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Annual Report: 1972

ECONOMIC DEVELOPMENT CENTER
Department of Economics, Minneapolis
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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 and 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: 1972

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INTRODUCTION

The initial section of the *Annual Report: 1972* is devoted to two papers based on research supported by the University of Minnesota Economic Development Center. The first paper by James M. Henderson, "Multi-Country Trade and Development: A Programming Analysis," outlines the conceptual basis of a major research activity that is in the process of shifting from an initial theoretical and methodological stage to empirical implementation. The second paper by Willis L. Peterson, "Social Returns to Public Information Services," reports the results of an effort, with Yujiro Hayami, to measure the social returns to public expenditure on improvements in the accuracy of agricultural statistics.

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

- Labor Markets in Developing Countries
- Trade and Development
- Commodity and Factor Markets in Developing Countries
- Technical Change and Resource Use

The second section of the *Annual Report: 1972* contains short reports on research recently completed or currently underway.

The *Annual Report: 1972* also describes several "Related Projects and Programs" in which members of the Departments of Economics and Agricultural and Applied Economics are involved. Particular attention is given to the work of the University of Minnesota in Tunisia. There is also a section which 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," "Workshops and Seminars," and "Sources of Support."

MULTI-COUNTRY TRADE AND DEVELOPMENT: A PROGRAMMING ANALYSIS

JAMES M. HENDERSON

James M. Henderson has been engaged in a major effort over the last several years in an attempt to develop an integrated empirical framework for the analysis of trade and development. The basic model can be extended for the analysis of a variety of trade and development problems including preferential trading arrangements, evaluation of national trade and development policies, and the effects of sector development programs on trade and development. The research has been supported by the UM Department of Economics and the Economic Development Center.

Input-output and linear programming models have been constructed to aid in investigations of trade and development for a number of countries. The works of Leontief, Chenery, Bruno and others are well known. A principal advantage of such models is that they can be empirically implemented and applied. The programming models are expressed in the concrete economic terms of optimization subject to constraints. The research described here entails the construction and application of an input-output programming model that encompasses not one, but many countries. The multi-country model emphasizes the interrelationships among trading countries and allows analysis beyond the one-country models. It also has considerably greater data requirements.

The current model is designed for empirical application. Consequently, its theoretical structure, though interesting, is kept relatively simple. Changes are analyzed through the method of comparative statistics, and other simplifying assumptions are made. The model is new. Therefore, much of the research is exploratory in character to see what can and cannot be done and to define the data requirements for future applications. Nonetheless, the research involves a number of specific applications. The research is described under four headings: (1) model formulation, (2) data collection and rectification, (3) computational methods, and (4) applications.

Model Formulation

The model covers m countries that produce n traded goods and u non-traded goods using k nonproduced factors. Production within each country is described by its individual matrix of constant input-output coefficients covering both produced and factor inputs. Final consumption within each country is assumed to be in fixed proportions. However, the proportions may vary from country to country. This assumption allows the consumption of each country to be described by a single variable.

The model is contained within a nonlinear programming format. The international value of GNP for the aggregate of the m countries is maximized subject to the following constraints:

1. *Output balance.* Output must be greater than or equal to inter-industry use plus final consumption. There is a single aggregate constraint for each country for each traded good, and an individual constraint for each country for each nontraded good.

2. *Factor limits.* Each country is assumed to have a fixed quantity endowment of each nonproduced factor. The amounts that each uses in production cannot exceed its endowments. The model accommodates both mobile and immobile factors.

3. *Natural-resource limits.* Some outputs require the existence of an approximate natural resource. For example, the output coal requires the existence of a natural resource in the form of a coal deposit. The amount of coal that a country can produce depends upon the amount of the natural resource that it possesses. In the extreme, if it has no coal deposit, it can produce no coal. These constraints limit the outputs of natural-resource goods.

4. *Balance of payments.* The international value of each country's exports plus foreign aid received or minus foreign aid given must equal the international value of its imports. These constraints are imposed for each country in a consistent manner.

5. *Trade restrictions.* Specific constraints describe import quotas, import prohibitions and a variety of other quantitative restrictions (QR's) that may be imposed by individual countries. Their imposition depends upon the particular case under investigation.

6. *Nonpositive profit.* The unit revenue for each good, i.e., its price, cannot exceed its unit cost. In equilibrium it is determined that revenue just equals cost for each good.

7. *Price equality.* The price for each traded good must be the same for all countries. The prices of nontraded goods and immobile factors differ from country to country, but are related to the prices of internationally traded goods through the cost and revenue structure of the model. International transport costs are assumed to be zero in this context. If this assumption were relaxed, the prices of traded goods would differ by no more than their transport costs.

The variables of the model are the output of each good in each country, the consumption level for each country, the price of each international good, the prices of each home good and each factor in each country, the unit rent for each natural resource in each country, and the shadow price for each QR. The net import or export level for each traded good in each country is determined by subtracting the amount used in that country from the amount produced. The model is nonlinear because its objective function and its balance-of-payments constraints are products of variable prices and quantities. Otherwise, the model is linear in its variables. The theoretical properties of the model have been reasonably well established. Its equilibrium solutions satisfy the normal conditions for economic efficiency.

Data Collection and Rectification

The data requirements for the model are satisfied, with a few exceptions, by input-output information for the m countries for which it is to be applied. Input-output tables are available for many different countries for many different years. However, these data require considerable rectification before they can be used for the implementation of the model. Different tables have different industrial classifications and different accounting methods. These must be reconciled to a uniform classification and accounting method. It is often necessary to collect additional information for this purpose. It is often desirable to disaggregate sectors of particular interest, e.g., agriculture, into more detailed subsectors.

Unfortunately, the job is still not complete when the m sets of data are converted to a uniform classification. A unit of physical output for the input-output table of a particular country is defined as the quantity that could be purchased for one currency unit during the appropriate year in that country. First, a uniform currency unit must be established for the m countries so that the data will reflect international values. Second, adjustments must be made if the data are for different years, and third, and most important, the data for each country must be adjusted to eliminate the cost effects of differential tariff and excise-tax rates in different countries.¹ This work should have considerable value for others who wish to use input-output data from two or more countries.

Preliminary work has been conducted with data for EEC countries for 1959. This system contains 52 traded goods, 4 nontraded goods, 1 non-produced factor and 9 natural resources. The data are now in good condition. However, an effort is being made to secure more recent data. A major task for the next fiscal year will be the collection and rectification of the new data required for the applications described below.

Computational Methods

It is necessary to obtain numerical solutions for the large-scale empirical models described here. Existing solution methods for linear and nonlinear programs are of little use. Consequently, new methods have been developed. The procedure is to treat the system as a linear program by assuming that the prices contained in the objective function and balance-of-payments constraints are known. Initial values are selected quasi-arbitrarily. Then, the linear program consisting of constraints (1) through (5) is solved. Its dual variables are good and factor prices and unit rents. Initially, the assumed and solution prices are very unlikely to be the same. A new linear program is formulated by replacing the initial

¹ Methods used for the purpose are given in J.M. Henderson, "Taxes, Tariffs, Comparative Costs and the Analysis of Multi-country Trade," ch. 6 of A.P. Carter and A. Brody (eds.), *Applications of Input-Output Analysis*, Amsterdam: North-Holland, 1969.

prices with the solution prices. This process is repeated until the two sets of prices converge. At that time the solution for the linear program provides a solution for the nonlinear program. It has been established that in general this process will converge. In practice, convergence has been quite rapid.

A general computer program has been written for the model that will allow its solution for any specified numbers of countries, traded goods, nontraded goods, factors, natural resources, and QR's. The program takes advantage of the special properties of the model and appears to be quite efficient in operation on the University of Minnesota CDC 6600 Computer. A system with 126 constraints was solved with less than 4 minutes of central processor time, and one with 190 constraints was solved with less than 6 minutes. Data availability, not computations, appears to provide the major limitation upon the application of the model.

Applications

Applications will constitute the major part of the research effort on this project during the next fiscal year. The applications of the model will be both general and specific. The model will be conceptually extended to cover a variety of general trade and development problems. Some of these extensions will provide the basis for specific empirical applications. The model is well suited to cover a variety of problems for customs unions and the effects of their extension to include a larger number of countries. One can ask whether current and new members will gain or suffer from their expansion. This model may also be used to cover the effects of extended trade between developed and underdeveloped countries. Are underdeveloped countries better off to form trading alliances among themselves or to extend their trade with developed countries? These questions will play an important role in the specific applications. The model is also well suited to investigate the effects of QR's upon the gains from trade for both the countries that impose them and their trading partners. Obviously, all countries cannot benefit if one or more institutes QR's. However, it is possible that a subset of countries may gain as a result of the altered terms of trade. Each QR has a tariff equivalent. The consequences of various tariff systems will also be investigated.

The specific applications will include a further analysis of the EEC and the potential effects of the entry of associate members. A Ph.D. dissertation will cover the consequences of the admission of Greece and Turkey with particular emphasis upon the agricultural industries.

A second Ph.D. dissertation will be concerned with a potential Latin American Common Market with emphasis upon the gains for expanded trade among the Latin American countries versus their expanded trade with the U.S. and EEC.

Further Extensions

The model will undoubtedly be extended further during the course of the research program. The conceptual difficulties of an extension to cover nonzero international transport costs are not difficult. However, the data problems appear insurmountable at the present time. The possibility of introducing variable consumption proportions will be investigated. Here again, however, there does not appear to be a reasonable empirical basis for such an introduction at this time.

SOCIAL RETURNS TO PUBLIC INFORMATION SERVICES

WILLIS L. PETERSON

Willis Peterson has been conducting a series of studies of the social returns to technical and institutional change. His most recent study, with Yujiro Hayami of Tokyo Metropolitan University, has involved the development of a theoretical framework for estimating the social returns to government expenditures on public information services. The study presents the results of an attempt to measure the social returns of reducing the sampling error of crop and livestock statistics reported by the U.S. Department of Agriculture. This research has been supported by the Minnesota Agricultural Experiment Station and by a grant from The Rockefeller Foundation.

An important function of government is the collection and reporting of information useful for decision making in both the public and private sectors. Yet decisions with respect to the development or modernization of statistical systems have usually been based primarily on only the vaguest intuitive judgments regarding the social returns to such efforts.

In this study an attempt is made to develop a theoretical framework for estimating the social returns to government expenditures on public information services. As an illustration of its use, the methodology is applied to information reported by the Statistical Reporting Service of the U.S. Department of Agriculture. An attempt is made to measure the marginal social returns of reducing the sampling error of crop and livestock statistics reported by the USDA. Both the methodology and the results are highly significant for the statistical agencies in developing countries as they attempt to extend and modernize their statistical services.

Theoretical Framework

The concepts of social welfare and social costs represent the basic theoretical concepts. In an economy in which producers, marketing firms, and consumers attempt to maximize profit and utility, inadequate information regarding the production or stock of commodities can be expected to lead to errors in economic decisions and to a less than optimum use of resources.

