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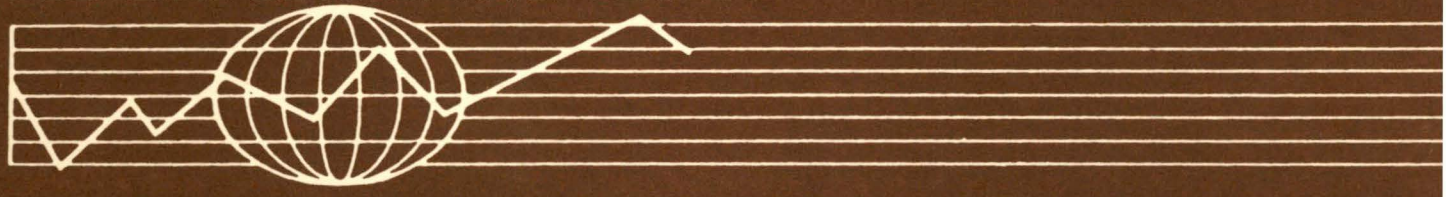
ECONOMIC DEVELOPMENT CENTER



UM/EDC REPORT: 1980-1982

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

UNIVERSITY OF MINNESOTA

The University of Minnesota Economic Development Center was established in 1967 as a joint activity of the Department of Economics and the Department of Agricultural and Applied Economics. It is one of several activities 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 reflects the conviction that the application of knowledge with respect to economic behavior can represent an efficient source of growth.

The objectives of the Center are sought through program activities designed to:

- Enrich graduate and undergraduate training through a series of seminars and workshops
- Provide support for graduate student and faculty research on problems of agricultural and economic development and trade
- Make the results of the research conducted under Center auspices available to private and public sector decision makers in the United States and other developed and less developed countries through publications and consultation
- Increase public awareness of development and trade issues, of alternative policies and procedures, and of their economic significance.

UM/EDC REPORT: 1980-1982

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INTRODUCTION

INTERNATIONAL PROGRAM ACTIVITIES OF THE UNIVERSITY OF MINNESOTA

by Philip W. Porter*

International activities at the University of Minnesota are diverse and they flourish throughout the institution. The Center for Economic Development is one unit, and an outstanding one indeed, among some 40 international units, centers, and programs. Established in 1967, the center brought faculty and graduate students from the Department of Agricultural and Applied Economics (College of Agriculture) and the Department of Economics (College of Liberal Arts) together in a common enterprise. The Office of International Programs assisted in the creation of the center and continues an interest in its ongoing programs.

The international activities of the University are so numerous that one is reduced to recitation of numbers and main headings in trying to describe them in a brief compass. The following figures (1981-82) may give some impression of the University's level of involvement in international activities.

International Units and Programs: Resource, Research, and Service Centers includes 24 different educational units and centers that provide research facilities and information to faculty and students interested in international education. There are 16 Area Studies Centers and Programs. Of the over 39 Study Abroad Programs a majority are funded by the more than 400 students who participate annually. There are six Training Programs Abroad and 13 Training Programs at the University of Minnesota. There are 24 Exchange Programs offered to students, faculty, and community professionals through the University. A number of federally funded exchange programs bring foreign scholars to the University and provide opportunities for our faculty and students to go abroad. The most prominent of these are the Fulbright and IREX programs and the Hubert H. Humphrey North-South Fellowship Program. In addition, there are some 47 international collaborative Research Projects and Programs.

The University lends staff time to seven Service and Assistance Projects and Programs which are primarily federally funded. A notable current example is the Morocco Project, wherein assistance is provided to Morocco's only college of agriculture (Institut Agronomique et

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Veterinarie Hassan II). There are currently 75 Moroccan students from the institute studying in the U.S. under this program, many of them at this University. Another notable effort is the Caribbean Agricultural Extension Project. The University is the lead institution for a Midwest Universities Consortium for International Activities Title XII contract with the University of the West Indies. Finally, there are four Community Outreach Programs administered by the University.

In all, it is estimated that $1.4 million* was contributed by the University in funding support of international activities (a figure which does not include salary of faculty who engage in international activities and research), and another $6.6 million* in support came from sources outside the University. Each of these efforts in teaching, research, and service is evidence of the commitment of the University to being in our interdependent world, trying to understand and hlep find solutions to international problems. In this task, the Center for Economic Development has a distinguished record and a promising future.

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* 1980-81 figures.

AN INTERNATIONAL AGRICULTURE PROGRAM'S OFFICE PERSPECTIVE ON THE UNIVERSITY OF MINNESOTA ECONOMIC DEVELOPMENT CENTER

by Malcolm Purvis*

The Economic Development Center of the University of Minnesota has achieved both national and international recognition for the quality of its work. This can be measured in a number of ways but the following are of particular significance:

* Professor Anne Krueger, Co-Director of the Center since 1978 and Center Member since its foundation in 1967, has been named Vice-President of the World Bank. This prestigious and important appointment is a reflection not only on Professor Krueger's distinguished scholarship and ability but on the value attached to the kind of work that Professor Krueger has conducted, and which in part has been sponsored by the Center, for its practical and applied significance to the real world of economic growth and development.

* The Center has been almost entirely supported by grants. Core financing of the Center's activities out of University of Minnesota resources over the last 4 years has been less than $4,000 per year but the Center, and individual members of the two core departments, have generated $2.3 million of contract research in this period.

* The productivity of the Center has been exceptional, in the period 1975-82, 11 books and monographs, 62 journal articles and book chapters and 25 staff papers and bulletinswere authored by Center staff members. In addition, 26 Ph.D. dissertations were completed under the direction of Center staff by students supported wholly or in part by Center funding.

The emphasis of the Center has been on growth and development of national economies in an international setting. As can be seen from the list of publications contained in this report, much of the Center efforts have been addressed to the problems of developing countries. However, there is a pervasive concern for such matters as technology, trade, natural resources and investment in human capital, which have significant importance for the United States and for the agricultural and non-agricultural sectors of the Minnesota economy. Some of the research, on trade policy for example, has obvious implications for Minnesota's export sectors. Other research has been directed at economic growth in the Upper Midwest (e.g., George Norton's work on the Sisseton-Wahpeton Sioux Reservation).

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The knowledge base created by the Center has had importance and relevance to domestic issues as well as those of the growing economies of the developing countries. Until recently, it was widely considered by economists that lack of growth was primarily a problem of the poor countries. Unfortunately, it is now realized that growth and development of the industrialized economies cannot be taken for granted and that the economic performance of countries, regions and states are powerfully interrelated.

The College of Agriculture and the College of Liberal Arts of the University of Minnesota have major concerns for the growth and development of the Minnesota and the national economy. The work of the Economic Development Center has been an important vehicle for focussing research on important and relevant problems and for aiding a better and wider understanding of the interdependent nature of the world that Minnesotans live in and in which agricultural and non-agricultural production and distribution play such a major part.

SELECTED RESEARCH PROGRESS REPORTS

FOOD PREFERENCES AND NUTRITION IN RURAL BANGLADESH

by Mark M. Pitt*

The dietary choice of households near subsistence levels of nutrient intake is an issue of obvious policy importance. In many countries, such as Bangladesh, national goals are set in terms of nutritional intake and there is heavy intervention in the markets for foods. However, little is known about the manner in which food preferences vary with food expenditure and nutrient intake. The design of efficient programs to aid nutritionally deficient households in attaining minimal levels of nutrient intake requires information on all own- and cross-price elasticities for both target and non-target groups. The net effect of a food price subsidy on the consumption of food nutrients cannot be predicted without knowledge of the complete elasticity matrix. Results presented below demonstrate that substitution effects can be so strong that the subsidization of certain foods quite often reduces nutrient consumption.

In this study, demand equations for nine foods which allow for extremely flexible consumer price response are estimated from the individual budgets of 5,750 rural Bangladeshi households. Estimation at the household level is preferred because it more readily permits the incorporation of household composition variables into the demand analysis, such as household size, occupation and employment status, that are typically lost in aggregation. There is also a greater range and variation in expenditure levels than found in grouped data. This is of particular importance in the study of nutritional well-being as it is the poorest households which are of special interest. Moreover, the household sample provides sufficient degrees of freedom to estimate a simply varying parameter model which requires the estimation of 270 parameters.

Estimation Methods and Data

Standard approaches of estimating demand systems are not appropriate when units of observation are individual households because of the problems that arise when the consumption of one or more goods is zero. As is well known, the application of the usual continuous variable estimation techniques would result in biased and inconsistent estimates because the random disturbances have nonzero means and are correlated with the exogenous variables. Moreover, dropping those households which do not consume at least one of the goods would severely reduce sample size and still result in inconsistent estimates. The limited dependent variable model of Tobin (1958) (tobit) provides a likely candidate for estimating demand equations in this case since it permits a positive probability of observing nonconsumption.

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The data used for the estimation are taken from the tapes of the Household Expenditure Survey of Bangladesh 1973/74, the results of which are summarized in Bangladesh Bureau of Statistics (1978) and Rabbani and Hossain (1978). Only data from rural areas were used in the estimation. The surveys were carried out in four successive quarters beginning in 1973 III. Nine commodities are distinguished for the purposes of this research: rice, wheat flour, mustard oil, fish, onions, spices, pulses, fresh milk and potatoes. These items constitute nearly 90 percent of total food expenditure, 95 percent of calorie intake, 93 percent of protein intake and no less than 80 percent of the intake of iron, thiamine, riboflavin and niacin by rural households in Bangladesh.

The parameter estimates, which are not reported here for reasons of space, are hard to interpret because the underlying parameters of the demand equations vary with per capita expenditure. Instead, we will closely examine elasticities.

Nutrient Price Elasticities

Ordinary demand elasticities provide information on the response of food intake to any change in food prices but do not directly provide information on the resulting intake of food nutrients. Although the subsidization of a food will increase its consumption, we cannot predict the sign of the change in nutrient intake. If substitution is strong, as our demand elasticities indicate, and the foods being substituted for are important sources of nutrients, the net effect of a subsidy on nutrient intake may be negative. Information on the response of nutrient intake to any change in food price is contained within the matrix of nutrient price elasticities, whose elements measure the proportionate response in nutrient intake to a proportionate change in food prices.

Results are presented below for two representative households. Both households have five members, one earner and are cultivators. The high expenditure household, labeled "percentile 25," has a level of per capita food expenditure greater than 75 percent of sample households, and the low expenditure household, labeled "percentile 90," has per capita food expenditure greater than 10 percent of sample households. The latter household represents the median level of food expenditure for the lowest 20 percent of households, a group with serious nutritional deficiencies, while the former household represents the median of the top 50 percent of food consumers, a group without serious nutritional deficiencies.

Information on pure substitution effects is required for designing cost effective target group-oriented food programs (Selowsky 1979), yet little is known about them at the household level. The compensated nutrient price elasticities of Table 1 tell us the net effect of pure substitution on the intake of the various food nutrients, perhaps induced by a price subsidy program.

Positive elasticities have the implication that an uncompensated increase in the price of that food will increase consumption of a

particular nutrient. A row of positive elasticities implies that an increase of that food price will increase the consumption of all nutrients. The onion price row has this property for the 90th percentile household. Onions would seem a likely candidate for this attribute because they are a high-cost source of nutrients.

The row of compensated nutrient price elasticities associated with pulses is also positive. This is somewhat surprising since pulses are an important and inexpensive source of protein in the Bangladeshi diet and have been considered favorably on nutritional grounds by the government in its deliberations on price policy. These results argue that compensated decreases in the price of pulses will in fact reduce the nutrient intake of the nutritionally deficient population.

