economies: The Indian Case."

Pillalamarri Leela, Andhra University, India, "Import Substitution as a Strategy for Economic Development."

Mark Pitt, "Trade Policy and Agricultural Production in Indonesia."

Eugenia Rubinstein, Centro Internacional de Agricultura Tropical, "Economics of Animal Health."

Robert Stern, University of Michigan, "Price Elasticities in International Trade: A Complication and Annotated Bibliography of Recent Research."

Yun Wing Sung, "Factor Proportions and Comparative Advantage in a Trade Dependent Economy: The Case of Hong Kong."

John Underwood, "Optimum Rules for Commodity Produced Groups in a Stochastic Market Setting, with Application to the Copper and Tea Markets."

Peter Warr, "Shadow Pricing in a Simple Open Economy."

SEMINARS*

DEPARTMENT OF AGRICULTURAL AND APPLIED ECONOMICS

Sherwood O. Berg, South Dakota State University, "An Agricultural Economist's Experience in Indonesia."

Hans P. Binswanger, Agricultural Development Council, Inc., "Technology Transfer."

George E. Brandow, Pennsylvania State University, "Price Spreads and Performance of the Food Industry."

Willard W. Cochrane, "India Revisited."

Reynold P. Dahl, "Unravelling the Great Salad Oil Swindle: The Role of an Agricultural Economist."

Alfred Dougherty and Clint Batterton, Federal Trade Commission, "The Federal Trade Commission and Agricultural Antitrust Activity."

Charles Erickson, Cargill Incorporated, "The Role and Methods of Economic Research in an AgriBusiness Firm."

John D. Helmberger, "Facing the Economic Woes of Welfare."

Frank Jarrett, University of Adelaide, Australia, "Agricultural Innovation and Rural Development in Developing Nations: An R and D Perspective."

Robert Jolly, "An Econometric Analysis of the Grain-Livestock Economy of Canada with Special Emphasis on Commercial Agricultural Policy."

Jean L. Kinsey, University of California, Davis, "Logit Analysis of the Effect of Debt on Household Welfare."

Nathan Koffsky, World Bank, "Achievements and Problems of the World Bank Council in Dealing with the Continuing World Food Crisis."

Wilbur R. Maki, "The Economist's Role in Energy Policy and Planning."

Turner L. Oyloe, U.S. Agricultural Attache, Bonn, Germany, "Current Issues in Agricultural Trade and EC Agricultural Policy."

Todd Petzel, University of Chicago, "Education and the Dynamics of Supply."

Mark Power, Commodity Futures Trading Commission, "Some Current Developments in Futures Markets and Their Regulations."

LeRoy Quance, Economic Research Service, USDA, "Long Range Projections for U.S. Agriculture: Methods and Estimates."

Regional Presidents of the Federal Land Bank, The Bank for Cooperatives, and the Farm Credit Bank, "The Federal Intermediate Credit Banks: Perspectives and Outlook for Agricultural Financing."

Richard A. J. Roberts, Marketing and Credit Service, FAO, Rome, "Results of the World Conference on Credit for Farmers in Developing Countries."

Mary E. Ryan, "High Protein Wheat: Exports and Prices."

Russel Thompson, University of Houston, "National Economy Policy Models of Industry."

Delane E. Welsch, "Current Developments in Southeast Asia, with Emphasis on Thailand."

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

DEPARTMENT OF ECONOMICS

Donald Brown, Yale University, "The Value of a Nonstandard Competitive Allocation," and "Collective Rationality."

W. Max Cordon, Oxford University, "Is a Flexible Exchange Rate Regine Inflationary?"

Ervin Diewert, University of British Columbia, "Ideal Log Change Index Numbers and Consistency in Aggregation."

Zvi Griliches, Harvard University, "Estimating the Returns to R and D Investments: Problems and Some New Evidence." (Jacob Schmookler Memorial Lecture).

David F. Hendry, London School of Economics and Cowles Foundation, Yale University, "A Control Variable Investigation of the Properties of Autoregressive Instrumental Variables Estimators for Dynamic Systems."

Nural Islam, Oxford University, "Issues in the New Economic Order."

William Jaffé, York University, "Jevons, Manger, and Watras Dehomogenized."

Peter Kenen, Princeton University, "Models of Balance Adjustment: Alternative Specifications."

Lung Fei Lee, University of Rochester, "Estimates of Limited Variable Models."

Mukul Majumdar, Cornell University, "Duality and Transversality for Infinite Programs."

Rolf R. Mantel, Instituto Torcuato di Tella, Buenos Aires, "Implications of Microeconomic Theory for Community Excess Demand Functions."

James Mirrles, Oxford University, "The Theory of Moral Hazard and Unobservable Behavior."

George Perry, Brookings Institute, "Lessons of Analysis and Experience for Aggregate Policy Management."

Steve Salop, Board of Governers, Federal Reserve System, "Spatial Competition Retravelled."

Hugo Sonnenschein, Northwestern University, "Foundations of the Theory of Monopolistic Competition."

Hideo Suzuki, University of New South Wales, "International Trade with Wasting Resources."

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