Erroneous information causes producers to make errors in production decisions and distorts both public and private decisions with respect to inventory carryovers. Hence, marginal improvements in the accuracy of these statistics reduce the social cost of misinformation and result in an increase in net social welfare. By relating the marginal cost of providing more accurate information to the value of the marginal improvements in the net social welfare, it is possible to estimate the change in social returns from successive increments in the accuracy of information provided by statistical agencies. Two models for estimating the social returns to improvement in information were developed: (a) an inventory adjustment model and (b) a production adjustment model.

The inventory adjustment model applies to situations where production cannot be altered significantly in the short run in response to output predictions, but where there is an opportunity for inventory holders to adjust stocks. A good example occurs in agriculture in the case of food and feed grains. Once the crops are planted, it is usually not profitable for producers to significantly expand or contract the output. On the other hand, it is relatively easy and inexpensive to store these commodities. In this case any market supply adjustment is possible mainly through adjustment in inventories.

For products of this type, the social cost of misreporting of production, through such errors as acreage or yield estimates, arises because of distortions in the optimum consumption patterns of the products. Because products of this type are produced during a relatively short period of time within the year, their consumption patterns depend very much on the inventory policy of marketing firms. For example, an erroneous expectation of an abnormally small crop and of a higher price in the forthcoming production period can be expected to result in a decreased rate of inventory depletion during the remainder of the current period. This, in turn, results in increased prices and a decreased rate of consumption during the current period. Although the increase in inventory carryover is available in the following period, the social gain resulting from the increased future consumption is less than the social loss incurred during the current period.

The production adjustment model is applied to situations where producers have an opportunity to adjust output in response to additional information. A basic assumption of the production adjustment model is that producers adjust output in response to changes in their price expectations. Furthermore, it is assumed that changes in price expectations come about as a result of new information on expected output provided by statistical reporting agencies. This model implies a process of adjustment similar to that of the well-known cobweb model. In this case errors in information contribute to a misallocation of resources and consequently result in a social loss. The model applies primarily to livestock products since it is primarily in the livestock sector that continuous adjustment is possible.

Costs and Returns of Statistical Reporting of Agricultural Production

For the purpose of reporting and predicting agricultural production, the Statistical Reporting Service of the USDA conducts a nationwide sample survey covering approximately 150 agricultural commodities. The costs of obtaining specified levels of accuracy in the sample survey are estimated by the Research and Development Branch of the Statistical Reporting Service. These cost estimates for degrees of accuracy ranging from a 0 to a 3 percent sampling error for the major farm commodities

are presented in Table 1. Also presented in Table 1 are the corresponding sampling errors for each of the individual commodities included in this group.

The Statistical Reporting Service is now shifting its methodology of sampling from an area technique to multiple frame techniques (using lists in conjunction with the area), in order to attain higher accuracy. At present the enumerative and objective yield surveys, using the area technique, are being conducted with a goal of attaining an average sampling error of 2 percent; the cost of these surveys is \$4.13 million. This cost would be similar for the multiple frame sampling scheme down to the 2 percent error level. This 2 percent error objective is based on the fact that the cost of a survey begins to rise rapidly, almost with a kink, at the 2 percent level of error. For sampling errors of less than 2 percent, the multiple frame technique is more efficient.

A relevant question at this point is whether the marginal cost of attaining greater statistical accuracy represents a socially profitable investment. We can shed some light on this question by comparing the marginal cost of greater accuracy with its accompanying marginal net social return as calculated by the techniques discussed in the previous sections.

In agricultural production it is possible to utilize both the inventory adjustment and the production adjustment models for the various kinds of products. Sampling errors in crop reporting data can be evaluated by the inventory adjustment model. In this case, there is little chance to adjust production once the crops have been planted. However, there is ample opportunity for inventory holders to adjust the rate of inventory depletion in response to information on acreages planted and on predicted yields. On the other hand, livestock and livestock products appear to be well suited to the production adjustment model. Here continuous adjustments in production can be made in response to information reported by the government.

Of course, we might expect some products to have applicability to both models. There are, for example, significant inventories of livestock products in cold storage which could be analyzed by the inventory adjustment model. There are, on the other hand, possibilities of production adjustments in crops, particularly if we consider interregional adjustments. For example, errors in the statistical reporting of the winter wheat acreage in Kansas and Oklahoma may influence decisions to plant spring wheat in Montana and North Dakota. The fact that we apply only one of the adjustment models to each major commodity would seem to imply, therefore, that our estimates of the social returns to improvements in sampling accuracy represent lower bounds of the true returns. Based on the estimates of the costs of the sample surveys reported in Table 1 and of the marginal social returns, the benefit-cost ratios for public investment in increasing accuracy or reducing sampling error in

Table 1. Costs of sample survey required for specified levels of typical sampling errors in major U.S. farm commodities, and their corresponding sampling errors

	Survey cost (million dollars)						
	3.40	3.76 ^c	4.13	5.80	7.90	17.10	62.00
Area sample	3.40	3.76 ^c	4.13	5.80	7.90	17.10	62.00
Multiple frame sample	3.40	3.76 ^c	4.13	5.60	7.60	13.00	44.20
Typical sampling error in major commodities ^a	3.0	2.5	2.0	1.5	1.0	0.5	0.0
Individual commodities sampling error ^b	(percent)						
Wheat	3.2	2.6	2.1	1.6	1.1	0.7	0.2
Rye	9.0	7.5	5.9	4.5	3.0	2.0	0.6
Rice	15.8	12.6	9.9	7.8	5.5	3.5	0.8
Corn	2.1	1.8	1.4	1.1	0.8	0.5	0.0
Oats	3.1	2.6	2.1	1.7	1.2	0.7	0.2
Barley	5.4	4.5	3.5	2.7	1.9	1.3	0.5
Potatoes	18.5	15.5	12.6	9.5	6.6	4.2	1.0
Soybeans	3.4	2.8	2.2	1.7	1.2	0.8	0.3
Peanuts	9.5	8.0	6.3	5.0	3.6	2.2	0.8
Tobacco	5.1	4.3	3.4	2.6	1.8	1.2	0.5
Cotton	4.8	4.0	3.1	2.4	1.7	1.1	0.4
Cattle	2.3	1.9	1.3	1.0	0.7	0.5	0.0
Hogs	4.4	3.8	2.9	2.2	1.6	1.0	0.4
Sheep & lambs	13.1	11.0	8.9	6.8	4.5	3.0	0.7
Poultry	9.2	7.8	6.2	4.8	3.3	2.0	0.5
Eggs	9.2	7.5	5.8	4.5	3.1	1.9	0.6
Milk	5.4	4.5	3.5	2.7	1.9	1.3	0.4

a Major commodities refer to items that are produced on most farms in the United States.

b Sampling errors in the production characteristics of individual items corresponding to the specified levels of typical sampling error in major U.S. farm commodities.

c Linear interpolation.

Source: Data prepared by the Statistical Reporting Service, U.S. Department of Agriculture.

the survey of agricultural production as being conducted by the Statistical Reporting Service, USDA, were calculated. The results are presented in Table 2.

In spite of the possibility of underestimation of social returns, the benefit-cost ratios calculated by dividing the marginal social returns by marginal social costs are extremely large. For example, our estimates reveal that each extra dollar invested in increasing the accuracy of statistics from the 2.5 to the 2.0 level of error returns more than \$600 worth of benefit to society. And increasing the level of accuracy from 2.0 to 1.5 percent error produces \$90 to \$100 of benefit for each extra dollar invested.

To a certain extent the reliability of the estimates of the marginal social returns and benefit-cost ratios depends on the accuracy of the price elasticities of demand and supply that we have utilized. Overestimation of the marginal social returns or the benefit-cost ratios would result from either an underestimate of demand elasticities (α 's), an overestimate of the supply elasticities (β 's), or both. In the interest of obtaining lower bounds to the various benefit-cost ratios, experiments were conducted

Table 2. Estimates of marginal social benefit-cost ratios corresponding to reduction in typical sampling error in the survey for statistical reporting of farm commodities, the United States

Change in typical sampling error	Marginal survey cost ^a		Marginal social returns ^b			Marginal benefit-cost ratio	
	Area sampling (1)	Multiple frame sampling (2)	Inventory adjustment (3)	Production adjustment (4)	Total (5)	(5)/(1)	(5)/(2)
(percent)	(million dollars)						
from 3.0 to 2.5	0.36	0.36	288.8	8.0	296.8	824	824
2.5 to 2.0	0.37	0.37	223.2	5.9	229.1	619	619
2.0 to 1.5	1.67	1.47	152.5	3.6	156.1	93	106
1.5 to 1.0	2.10	2.00	116.3	2.9	119.2	57	60
1.0 to 0.5	9.20	5.40	66.9	1.4	68.3	7.4	13
0.5 to 0.0	44.9	31.2	42.7	0.9	43.6	1.0	1.4

^a Increases in the cost of sample survey corresponding to changes in the typical sampling error; data from Table 1.

^b Aggregates of marginal social returns.

using progressively larger demand elasticities and progressively smaller supply elasticities in making our calculations. As expected, the benefit-cost ratios decline using progressively larger α 's and smaller β 's. However, even when the 500 percent larger α 's and 500 percent smaller β 's are applied, an extra dollar invested in increasing the accuracy of statistical reporting of the products considered returns over \$100 worth of benefit to society at the 2.5 to 2.0 percent range of accuracy and nearly \$20 of benefit at the 2.0 to 1.5 percent range.

Summary and Conclusions

These estimates of the social returns to investment in the collection and reporting of information are very rough and are intended primarily as an illustration of the methodology. Nevertheless, it seems apparent that the benefits from investments to increase the accuracy of agricultural production statistics exceed by a large margin the costs of making such improvements.

The results suggest that in the U. S. there is an underinvestment in the statistical reporting of agricultural production. The social returns to a dollar invested in improving the accuracy of statistical information is comparable to the returns from such high pay-off investments as agricultural research. In many developing countries, where the accuracy of the existing statistical estimates is substantially less than those used in the U. S. illustration, the social returns from improvements in the statistical system may be even higher than those obtained in the U. S. study.

CENTER RESEARCH REPORTS

LABOR MARKETS IN DEVELOPING ECONOMIES

TURKISH WORKERS AT HOME AND ABROAD **TERRY D. MONSON**

One problem facing Turkey's industrialization efforts is the need to meet industry's demands for an adequately trained labor force. Turkish Development Plans have recognized this problem and have attacked skilled manpower deficiencies by emphasizing formal training programs (e.g., vocational education, on-the-job training) as means of providing workers for the upper echelons of the industrial labor force. There tends to be no corresponding emphasis upon training of semi-skilled and unskilled labor in Turkey. Consequently, these workers usually are trained through an informal process associated with the acquisition of on-the-job experience during which they adapt to industrial working conditions and learn rudimentary industrial skills without being offered formal training by the firm.

This experience-generated learning concept is first briefly developed and applied to the conditions of a developing country. It is then used to measure and compare the differential impact of experience gained by new entrants into the labor force when employed in an industrial economy having an experienced and skilled labor force (West Germany) with that gained when employed in a country that is just beginning to industrialize (Turkey). This research is important insofar as it provides an empirical examination of the impact of industrial experience on the productivities of the industrial labor force in developing countries.