For policy makers intent on using selective food price subsidies as a means of attacking malnutrition, it is the negative elasticities of Table 1 that are of key importance. Subsidization will augment calorie consumption in the cases of only four of the nine foods - rice, wheat, milk and potatoes. In the case of protein, only for wheat, mustard oil, milk and potatoes will this be true. The compensated subsidization of wheat has a greater positive effect on both calorie and protein intake than proportionately equivalent subsidies on any of the other foods. It is interesting to note that potatoes are second only to wheat in its subsidy induced effects on protein consumption. This is surprising since potatoes are a more expensive source of protein per unit of expenditure than all other foods except spices in our sample. Indeed, the cost of protein derived from potatoes is over 11 times greater than protein derived from wheat or pulses. Its large and negative protein price elasticity compared with the positive protein elasticity of pulses indicates the importance of studying substitution and the errors that can arise by using cost per unit of nutrient provided as the criterion by which nutrition oriented price policy is formulated.

The results of Table 1 make it clear that pure substitution effects make rice, the preferred food grain, a foodstuff whose compensated subsidization would reduce the consumption of most food nutrients. Treating fat and carbohydrate as components of calories, note that lower rice prices will reduce the intake of all food nutrients by the low expenditure household except for a very small gain in calories. The magnitude of the reductions in protein, calcium, iron, thiamine and riboflavin intake are quite large - all of these elasticities are above .3. In contrast, wheat would seem an ideal candidate if subsidization is desired because all of its compensated nutrient price elasticities are of the correct sign and have the largest magnitudes for every nutrient except calcium. Treating carbohydrates as a component of calories, potatoes also have a row of negative nutrient elasticities.

Pure substitution effects on nutritionally better off households are quite different. The wheat price row of compensated nutrient price elasticities for the percentile 25 household is now uniformly positive. That is, a compensated wheat subsidy will reduce the intake of all nutrients

Table 1. Compensated Nutrient Price Elasticities

Percentile 25 Expenditure	Protein	Fat	Carbohydrate	Calories	Calcium	Iron	Thiamine	Riboflavin	Niacin
Rice	.065	.102	-.061	-.029	.126	.201	.184	.201	-.011
Wheat	.056	.003	.080	.070	.028	.036	.040	.042	.069
Pulses	-.013	.122	-.079	-.055	.244	-.000	-.020	-.011	-.055
Fish	-.033	-.054	.068	.047	-.206	.024	.054	.066	.060
Mustard Oil	-.061	-.322	.052	.008	-.157	-.126	-.092	-.079	.016
Onions	.030	.011	-.007	-.011	.036	.026	.004	-.012	.001
Spices	.028	.086	.019	.024	.059	-.009	.001	.011	.013
Milk	-.015	.093	-.071	-.053	.088	-.066	-.083	-.086	-.070
Potatoes	-.027	-.047	.027	.015	-.096	-.014	-.010	-.008	.014
Percentile 90 Expenditure									
Rice	.201	.041	-.061	-.011	.308	.403	.362	.365	.045
Wheat	-.186	-.020	-.109	-.119	-.102	-.339	-.314	-.261	-.170
Pulses	.045	.092	.025	.035	.135	.108	.090	.054	.057
Fish	.028	-.078	.105	.084	-.142	.075	.092	.094	.097
Mustard Oil	-.015	-.063	.053	.037	-.106	.021	.025	-.004	.052
Onions	.071	.059	.016	.027	.114	.086	.067	.054	.036
Spices	.013	.019	.000	.001	.052	-.041	-.032	-.020	-.011
Milk	-.011	.008	-.029	-.027	.038	-.115	-.118	-.118	-.054
Potatoes	-.109	-.096	.009	-.016	-.240	-.145	-.127	-.121	-.033

for this household. This complete change in signs reflects both the smaller share of nutrients derived from wheat by this household and the large differences in own- and cross-price compensated elasticities between high expenditure and low expenditure households.

Nutrient Expenditure Elasticities

The nutritional effect of incremental food expenditure can be summarized by the nutrient expenditure elasticity, which measures the proportionate response of nutrient intake to a proportionate change in the total food budget.

Table 2 provides estimates of these elasticities for both representative households. The vector of nutrient expenditure elasticities for the percentile 90 household consists of elements which are all less than unity. That is, increments in food expenditure result in less than proportionate increments in the consumption of all nutrients. In choosing foods, poorer households put more emphasis on meeting perceived nutritional needs than on taste. These households choose foods which are inexpensive sources of nutrients, for example, obtaining the bulk of their protein from vegetable sources. At higher levels of expenditure, households substitute for foods desired on "taste" grounds even though this may mean obtaining nutrients at higher average cost. This is seen clearly in the data on cost of nutrients consumed found in Table 2. The percentile 25 households spent 22 percent more per gram of protein, 15 percent more per calorie and as much as 44 percent more per milligram of iron than did the percentile 90 household. Of course, if this household had consumed foods in the same proportions as the 90th percentile household, its consumption of these nutrients would be higher by these same percentages. Recall that both households face the same set of prices so that these costs of nutrient differences represent only differences in diet.

The small size of the nutrient expenditure elasticities of the percentile 90 household may be rather surprising. The nutrient intake of this household is significantly below requirements and yet nutrient elasticities are as low as .45 and none is higher than .78. One implication is that even very poorly nourished households can improve nutrition by altering their diet. For example, highly subsidized wheat flour is a much cheaper source of protein, calories, calcium and iron, and of all other nutrients identified in this study. Substitution of wheat flour for rice will have a dramatic impact on nutritional status. At the extreme, if the 90th percentile household consumed nothing but wheat flour their consumption of protein and calories would rise by 110 and 77 percent respectively and they would exceed the minimum nutritional requirements for protein, iron, thiamine, riboflavin and niacin. To achieve an equivalent rise in calories by augmenting total food expenditure given the existing pattern of food preferences would require it to more than double. A tripling of expenditure would be necessary to get the same increase in protein intake. Thus, even for the very malnourished, substitution among foods could improve nutritional status rather dramatically. The fact that this substitution does not occur is a reflection of the high value that even the very poor place on variety in their food consumption.

Table 2. Nutrient Expenditure Elasticities and the Cost of Nutrients Consumed

	Nutrient Expenditure Elasticity		Cost of Nutrients Consumed by Percentile 25 Household ÷ Cost of Nutrients Consumed by Percentile 90 Household
	Percentile 25	Percentile 90	
Protein	.79	.64	1.22
Fat	1.13	.79	.97
Carbohydrate	.80	.81	1.15
Calorie	.82	.78	1.15
Calcium	1.08	.65	1.06
Iron	.60	.45	1.44
Thiamine	.65	.50	1.38
Riboflavin	.79	.58	1.25
Niacin	.76	.71	1.21

Summary

A number of lessons emerge for policy makers concerned with designing target group oriented food programs. First, disaggregation by income class is essential because the poor respond very differently to changes in prices and total expenditure. It is these differences in response which suggest that it may be possible to target interventions toward poor households. Second, substitution effects are strong and cannot be ignored in formulating policy. In Bangladesh, there are many instances where subsidization of foods would result in absolute declines in nutrient intake because of cross-price effects. A related point is that although households obviously benefit nutritionally from substituting low cost sources of nutrients from high cost sources, cost per unit of nutrient is a poor and often misleading guide in identifying candidates for subsidization. For example, subsidization of pulses, the lowest cost source of protein in Bangladesh (along with wheat), would result in a net decline in protein consumption by poor households. Third, supplemental income may not be as effective at augmenting nutrient intake as programs which induce substitution for foods which are low cost sources of nutrients. Nutrient elasticities with respect to total food expenditure were found to be surprisingly small for low income households.

Knowledge of the complete matrix of nutrient price elasticities would be extremely useful in designing nutrition-oriented food policy. Nutrient price elasticities summarize the net effect of food price changes on net nutrient intake. Examination of the matrix of nutrient price elasticities estimated for rural Bangladesh reveals wheat flour as an ideal candidate if it were decided to use subsidies to achieve nutritional objectives. The uncompensated and compensated elasticities of nutrients with respect to the price of wheat flour are uniformly negative and of large magnitude for a representative poor household. In addition, wheat flour possesses other attributes which, as noted by McCarthy (1975), tend to target subsidies towards the poor and thus increase cost-effectiveness. It constitutes a significant fraction of the consumption of the poor but little of the rich. Indeed, its demand elasticity with respect to total food expenditure is negative over the entire range of expenditure studied. Furthermore, poor consumers are much more responsive to its own-price than are wealthier consumers. Rogers and Levinson (1976) document that wheat flour, in particular pre-ground wheat flour, has these same attributes in Pakistan and that its subsidization is effectively being targeted towards nutritionally deficient households.

This paper is based on research conducted with the support of the Ford Foundation while the author was in Bangladesh in 1979/80. It was conducted in collaboration with the Ministry of Agriculture and Forestry and the Bangladesh Bureau of Statistics. A more technical report on the results of this research will be published in a forthcoming issue of the Review of Economics and Statistics.

References

Bangladesh Bureau of Statistics. A Report on the Household Expenditure Survey of Bangladesh, 1973-74. Dacca, 1978.

McCarthy, Desmond. "Consumption Planning in Pakistan: Preliminary Analysis of Some Options," International Nutrition Program, MIT, 1975.

Rabbani, A.K.M. Ghulam and Shadat Hossain. Rural and Urban Consumption Patterns in Contemporary Bangladesh. Dacca: Bangladesh Bureau of Statistics, 1978.

Rogers, Beatrice L. and F. James Levinson. "Subsidized Food Consumption Systems in Low Income Countries: The Pakistan Experience." International Nutrition Program Discussion Paper 76-1, MIT, 1976.

Selowsky, Marcelo. "Target Group Oriented Food Programs: Cost Effectiveness Comparisons," American Journal of Agricultural Economics 61, 1979, 988-94.

Stone, J.N.R. The Measurement of Consumers' Expenditure and Behavior in the United Kingdom. Cambridge: Cambridge University Press, 1953.

Tobin, James. "Estimation of Relationships for Limited Dependent Variables," Econometrica 26, January 1958, 24-36.

PRIVATE AGRICULTURAL RESEARCH IN ASIA

by Carl E. Pray*

At present there is almost no information available on privately financed agricultural research in the developing countries of Asia. This paper brings together the available information on the role of private agricultural research in Asia. The first section reviews the role of the private sector research in the United States and Latin America. Then there is a discussion of the trends in private agricultural research in Asia. The final section raises a number of important issues regarding the role the private sector should play in Asian agricultural research.

There are three types of research institutions that I want to distinguish in this paper. The first is the public agricultural research system which is government run and financed through general taxation. The second is research which is controlled and financed by the producers of a commodity sometimes in cooperation with industrial users of the commodity. The third type of research is conducted and financed by individual private companies. These last two types of research are classified as private research in this paper.

Private Sector Research in the Americas

The role of the private sector and the trend in its involvement in the U.S. differ by type of research. The private sector has been dominant in the development of new mechanical technology while the public sector plays a larger role in the biogenetic technologies. Chemical and pharmaceutical inventions were mainly made by the private sector, but public sector research has been important in finding applications for them. The relative importance of the private and public sector research activities has remained fairly stable in the development of mechanical technology. Chemical inventions and research seem to have fallen somewhat in the 1970's after strong growth in earlier decades, (CAST, 1980:5).

Biogenetic research has shown a long term trend of more private involvement--particularly on the plant side. Before the 1930's and the development of hybrid corn, the public sector did almost all of the research on plant breeding. With the development of hybrid corn and

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then sorghum, it became possible for seed companies to establish proprietary rights in certain varieties. Thus, they could capture the gains to research in developing new varieties, and they started investing heavily in plant breeding research. The passage of the breeders' rights legislation gave private sector biogenetic research more incentive to do research. Most recently the breakthroughs in the field of recombinant DNA and the Supreme Court's ruling that a living organism can be patented have induced more private investment in this area.

In aggregate, private research has been expanding steadily since the 1940's. One study reports that private research went from 20 percent of total agricultural research in the 1950's to 40 percent in the 1960's, (Boyce and Evenson, 1975:66). Ruttan estimates that this percentage went from 55 percent in 1965 to 65 percent in 1979 (Ruttan, 1982:185). This implies a substantial real increase of the private sector expenditure on agricultural research.