The phenomenon of Turkish migration to West Germany for purposes of short term employment (3-5 years) offers a unique opportunity for this analysis. Data were collected over the winter of 1971 for a relatively homogeneous, but small, sample of inexperienced Turkish workers employed in the German and Turkish metal industries. The sample consists of 135 workers and 11 groups of workers with most sample members being male, having only the basic 5 years of Turkish primary education, often being from a rural background, and having little, if any, prior industrial experience. Thus sample members are roughly similar but they work in labor forces widely divergent in their levels of human capital.

The statistical procedure was divided into two steps. First, learning curves were fit to data for each sample member in order to provide estimates of the worker's rate of learning, his beginning productivity level, his absolute productivity gain from experience-generated learning, and the length of his learning period. In the second step, the parameters

estimated for each sample member become dependent variables for further regression analysis with the independent variables representing the workers' experience and educational levels, occupational differences, and the firms' human and physical capital contents.

Precise comparison of learning behavior between countries was impossible because of data limitations. However, the results did indicate that inexperienced entrants into the semi-skilled labor force go through a process of adapting to industrial working conditions and to learning rudimentary industrial skills. The hypothesis was verified that a worker's learning behavior is influenced by the skill and experience of the other workers with whom he is employed. In addition, the evidence indicates the already pronounced differences in the efficiency of the Turkish and West German labor forces may be getting more unequal over time because of differences in the effectiveness of experience-generated learning. For our sample, experience in Germany had a greater effect upon productivity than experience obtained in Turkey. German experience provided more systematic and larger absolute improvements in productivity, tended to be more transferable among firms, required a shorter learning period, and was obtained at a much lower productivity loss than Turkish experience. It appears that experienced workers are generated more slowly, less systematically, and more expensively in Turkey. The effect is to widen the already large productivity differential between the two countries.

The evidence confirms that lack of an experienced labor force acts as a constraint on Turkish industrial development. To overcome this problem, efforts should be made to improve the efficiency of the experience-generated learning process in Turkey and to increase the transferability of the experience received from firm to firm. Furthermore, the results tend to support the contention that an efficient and inexpensive means of developing an industrial labor force is to encourage utilization of migrants upon their return to Turkey. Efforts should be made to ease the reentry of Turkish workers with experience in Germany into Turkish industrial employment in Turkey.

The research on this project has been supported by a grant from USAID. Mr. Monson is a Research Associate at the University of Michigan. He is currently with the Michigan Center for Research on Economic Development with assignment in Africa.

FAMILY FERTILITY DECISIONS AND ECONOMIC DEVELOPMENT URI BEN-ZION

The objective of this research is to obtain a more precise understanding of the relationship between family fertility decisions and economic development. The project is proceeding in two stages.

The first stage involves the refinement of models of family decisions regarding number of children and the quality of children. Family investment decisions with respect to the returns to investment in education and in other forms of capital will be given careful consideration in the design of the model.

The second part of the project will analyze the dynamic properties of the model in terms of the effect of economic growth on family fertility decisions. The differential effects of agricultural and industrial development will be examined.

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

RURAL TO URBAN MIGRATION IN TUNISIA MICHAEL J. HAY

Tunisia is characterized by high rates of unemployment and underemployment in both urban and rural areas. There is substantial migration from rural areas to urban areas in Tunisia and substantial migration to Europe. The major objectives of this research project are to determine the importance of the several personal, family, and community characteristics which determine migration behavior and to measure the effect of migration on earnings. A human capital framework is being employed in which migration, along with education, is viewed as a form of investment in the human agent.

The field phase of the research is being conducted primarily in 4 cheikhats of Testour, a cereals growing area of Northern Tunisia. A survey program involving 240 interviews of migrants and non-migrants was scheduled for July and August 1972.

The research on this project is being supported by a grant from the Midwest Universities Consortium for International Activities, Inc. (MUCIA). The research in Tunisia is being carried out in cooperation with the Center for Economic and Social Research (CERES) in Tunis. Mr. Hay is a Research Assistant in the University of Minnesota Department of Agricultural and Applied Economics.

**ECONOMIC GROWTH AND INDIVIDUAL INCOME DISTRIBUTION:
A CASE STUDY OF COLOMBIA
BERNARDO KUGLER**

There has been considerable concern at both analytical and policy levels with "under performance" of the Colombian economy. There is a general presumption that per capita income in Colombia is below that in other countries with comparable resource endowments. A large proportion of the population is characterized by low productivity, low incomes, and low levels of training and education.

The objectives of this study are to clarify the relationships between income distribution and the distribution of skills in the labor force in Colombia.

The research was initiated at the University of Minnesota during the summer of 1971 and is being completed in Colombia.

The research on this project has been supported by a grant from the Ford Foundation. Mr. Kugler is a member of the Faculty of Economics, University of the Andes, Bogota, Colombia.

**TECHNICAL CHANGE AND POPULATION GROWTH IN THE
ECONOMIC DEVELOPMENT OF JAPAN AND THE UNITED
STATES
MITOSHI YAMAGUCHI**

The relationships among technical change, population growth, and economic development are poorly understood. In this study an attempt will be made to measure the effects of differential rates of technical change and population growth in the agricultural and nonagricultural sectors of the Japanese and United States economies for the period 1880-1970.

Two-sector models in which economic activity is partitioned between the agricultural and nonagricultural sectors will be constructed for both economies. The model will be constructed to permit an evaluation of the effects of differential rates of technical change and population growth on the flow of physical and human resources among sectors through product and factor markets.

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

TRADE AND DEVELOPMENT

IMPACT OF P.L. 480 SHIPMENTS IN BRAZIL PETER M. GREENSTON

Brazil has been a substantial importer of wheat from the United States. Much of this wheat has been made available on concessional terms under the provisions of the Agricultural Trade Development and Assistance Act of 1954 (P.L. 480). Under Title I the United States accepted local currencies (cruzeiros) in payment for wheat and under Title IV sales for dollars were financed at concessional rates. Sales of commodities under the P.L. 480 arrangements involve, therefore, an aid component.

A major objective of this project was to measure the aid component of the P.L. 480 wheat imports to Brazil. An attempt is also made to evaluate the impact of the P.L. 480 wheat imports on the efficiency of resource use and the rate of development in Brazil, as well as that on other commercial suppliers.

Wheat imports have accounted for 80-90 percent of the apparent wheat consumption in Brazil over the last two decades. The U.S. and Argentina have been the primary sources. And imports under the P.L. 480 program have represented a substantial share of U.S. foreign aid to Brazil (Table 3).

The effect of the P.L. 480 wheat imports was to hold prices to both producers and consumers below the levels that would have prevailed in the absence of the program. It is estimated that a policy of free trade in wheat would have resulted in an increase of 27 percent in the price of wheat products to the consumer; an increase of 3 percent in the price of wheat to the producer; an increase in commercial imports of approximately 38 percent; and a decrease in wheat consumption of 15 percent. If the policies that prevailed before the initiation of the P.L. 480 program had been continued, prices to consumers and producers would have risen less and imports would have been larger than under the free market case.

The average gain to Brazil from participating in the P.L. 480 program rather than continuing its previous program is estimated at approximately .79 percent of GNP. The P.L. 480 program involved gains to both the U.S. and Brazil. The cost to the U.S. per dollar of aid supplied in the form of P.L. 480 wheat was approximately \$.31. The gain to Brazil from obtaining wheat through the P.L. 480 program rather than financing the purchases commercially was approximately \$.75 per dollar of P.L. 480 wheat supplied.

The research on this project was supported by a grant from the Ford Foundation. Mr. Greenston is Economist, Urban Institute, Washington, D. C.

Table 3. U.S. foreign aid to Brazil by program, 1956-70 (net new obligations in millions of dollars)

	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
AID loans & grants	3.6	4.0	5.8	8.9	11.9	7.0	84.5	86.3	178.6	230.7	242.3	213.7	187.7	-11.7	61.2
Food for Peace (P.L. 480)	35.6	110.2	3.6	3.0	1.8	84.7	72.9	48.6	152.8	25.0	79.4	21.6	85.0	10.3	68.6
Export-import bank loans	56.0	193.3	17.5	122.2	6.8	188.3	—	—	—	6.0	16.9	30.0	50.8	29.1	65.6
Other	.5	6.6	—	—	—	—	47.9	7.4	6.5	11.3	6.2	3.5	3.9	3.5	3.0
Total economic aid	95.7	314.1	26.9	134.1	20.5	280.0	205.4	142.3	337.9	273.0	344.8	268.8	327.4	31.2	198.4
P.L. 480 as % of total	37	35	14	2	9	30	36	34	45	9	23	8	26	33	35

Source: U.S. Agency for International Development, *U.S. Overseas Loans and Grants and Assistance from International Organizations, Obligations and Loan Authorizations, July 1, 1945 – June 30, 1970*; and special tabulations prepared by P. Schwab, Brazilian Affairs, U.S. Department of State.

INTERNATIONAL TRADE IN USED DURABLE GOODS

FRANCISCO E. THOUMI

Suggestions have frequently been made that less developed countries should encourage the importation of used rather than new capital equipment. It has been argued that used machines are often more suited to the factor endowments of developing economies than new machines. The labor saving features of new machines tend to reflect the relatively high wages of labor in the developed countries. Furthermore, the maintenance of used machines is frequently more labor intensive than the manufacture of new machines.

The objective of this study is to estimate whether it would be advantageous for a country like Colombia to encourage trading in selected secondhand capital goods. A detailed empirical study has been completed of the optimum age at which bus chassis should be imported. A large share of public transportation in Colombia is provided by buses. Colombia has excess capacity, particularly trained manpower, for bus maintenance.

Preliminary results indicate that the optimum policy would be for Colombia to import 7-year-old chassis and use them for approximately 5 years. The total yearly saving that Colombia could realize in bus transportation by switching to an optimum import and use pattern rather than importing new chassis ranges from \$8.4-11.0 million per year. Even though only bus chassis were considered in this study the gains amount to approximately 0.3 percent of Colombian GNP. A general policy to encourage importation of used durables could result in substantially larger gains.

The research on this project was supported by a grant from the Ford Foundation. Mr. Thoumi is Economist, Economics Department, International Bank for Reconstruction and Development, Washington, D. C.

WELFARE COSTS OF COMMERCIAL POLICIES IN THE ARGENTINE AUTOMOBILE INDUSTRY

ENRIQUE O. SCALA

The automotive industry is an example of the new stage of the import substitution in Argentina that started in the late fifties and took place mainly in sections with high capital and technical requirements. Its importance arises both because of this reason and of its importance in the total economy. The program has been characterized by progressively restricting the import content of production.

The objectives of the research are (a) to compare the efficiency of the policies followed by Argentina against the alternative of importing complete units; (b) to evaluate the possible results of changes in import content restrictions; and (c) to measure the effects of different scales of production.