The recent increase in private research in plant breeding and biogenetics in the U.S. has led to considerable discussion about the impact of this research on both public sector research and the generation of agricultural technology in general. The most general issue is the relative importance and the respective roles of the public and private sector. A second issue is the impact of expanded private research on client support of public agricultural research. A third issue is the shortage of biologists and the fear of the public sector that private industry will lure away many of the best biologists. Finally, there is the fear that increased proprietary rights and private research will decrease the flow of scientific information and genetic material, impairing the effectiveness of public and private research.

In the third world there has been little discussion of the role of the private sector in developing new agricultural technology. Several recent papers which have discussed this question have concentrated on Latin America and have reached very different conclusions. Trigo and Pineiro state that, "In Latin America, and probably in other less developed regions, this process (the increased role of the private sector in agricultural research) has developed beyond what regional and national modernization and development conditions would warrant. This is largely due to the increased importance of multi-national firms operating in these fields," (Trigo and Pineiro, 1981:6). They say that in most countries in Latin America in the 1960's the public sector had a monopoly on agricultural research and that this monopoly has been broken down in recent years by increased private sector research by producer groups and private industry. Private research increased due to the modernization of agriculture which increased the size of the markets for agricultural inputs.

They emphasize the negative effects of the increased private sector research. The public sector is forced to specialize in producing technology for the small farmers who have little political clout so the budget declines. The private sector at the same time is hiring the best scientists away, reinforcing the decline. This leaves a weak public sector servicing the small farmer and the market rather than the government determining the priorities of research and technology.

The papers by Evenson and Evenson (1981) and Judd and Evenson (1982) take a more positive view of the role which the private sector can play. There is some evidence that for a certain range of inventions "private self-interested firms and individuals are superior to public sector research system." (Judd and Evenson, 1982:51). They suggest that the private sector is a threat to public sector researchers because "bureaucracies want monopoly power to protect inefficiency in many cases," (Judd and Evenson, 1982:56). Thus, competition from the private sector might have positive effects. They also suggest that the main negative effects would be the loss of trained personnel from the public sector to the private sector.

Governments can provide incentives for private inventive activity. Some LDC's have reformed their legal system to give more patent protection to private sector inventions by local inventors and companies rather than continue to rely on international patent agreements that favor multi-nationals. The "petty" patents in Brazil and South Korea seems to have encouraged private inventive activity. If private research does play a greater role, this would allow the public sector to shift its emphasis into two major activities: (1) the conduct of intermediate and basic research with the findings made available to all, and (2) developing technology as an alternative to the private sector to provide it with competition and undertaking various testing and verification activities designed to curb abuses of the private sector. (Judd and Evenson, 1982:55). These activities would complement the research of the private sector and increase its efficiency.

Private Sector Research in Asia

In Asia the first stage in the development of agricultural research was a combination of research by commodity groups and public institutions with some research by private firms. During the colonial period in the Dutch and British colonies, the commodity groups were particularly important. Tea research was carried out by the Indian Tea Association with little government assistance. Cotton research in British India started in the public sector, but just after World War I the Indian Central Cotton Committee was set up. This committee had its own research stations and also funded research at public research stations. In the 1930's and 1940's similar committees were set up for almost all of the major cash crops in India. They were financed through a cess that was given legal status by the government, and they had government representatives who headed the committees. The processors, manufacturers, traders and farmers were all represented on these committees, (Randhawa, 1979:32).

In Malaya the agricultural department conducted some rubber research after it was formed in 1905, but did not have much success. Plantations and planters' associations went back to doing their own research. They were able to merge the public and private research programs under the Rubber Research Institute of Malaya in the 1920's, (Ruttan, 1982: 102). In the Dutch East Indies also the cash crops were in a research institute which was separate from the public sector program. These institutions were supported by commodity organizations funded by a cess on exports or production. Food grain research in all Asian colonies was supported out of general revenues.

Some small research programs were also carried out by private sector firms during the colonial period. British American Tobacco Company had applied research programs on cigarette tobacco in a number of Asian countries including India and Indonesia. Private companies like Imperial Chemical Industries ran fertilizer trials in India. Several large sugar mills did applied research in the Philippines. Some rubber estates continued to do their own research in Malaya. However, research by the commodity groups and the public sector research played the dominant role in India, Indonesia, Malaya and the Philippines.

In Asia the second stage in development of the research system was the consolidation of the commodity research programs under the public sector in the 1960's and 1970's. The Indian Council of Agricultural Research took control of the commodity research programs from the central commodity committees in 1965, (Randhawa, 1979:76). They established a near monopoly on biogenetic research in India although tea, rubber, coffee, and cardamon still remained outside their control. In 1976 the Agency for Agricultural Research and Development took over the Estates Crop Research Institute in Indonesia ending the independent status of research on rubber, cocoa and other cash crops. The Philippines Council for Agriculture and Resources Research consolidated its powers in the Philippines in the early 1970's and Pakistan and Bangladesh Agricultural Research Councils are still trying to establish their control over the various commodity research organizations.[2/] These developments were financed and carried out with the assistance of foreign aid.

During the 1960's research by private firms seems to have grown in some countries and declined in others. In India, research on pesticides, fertilizer and probably pharmaceuticals by the private sector grew rapidly. By 1970 most of the large pesticide companies were doing research. This included both field trials and laboratory work on formulation of the pesticides, (Fredrickson, 1982). In contrast, the nationalization of the sugar, jute and cotton industries in Bangladesh meant the end of some small research efforts by sugar mills and the end of support for research by the jute industry and the cotton industry.

A third stage in Asian agricultural research development may be starting. The rise of private sector research induced by modernization that is predicted by the theory of Trigo and Pineiro has taken place to a limited extent in Asia. However, the evidence on the rise of producers' groups in Asia is mixed and as yet there is little evidence of a decline of public sector research expenditure.

2/ However, effective commodity organizations in Pakistan and Bangladesh had been replaced by government sector institutions with little responsiveness to the growers soon after Pakistan became independent in 1947. Thus, the recent changes moves are more power struggles within the public sector than movements from the private to the public sector.

It seems very likely that in the mechanical invention area there has been an increase in the rate of private activity. This has not come as a result of a shift out of public research but as an increase in overall activity in reaction to the increasing use of machinery in Asian agriculture. Thus, in Thailand, the small scale power tillers, which were originally based on Japanese power tillers of the early 1960's, continue to be modified to meet farmers' changing needs. There is also the example of the bamboo tubewell in Bihar, India where experiments by contractors, farmers and a philanthropic organization led to the development of a tubewell more appropriate for the needs and economic conditions of Bihar, (Clay, 1980). In India some of the large tractor manufacturers now have their own research and development divisions which are designing new types of tractors and other implements. Thus, considerable inventive activity is taking place despite weak patent laws. The Philippines have more patent protection and so one would expect considerable inventive activity there.

In India and other large consumers of pesticides such as the Philippines and Malaysia, private research is expanding. In Bangladesh and Pakistan the pesticide distribution system was shifted from the public to the private sector. The increased market has led private companies to be more active in setting out field trials which are partly applied research and partly demonstrations for farmers. The public sector was also involved through research financed by private companies. Research at public stations on the effectiveness of specific pesticides was carried out. There is research by multi-nationals in LDC's in the area of veterinary medicine. Research is needed to develop vaccines against local virus strains and other diseases which are not important in the U.S. or Europe. Smith-Cline and other U.S. companies operate laboratories which do this type of research in India.

It is the biogenetic type of invention which seems to be closet to the public sector monopoly at the moment and has the potential for the expansion of the private sector. In the area of hybrid corn there are signs of considerable private sector activity by both multi-nationals and local firms. In India, Pioneer and several local companies such as Maharashtra Hybrid Seed Co. are developing hybrid corn. In the Philippines the San Miguel Beer Company has started breeding hybrid corn for a seed operation and Pioneer is active (Evenson, Waggoner and Bloom, 1981). Cargill and Pioneer have seed corn operations in Thailand (Winkelman, 1982).

However, expansion in this biogenetic area is dependent on the public sector breeders who have a tendency to protect their monopoly through their power to certify seed. In India, legislation is pending which would require that all seed sold in India be approved by a national seed board. Pioneer Hybrids in India has not been able to get a single variety certified or approved by the board in the six years that it has been selling corn varieties in India, despite the fact that these varieties have passed the most important test, farmer acceptance. The people who sit on this board are the public sector plant breeders who are competing with Pioneer. They have little incentive to approve anything that Pioneer produces. At the moment,

Pioneer and other companies are allowed to sell uncertified seed. However, if the new laws pass, their entire seed operation and with it most of the research activity will go out of business. This type of uncertainty prevents large scale private investment in research.

The most recent development in the biogenetic area is the joint venture between Sime Darby, the huge Malaysian palm oil, rubber, and cocoa producer, and the International Plant Research Institute, a California biotechnology company. They plan to set up Asean Biotechnology Corp. which will take over Sime Darby's laboratories and install a small number of U.S. personnel there. They will work with the team of Malaysian researchers who are there at present, on a "fee-paying basis" for Sime Darby plantations and outside clients, (Segal, 1982:106).

In contrast to biogenetic research on plants, there is still little private sector animal breeding in most parts of Asia. Little private sector poultry breeding and research is carried out in Asia despite the fact that a hybrid poultry breed has the same type of natural proprietary rights that a hybrid corn variety does. However, the public breeder does face increasing competition from the improved hybrid birds which have been produced by private sector breeding programs in the U.S., Canada, and Europe. These companies supply grandparents of the commercial broilers or layers to most of the countries of South and Southeast Asia to be used in modern commercial poultry operations and they are growing rapidly. In India, this competes directly with the government breeders which provide cheaper but less efficient birds. In Pakistan public sector breeders have chosen not to compete in the commercial market and instead are concentrating their breeding work on the village multi-purpose bird which is mainly a scavenger.

Dairy and beef cattle have apparently not attracted investment by multi-nationals in either the provision of genetic material or in-country research. In most Asian countries private farmers, villages or regions have specialized in breeding, selecting and selling the best draft animals and milk animals. In recent years the public sector has been quite active in bringing in new genetic material, particularly for milk animals. The one country that does seem to have a fairly strong private research and development program for milk animals is India. There the National Dairy Development Board, a farmer-owned cooperative, has an extensive breeding program using exotic, improved local and crossbred cattle with an effective artificial insemination program to implement it.

Commodity groups which support research seem to be on the rise in some countries, but they are generally not as strong as they were in the past. In India, there is the huge National Dairy Development Board (NDDB) and the Associated Exporters of Onions which partially support the Associated Agricultural Development Foundation (AADF). The NDDB conducts a wide range of research ranging from trials of different fodder varieties and breeding milk cattle to engineering research to develop better equipment for their milk processing and distribution

programs. They also do a substantial amount of social science research and are moving into oilseed and cotton research. The AADF concentrates its efforts of developing better export varieties of onion and storage and shipping facilities. In the Philippines, commodity groups such as the sugarcane growers, tobacco growers, and coconut growers had considerable power at one time and financed some research. However, their political power became a threat to the government, so they were taken over by the government. Only the fisheries commodity group has remained organized but somewhat independent of the government. In Indonesia there seems to be little interest in reviving private commodity groups to support research. In Bangladesh there have been suggestions by aid donors that the Tea Research Institute be given back to the producers, but this proposal seems to have generated little interest on the part of the government. In Malaysia the recent transfer of oilpalm, research from MARDI to the Oilpalm Research Institute of Malaysia, and the continuation of the Rubber Research Institute indicates the continuing influence of these commodity groups.