The results indicate that there was substantial cost to the economy in the early stages of the program. The domestic price in 1967, adjusted for some of the taxes paid by the industry, was about 35 percent higher than the CIF price of imports. Since 1968, however, prices have declined steadily and the difference between the domestic and the import price has been reduced substantially. This does not mean the industry is internationally competitive but that the transport cost approximately compensates for the present excess cost of production. Although the cost of the policies adopted has been high, particularly during the initial years, it appears that Argentina has been successful in establishing a reasonably efficient automobile industry.

Even though the gains from importing finished units do not appear to be very important now, the study suggests that additional gains may be achieved by specializing in the production of parts in which Argentina production is most efficient. This would involve importing those parts in which the potential scale economies preclude efficient production in Argentina. Although the domestic content would be somewhat lower than at present, it would place Argentina in a stronger competitive position and open up the possibility of exports of automobiles to other Latin American markets.

The results obtained for the analysis of economies of scale are within the range of previous estimates made for the industry. However, the cost reductions achieved in recent years have been due, in the main, to an increase in the utilization of the existing production capacity rather than from capacity expansion to achieve scale economies.

The saving of foreign exchange from the increase in domestic content has been less than it was ordinarily believed. For a nominal import allowance of 5 percent of the import price of cars and 13 percent of trucks, the average total foreign exchange requirement is almost 30 percent. This difference is due to the import requirements for the domestic production of components, repatriated profit, and royalties. In addition, the economic cost of content protection has been exaggerated in Argentina because of quotas on output and restrictions on the use of foreign exchange.

The research on this project has been supported by a grant from the Ford Foundation. Mr. Scala is a Research Assistant in the University of Minnesota Department of Economics.

THE COMMON MARKET AND TURKEY

TERCAN BAYSAN

Turkey is presently an associate member of the European Economic Community (EEC). It is scheduled to become a full member following a series of transitional stages. The EEC countries have abolished internal trade barriers, erected common tariffs on imports from non-member countries, and are applying common agricultural and tax policies. Entry into the common market is expected to create substantial problems of adjustment for the Turkish economy. The objective of this research project is to measure empirically the effects of entry into the EEC on the economy of Turkey.

The analysis will be conducted within the framework of the general equilibrium model of production and trade being developed by James M. Henderson (see pp. 7-11).

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

REGIONAL DEVELOPMENT IN ARGENTINA

JOSE ANTONIO CERRO

Argentina is characterized by substantial regional differences in growth and development. The country is dominated economically by a single urban region. In spite of attempts to achieve diversification of economic activity the share of total national income and employment accounted for by the greater Buenos Aires region has continued to rise.

The objective of this study is to measure the regional and inter-regional impact of regional development programs in Argentina. The initial step will be to construct a regional model of the Argentina economy. The second step will involve the evaluation of the impact of four specific programs: (a) the construction of the Chocon Dam in southern Argentina; (b) the closing of approximately half of the sugar refineries in Tucuman, (c) the growth of the automobile industry in Cordoba; and (d) the Inter-American Development Bank (IDB) sponsored agricultural development program in Santiago.

The research on this project has been supported by a grant from the USAID. Mr. Cerro is a member of the Faculty of Economics, University of Tucuman, Argentina.

THE DETERMINATION OF SPECULATIVE PRICES

PETER K. CLARK

A model relating futures prices to the time distance of relevant spot prices is being studied. Such a model, supported by empirical evidence, will investigate the role of futures markets as a financial method for averting risk as opposed to physical crop diversification or storage facilities. Use of such financial instruments is very important to developing countries whose foreign exchange earnings are generated by single crops or commodities.

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

COMMODITY AND FACTOR MARKETS IN DEVELOPING COUNTRIES

FERTILIZER USE, DISTRIBUTION, AND MANUFACTURE IN SOUTH KOREA: AN ECONOMIC ANALYSIS

DALE C. DAHL

YOUNG K. SHIM

BAI YUNG SUNG

During the 1960's the Korean demand for food crops rose at twice the annual rate of domestic food grain supplies. Closing this widening gap has been central to Korean agricultural planning. Increased use of commercial fertilizer is central among the policy alternatives available to increase total crop production.

This study is primarily concerned with quantifying the potential demand for fertilizer in South Korea and with the economic analysis of alternative supply structures that best satisfy that demand. These general concerns can be more specifically listed as four major objectives:

1. To estimate the actual and potential demand for fertilizer in South Korea totally, by nutrient, by crop, and by geographic region.
2. To mathematically characterize the distribution system for fertilizer in South Korea from both import and manufacturing points to the farmer-user and to study alternative systems that could reduce the severity of the logistical problems encountered.
3. To study the cost of manufacturing fertilizer in Korea compared with an "engineered" or simulated cost analysis among plants and to compare these costs with manufacturing costs in other countries and the price of imported fertilizer materials.
4. To extend the results of this study to the South Korean government for policy consideration and to other East Asian countries to suggest similar economic analysis where appropriate and to assess the implications of changes in Korean fertilizer policies on nearby countries.

The research on this project is supported by a grant from the USAID. Mr. Dahl is a Professor in the University of Minnesota Department of Agricultural and Applied Economics; Mr. Shim is a Professor in the Seoul National University Department of Agricultural Economics (Suwon, Korea); and Mr. Sung is a Research Assistant in the University of Minnesota Department of Agricultural and Applied Economics.

**ECONOMICS OF FORESTRY INFORMATION: CASE STUDIES
IN CENTRAL AMERICA
ROBERT P. LATHAM
HANS M. GREGERSEN**

The objective of this project is to develop an analytically based methodology for designing and evaluating information programs for forestry sector planning. The primary focus of the field research effort is in Central America.

Conceptual models have been developed for two purposes. The first model provides a means for determining the total budget size appropriate for a forestry information program. Based on (a) the risk aversion of the decision-maker, (b) the characteristics of the processes being investigated, (c) the current state of knowledge, and (d) the characteristics of the information gathering activities, the model provides an economic rationale for the funding of information generating projects.

The second model provides a framework for analyzing the internal allocation of a previously determined budget between the relevant factors in an information generating program. Using quantitative estimates of (a) the marginal costs of information gathering, (b) the relative impact of the relevant factors on organizational performance, and (c) the current knowledge about the relevant factors, this model yields a conceptually unique solution to the allocation problem.

Field studies which are aimed at determining the usefulness of these models for policy and planning have now progressed through the data collection phase. Data for six case studies have been gathered in the Central American Common Market region. Analysis is underway. An attempt will be made to ascertain what implications the analysis has in terms of information policy for LDC's. Preliminary evidence indicates that significant improvements may be possible in the design and management of natural resource information systems.

This research has been supported by a grant from the USAID. The field phase of the research has received close cooperation from GAFICA, FAO advisory group attached to the Secretariat for the Central American Economic Integration program (SIECA). GAFICA/SIECA is also providing logistical support. Mr. Gregersen is Associate Professor in the College of Forestry and in the Department of Agricultural and Applied Economics, University of Minnesota. Mr. Latham is Research Fellow in the School of Forestry, University of Minnesota.

THE PRODUCTION AND EXPORT POTENTIAL OF THAILAND'S OILSEED SECTOR

PETER K. POLLAK

Thailand's agriculture is predominantly oriented towards the production and export of rice. The introduction of high-yielding rice varieties in Southeast Asia contributed to a weakening of Thailand's traditional export markets. A persistent imbalance in Thailand's foreign trade and a rapidly increasing population (with a growth rate of 3.2 percent) has placed a severe constraint on Thailand's economic development. The Third Five Year Plan (1972-1976) attempts to focus developmental efforts on a limited number of agricultural commodities with a substantial export potential. Among the crops singled out for promotion are soybeans and peanuts. Although both crops have been of minor importance in the past, the steadily rising demand for oilseeds, particularly in Japan, was apparently a decisive factor in the emphasis placed on these crops.

The main objective of this research project is to evaluate and to project the production and export potential of Thailand's oilseed sector. The study will consist of three major parts. First, an analysis of the production and marketing of oilseeds. Thailand's economy is basically oriented towards free trade and a minimum amount of government interference. The realization of the goals laid down in the Third Five Year Plan will depend, at least partially, on the price policies that are adopted. To evaluate the production potential on the analysis of the farmer's response to price incentives, a survey of the marketing sector will be undertaken. Particular consideration is being given to the specific socio-economic environment in which farmers and merchants make their decisions. An analysis of the domestic and foreign demand will be the objective of the second part. Domestic consumption presently absorbs almost 80 percent of Thailand's soybean and peanut production. The basis for an evaluation of the export potential is, therefore, a detailed analysis of the domestic demand for oilseeds. The results of these two parts will be used to develop the implications of alternative policies and developmental strategies for Thailand's oilseed sector.

Several marketing surveys, which included most major marketing centers in central and northern Thailand, have been completed. The great variation in production methods made several farm surveys in each of the selected agro-climatic regions necessary.

Research on this project has been supported by the Rockefeller Foundation. Mr. Pollak is a Research Assistant in the University of Minnesota Department of Agricultural and Applied Economics.

ECONOMIC DEVELOPMENT AND FOOD DEMAND: AN EXPLORATION INTO THE ECONOMICS OF TASTE
SACHIKO YAMASHITA

The conventional theory of the consumer's choice does not give explicit attention to the origin of tastes. Differences in tastes are assumed as given and tastes are normally assumed to be constant. However, for some empirical and theoretical purposes, it is useful to be able to introduce differences in taste among areas and changes in tastes over time, and to measure them quantitatively.

The purpose of this study is to estimate long-term demand equations for food commodities. A model is constructed which permits explicit handling of differences in tastes in cross-section analysis and changes in tastes in time-series analysis.

The framework used to conceptualize the mechanism of formation of tastes is modeled on the induced innovation theory in production, first developed by J. R. Hicks. It is assumed that people have potentially common preferences and that there exists a relatively stable ordinal meta-utility function which represents the fundamental physical and psychological factors that condition changes in tastes over time. The meta-utility function is a counterpart of the meta-production function in production theory.

In this study the following hypotheses are being investigated:

- (a) The commodities which have a comparative advantage in production, consistent with resource endowment and climatic conditions of an economy, induce formation of relative taste preferences favorable to them.
- (b) When the relative availability of commodities changes, as a result of technological development in production and marketing or by the opening up of international trade, people change their tastes in response to changing relative prices.

It is assumed that these changes occur along an ordinal meta-utility function.

Preliminary findings from a cross-section analysis of intercountry data support the first hypothesis. Tests of the second hypothesis against time-series data are still being pursued.

Research on this project has been supported by grants from The Rockefeller Foundation and the USAID. Miss Yamashita is a Research Assistant in the University of Minnesota Department of Agricultural and Applied Economics.