In addition to input suppliers and commodity organizations, the other type of industry which has financed private research and may increase in size due to modernization are the processing industries. The cigarette and sugar industries have private research programs in many Asian countries which include chemical, mechanical and biogenetic research. British American Tobacco (BAT) and its affiliates have applied research programs in India, Pakistan, Bangladesh, Indonesia, and Thailand. These programs concentrate on agronomic research and ways of cutting the cost of flue-curing tobacco. In Pakistan, it has been able to shift some of the research to the public sector. Sugar mills in the Philippines continue to have strong applied research programs which gather and screen sugarcane varieties from the Philippines and abroad for use by their growers. These programs have been growing recently after several years of decline. Several Pakistan sugar mills also have variety testing programs. However, they do not seem to have grown in recent years. In Pakistan, CPC International has set up a small corn research program to support extension program for the contract breeders who provide corn to its wet-milling operation (Goldberg and McGinity, 1979:425).

Issues Regarding the Appropriate Role of Private Research in Asia

Should There be More Private Research in Asia?

This initial survey seems to indicate that in many Asian countries private sector agricultural research plays a very small role. Furthermore, private research does not expand automatically with the expansion of the market. The question is, should the governments and USAID encourage them to play a larger role in the future? At present there is not enough empirical evidence to answer this question in a definitive manner. This answer will be determined by the answers to the following questions: Is the private sector more efficient at producing some types of technological innovation than the public sector? Can increased private sector research bring society closer to the optimal level of

total expenditure on agricultural research? Would more private sector activity make the public sector more efficient either through providing it with some competition or as a means of transforming basic research from the public sector into practical inputs which farmers can use? Is the private sector a more efficient means of transferring technology and/or scientific information between countries than the public sector? What are the social costs of allowing the private sector to play a larger role in agricultural research? Can increased private sector research bring society closer to the optimal level of total expenditure on agricultural research? The rest of the paper will discuss the preliminary evidence available on each of these questions.

Relative Efficiency of Private vs. Public Research

We have few case studies of Asian private research from which to draw so it is not possible to conclude that the private sector is more efficient. Sugarcane research in the Philippines is a case that needs further study. The public sector took over most of the sugarcane research from the private sector in the 1970's. However, now the private sugar mills have apparently decided that the public sector will not produce the results they need so they have strengthened their research program. The only LDC case study of private research that was less efficient than the public sector research that I could locate, was the case of bananas in Central America (Evenson, Houck, Ruttan, 1970: 434).

An example that has been studied in some detail is tobacco research in Bangladesh.[3/] The public sector research program is carried out by the Bangladesh Agricultural Research Institute (BARI) in northwestern Bangladesh which has traditionally been the main area of tobacco production. Private sector research is done by Bangladesh Tobacco Company (BTC) which is 60 percent owned by British American Tobacco. The contrast between these research programs points out the weaknesses of the public research system. The two operations spent about an equal amount of money on agricultural research in the late 1970's.

BTC has been very successful in developing new varieties and cultural practices and these have gained widespread acceptance by farmers. BARI has developed few varieties and these varieties have had little acceptance. There were four reasons for the difference in performance. First, motivation of the institutions and researchers differed. Since BTC controlled 60 to 70 percent of the cigarette market in Bangladesh, technology which reduced the cost of tobacco production also reduced the price at which they bought tobacco and increased their profits. BARI as an institution had no such incentive. In fact, increased tobacco production and the reduction of imports may lead the government to put less emphasis on tobacco in the future and probably cut BARI budget for tobacco. The institutional incentives mean that BAT offered promotion or better salaries for improved tobacco production, while BARI offered only personal satisfaction. Second, BAT researchers were in close touch with both market demand and the farmers. Thus, they could focus their research on the problems that

were really of economic importance - the quality of the leaf produced, reducing the cost of production and recently the cost of flue-curing tobacco. BARI meanwhile had the flexibility and the resources to focus quickly on problems as they came up. They were not tied to one experiment station; rather, they ran their experiments on land leased from the farmers. When they decided to shift part of their operations to another part of the country, their research program could come along while the government program could not move its farm from the Northwest. Also, they had the capital to try to find new fuels for flue-curing tobacco and to build a laboratory for testing leaf quality. Fourth, BAT has access to a huge collection of genetic material and scientific information through their parent company. On the other hand, the BARI scientists have to travel to Dacca to get any technical journals. Their program to breed disease resistance is hindered by the lack of disease resistant genetic material. They apparently do not get any genetic material from BAT and have no access to international collections at present.

The Impact of the Private Research on Public Research

The impact of greater private sector research on the public sector is not clear and as yet I have not been able to find many examples of their interaction in Asia. There are numerous examples of private firms giving grants to universities or public research organizations to finance research on their chemicals or fertilizers. Indian pesticide companies have been active in this type of activity and this is also going on in Pakistan, Bangladesh, and Thailand. Private cigarette companies in Pakistan provide money to the public tobacco research center to work on ways of cutting the cost of flue-curing tobacco. A joint PCARR-private ranch beef research project was carried out in the Philippines. More private sector research, which would inevitably be on the most applied problems, could well mean increased financial and political support for public sector research from these well organized business interests. This support could be particularly important for more basic research which has virtually no constituency in LDC's today but could build up a constituency on some topics if the result could be an input into the private sector research program.

The impact on the public sector of competition by the private sector research has so far not been apparent. Instead of trying to keep up with the private sector research, the general reaction of the public sector has been to try to block private sector research. This can take the form of not approving private sector crop varieties or of isolating the researchers and institutions from the scientific inputs and contacts that are needed for a successful research program.

3/ This case study is based on the author's research while in Bangladesh, 1978 to 1980.

Efficiency of Technology Transfer by the Private Sector

The private sector can also be very important in the transfer of agricultural technology even if it does no research in the LDC's. This is obvious in the case of fertilizer, pesticides, and pharmaceuticals which are developed and manufactured by multi-nationals. Likewise, tractors, power tillers, and pumps were developed in industrial nations and transferred by trade or production to the LDC's by multi-nationals. In the area of biogenetic invention, the private sector can play a large role. The role of multi-nationals in the poultry business was mentioned above. Pioneer has a pool of germplasm for corn which it uses in the countries where it develops hybrids. BAT has a large collection of tobacco germplasm from throughout the world. When BAT subsidiaries in Asia have a particular problem, BAT sends out the varieties that have overcome this problem elsewhere.

The private sector also has networks of information transfer which include the provision of the latest technical material to different branches of the same company and also trade associations and consulting firms through which information is exchanged. Groups like the British Cotton Growers Association of the Colonial period moved information throughout the British Empire. Today the private tea researchers are in contact with each other and consulting firms are bringing the expertise of experienced tea scientists from India and Kenya to work on improving the Bangladesh tea research and extension program. The contrast between the way in which the private sector transfers information, genetic material for plant breeding and new technology which is embodied in mechanical and chemical inputs and the way in which the International Agricultural Research Centers and other international organizations operate, need to be studied.

Social Costs of More Private Research

The social costs of providing incentives for more private research may be high. First, there are the possible negative effects on the public research system with the possibility that the small farmers who do not grow major cash crops may be left without a source of improved technology. This could be due to the weakened public support which is translated into lower budgets, and also to the shift of trained manpower to the private sector. This can be avoided by politically astute leadership of the research system. Second, there is the social cost of granting a private individual or firm monopoly rights to a product through a patent, breeders rights or allowing the firm a certain amount of monopoly power over the entire market such as the Bangladesh Tobacco Company case. A third problem is that local scientific inventive activity may be swamped by multi-nationals. These last two types of costs can be minimized by proper design of the patent laws so that there is public disclosure of the innovation and some chance for the local inventor. Proper regulation of the monopoly power of the firms and competition by the public sector can keep monopolies under control. Thus, it appears that social costs of increased private research can be held to a minimum by politically astute leadership of the public research system and by careful legislation and regulation of private research.

On the other hand, too much public sector research can place an unfair burden on certain groups in society. Since research on some crops primarily benefit a relatively small segment of society, this segment should pay for the research rather than the taxpayers of the country as a whole. Thus, if a few large sugarmills will be the chief beneficiaries of sugarcane research, they should pay for it.

Private Research to Increase Total Research Effort?

The expost social rates of return to public investment in agricultural research in Asia have been high, and the public sector is quite constrained by budgets and is likely to be more constrained in the future. More expenditure by the private sector could bring societies' total expenditure on agricultural research in line with expected returns. This argument would seem to hold true for most of the countries of South and Southeast Asia although a few public systems have recently been expanding their expenditure so greatly that it is no longer certain that they are underinvesting. It appears that for South and Southeast Asia private research is below the optimum level. In particular, insufficient private sector research appears to be going on in biogenetic research, an area in which private research is very important in the U.S.

Role of Government in Encouraging Private Research

We would hypothesize that private firms' decision to do a limited amount of research in Asia is an optimal decision in terms of their individual returns to research. They do not have strong property rights over innovations because of the government interventions and the legal system of many of these countries. Secondly, many of these technologies are not sufficiently location-specific that they require much research in-country to adapt them to local conditions. Thus, local companies find it cheaper to buy the technology from outside and multi-nationals find it cheaper to do their research in developed countries. Third, in some countries input supply and agribusiness have been government monopolies. These monopolies have little incentive to improve technology and in general have no mandate to do research.

These conditions can be changed to a certain extent by government policy. More legal protection in the form of patents and plant breeders rights could induce more private research. Also, the size of the pool of trained manpower and their salaries in areas like plant breeding, influence the relative cost of doing research in India or the U.S. The recent privatization of input supply in Bangladesh and Pakistan should give pesticide companies more incentive to do research.

The general climate for doing research can be influenced. The Taiwanese have set up Hsinchu Science-Based Industrial Park which seeks to induce high technology firms to invest in Taiwan. The park offers tax breaks, low interest rates, two nearby universities, a large supply of highly trained personnel, especially engineers, who are presently available at wages lower than in the West and Japan, and the promise of more trained manpower on the way. While they are primarily seeking firms in the computer and communications fields they specifically

have announced their aim to "lure well-known biotechnology companies to this land within five years," (Murray, 1982). It is clear that this last course is not for every country and that it would have to be modified substantially if the main aim was to induce local agricultural research. However, it is also clear that governments can do quite a lot to encourage greater participation of the private sector in agricultural research, and probably should do so in South and Southeast Asia.

Conclusion

Many of the forces that caused the growth of private agricultural research in the United States and Latin America are at work in South and Southeast Asia today. Markets are expanding, breakthroughs in basic science are applicable there, and in a few countries the property rights are being changed to give inventors more incentive to invent. However, there is still considerable debate in Asia and in the West about the proper role of the private sector in agricultural research. Even in some of the strong market economies of Asia public officials are very antagonistic towards the private sector in general and private research in particular. These officials can quickly cut off the growth of private sector research if they wish. Thus, there is an important challenge ahead in both the developed and the developing world to determine what the optimal role of the private sector is and then to develop policies that will assist the private sector in playing that role.

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References

Boyce, James and Robert E. Evenson. Agricultural Research and Extension Programs. New York: Agricultural Development Council, 1975.

C.A.S.T. Impact of Government Regulations on Development of Chemicals Used in Animal Production. Council for Agricultural Science and Technology, No. 5, 1980.

Clay, Edward. "The Economics of the Bamboo Tubewell." Ceres, May-June, 1980.

Evenson, D.D., and R.E. Evenson. "The Private Sector in Agricultural Research." Prepared for seminar at IICA, Costa Rica, 1981.

Evenson, Robert E. "International Inventions Implications for Technology Market Analysis." Mimeo, Yale University, 1982.

Evenson, R.E., J.P. Houck, Jr., and V.W. Ruttan. "Technical Change and Agricultural Trade: Three Examples - Sugarcane, Bananas, and Rice." In The Technology Factor in International Trade, by Raymond Vernon, New York, NBER, 1970.

Evenson, Robert E., Paul E. Waggoner, and Paul R. Bloom. "The Agricultural Research System of the Philippines: A Reconnaissance Report." Economic Development Center, Bulletin Number 81-3, May 1981.

Fredrickson, Channing. Personal Communication, June 1982.