TECHNICAL CHANGE AND RESOURCE USE

TECHNICAL AND ECONOMIC CONSTRAINTS ON BOVINE PRODUCTION IN THREE VILLAGES IN THAILAND **A. JOHN DEBOER, JR.**

The multiple roles of cattle and water buffalo in crop and live-stock production by farmers was the subject of this study. Objectives were to describe and analyze crop production, cattle and water buffalo (bovine) production, and their interrelationships in three case study villages over a 1-year period. Major emphasis was placed on (a) bovines as draft inputs into crop production, (b) the crop production-bovine production interrelationships, (c) returns to bovines as an investment, and (d) formulation of a model describing the technical and economic factors constraining output increases.

Crop production function analyses indicated, in most cases, bovine input allocation was close to profit maximizing levels. Considerable variations in draft animal usage were found (a) between crops within a given village and (b) between the same crop grown in more than one village.

Livestock production patterns were tied closely to the crop production system which controlled (a) grazing and (b) the quantity and quality of roughage provided from the crops. Bovine herd ownership patterns ranged from 95 percent of all animals being held as cattle to 73 percent held as buffalo. Herd composition and sources of biomass changes were tied closely to the primary function of the animal.

The technical and economic information influencing bovine costs and returns was utilized to construct enterprise net cash flows over time. The cash flows were evaluated using an internal rate of return (Table 4). Generally, the rates were close to institutional lending rates. Differences in enterprise rates of return seemed to reflect dynamic changes in the herds which were occurring over the study period.

The components of the system were then combined into a formal model which allowed estimation of (a) bovine biomass levels supported by the village resource base, (b) allocation of the biomass between draft and breeding enterprises, and (c) outputs flowing from the herd thus determined. Results of the model indicated major increases in meat production came from increasing herd size or a change in herd age-sex structure in response to primary herd functions, rather than through increases in basic herd efficiency.

Research on this project was initially supported by a grant from the Ford Foundation. The field work was supported by The Rockefeller Foundation. It was completed under a grant from the USAID. Mr. DeBoer is a Lecturer in Agricultural Economics, the School of Agriculture, University of Queensland (Australia).

Further modifications of this model are needed to account for major changes in (a) cropping patterns and crop production technologies, (b) mechanization, and (c) price relationships.

Table 4. Estimates of internal rates of return

Village	Type	Sex	Enterprise	Internal rate of return
Mapkhae	Cattle	Male	Raised from birth to 4, used as draft from 4-11, sold at end of 11 years as culls.	15.0%
	Cattle	Female	Raised from birth to 4, bred from 4-11, sold at end of 11 years as culls.	15.5%
	Buffalo	Male	Raised from birth to 4, used as draft from 4-11, sold at end of 11 years as culls.	15.2%
	Buffalo	Female	Raised from birth to 4, used as draft from 4-8, used as breeding 4-11, sold at end of 11 years as culls.	26.5% ^a
Non Som Boon	Cattle	Female	Raised from birth to 4, bred from 4-11, sold at end of 11 years as culls.	8.2%
	Buffalo	Male	Raised from birth to 4, used as draft from 4-11, sold at end of 11 years as culls.	6.1%
	Buffalo	Female	Raised from birth to 4, used as draft from 4-8, used as breeding 4-11, sold at end of 11 years as culls.	10.9% ^a
Nong Jek Lee	Cattle	Male	Raised from birth to 4, used as draft from 4-11, sold at end of 11 years as culls.	8.9%
	Cattle	Male	Purchase replacement males at 3, used as draft from 4-11, sold at end of 11 years as culls.	16.0%
	Cattle	Female	Raised from birth to 4, bred from 4-11, sold at end of 11 years as culls.	-1.0%

^a Returns assumed power return = .5 of male draft animal and breeding returns equal to nonworked breeding females.

**SCIENCE AND AGRICULTURAL PROGRESS: THE JAPANESE
EXPERIENCE
YUJIRO HAYAMI**

In Japan agricultural science has been deliberately employed as an instrument of modernization since the time of the Meiji restoration. The modernization process involved the development of public sector experiment station capacity capable of producing a continuous stream of biological technology adapted to the resource endowment and the economic environment of the Japanese economy. This process of induced technical change has been described more fully in a previous study (Yujiro Hayami and Vernon W. Ruttan, *Agricultural Development: An International Perspective*, Baltimore: Johns Hopkins Press, (1971).

The purpose of this study is to develop a more complete understanding of the process of technical and institutional change that enabled Japan to achieve levels of output per hectare that are exceptionally high by world standards while retaining an agricultural system characterized by small farms and a relatively favorable distribution of income in rural areas. Particular attention is being given to the significance of centralization and decentralization in research decision and resource allocation systems and to the information linkages between the national and prefectural research systems, veteran farmers and farmers associations, and local and national political organizations and legislative bodies.

Research during 1971/72 was focused primarily on establishing the data base for the study. This included an intensive review of Japanese rice policy (see EDC Reprint 72-1); a revision of data on long-term growth rates of Japanese agriculture for 1880-1965; and an analysis of the sources of agricultural growth in Japan between 1880 and 1965. Among the more significant findings of the first year's effort is that only about half of the long-term growth of agricultural output in Japan is accounted for by changes in conventional inputs (land, labor, capital, and fertilizer). Approximately one-quarter of the increase was accounted for by public expenditures for research and extension and another quarter by the increase in the education of the Japanese rural population.

During the 1972/73 year primary attention will be directed to an exploration of the institutional foundations for that portion of the agricultural growth accounted for by research and extension. Case studies will be conducted on the coordinated efforts by the national and prefectural research stations in crop breeding which emerged in the

1920's and 1930's, on the interaction between farmers and the industrial sector in the development of mechanical equipment, and on the interaction between farmers and experiment station scientists in the development of new rice production technology.

The research on this project has been supported by a grant to the UM Economic Development Center from the Rockefeller Foundation. Mr. Hayami is Professor in the Tokyo Metropolitan University Department of Economics.

BIOLOGICAL AND MECHANICAL TECHNOLOGY ON SMALL FARMS IN MEXICO CLAYTON OGG

This research is part of a larger study being conducted in the state of Michoacan (Mexico) in cooperation with the University of Minnesota Center for Comparative Studies in Social and Technical Change and the Instituto Mexicano de Estudios Sociales. The objective of this sub-project is to determine the opportunities and constraints on the adaptation of biological and mechanical technology in a region characterized primarily by small scale farmers of Indian origin.

Response to fertilizer use in the Zacapu area in Mexico provides an interesting exception to the generally held belief that native plant varieties are not responsive to fertilizer application. All of the 72 farmers who were interviewed said that hybrids did not work as well as presently used native corn seed. Yet farmers using fair amounts of fertilizer were generally obtaining at least double the 1.1 tons per hectare obtained by farmers who did not use fertilizer. Of the variables considered, fertilizer application was the only one which clearly and consistently was accounting for productivity differences among and within villages.

An effort was made to determine the constraints which prevented most of the region's 1-4 hectare farmers from using fertilizer. Plots around one of the four villages appeared to be rented to one large operator, but in the other three villages, there was evidence that capital and credit were the main constraints on fertilizer use. Nearly all of the farmers in those three villages who were not using fertilizer indicated that lack of money or credit was the main reason. All but one of the farmers who used fertilizer either obtained credit or had large sources of income off the farm. One qualification should be noted. When asked what they would buy if credit became available, only 24 percent of the farmers who had complained of the capital constraint actually indicated that they would use credit to buy fertilizer. Although this result casts some doubt on the capital constraint hypothesis, it seemed apparent that the hesitation to borrow stemmed from previous difficulties with credit sources.

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

AGRICULTURAL MECHANIZATION IN BRAZIL

JOHN H. SANDERS

The basic rationale for this research is the hypothesized divergence between the private and the social costs of farm mechanization resulting from the impact of mechanization on labor replacement and the distribution of income among farms. It was also hypothesized that there is a systematic bias toward more mechanization than is socially optimal due to the distortions of factor prices, especially the subsidization of the interest rate and the over valuation of the domestic currency.

In the aggregate, mechanization is still not very significant as a power source in Brazilian agriculture. In 1960 almost 77 percent of the farms used only human power, 22 percent only animal and human power, and 1.4 percent some mechanical power. Nevertheless, the stock of agricultural machinery is increasing at a very rapid rate with 8,372 to 156,592 tractors from 1950 to 1970. Moreover, present government policy is to stimulate agricultural machinery use in the most underdeveloped areas with the largest pools of underemployed labor.

Tractor prices in Brazil were artificially deflated by preferential exchange rates during the 1950s and by subsidized credit, especially after the initiation of domestic production, in the 1960s. The exchange rate subsidy resulted in a price decrease at the farm level of approximately 17 percent over the period 1954-1961. The real value of Bank of Brazil credits for agricultural mechanization increased from 48.7 million cruzeiros in 1961 to 349 million in 1971. These loans were provided at interest rates substantially below the commercial rates and below the inflation rate, hence negative in real terms. A time series statistical analysis of the demand for tractors indicates that the quantity of these credits was one of the most significant variables determining tractor sales over the period 1950-1969.

In a cross-sectional analysis tractor demand was estimated as a function of the prices of alternative power sources, the crop mix, the intensity of operation, and the average farm size. The preliminary analysis indicates that the elasticity of substitution between labor and tractors for all Brazil was approximately 1.4. Hence the above machinery subsidies might be expected to have had a substantial effect upon factor proportions. The agricultural wage was the most significant variable, implying that mechanization was induced primarily by variations in labor cost.

The research on this project has been supported by a grant from the USAID and by a Foreign Area Fellowship. Mr. Sanders is conducting his research in São Paulo (Brazil) in cooperation with the São Paulo State Department of Agriculture.

TECHNICAL CHANGE IN WHEAT PRODUCTION IN PUNJAB (INDIA) SURJIT S. SIDHU

During the past six wheat growing seasons indigenous wheat varieties have been replaced by the exotic dwarf (Mexican) wheat varieties in a major part of the wheat area of North India. The exotic varieties of wheat are reported to have a 30-35 percent yield advantage over the indigenous wheat varieties. Input requirements of the exotic wheats, relative to the old wheats, per unit of land are considerably higher. And there has been some question as to whether the unit costs of the exotic wheats are lower than the old wheats. It appears that the cost structure of the two wheat types has not been studied and compared. The matter has, however, far reaching policy implications for product and factor price policy and for the supply of wheat. The objectives of this study are to estimate and compare production and cost function for the indigenous and exotic wheat varieties.

The study is based on data for four years from 1967/68 to 1970/71. Preliminary results indicate that the technical change associated with the introduction of the new varieties has been approximately neutral – it has not been strongly biased in either a labor saving or a capital saving direction. It has been cost saving. Technical efficiency has increased by almost one-fourth and unit costs of production have declined by about 16 percent. The demand for labor and capital inputs per acre have increased by about one-fourth.

The new wheat technology also appears to be neutral with respect to farm size. After adoption there appear to be no differences in either technical efficiency or overall economic efficiency between wheat farms that are smaller than ten acres or larger than ten acres.

Research on this project was supported by The Rockefeller Foundation (India) and by a grant from the USAID. Mr. Sidhu is a Research Assistant in the University of Minnesota Department of Agricultural and Applied Economics.