Goldberg, Ray A. and Richard McGinity. Agribusiness Management for Developing Countries - Southeast Asian Corn System and American and Japanese Trends Affecting It. Cambridge, Ballinger, 1979.

Hansavivek. "Fillip to Indigenous Research and Development." Economic and Political Weekly, April 24, 1982.

Judd, M. Ann and R. Evenson. "Resources for Production of Agricultural Growth in the Pacific Basin Region." Yale University Economic Growth Center, 1982.

Murray, Geoffrey. "How Taiwan Plans to Leap from Shoes into Software Science Park Seen As Key to a New Industrialization." Christian Science Monitor, June 30, 1982.

Randhawa, M.S. A History of the Indian Council of Agricultural Research. New Delhi, ICAR, 1979.

Ruttan, Vernon. Agricultural Research Policy. Minneapolis: University of Minnesota Press, 1982.

Segal, Jeffrey. "Splitting the Bean Gene." Far Eastern Economic Review, April 23, 1982.

Winkelman, Don. Personal Communications, 1982.

EVALUATING HEALTH, POPULATION AND REDISTRIBUTIVE PROGRAMS IN DEVELOPING COUNTRIES

by Mark R. Rosenzweig*

Among the most important goals of government policies are the improvement of social welfare through economic growth and the equitable distribution of the benefits of economic progress. An unresolved and major issue is the extent to which, if at all, egalitarian income distributional goals and overall economic growth are compatible. The reduction of population growth is an additional policy objective in many developing countries in which population increases are viewed as impediments to achieving rapid increases in per-capita income. In this essay, I briefly examine the natalist and distributional effects of a number of potential and actual governmental policies and programs, including policies serving to redistribute income, promote economic growth and/or to directly influence family size choices. Particular attention will be paid to identifying serendipitous policies which would appear to both equalize incomes, facilitate economic growth and reduce the rate of population increase.

The analysis of the demographic impact of governmental programs in this paper is guided by an underlying theoretical framework which views the household as a unified institution which responds to alterations in its total resources and to changes in prices in allocating those resources which it commands. Among these are the goods and services devoted to the bearing and rearing of children. From this perspective, the central focus is on how public policies influence the resources allocated by households to children, with increases in the level of real resources expended on each child, on the "quality" of the next generation's population, viewed as enhancing economic growth. Among the questions to be addressed are: whether policies which serve to increase the amount of resources allocated per child will also reduce population growth, how policies which redistribute income from high to low-income households affect overall population growth and future population quality, how policies or programs designed to reduce population growth affect the contemporaneous distribution of income and the average level of resources devoted to children, and whether egalitarian objectives necessarily constrain the achievement of lower fertility and greater economic growth.

In the first section, I discuss the demographic consequences of pure redistributive policies and briefly review the empirical literature. In the next sections the impact of policies which alter price structures and mandate patterns of household expenditures are examined and the conditions under which the allocation of subsidies disproportionately to the poor is "optimal" in terms of maximizing population quality and lowering population growth are described. The implications of optimal

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governmental behavior for empirical evaluations of the effects of governmental programs on household decisions are then discussed. In the final section, the demographic and distributional effects of some economic development programs are briefly reviewed, followed by a summary and concluding comments.

Natalist Effects of Pure Redistribution Schemes and Land Reforms

I first consider the effects of overall population growth of a "pure" redistribution of income from high to low-income households. By "pure" it is meant that the interhousehold transfers are unaccompanied by any changes in costs or prices of resources. It should be noted that in real life it would be very difficult to accomplish a continuous "pure" transfer scheme without affecting incentives for and the resources allocated to income-enhancing activities--labor supply, investment in skills, etc. Moreover, it is likely that differences in income distributions across countries are highly correlated with differential price structures, making the identification of the effects of pure income distributions quite difficult from cross-national data.

To circumvent the possible conceptual contamination of pure income transfers, consider the fertility effects of distributing foreign aid monies equally among households compared to providing more to low than to high-income households. If under the progressive distribution scheme overall fertility is to fall, it is obviously necessary that the income effect on fertility be smaller for low than for high-income households. Unfortunately, with no price changes, conventional consumer or household demand theory is completely silent on either the direction of income effects or on the variation of income effects (if any) with levels of income. However, even this "pure" distribution of monies results in subtle (and perhaps unmeasurable) but potentially important price changes. For example, as discussed in Willis (1973), in households in which the wife does not participate in the labor force, the marginal productivity of the wife's time, given her participation in household production, will vary positively with income. If the rearing of children is "time-intensive" in the wife's time, the effect of income on fertility will be greater in working wife than in non-working wife households, since only in the latter will the price of the mother's time and thus the relative cost of children rise when income increases. Since whether or not the wife works also depends on her potential market wage and husband's earnings, a non-linear and interactive relationship is established between husband's income (considered exogenous), and the wife's potential wage and fertility.

These latter considerations suggest that because women with wealthier husbands are less likely to work (ceteris paribus), the "pure" income effect on fertility will be less positive in high than in low income households. The strength and direction of this relationship will depend, however, on the correlations between wives' potential wages and husbands' earnings (on assortative mating) and on the sensitivity of (married) female labor-force participation to income and wages. Thus, it is not likely that the association between income effects on fertility and income will be stable or the same across societies.

An additional relationship between exogenous changes in income and in the cost of children arises if parents want to allocate approximately equal resources to each child (Becker and Lewis (1973)). The cost of children thus depends positively on the level of the per-child resources desired, while the cost of increasing the resources devoted to each child depends in turn on the number of children wanted. Moreover, if the "quality" of children is the sum of their exogenous endowments as well as parental resources and if the number of children are "normal" goods, the price of fertility will rise relative to that of quality when a family's income exogenously increases. More importantly, the observed fertility-income elasticity will be lower (and the observed child investment income elasticity higher) in low-income families than in high-income families because the ratio of child endowment to total child quality will be higher in lower income families. Such families thus need to spend proportionately more on each child than do high income families to achieve the same proportional increase in total child quality. As a consequence, the shadow price of children rises proportionately more in low income families receiving the same income increase. Note, however, that this "prediction" assumes that the unobservable "true" income elasticities are not significantly different in high and low-income households.[1/]

The empirical evidence on the shape of the income-fertility relationship is weak. The most prominent studies of the relationship between the distribution of income and fertility are found in Repetto (1973, 1978, 1979), Kocher (1973) and Rich (1973). While all these authors conclude that equalizing income would lower population growth, their empirical analyses suffer from such severe methodological and conceptual problems that they cannot be relied upon (see Boulier (1981)). Indeed, no studies from household data sets taken from individual countries appear to suggest that income effects on fertility are of such magnitudes as to warrant the implementation of income transfer schemes of realistic scale in order to affect fertility.

While, as noted, an ongoing pure tax-subsidy redistribution program which would significantly affect the distribution of income is likely to have important incentive effects which might significantly impede efficiency and economic growth, a "one-shot" land reform can be a less costly means of altering the distribution of income in many LDC's, since it induces fewer accompanying distortions. Indeed, such programs have been implemented in a number of countries--China, Colombia, India, Korea, Mexico, the Soviet Union. The overall efficiency (total income) effects of land reform have been debated, with effects depending upon the existence of scale economies and labor and credit market imperfections

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1/ A reason why transfers of income to poor households might initially raise fertility is that in such households, desired family size may exceed potential family size. Improvements in diet associated with increased income might then raise fecundity and reduce infant deaths. The number of surviving children would increase even if the demand for children were negatively related to income.

(Rosenzweig, 1978). In the absence of these, little change in productivity would evidently ensue.[2/] The land reform, even in this case, however, would still not leave prices unaltered, as differences in income-leisure effects across income groups would lead to changes in aggregate agricultural wage rates. Rosenzweig (1978) finds evidence from India that in districts in which the distribution of land is more equally distributed among landowners, wage rates are high for men, women and children, although higher relatively for men. The district-level, wage-constant association between fertility (the child-woman ratio, age adjusted) and land-holding inequality reported by Rosenzweig and Evenson (1977) is negative. The computation of the "reduced-form" land-inequality effect on fertility based on the wage-fertility and wage-land effects from the two studies suggests that the total effect (wage plus direct) of an equalization of land-holdings among holders of land would be to slightly increase fertility.

Subsidizing and Mandating "Basic Needs": Natalist, Growth and Distributional Effects

Neither theory nor the existing empirical evidence provides much support for the proposition that a redistribution of income per se is desirable because of its anti-natalist impact; indeed the direct demographic consequences associated with non-distorting income transfers are likely to be small. Policies aimed at altering the resource allocations of families through price changes, however, both importantly affect the distribution of real income and have demographic consequences. Moreover, economic models of household-decisionmaking are less agnostic about the effects of policies which alter prices and incentives or constrain allocations, and some empirical regularities regarding them have begun to emerge. In this section I consider the demographic consequences of the governmental subvention or provision of such "basic needs" services as health and education and rules which mandate minimum household resource allocations. I also examine the income distributional effects of such policies when they are implemented equally across households and financed by foreign aid (to abstract from the consequences of financing). The desirability of targeting subsidies to certain groups or areas, and the econometric implications for program evaluation of targeting, are discussed in the next section.

There are two important income-distributional aspects of basic needs subsidy programs. First, basic needs services presumably consume a larger proportion of the total household budget of the poor than of the rich; across-the-board subsidies are thus progressive. Second, subsidies of schooling and health services induce families to transfer

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2/ Welch (1977) argues, and the empirical evidence confirms (Rosenzweig, forthcoming; Huffman, 1974) that the returns to but not the costs of innovation are higher on larger farms. The existence of these dynamic scale economies suggests that slower growth may be a consequence of an equalizing land reform.

resources to the young. However, the rich may consume more of such services than the poor, and thus may receive more total subsidies. More importantly, the intergenerational resource transfer induced by subsidization may take the form of higher numbers of children rather than more resources per child. I will employ a simplified model of fertility behavior, which focuses on the division of the total resources spent on children into quantity and quality components, to illustrate the issues concerning the effects of basic needs subsidies and to provide guidance for obtaining and interpreting empirical results.

Assume that all households maximize a utility function which expresses household preference orderings for family size, for the total resources devoted to each child (health, education services) and for other goods. In order to achieve a desired family size each household must expend resources to avert births, at a price per averted birth.

Based on the budget constraint faced by households, it can be shown that the total value of a given per-unit subsidy for good i to a household depends on its level of consumption of good i. If, for example, high income households desire to have a lower family size than do low-income households they will consume more of the contraceptive subsidy; moreover, if they reduce fertility proportionally less than they increase resources per child, they will also consume more "basic needs" subsidies. Whether or not basic needs uniform subsidies increase or decrease income inequality thus depends on the relationships between income, fertility and per-child resource allocations.[3/]

A fundamental implication of such a household model is that the subsidy to any one good or service will affect the consumption of all commodities--family planning subsidies will affect the level of resources allocated to children; subsidies to the services used to augment child "quality" will influence fertility, etc. Despite this implication, only very recently have researchers begun to examine these potentially important program "cross-effects"; most empirical work has looked at "own" program effects--family planning effects on fertility, for example, sometimes mistakenly holding constant other household choices (Hermalin, 1976; Khan and Sirageldin, 1979).

Can the household models, such as outlined here, provide insights into how basic needs subsidies will affect fertility or investments in children? First, family planning should reduce births (if the relationship between fertility and income is small or negative). The cross

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3/ Very little empirical evidence exists on the actual distribution of subsidies. Selowsky's study (1979) of the distribution of government subsidies in Colombia, which makes use of a special survey of households, suggests that total health and education subsidies per household are approximately equal across income groups. However, households are sorted into income classes according to their income per capita rather than the more appropriate household full income.

effect of changes in family planning subsidies on expenditures per child cannot be predicted. However, the dependence of the cost of increasing per-child expenditures on the number of children and vice versa implies that this effect is likely to be positive (Becker and Lewis, 1973; Rosenzweig and Wolpin, 1980). Assuming that family planning subsidies do induce increases in the level of resources devoted to each child (I present evidence which confirms this below), however, the model cannot predict how a subsidy to health or education will influence fertility or even investments in health or schooling; it can only predict that total resources allocated to children will rise, since investments in both numbers and the quality of children are made cheaper by subsidization of basic needs.

Table 1 reports results from two studies (Rosenzweig and Wolpin, 1982, Rosenzweig and Schultz, 1982) of the effects of governmental health and family planning programs on fertility, child survival and surviving children based on Indian merged household and district-level data and Colombian merged household and municipio-level urban data. Both studies indicate that where family planning is present fertility and child mortality are reduced. These family planning results are also consistent with the finding of Rosenzweig and Wolpin (1980) that families in India experiencing multiple births (twins) tended to reduce schooling investments in their other children. Table 1 also indicates that health programs reduce mortality and also reduce fertility and surviving children. Basic needs subsidies to fertility control, to health and to schooling thus appear to have the same joint outcomes--smaller family size and more investments in each child.

Reducing fertility and the provision of basic needs thus appear to be not only compatible goals, but evidently can be achieved by either health or family planning programs. These results may not be universally true, however. In high-income societies in which families are small and investments per child large, both fertility and investments per child could rise in response to health or educational services subsidies, since such subsidies would induce greater increases in real income.

While education, health and family planning subsidies can, at least in India and Colombia, lead to lower population growth and higher investment levels in children, we have seen that uniform (across income groups) subsidies (financed from foreign aid) are not income-equalizing as long as higher income families spend more total resources on their children and make greater use of contraceptives (have lower numbers of children). However, poor households benefit absolutely from such subsidies and share, in part, the rise in resources with their offspring. Both the current adult poor and the next (smaller) generation thus benefit from subsidies to health, education, and family planning services.

Compulsory schooling (and child labor) laws, given the empirical results, can be shown also to transfer resources to the young and reduce fertility. However, their income distributional consequences are quite different from subsidization of education. It is shown in Rosenzweig and Wolpin (1980) that the effect on fertility of a law which forces

parents to educate their children at a level above the level they would have chosen is equal to the ratio of compensated cross and own price effects involving family size and resources per child. Compulsory schooling laws thus would lower fertility in India and Colombia, where the effect of a subsidy to family planning evidently raises schooling and lowers fertility. With respect to income distribution, however, such laws i) make poor adults worse off absolutely and relative to rich adults, since if the rich desire higher levels of schooling than do the poor, compulsory schooling laws may be binding constraints only for the poor and ii) tend to equalize the educational levels of the next generation. Economic growth (through human capital investment) and greater future income equality (with less poor offspring) are achieved at the expense of the current generation's poor when rationing rather than subsidization is the means by which additional resources are allocated to children.

The Optimal Distribution of Government Subsidies: Income Equalization, Fertility Decline and Improvements in Population Quality

I have discussed in the last section how subsidization of health, education and/or family planning services can simultaneously reduce population growth and lead to higher aggregate investments in population quality, with evidence from at least two low-income countries supporting this theoretical possibility. Under the assumption that high income families have smaller families and invest more resources in children than do poor families, however, income-independent subsidies to "basic needs" exacerbate income inequality. An alternative scheme, targeting subsidies to the poor--providing poor households with greater subsidies of "basic needs" services than rich households--would clearly be income-equalizing. However, skewing the distribution of such subsidies to the poor may alter the program's effectiveness in achieving reduced aggregate population growth and greater economic growth. I now show that if the poor receive higher basic needs subsidies than the rich, the aggregate effect on investments in children can increase.

Let us assume that the government has a fixed amount (for foreign aid) to allocate to household-specific subsidies of the goods allocated to children by two families who behave according to the model described in the previous section and face the same unsubsidized prices. In family 1 (2), the planned number of children is N_1 (N_2) and investments per child q_1 (q_2), with $N_1 > N_2$ and $q_1 < q_2$ because family 1 is the lower income family. The government seeks to maximize the average level of quality in the population Q, given by:

$$Q = \left(\frac{N_1}{N_1 + N_2}\right)q_1 + \left(\frac{N_2}{N_1 + N_2}\right)q_2 = \alpha_1 q_1 + (1 - \alpha_1)q_2 \qquad (1)$$

subject to its budget constraint:

$$G = N_1 q_1 s_1 + N_2 q_2 s_2 \qquad (2)$$

where s_1 and s_2 are the subsidies per unit of q_i provided families 1 and 2. Note that, from (1), i) the average level of q can be increased merely by lowering family size in the lower q family relative to that in the higher q family and ii) that increases in q in the low-income (high fertility) family have a greater effect on average child quality Q. However, from (2), subsidies allocated to the low-income family cost more, ceteris paribus, because they are allocated to more chilren.

Based on the maximization of (1) subject to (2), it can be shown that higher subsidies to goods which augment population quality should be given to the low-income (low q) households i) even if price elasticities are equal across income groups, as long as subsidizing such goods leads to a reduction in fertility and ii) a fortiori if the absolute value of the fertility and q price elasticities are greater in low than in high income households.

These results suggest that in populations with a high average family size, low levels of investments (quality) per child and with the average income elasticity for quality exceeding that for family size, equalizing real incomes through disproportionate subsidization of health, family planning and educational services for low-income households may enhance average investments in children and lower aggregate population growth more than would non-egalitarian subsidization schemes, including uniform subsidization.[4/] This serendipitous result, however, is only a theoretical possibility, only partly confirmed by available evidence. Information is needed on the differential effects of basic needs programs on correlates of child quality and family size by income before the optimality of progressive income-conditioned subsidies is confirmed. Very little information currently exists on the interactions between income and health and education program effects within a population. Results in Rosenzweig and Schultz (1982), based on urban Colombia data, do suggest that the impact of such programs on child survival is weaker among more educated women, but such a finding may be interpreted in a number of ways, given that education plays important roles other than proxying income.[5/]

If the simple optimization rules from the planning model is seen as a predictive rather than a prescriptive model, that is, if governments actually distribute program expenditures according to the levels of the targeted behavior (fertility, child health) in order to maximize their aggregate effects, more fundamental problems are raised. In

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4/ Note that subsidization of family planning services only for the poor (with relatively high family sizes) would also raise average population quality more than would a uniform family planning subsidy due to the compositional shift associated with lowering the population share of low-q children. There is no theoretical presumption, as in the q-subsidy case, that the price elasticities with respect to family planning subsidies vary with family size, q or income.

5/ The informational roles of health programs may be less important for more educated mothers, for example. Education may thus serve as a substitute for health programs in the production of health.

particular, program effects on fertility and indicators of child quality estimated on the basis of areal differences in program levels within a country (such as in Table 1) may be seriously biased since program placement may itself be a function of fertility levels of expenditures per child. Indeed, the simple government model suggests that, with programs costs constant, program activities will be more intensive where fertility is relatively high and investments per child relatively low.6/ If so, cross-sectional program estimates may underestimate true program impacts.

The coefficients reported in Table 1 and other cross-sectional estimates of program impacts may thus confound governmental program placement with household behavior. To obtain estimates of true program effects from cross-sectional data it may be necessary to explicitly model the distribution of governmental programs (in a more realistic way). Alternatives are the use of panel data from areas with program interventions occurring during the panel or data from environments containing randomized program interventions. Preliminary work with Kenneth Wolpin on longitudinal data from 20 barrios in Laguna, Philippines, indicates that in this relatively homogeneous rural area with respect to program costs, governmental health and family planning programs were introduced significantly earlier in barrios where average real incomes (and child health) were lower. Inattention to the "progressive" placement of programs, moreover, severely biased the estimates of the effects of the program variables on measures of the nutritional status of children. Corrected estimates, however, were qualitatively similar to those reported in Table 1, with exposure to either family planning or health programs significantly augmenting child health. Such program interventions were evidently both egalitarian and efficient.

Conclusions

Theories of household behavior and the available evidence provide little support for the proposition that income transfers from the rich to the poor, in the absence of significant price changes, will importantly affect either economic or population growth. The simultaneous achievement of increased economic welfare, fertility decline and a more equal distribution of income through governmental intervention, however, is not ruled out by these findings. Consistent with economic models of household choice, evidence from a number of high-fertility developing countries suggests that subsidies to family planning, health and educational services together or separately induce reductions in family size and promote economic growth through human capital investment. An important implication of the existence of the favorable "cross effects" of such

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6/ Such costs are not simliar, for example, in urban and rural areas. Given the differences in population densities, a dollar spent on a health program in an urban area may have a greater impact, ceteris paribus, than a dollar allocated to a rural health program. Indeed, Selowsky's study indicates that public health subsidies per household in rural areas of Colombia are 60 percent of those in urban areas.

programs is that in settings in which fertility rates are higher in low than in high-income families, providing higher rates of subsidization to such basic needs services for the poor than for the rich is an efficient means of achieving reductions in population growth and higher aggregate rates of economic growth. The compatibility of these redistributive, demographic and development goals associated with income-dependent subsidization of human capital and fertility control inputs is a fortuitous policy result, which, however, also suggests that empirical investigations of the effects of public programs may need to take into account more carefully the rules by which governments allocate services and subsidies.

Finally, while this paper has focused on some of the consequences of income transfer and "basic needs" subsidy programs, these are by no means the only or most important of effective policies aimed at promoting economic growth. The improvement of capital markets, which may reduce the returns to children as sources of old-age security and increase investment, and the importation and diffusion of continuous technological innovations, which may increase incentives for human capital investment for given factor bias (Rosenzweig, forthcoming) and augment productivity, are other instruments whose distributional and demographic consequences require study.

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References

Becker, Gary and H.G. Lewis. "On the Interaction Between Quantity and Quality of Children." Journal of Political Economy 82, March/April 1973, S279-S288.

Becker, Gary and N. Tomes. "Child Endowments and the Quantity and Quality of Children." Journal of Political Economy 84, August 1976, S143-S162.

Boulier, Bryan. "Income Distribution and Fertility Decline: A Skeptical View." Office of Population Research, January 1981.

Hermalin, Albert. "Regression Analysis of Areal Data." In C. Chandrasakaren and A. Hermalin, Measuring the Effect of Family Planning Programs on Fertility. Dolhain, Belgium, Ordina Editions for IUSSP, 1976.

Huffman, Wallace. "Decision Making: The Role of Education." American Journal of Agricultural Economics 56, February 1974.

Khan, Mohammad Ali and I. Sirageldin. "Education, Income and Fertility in Pakistan." Economic Development and Cultural Change 27, April 1979, 519-548.

Kocher, James. Rural Development, Income Distribution and Fertility Decline. New York: The Population Council, 1973.

Repetto, Robert. Economic Equality and Fertility Decline in Developing Countries. Baltimore: Johns Hopkins University Press, 1979.

Rich, W. Smaller Families Through Social and Economic Progress. Washington, D.C.: Overseas Development Council, 1973.

Rosenzweig, Mark. "Female Work Experience, Employment Status, and Birth Expectations: Sequential Decision-making in the Philippines." Demography 13, August 1976, 339-356.

Rosenzweig, Mark. "Rural Wages, Labor Supply, and Land Reform: A Theoretical and Empirical Analysis." American Economic Review 68, December 1978, 847-861.

Rosenzweig, Mark. "Redistribution, Population Policies and Household Behavior: Implications for Population Growth and Economic Development." In Proceedings of the International Population Congress of the IUSSP, 1981, Liege: Ordina Press, 1981.

Rosenzweig, Mark. "Agricultural Development, Education and Innovation." In M. Gersovitz, C. Diaz-Alejandro, G. Ranis, and M. Rosenzweig, The Theory and Experience of Economic Development: Essays in Honor of W. Arthur Lewis. London: Allen and Unwin, forthcoming.

Rosenzweig, Mark and R. Evenson. "Fertility, Schooling and the Economic Contribution of Children in Rural India: An Econometric Analysis." Econometrica 45, July 1977, 1065-1080.