POTENTIAL BENEFITS AND PRICING OF IRRIGATION WATER: A CASE STUDY OF THE SANTA CRUZ SYSTEM REMIGIO D. TORRES

The general objective of this study is to determine the potential economic returns that can be realized from improvements in the management of small gravity irrigation systems serving rice producing areas in the Philippines. More specifically, the study attempts to: (a) describe how a typical irrigation system is organized, operated, and managed; (b) determine the level and structure of farm costs and returns in irrigated rice areas; (c) calculate the net gains associated with irrigation water made available under different levels of probability of rainfall and canal discharge; and (d) measure quantitatively the marginal value product (MVP) of irrigation water.

A linear programming (LP) model has been developed with an objective function which maximizes the value (V) of the net contribution of irrigation water to rice output. The net contribution (V) is defined as the difference between the gross value of a system-wide output and the cost of production (fertilizer, chemicals, land, labor, and other farm costs). It therefore embodies return to water *plus* the income imputed to operator and family labor.

The LP analyses revealed that the value of the net contribution (V) ranges from 7.03 million to 8.39 million pesos per year for the entire system of 4000 hectares, depending on conditions during the season. This is equivalent to a per hectare net value of about 1276 pesos (median planting date, dry season, $P \leq 0.50$). The implied value of water is about 95 pesos per hectare-millimeter of 617 pesos per hectare during the dry season (at the optimal water level of 6.5 mm/day).

Relaxing the water restraint from that level associated with 90 percent to that associated with ten percent level of certainty resulted in an increase in the net contribution of water from 6.58 to 8.62 million pesos over the entire system (median planting date).

On the basis of the expected weekly rainfall amounts (generated by fitting an Incomplete Gamma Function to the rainfall data) a two-rice-crop irrigation schedule was designed. A total of 6500 hectares could be planted per year using this schedule; available irrigation water during the period between successive rice crops can irrigate as much as 1800 hectares of short-duration (8-10 weeks) vegetable crops. With a shorter turnover time between rice crops, a three-rice-crop irrigation schedule was designed. This schedule would enable the irrigation of as much as 8600 hectares of riceland per year over the entire Santa Cruz System.

The research on this project has been supported by grants from The Rockefeller Foundation and from the USAID. During the field phase of the project, Mr. Torres was a Research Scholar at the International Rice Research Institute in the Philippines. He is currently instructor, Department of Agricultural Economics, University of the Philippines.

INDUCED TECHNICAL CHANGE AND AGRICULTURAL DEVELOPMENT IN WESTERN EUROPE

WILLIAM W. WADE
ADOLPH WEBER

The objective of this research is to test the induced innovation hypothesis against the agricultural development experiences of Denmark, France, Germany, and Great Britain since 1880. The differential response of the several countries of Western Europe to the drastic decline in grain prices after 1870 has long been an issue of concern to economic historians. The experience takes on new importance with the decline

in world grain prices in the late 1960's and early 1970's associated with the "Green Revolution."

During the past year Mr. Wade's research has focused primarily on the lag in both land and labor productivity in French agriculture during the last half of the 19th century and the first quarter of the 20th century.

The mechanization of French agriculture was particularly slow in spite of a number of factors which might have been expected to encourage horse mechanization. In spite of favorably expanding supplies and declining prices of fodder after 1850, horse and mule numbers remained nearly constant well into the 20th century. During the same period wages for hired farm labor rose steadily. The improvements in metallurgy and machine technology within France and the falling prices of machinery suggested that France clearly had the capacity to provide its farmers with effective horse drawn mechanical equipment which might be substituted for hand tool equipped labor during this period.

Instead, France experienced a proliferation of peasant farm entrepreneurs and a decline in average farm size throughout the last half of the 19th century. Rather than expanding the average farm to a size that would rationally support draft animal mechanization, the average farm shrank to a size that could be farmed by the peasant entrepreneur and his family. Continuing research is attempting to identify the economic and institutional forces associated with the French pattern of agricultural development.

Since returning to Germany in the summer of 1972, Mr. Weber has been involved in testing the induced innovation hypothesis against time-series data on German agricultural development. Preliminary results indicate that the process of substitution of power for labor and land saving technology for labor has been closely associated with changes in the prices of labor relative to power and of land relative to land substitutes (such as fertilizer and imported livestock feed). An element of particular interest in Weber's analysis of the German experience was the important role of small scale livestock production. In the German experience land substituting technology was embodied in both fertilizer and imported livestock feed (grain and oilseeds).

The research on this project has been supported by grants from the Ford Foundation and from the USAID. Mr. Wade is a Research Assistant in the University of Minnesota Department of Agricultural and Applied Economics. Mr. Weber is Professor, Institut für Agrarpolitik und Marktlehre, University of Kiel (Germany). In 1971/72 he was Visiting Professor in the University of Minnesota Department of Agricultural and Applied Economics.

RELATED PROJECTS AND PROGRAMS

In addition to the activities funded directly by the Economic Development Center, both the Department of Economics and the Department of Agricultural and Applied Economics and individual staff members of the two departments are involved in a wide spectrum of international programs and activities.

THE UNIVERSITY OF MINNESOTA IN TUNISIA

The University of Minnesota has been engaged in a technical assistance program in Tunisia since 1967 under contract AID/afr 469. The program is administered through the Office of International Programs and the Office of International Agricultural Programs. It has been staffed primarily by the Departments of Agricultural and Applied Economics and the Department of Economics.

The program has as its objectives the establishment of a Bureau of Economics in the Tunisian Ministry of Agriculture and the staff development of the Faculty of Economics at the University of Tunis. The principal activities have been in participant training in the United States and institution building related activities in Tunisia. Nine Tunisian students have been sent to the U.S. for M.S. training in agricultural economics. The first of these returned to Tunisia in the fall of 1971 and four more will return in 1972. Additional participants are being selected at the rate of about four a year with the expectation of training some 25 Tunisians by 1979, including five at the Ph.D. level. In economics 19 participants have been sent to the United States for Ph.D. training. Although some of these will be returned to Tunisia with M.S. degrees, the first four students will start their doctoral dissertation research in Tunisia in 1972/73. It is expected that some 15 Ph.D.'s will be completed under this program.

The University of Minnesota currently has a resident team in Tunisia of four agricultural economists and one economist (with the Faculty of Economics). Short term consultants and visiting lecturers are also used on a regular basis. In the Ministry of Agriculture work has concentrated on developing an institutional capacity for applied economics analysis to service its planning and policy functions. Research has focused on major commodities or subsectors: cereals, irrigation, olive oil, livestock, and fruits and vegetables. In the Faculty of Economics emphasis has been on undergraduate teaching, curriculum development, and research organization.

As a result of the experience the University is developing an institutional capacity for work in Francophone, Africa. Michael Hay has been in Tunisia, 1971/72, under a MUCIA grant for dissertation research on rural urban migration. Further coordinated and substantive research is planned to build upon the fund of experience being acquired by the University in economic development problems of North Africa.

University Staff Members Returned From Tours in Tunisia

R.P. Dahl (1967-70), Malcolm J. Purvis (1968-71), Osama Al-Zand (1968-71), and J. Donkers (1967-68).

University Staff Members in Tunisia

Jerome Hammond (Chief of Party), Herman Van Wersch, Tom Daves, Pascal Wick, and Jean-Claude Koeune.

Publications

1. French Language Publications¹

A. Reports

John D. Hyslop et Reynold P. Dahl, *Production de Blé en Tunisie, Tendances et Variabilités*, Rapport No 1 – Mai 1970.

John D. Hyslop et Reynold P. Dahl, *Prix du Blé et Politique de Prix en Tunisie*, Rapport No 2 – Août 1970.

John D. Hyslop, *Analyse de Politiques Possibles de Production Céréalière en Tunisie*, Rapport No 3 – Juin 1971.

Osama Al-Zand, *Politique de Prix de l'Huile d'Olive en Tunisie*, Rapport No 4 – Mai 1970.

Reynold P. Dahl, *Commerce International et Perspectives de Prix pour les Céréales leurs Répercussions en ce qui concerne la Tunisie*, Rapport No 5 – Janvier 1970.

Osama Al-Zand, *Prix à la Production des Olives et de l'Huile d'Olive en Tunisie*, Rapport No 10 – Août 1971.

Malcolm I. Purvis et Taoufik Ben Ammar, *Guide de l'Evaluation Economique des Projets Agricoles par Système Standardisé*, Rapport No 11 – Août 1971.

H.J. Van Wersch, J.W. Hammond, Y. Riffi et A. Sahnoun, *La demande de Produits Agricoles en Tunisie, 1966 – 1985*, Rapport No 12 – Decembre 1971.

B. Articles

Reynold P. Dahl, "Les Strategies de Developpement Agricole dans une Economie de Petite Taille: le Cas de la Tunisie," *Options Mediterraneennes*, No. 11, le developpement, February 1972.

Osama Al-Zand, "Un Plan de Stabilisation du Marche de l'Huile d'Olive pour la Region Mediterraneenne," Conference Internationale de Techniciens Oleicoles, June 14-19, 1971, Torremolinos, Spain.²

2. English Language Publications

A. International Agriculture Series³

John D. Hyslop, "The Tunisian Cereals Sector: An Examination of Production, Prices, and Some Alternatives for the Future," *International Agriculture Series 12*, Institute of Agriculture, University of Minnesota, 1972.

¹ Available from Chief of Party, University of Minnesota in Tunisia, American Embassy, USAID, Tunis, Tunisia

² Available from Federation Internationale D'Oleiculture, Agustina De Aragon, 11 Madrid-6-Espagne.

³ Available from Office of International Agricultural Programs, University of Minnesota, St. Paul, Minnesota 55101.

B. Staff Paper Series, Department of Agricultural and Applied Economics, University of Minnesota⁴

John D. Hyslop and R.P. Dahl, "Wheat Production in Tunisia – Trends and Variabilities," P70-9, June 1970.

J.D. Hyslop and R.P. Dahl, "Wheat Prices and Price Policy in Tunisia," P70-10, June 1970.

Osama A. Al-Zand, "Olive Oil Price Policy in Tunisia," P70-11, June 1970.

Jerome Hammond, "Characteristics of the Fruit and Vegetable Sector of the Tunisian Economy," P71-18, September 1971.

Osama A. Al-Zand, "Olive Oil Market Stabilization Scheme for the Mediterranean Region," P71-19, November 1971.

Osama A. Al-Zand, "Producer Prices for Olives and Olive Oil in Tunisia," P71-21, October 1971.

Reynold P. Dahl, "International Trade and Price Prospects for Cereals and Their Implications to Tunisia," P71-24, November 1971.

Reynold P. Dahl, "Agricultural Development Strategies in a Small Economy: The Case of Tunisia," P71-28, December 1971.

Malcolm J. Purvis, "The Adoption of High Yielding Wheats in Tunisia," P72-7, February 1972.

⁴ Available from Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, Minnesota 55101.