Rosenzweig, Mark and T.P. Schultz. "Child Mortality and Fertility in Colombia: Individual and Community Effects." Health Policy and Education, forthcoming.

Rosenzweig, Mark and K. Wolpin. "Testing the Quantity-Quality Fertility Model: The Use of Twins as a Natural Experiment." Econometrica 48, January 1980, 227-240.

Rosenzweig, Mark and K. Wolpin. "Governmental Interventions and Household Behavior in a Developing Country: Anticipating the Unanticipated Consequences of Social Programs." Yale Economic Growth Center Discussion Paper No. 354, July 1980.

Selowsky, Marcello. Who Benefits from Government Expenditures. New York: Oxford University Press, 1979.

Welch, Finis. "The Role of Investments in Human Capital in Reducing Constraints on Agricultural Production." Mimeo, October 1977.

Willis, Robert. "A New Approach to the Economic Theory of Fertility." Journal of Political Economy Supplement March 1973, S14-S64.

SHORTER RESEARCH REPORTS

ECONOMICS OF IRRIGATION IN LDC'S

by K. William Easter and Delane E. Welsch*

The Department of Agricultural and Applied Economics at the University of Minnesota is jointly involved with the Economics Department at Colorado State University in analysis of economic problems associated with irrigation in LDC's. The project is funded by the U.S. Agency for International Development.

This project will seek to: (a) analyze, for selected irrigation projects, water policies, originating at different levels of aggregation viz., national, sector, and project levels in terms of service area economic and financial performance; (b) analyze impacts of alternative types of management institutions on service area income (including income distribution); (c) identify data and methodological requirements for improved understanding of irrigation water development in selected LDC's; and (d) provide technical economic assistance to AID/W, USAID missions and the various LDC's in carrying out their programs and projects for water resource development and utilization.

The efforts are now concentrated in four countries: Thailand, India, Egypt and Pakistan. The University of Minnesota has taken the leadership in Thailand and India. Minnesota's studies have been concentrated in northeastern Thailand and southern India. Collaborative arrangements have been established with professionals and institutions in both countries. Collaborators in Thailand are faculty members at Kasetsart University in Bangkok and Khan Kaen University in northeastern Thailand. Collaborators in India are at Tamil Nadu University, Coimbatore.

The emphasis in these studies has been on small scale irrigation systems. In Northeastern Thailand, an ex-post analysis of five small reservoirs was completed in 1981. The analysis showed that three out of five projects had rates of return comparable with the private sector investments while the other two projects were marginal investments with real internal rates of 12 to 13 percent. Fishery benefits turned out to be very important and accounted for 70 percent of the benefits in the two smaller reservoirs. The distribution of project benefits favored the small and medium-sized farms. The small farms (less than 6 acres) received 39 percent of the benefits while they accounted for 37 percent of the population. In contrast, the large farms (greater than 12 acres) obtained 14 percent of the project benefits and represented 23 percent of the population.

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* K. William Easter and Delane E. Welsch are Professors in the Department of Agricultural and Applied Economics, University of Minnesota.

The second stage of the study of small scale irrigation in Thailand is concerned with why lift irrigation systems have been more successful in obtaining dry season irrigation than the small reservoirs. In addition, a more detailed analysis will be made of domestic water use and fishery benefits.

In southern India, in collaboration with Tamil Nadu Agricultural University, we are analyzing the operational efficiency of ten small reservoir irrigation systems. Two hundred farmers were surveyed in the winter of 1982 to estimate how water availability influenced farm productivity. We want to determine the impact on crop output of reservoir rehabilitation including improved water management.

This project is partially funded by USAID (DS/AGR/ESP), under a joint contract with the University of Minnesota (UM) and Colorado State University (CSU). K. William Easter is the UM project leader and overall coordinator.

MOROCCAN MOULOUYA IRRIGATION PROJECT

by Robert Holt, Terry L. Roe and Malcolm Purvis*

A major component of this project was a benefit cost analysis of the lower Moulouya region comprising approximately 60,000 hectares of land under irrigation. The development of this region for irrigation began in the 1960's and is expected to reach completion in the early 1990's. This rather extensive analysis estimated the social profitability of the project with a benefit to cost ratio of 1.25 and an internal real rate of return of 10.5%. The economic success of the project can be attributed to four major causes: (1) to substantial gains in efficiency in agricultural production because of a decline in yield variability, a switch to higher value crops and a substantial increase in livestock production; (2) a high rate of utilization of the irrigation perimeter in the early stages of the project due to an experienced reservoir of agricultural laborers who were familiar with irrigated agriculture so that as the perimeter expanded it was relatively easy to expand the area in irrigated crops accordingly; (3) sound management of the project during construction and sound management of the distribution of water within the perimeter appears to have contributed to expanding the production of irrigatable crops; (4) the high utilization rate of the perimeter is also explained by access to markets created by the relatively close proximity of the large urban areas of Oujda and Melilla which experienced rising per capita income from local employment and from remittances from western Europe.

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This project was funded by USAID contract AID/NE-C-1507.

PRICE POLICY, IMPORTS AND HOUSEHOLD BEHAVIOR

by Terry L. Roe and Benjamin Senauer*

This project had a macro-economic and a micro-economic focus. The macro-economic component of the project focussed on the import demand for wheat in the four countries: Brazil, Korea, Morocco and Egypt. The micro-economic component of the project was to study the impact of pricing policy on agricultural households in a selected LDC.

The study of wheat imports found that wheat consumption and imports grew faster than all other grains in the four countries studied. Wheat clearly played the role of the food gap grain between 1960 and 1979. Even in those countries which experienced rapid increases in wheat production, wheat imports grew rapidly. The results suggest that wheat imports are given high priority in the allocation of foreign exchange, with the possible exception of Brazil. The results also suggest that the desirability of wheat imports as a food gap grain is explained to a large extent by both the stability of wheat prices and the level of wheat prices relative to rice since 1960.

The second component of the project focusses on problems of measuring the effects of market interventions on the welfare of agricultural households. The distinction here is to capture the economic behavior of the agricultural household in the allocation of resources to the production of agricultural commodities, the allocation of income to the consumption of goods and services and the allocation of household labor to both the farm, leisure, and off-farm employment. Relative to other models of the agricultural household, attention was focussed to the affects of marketing margins and production risk. This framework is now in the process of being fit to farm-household survey data obtained in the Dominican Republic.

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This project is funded by the Office of International Programs, University of Minnesota, from a USAID Title XII grant.

FOOD GRAINS POLICY

by Terry L. Roe, Benjamin Senauer and Jerry Hammond*

The two general thrusts of this project are: to survey, in cooperation with IED/ERS, government intervention in the food sector of 21 LDC's, and to conduct more indepth case studies of food policy in selected countries in this group. The assessment of government intervention in the 21 countries is nearly completed. While market intervention is common in all of the countries in the group, significant differences are found to exist among the countries in food policy objectives, in the policy instruments chosen to intervene and in the degree of intervention. Self-sufficiency and producer welfare were the stated priority objectives of most African and Asian countries. However, Asian countries had a broader range of objectives including consumer welfare, stable prices and food security. Producer welfare was a stated objective for most Latin American countries. Consumer welfare and foreign exchange objectives were usually the secondary objectives.

The instruments of food grain policy appear to exhibit regional differences with respect to price controls. African nations frequently make use of government monopolies and parastatel agencies to control marketing and pricing of cereals where producers are taxed either directly or indirectly and the marketing functions are subsidized. Asian countries emphasize public food distribution programs for low income families. Price control invariably required control over imports and exports of basic food grains.

Case studies of two countries (Kenya, Tanzania) are completed and several others are underway. Tanzania and Kenya were found to have essentially the same food policy objectives of food grain self-sufficiency at low and stable consumer food prices. While both countries manipulated similar policy instruments to attain these objectives, the extent of intervention in Tanzania was greater than that in Kenya. The results of the analysis suggested that relative to border market prices, both countries tended to tax the production of those crops that could be produced at low cost and subsidize the production of those crops that were otherwise more costly to produce. The results indicated that both countries could have been net exporters of rice and corn (Tanzania) and wheat (Kenya) rather than net importers of these crops. Studies of Indonesia, Tunisia, Senegal and Dominican Republic are underway.

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U.S. AGRICULTURE IN AN INTERDEPENDENT WORLD ECONOMY

by G. Edward Schuh*

U.S. agriculture, together with the U.S. economy in general, has become increasingly internationalized. In particular, trade grew rapidly over the last decade with the less-developed countries and the centrally planned economies. Moreover, the international capital market has evolved to the point where it effectively links the economies of the world together and serves as a source of disturbances to commodity markets, and a link between monetary and fiscal policies in the U.S. and commodity markets in the U.S. and other countries.

With support from, and in collaboration with the U.S., the Department of Agricultural and Applied Economics is engaged in an analysis of these linkages. As the first step of the research a state-of-the-arts paper is being prepared on the effect of exchange rate realignments on commodity prices. Further work will be devoted to developing models which provide the means of understanding these monetary linkages and the impact of monetary disturbances on international commodity markets. Particular emphasis will be given to the impact of U.S. monetary disturbances on the agriculture of less-developed countries.

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FACTOR PROPORTIONS AND COMPARATIVE ADVANTAGE IN A TRADE-DEPENDENT ECONOMY: THE CASE OF HONG KONG

Yun Wing Sung

This study tests the factor-proportion hypothesis of trade with the data of Hong Kong (HK). The n-commodity, m-country, 2-factor model of Krueger (1975) is chosen as the analytical framework because it is more general than the standard 2-commodity, 2-country Heckscher-Ohlin-Samuelson (HOS) model.

The years of 1962 and 1973 are chosen for the test because these are the only two years for which inter-industry data are available. Despite the rapid accumulation of capital and skills in HK, HK manufacturing in 1962 and 1973 have been found to be less capital and skill intensive than manufacturing in most developing countries (DC's) and less developed countries (LDC's), though the capital/skill intensities of HK manufacturing might have "passed" some LDC's by 1973.

Since HK is close to the labor-abundant end of the endowment spectrum, the predictions of the Krueger model for HK are: (1) The capital/skill intensities of competitive-import replacements will be higher than that of exports for trade with all countries, especially for trade with DC's, but less so for trade with LDC's. The capital/skill intensities of noncompetitive imports (mostly from DC's) will be much higher than that of exports and competitive-import replacements. (2) HK exports to DC's should be less capital/skill intensive than that to LDC's. The reverse should hold for competitive-import replacements. (3) The rapid capital/skill accumulation in HK should change the production pattern towards more capital/skill intensive products.

To compute the total (direct and indirect) factor requirement of trade, intermediate inputs can be assumed to be imported or domestically produced. In the previous literature on the testing of the HOS hypothesis, there were four different approaches to the problem, ranging from the extreme assumption that all intermediate inputs are imported (approach 0) to the other extreme that all intermediate inputs (except noncompetitive imports) are domestically produced (approach 3). Another assumption is that all tradable intermediate inputs are imported whereas home goods are domestically produced (approach 1). All of these approaches are, however, mistaken. Conceptually, to conduct an ex post test of an equilibrium trade position, intermediate inputs produced domestically at the existing equilibrium should be included in the computation of factor requirements whereas currently imported intermediate inputs should be excluded (approach 2).

HK has been observed to specialize in "footloose industries" (e.g., electronics) by importing capital/skill intensive inputs for the labor-intensive assembly of the final product. HK can save capital by specializing in the labor-intensive, assembly stage of production in addition to specializing in labor-intensive products. The proper treatment of imported inputs is thus an important issue. To gauge the magnitude of the differences of using the different approaches, the factor requirements of trade are computed by the four approaches.