OTHER PROJECTS AND ACTIVITIES

The Department of Agricultural and Applied Economics has been engaged in a long-term program in cooperation with The Ford Foundation in Argentina. The main objective of the Argentine Agricultural Economics Project (Proyecto Pro Economia Agraria – PPEA) is to help develop the profession of agricultural economics in Argentina. The first students under the PPEA left for study in the United States in 1965. Each fellow in the program is sponsored by an Argentine institution (university, research center, or government agency) and has a commitment to work for his sponsoring institution upon completing the Ph.D. degree. The training program includes two principal stages: first, to complete all Ph.D. requirements except the thesis at one of several universities in the U. S.; second, to conduct in Argentina Ph.D. thesis research dealing with problems of Argentine agriculture. At present five fellows have completed M.S. degrees and have terminated their studies; 11 fellows have completed their Ph.D. degrees; 15 fellows are presently preparing theses in Argentina; and one fellow is currently completing course work in the United States. Darrell F. Fienup is Director of the PPEA in Argentina. Selmer A. Engene is U. S. Coordinator of PPEA. Both are professors in the University of Minnesota Department of Agricultural and Applied Economics. Willis L. Peterson spent the 1972 winter quarter in Argentina working with graduate students who are completing their Ph.D. thesis research under the PPEA program.

The two departments have continued their long term association with the program of The Ford Foundation in India. K. William Easter has served as agricultural economist with the Foundation. He has been conducting research on the economics of improving village irrigation systems and has been teaching a course in resource economics and advising graduate students on their research in the Division of Agricultural Economics at the Indian Agricultural Research Institute. Leonid Hurwicz spent the fall quarter in India serving as visiting professor at the Delhi School of Economics and the Institute of Economic Growth under Ford Foundation auspices. He continued his research on the information requirements of decentralized planning. Martin E. Abel continued his affiliation with the Foundation as a U. S. based consultant. He has continued his research on policy problems of Indian agricultural development.

The Department of Agricultural and Applied Economics has continued its cooperative program with The Rockefeller Foundation in Thailand. During the 1971/72 academic year, James P. Houck was a visiting professor in the Department of Agricultural Economics at Kasetsart University in Bangkok. He taught graduate courses in

mathematical economics, statistics, and agricultural policy. He also served as an advisor on Master's thesis research at both Kasetsart and Thammasat Universities and conducted research on the economics of export policy for corn in Thailand. Delane E. Welsch, who had previously worked with The Rockefeller Foundation in Thailand, spent the 1971/72 academic year in residence at the University of Minnesota. He taught in the areas of production economics and agricultural development and advised on several Ph.D. thesis research programs. Welsch returned to Thailand in June 1972. Two University of Minnesota graduate students have been associated with the program. A. John DeBoer, Jr. completed his Ph.D. thesis on "Technical and Economic Constraints on Bovine Production in Three Villages in Thailand." Peter Pollak initiated the field phase of research on "The Production and Export Potential of Thailand's Oilseed Sector."

Anne O. Krueger of the Department of Economics has been engaged in a major research project on "Exchange Control, Liberalization and Economic Development" at the National Bureau of Economic Research. The project involves a series of country studies and is jointly directed by Jagdish N. Bhagwati. She has continued to consult with the government of Turkey on problems of economic policy and planning.

Hans Gregersen of the College of Forestry and the Department of Agricultural and Applied Economics is engaged in an analysis of "Foreign Investment and Renewable National Resources." The project is supported by Resources for the Future. The objective of the project is to evaluate the consistency between the overseas investment policies of the U.S. forest industry and the forest industry and national development policies of developing countries.

Harald Jensen of the Department of Agricultural and Applied Economics spent the year, September 1971-August 1972, in Washington, D.C. with the Technical Assistance Bureau, USAID. This assignment was made available under the provisions of the AID 211(d) grant to the University of Minnesota.

Other staff activities include the participation of Philip M. Raup for a course on "Land Policy for the Developing Nations" on the staff of the University of Wisconsin (June 19-July 14) sponsored by the Agricultural Development Council and the University of Wisconsin Land Tenure Center. Vernon W. Ruttan served as a member of the Board of Trustees of the Agricultural Development Council (A/D/C) and on the Research Advisory Committee of the U.S. Agency for International Development. Pat R. Hasbargen consulted with the government of Botswana on livestock investment and development. Malcolm Purvis consulted with the government of Zaire on problems of education and research in agricultural economics and with the government of Tunisia on agricultural sector planning.

**THE GRADUATE PROGRAM IN ECONOMIC DEVELOPMENT AT
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GRADUATE COURSE OFFERINGS

Economic Development and Area Studies (Economics)

- 5-301* ECONOMIC DEVELOPMENT. (4 cr)**
Problems of economic growth in low income countries. Theory of aggregate and per capita income growth. Role of population growth, productivity increases and capital formation. Allocation of resources between consumption and investment and among sectors.
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Analysis of current economic problems: exchange controls, land reform, inflation and fluctuation in prices of basic commodities. Evaluation of foreign aid proposals.
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Analysis of current economic problems: exchange controls, land reform, inflation, and fluctuation in prices of basic commodities. Evaluation of foreign aid proposals.
- 5-315 ECONOMICS OF ASIA. (4 cr)**
Economic development of the Far East following contact with Western civilization. Current problems: population growth, capital formation, international economic relations, choice between types of economic organization.
- 8-311, 8-312 ECONOMIC GROWTH AND NATIONAL PLANNING. (3 cr per qtr)**
Models of the process of economic growth; exogenous factors to which growth is attributed. Techniques useful in planning, e.g., input-output, national income accounting programming. Questions of policy.

*Not available to economics majors.

**8-831, 8-832 ADVANCED TOPICS IN ECONOMIC DEVELOPMENT.
(3 cr per qtr)**

International Economics (Economics)

- 5-401* INTERNATIONAL ECONOMICS. (4 cr)**
The case for free trade. Effects of tariffs; protection of infant industries; common markets. Balancing international receipts and payments, the role of exchange rate changes, international monetary reform.
- 5-431 INTERNATIONAL ECONOMICS. (4 cr)**
The case for free trade. Effects of tariffs; protection of infant industries; common markets. Balancing international receipts and payments, the role of exchange rate changes, international monetary reform.
- 5-461, 5-462, 5-463 INTERNATIONAL TRADE AND PAYMENTS THEORY. (3 cr per qtr)**
Gains from trade; effect of trade on factor prices; tariffs; customs unions. Relation of trade theory to growth and development. Balance of payments disequilibrium, exchange rates, capital movements, international liquidity.
- 5-411 U.S. FOREIGN ECONOMIC POLICY. (4 cr; offered 1972-73 and alt yrs)**
Development of U.S. foreign economic policy in 20th century and current issues of U.S. foreign economic policy.
- 8-481, 8-482 ADVANCED TOPICS IN INTERNATIONAL TRADE THEORY. (3 cr per qtr) Chipman, Krueger**

General Economics (Economics)

- 5-307* COMPARATIVE ECONOMIC SYSTEMS. (4 cr) Maynes, Smith**
Functions of all economic systems; the market economy, liberal socialism, the centrally planned economy. Analysis of American and Soviet economies.
- 5-337 COMPARATIVE ECONOMIC SYSTEMS. (4 cr) Maynes, Smith**
Functions of all economic systems; the market economy, liberal socialism, the centrally planned economy. Analysis of American and Soviet economies.

Agricultural Economics (Agricultural and Applied Economics)

- 5-720 ECONOMICS OF WORLD AGRICULTURE. (3 cr) Raup**
Distribution, quality, and utilization of agricultural resources, agricultural organization and structures; location of agricultural activity; national and international agricultural policies.

*Not available to economics majors.

- 5-750 AGRICULTURAL TRADE AND COMMERCIAL POLICY. (3 cr) Houck and Abel**
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.
- 5-790 SEMINAR: WORLD FOOD SUPPLY PROBLEMS. (3 cr)**
Martin and others
- 8-278 AGRICULTURAL AND ECONOMIC DEVELOPMENT. (3 cr)**
Cochrane and Ruttan
Theories of socio-economic growth; models of economic growth; consumption, production, and supply relations in agricultural development; agricultural development policy.
- 8-378 SEMINAR: AGRICULTURAL DEVELOPMENT. (3 cr) Ruttan**

Development Workshops

Three workshops with a strong development orientation are available to graduate students and staff:

Agricultural Development Workshop (Abel, Peterson, Ruttan)

Human Capital Workshop (Hause, Krueger)

Trade and Development Workshop (Krueger, Ruttan)

The workshops meet on a weekly or semi-weekly basis throughout the academic year. Participants consist of staff members and graduate students conducting active research on topics related to the workshop subject matter area.

STAFF

ECONOMICS

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^aTerm expired July 1, 1972.

^bTerm began July 1, 1972.

STAFF DEVELOPMENTS

During the 1971/72 academic year and the 1972 summer session the graduate education programs of the two departments were strengthened through the participation of several visiting professors. Lance Taylor of Harvard University spent the fall quarter as visiting professor in the Department of Economics. He conducted research and taught a graduate seminar in economic growth and national planning. Rainer Schickele, formerly of the UN Food and Agriculture Organization and the Agricultural Development Council, spent the 1972 winter and spring quarters as visiting professor in the Department of Agricultural and Applied Economics. He shared in the teaching of courses in agricultural development and conducted research on problems of income distribution in developing economies.

Assaf Razin, Lecturer in Economics, Tel-Aviv University (Israel), spent the 1972 summer session as Visiting Assistant Professor in the Department of Economics. He taught courses in microeconomic theory and conducted research in the areas of trade and development. Baran Tuncer, Docent, Faculty of Political Science, University of Ankara (Turkey), spent the 1972 summer session as Visiting Assistant Professor in the Department of Economics. He taught courses in economic development and macroeconomics. Besim Ustunel, Professor, Faculty of Political Science, University of Ankara, spent the summer and fall quarters of 1972 as Visiting Professor in the Department of Economics where he taught courses in international economics and microeconomics and conducted research on the comparative development of Japan, Turkey, and Sweden.

T. Paul Schultz of the RAND Corporation will join the Department of Economics as Professor in September 1972. Schultz received his Ph.D. from MIT. He has taught at the University of California (Los Angeles). His research has been in the area of population policy, human resource development, and consumer behavior.

Uri Ben-Zion will spend the 1972/73 academic year on a Postdoctoral Fellowship in the Department of Economics where he will conduct research on "Family Fertility Decisions and Economic Development." He is completing his Ph.D. at the University of Chicago. His research will focus on the implications of human and nonhuman capital investment alternatives on family fertility decisions.

Hans Binswanger, who is completing his Ph.D. at North Carolina State University, will spend the 1972/73 academic year as a Postdoctoral Research Associate in the Department of Agricultural and Applied Economics. He will conduct research on induced technical change and agricultural development. It is expected that Mrinal Datta-Chaudhuri, Professor of Economics, Delhi School of Economics, will be at the University of Minnesota as Visiting Professor in the Department of Economics for one year beginning in the 1973 spring quarter. He will teach in the area of economic development.

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.

CENTER REPRINT SERIES

- 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 V.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 V.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 V.W. Ruttan, "Agricultural Productivity Differences Among Countries," *The American Economic Review*, Vol. 60, No. 5, December 1970, pp. 895-911.
- 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.
- 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.
- 71-5 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.

Single copies of UM FDC reports may be obtained from the Center offices at the University of Minnesota.

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, "Developing 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 Process 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.
Vernon W. Ruttan and Yujiro Hayami, "Technology Transfer and Agricultural Development." Paper presented at the Conference on Agriculture and Economic Development, Tokyo, September 6-10, 1971 (AAE SP71-10).
Peter Gregory, "Wages Under Conditions of Surplus Labor in Japan." Draft, University of Minnesota, Department of Economics, 1971.
Adolph Weber, "Agricultural Modernization in Market and Planned Economies: The German Experience," August 1971 (AAE SP71-16).
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).

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

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

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.

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

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WORKSHOPS AND SEMINARS
July 1971 – July 1972

WORKSHOPS

AGRICULTURAL DEVELOPMENT WORKSHOP

July 9

Martin Abel

A Regional Approach to Agricultural Development in India

July 19

Assaf Razin

Investment in Human Capital and Economic Growth

July 30

Surjit Sidhu

The Economics of New Wheat Varieties in the Punjab

August 2

Richard Blue, Darrell Frohrib and Norman Fox

Modeling Regional Development in Rajasthan

August 13

Michael Hay

A Human Capital Approach to Rural-Urban Migration in Tunisia

October 1

John DeBoer

Economics of Livestock Production in Thailand

October 8

Terry Roe

Induced Innovation: A CES Production Function Approach

October 15

John Sanders

Economics of Mechanization in Latin America

October 22

Remegio Torres

Economics of Irrigation Investment in the Philippines

October 29

Edgardo Barandiaran

The Control of Money and Bank Credit in Argentina

November 5

Robert Latham

Economics of Forestry Information in Developing Nations

November 12

Sachiko Yamashita

Explorations in the Economics of Taste

November 19

Delane Welsch

Rice in Thailand: History, Strategy and Potential

November 23
Surjit Sidhu
Economics of Wheat Production in Punjab: A Progress Report

December 3
Malcolm Purvis
Economics of Wheat Production in Tunisia

December 10
Dale Dahl and Y.K. Shim
Economics of Fertilizer Use, Distribution and Manufacture in South Korea: A Project Proposal

January 7
Clayton Ogg
Productivity Differences on Small Farms in Michoacan, Mexico

January 28 and February 4
Sachiko Yamashita
An Exploration of the Economics of Taste: A Progress Report

February 11
Mitoshi Yamaguchi
Technical Progress, Population Growth and Agricultural Development: A Research Proposal

February 18
Osama Al-Zand
The Tunisian Olive Oil Economy

February 25
G.R. Gregory, University of Michigan
Forestry and Economic Development: The Case of India

March 3
Remegio Torres
Economic Returns to Irrigation Investments in the Philippines: A Progress Report

March 17
Delane Welsch
Resource Constraints on Farm Family Production and Income: The Case of Thailand

March 24
Martin Abel
The Economics of Diversification: A Preliminary Inquiry

March 31
Surjit Sidhu
Economics of Wheat in the Punjab: A Progress Report

April 7

Pranab K. Bardhan, Indian Statistical Institute, New Delhi and Visiting Professor, MIT

Farm Size, Productivity and Returns to Scale: An Analysis of Farm-Level Data for Indian Agriculture

April 14

John DeBoer

Technical and Economic Constraints on Livestock Production

April 21

C. Peter Timmer, Food Research Institute, Stanford University

Choice of Technique in Rice Processing

April 28

Lee Martin

Some Market Effects of Agricultural Development on Functional Income Distribution in Developed Countries

May 5

Surjit Sidhu, Jitendar S. Mann, and Martin Abel

Demand for Cotton in India

May 19

William B. Wade

Productivity Growth in French Agriculture

May 26

Paul Hasbargen

Development Strategy for the Livestock Sector in Botswana

June 2

Osama Al-Zand

Analysis of Distortions of Producer Prices of Olives in Tunisia

June 9

Willis Peterson

Economics of Nitrogen Fertilization of Corn in Argentina

June 16

Howard Engstrom

Productivity Differences Among Experiment Stations

June 30

Mitoshi Yamaguchi

Population Growth and Development in the U.S. and Japan

HUMAN CAPITAL WORKSHOP

Thursday, October 7

Anne Krueger, University of Minnesota

Rates of Return to Turkish Higher Education

Thursday, October 28

Susan Westin, University of Minnesota

An Empirical Investigation into the Differences of Size and Quality of Public Research Universities

Thursday, November 11
Gilbert Ghez, University of Chicago
Allocation of Time and Goods Over the Life Cycle

Wednesday, December 1
Yoram Ben-Porath, Harvard University
Fertility, Education, and Income

Thursday, January 13
Uri Ben-Zion, University of Chicago
The Relationship Between the Desired Expenditure per Child and the Family Size: The Investment Approach

Friday, March 10
Richard Freeman, University of Chicago
Black-White Economic Differences: Why Did They Last So Long?

Thursday, March 30
Charles Rambeck, University of Minnesota
A Discussion on Public School Expenditures in Minnesota

TRADE AND DEVELOPMENT WORKSHOP

November 16
Jose Cerro
Regional Development in Argentina: The Interregional Impact of Development Projects

November 30
Norman Fox
Interrelationships Between Rural and Urbano-Industrial Development in Rajasthan (India)

December 7
Enrique Scala
Welfare Costs of Commercial Policies in the Argentine Automobile Industry

December 9
Sudhin Mukhopadhyay
Income Distribution Implications of the Green Revolution

January 4
Francisco Thoumi
International Trade in Used Durable Goods: An Application to Colombia

January 18
Vernon Ruttan
Factor Prices and Technical Change: Agricultural Development in the United States and Japan

January 25
Terry Monson
Migration, Learning and Infant Industries: A Case of Turkey

January 28
Terry Roe
Induced Innovation: A CES-Type Meta-Production Function

February 22
Robert Holt
Project Planning and Implementation

February 29
Francisco Thoumi
Industrial Capacity Utilization in Colombia: Some Empirical Findings

March 7
James Henderson, University of Minnesota
A General Equilibrium Model of International Production and Trade

April 10
Aldo Biondolillo
Welfare Cost of Agricultural Production Fluctuations: The Case of
Grapes-Wine Production in Argentina

April 17
Enrique Scala
Welfare Costs of Commercial Policies in the Argentine Automobile
Industry: A Progress Report

May 22
Peter Clark
Determination of Future Prices in a Competitive Market

DEPARTMENTAL SEMINARS

July 13

William Easter, University of Minnesota and Ford Foundation, New Delhi Water Control and Agricultural Productivity: Sambalpur Study

September 8

Shanker Shetty

Foreign Aid and Economic Development - A Case Study of India

September 16 and 17

V.M. Dandekar, Gokhale Institute of Politics and Economics, Poone-4, India Anatomy of Rural Poverty in India

Rural Poverty in India: What is the Solution?

November 2

Lim Chong Yah, University of Singapore

Consequence of U.S. Aid to Malaysia

November 22

Frank Petrini, University of Uppsala, Sweden

Some Current Agricultural Economics Problems in Sweden

November 23

S.S. Johl, Punjab Agricultural University, India

The Green Revolution—Technology and Prices

December 1

Yoram Ben-Porath, Hebrew University

**Fertility, Education, and Income in Cross Section Data in Israel—
Point and Counterpoint**

January 11

Thomas Daves, University of Minnesota

Economics of Irrigation in Tunisia

January 18

Mathew Shane, University of Minnesota

Devaluation of the Dollar and Alternatives

January 31

Richard Marston, MIT

**American Monetary Policy and the Structure of the Euro-dollar
Market**

February 15

Hans Binswanger, North Carolina State University

Testing the Induced Innovation Hypothesis

February 18

Ranier Schickele, Visiting Professor, University of Minnesota

Increasing Output and Reducing Poverty: Is There a Conflict?

February 25

Ranier Schickele, Visiting Professor, University of Minnesota

Conceptual Framework for Analyzing Income Distribution

February 25
G.R. Gregory, University of Michigan
Forestry and Economic Development: India as an Example

February 28
T.N. Srinivasan, India Statistical Institute, New Delhi
Farm Size and Productivity: Implications of Choice Under Uncertainty

March 3
Ranier Schickele, Visiting Professor, University of Minnesota
Planning and Policy Implementation: From Theory to Practice

March 10
Ranier Schickele, Visiting Professor, University of Minnesota
Beyond Production Functions and Lorenz Curves
Increasing Output and Reducing Poverty: Is There a Conflict?

March 13
James Henderson
A Model of an International Payments System

April 4 (South Asian Center Colloquium)
Ramashray Roy, Centre for the Study of Developing Societies, Delhi
The Social Sciences in India and Academic Colonialism

April 6
Pranab Bardhan, Indian Statistical Institute, New Delhi, and Visiting Professor, MIT
Uncertainty and Trade Theory: Some Comparative-Static Results

April 10
W. B. Sundquist, University of Minnesota
Report from Tunisia

April 20
C. Peter Timmer, Stanford University
The Political Economy of Indonesian Rice Policy

May 18
K.A. Naqvi, Delhi School of Economics, India
Marxian Theory of Value

May 18
Malcolm Purvis, University of Minnesota
Agriculture, Economics, and Technical Assistance in Zaire

May 23
Nachum Gross, Hebrew University and Visiting Professor, Harvard University
Why Economic Growth Fails

May 31
Daniel Martin, University of Michigan
The French Linear Programming Model of Tunisian Agriculture: Pitfalls for Planners

June 6

**L.S. Venkataramanan, Indian Agricultural Research Institute, New
Delhi**

**The Advanced Center in Agricultural Economics in the Indian Ag-
ricultural Research Institute: Program and Prospects.**

June 15

S.C. Hsieh, Asian Development Bank, Philippines

**Strategy for Asian Development: The Role of the Asian Development
Bank**

SOURCES OF SUPPORT

Since its establishment in 1967 the University of Minnesota Economic Development Center has received support from the following sources:

Ford Foundation, July 1, 1967	
Allocation to the EDC by the Office of International Programs from a 1964 Ford Foundation institutional development grant to the University of Minnesota	\$ 50,000
U.S. Agency for International Development, July 1, 1971	800,000
A211(d) grant for Research on the Policy Problems of Agricultural Development. Funds are made available to support two programs for five years.	
(I) Agricultural Economics Research and Training Program (\$230,000)	
(II) Development Policy Program (\$570,000)	
Rockefeller Foundation	
For support of research on "Science and Agricultural Progress: The Japanese Experience"	
July 1, 1971	12,200
July 1, 1972	12,900

Expenditures by the University of Minnesota Economic Development Center for its program of research, publication, graduate education and related activities during the fiscal year ending June 30, 1972 were as follows:

Ford Foundation grant	11,678
U.S. Agency for International Development Program I (\$48,266) and Program II (\$99,497)	147,763
Rockefeller Foundation grant	12,200
Total	\$171,641

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