The pattern of trade in both 1962 and 1973 is remarkably consistent with the predictions of the Krueger model (an input-output table is compiled for 1973 because none is available). It is found that HK exports labor and imports skills and capital through commodity trade, and this is especially true for trade with DC's. The sectoral capital/skill ratios are significantly correlated with sectoral standardized net imports (net imports in each sector divided by its output). The correlations for approaches 1 and 2 are higher than that of 0 and 3. Moreover, HK saves significant amounts of capital by specializing in the labor-intensive, assembly stage of production (by importing capital-intensive inputs) in addition to specializing on labor-intensive products. As expected, the capital/skill intensities of HK trade have increased markedly between 1962 and 1973.

AN ESTIMATE OF THE WELFARE CHANGES FROM FORMATION OF A CUSTOMS UNION AMONG SOME COUNTRIES IN SOUTHEAST ASIA

Joon Hak Yoo

This thesis estimates the changes in consumers' surplus, welfare, import bills, and exports from formation of a customs union among Taiwan, Hong Kong, India, Korea, Malaysia, The Philippines, and Thailand in 1969. The common tariff rate on each of the commodities is the simple arithmetic average of the tariffs that were levied by the members on the same commodity in 1969. The same things are estimated under the common tariffs of 50% of that simple arithmetic average. The commodities that are investigated by this thesis are manufactured goods in Standard International Trade Classifications 5 and 6.

As tariffs are changed upon formation of the union, prices to consumers and welfare would change. This thesis estimates these welfare changes under the assumptions that the price elasticities of demand are unity, the sum of the cross elasticities is zero, supply curves of export industries are infinitely elastic with respect to their own prices, and domestically produced import-competing goods are not identical with the imported goods. The welfare changes are estimated with price elasticities of demand of -0.5. All estimates in this thesis are made by using the official exchange rates which are assumed to be fixed during 1969.

Chapter II presents the results of the estimates under the union. Except for Hong Kong which did not impose any tariffs at all, the changes in consumers' surplus are positive, but the size is less than 1% of each member's GNP. As the common tariffs are reduced by 50%, the changes in consumers' surplus are greater. As the price elasticities of demand are halved, the size of consumers' surplus changes are halved. The total welfare changes are even smaller than the consumers' surplus changes. This means the transfer of welfare from importing members to exporting members in a form of higher prices is quite substantial. As the demand elasticities are halved, the size of the welfare changes are decreased by more than 50%, and for some members, the welfare changes turn from positive to negative. This again indicates the influential role of transfer of welfare in determining the size of the welfare changes. As the common tariffs are reduced by 50%, welfare would increase by more than 50% for most members, but degree of trade diversion would not change greatly.

Under the union, import bills of each member would increase due to increased import prices and increased quantities imported. But this increase is small compared with the increase in exports of each member to the other members. This increase in exports is due to trade diversion, which is supported by the fact that a reduction of the demand elasticities has a negligible effect on the increase in exports.

Chapter III presents estimates under free trade among the members. Consumers' surplus would increase by more than consumers' surplus and welfare would increase under the union. Import bills would increase under free trade because quantities imported would be larger at the same unit import prices. Unlike under the union, exports would increase by a small amount. The source of this increase in exports is the increase in quantities imported due to decreased prices.

Chapter IV presents a prediction of increases in exports and imports of Korea from 1970 to 1985 in the trade with the other members under the union. The prediction is made by estimating the marginal propensities to import the commodities, changes in the market shares which would be caused by the union, and predictions of national incomes of the members. Korea would have a surplus in the trade with Hong Kong, India, Thailand, and Malaysia (only up to 1975); a trade deficit in the trade with China, the Philippines, and Malaysia (only after 1976). Overall, Korea would have a surplus throughout the prediction period.

AN ANALYSIS OF BRAZIL'S SUGAR PROGRAM, 1953-1975*

Frederick Ian Johnson

Since 1931 Brazil has protected and regulated its domestic sugar industry. This study examines, in the context of a supply and demand analysis, how Brazil's sugar program has affected its domestic and foreign sugar market. The analysis covers the two key instruments

* Recipient of American Agricultural Economics Association Outstanding Ph.D. Thesis Award, 1981.

of the sugar policy (the setting of prices and the restricing of sales); it considers separately the two main regions (the North-Northeast and the Center-South); and it encompasses primarily the period 1953-1975.

The first step in the analysis is the construction of a model of production in which crop yields are stochastic. Several quota systems are considered, and in each case the producer response to the quota is inferred. It is shown that, in this stochastic framework, the quota can be treated as reduction in the effective price received by the farmer. The fraction by which the actual price is effectively reduced hinges upon the size of the quota and on the moments of the distribution of crop yields. Acknowledging the stochastic nature of the crop allows the estimation of the effective price and, in turn, the estimation of the free market supply relation.

Supply and demand are then estimated. Employing these estimates, the impacts of the quotas are examined by simulating no-quota production, and the effect of price setting is examined by simulating production and consumption at world prices.

A SIMULATION MODEL FOR INDONESIA WITH ECONOMIC PROJECTIONS AND REGIONAL DISTRIBUTION OF GROWTH FROM 1972 TO 1985

Johannes Wahani Pieter Mandagi

In this study, a Simulation model is constructed for Indonesia. The model is based on an Input-Output model, involving 17 sectors to represent the economy of Indonesia. The levels of output, gross domestic product and employment of the sectors are projected from 1972 to 1985.

An auxiliary model, which is based on the Shift-and-Share analysis is constructed to project the distribution of gross domestic product among the 26 provinces of the country under study.

The general results of this study are: (1) the country is decreasing its reliance on the natural resource oriented sectors and is moving toward a more industrialized economy, and (2) there is a widening income disparity among the provinces which resulted from the concentration of past investments in certain provinces. Based on these results, this study suggests a policy of decentralizing development through the development of the existing "Major Development Regions."

TRADE, DISTORTIONS AND EMPLOYMENT IN THE ARGENTINE MANUFACTURING SECTOR

Julio Jorge Nogues

The study analyzes the empirical relationship between trade policies, factor-market distortions and the effect of these policies on factor use within the Argentine manufacturing sector.

The theoretical framework of analysis is provided by the factor proportions theory of trade. According to this theory a country tends to specialize and export those manufactured goods using intensively the country's relatively abundant factor. Estimates of the manufacturing capital-labor endowment show that Argentina is labor-abundant relative to developed countries and capital-abundant relative to less developed countries. Theory predicts that countries with these factor proportions will tend to specialize in goods whose labor-intensity lies somewhere in-between extreme values in the labor intensity ordering of industries for a given ratio of factor prices.

Argentina's pattern of specialization during 1973 were in line with this prediction. More concretely we estimate that exportable industries are 41% (14%) more (less) labor-intensive than import-competing industries competing with imports from developed (less developed) countries.

Nevertheless, estimates of effective rates of protection show that import-substitution policies followed during more than 40 years have pulled-out resources from industries where Argentina has a natural comparative advantage. Since the mid 50's these policies have been biased in favor of relatively capital-intensive industries and by 1973 this set of industries produced the bulk of import-competing manufacturing output. Thus, the adoption of an export-oriented trade strategy by changing the structure of manufacturing output in favor of exportable industries will shift upward the labor demand schedule of the manufacturing sector.

Theoretical analysis within the factor proportion theory of trade have shown that factor-market distortions may lead to trade-reversals. Our estimates show that in 1973, 35% of manufacturing exports were produced by import-competing industries. Nevertheless these trade-reversals are occasioned not only by factor-market distortions but also by export subsidies and probably of major significance are incentives created for manufacturing trade within the Latin-American Free Trade Association (LAFTA). Import-substitution industries exporting to LAFTA are mainly capital-intensive. Thus, the adoption of an export-promotion strategy is expected to increase trade flows with countries whose manufacturing capital-labor endowment diverge from that of Argentina. In the past, these countries have been mainly developed countries. We conclude, therefore, that the adoption of an export-promotion strategy will in all probability be accompanied by increasing exports to developed countries and therefore be an increase in the labor-intensity embodied in the basket of manufactured exports.

On the other hand, quantification of factor market distortions shows that the wage-rental ratio faced by manufacturing industries have been increased above values which would have probably been observed with less controls. Under a plausible set of assumptions removal of these distortions could lead to a 19% increase in the labor-output ratio of the manufacturing sector.

Finally, both goods and factor market distortions have long-since been regarded as policies reducing national welfare beyond levels attainable under optimal resource allocation. We estimate significant marginal gains in income generated by the manufacturing sector from a reallocation of productive factors from import-substitution towards exportable manufacturing industries.

Removal of distortions will then increase both income and employment opportunities. Thus, improvements in allocative efficiency are expected to be accompanied by an increase in the share of manufacturing output going to labor. Optimal trade policies and income distribution considerations are apparently not in conflict, at least within the manufacturing sector.

RATIONAL EXPECTATIONS MODELING OF AGRICULTURAL SUPPLY: THE EGYPTIAN CASE

Zvi Eckstein

This work is best viewed as suggesting a framework for investigating the impact of product prices on agricultural production and land allocation, using time series observations on a small open economy. In particular, it is argued that dynamic linear rational expectations models are suitable for this type of analysis.

Introducing a deterioration effect in land yields from year after year use of land for the same crop, implies a dynamic element in farmers' objective functions. Using quadratic production technology will give rise to linear decision rule for land allocation. The decision rule can be interpreted as crop rotation, where current land allocations depend on past land allocations as well as expectations of future prices and other exogenous variables. Assuming rational expectations, and that for a small open economy prices are exogenously given, we can get a closed form of linear equations for estimation. These equations are in the forms of distributed lags, where the coefficients in the decision rules are non-linear functions of the parameters in farmers' objective functions and the stochastic processes of the exogenous variables.

Even though the land allocation decision rule of this analysis has a form similar to Nerlove's supply response type model, this analysis has a completely different interpretation of the equation, especially with respect to the effect of changes in prices on production and land allocations.

The model is estimated using aggregate data from the Egyptian agriculture. Estimating unrestricted vector autoregression of cotton land productivity, cotton land allocations and relative prices, we show that cotton land allocations frequently fluctuate as response to shocks in price. Our model interprets these fluctuations as an optimal response to farmers due to deterioration in land productivity. Furthermore, maximum likelihood methods are used to estimate the model's parameters and testing the restrictions that the theory imposes on the estimated vector stochastic process.

ECONOMIC DEVELOPMENT, GOVERNMENT-CONTROLLED MARKETS, AND EXTERNAL TRADE WITH FOOD GRAINS: THE CASE OF FOUR COUNTRIES IN EAST AFRICA

Christopher David Gerrard

The dissertation is a comparative study of four countries in East Africa--Kenya, Malawi, Tanzania, and Zambia. The major purpose is to understand why the four countries, although relatively well-endowed with agricultural resources, have increasingly become net importers of food grains since independence in the early 1960's.

The countries are exemplary of deep government involvement in domestic food grain markets. They generally try to isolate domestic and international markets, not by tariffs, but by domestic price controls on food grains that are enforced by quantity adjustments that equilibrate supply and demand in each year. The author describes this involvement and measures its impact econometrically by means of a trade model that comprises government price-setting, stock-adjustment, and net import demand equations in addition to the usual domestic demand and supply equations found in such models.

The author estimates the same model, within limitations of the data, for eight commodities--maize, wheat, and rice in Kenya and Tanzania, and maize in Zambia and Malawi. The econometric results demonstrate that government policy seeks to maintain a degree of self-sufficiency in domestic food grain production. Given the rate of taxation on non-food agricultural exports and the government-determined margins between consumer and producer prices of food grains, the rate of taxation on food grain production in relation to the world price has generally been the maximum consistent with domestic self-sufficiency.

Over the long term, these policies have reduced the countries' participation in international trade in food grains. For the major staple, maize, the countries would have been significant net exporters in the 1960's and 1970's but policy has generally taxed maize production and reduced net exports. Net imports have been increasing over time because governments have tended to over-tax maize production in relation to domestic self-sufficiency in the 1970's.

From year to year, the countries have been very unstable participators in international trade due to short-term "constraints" such as government-held stocks and foreign exchange reserves inherited from previous periods, PL480 imports, and unanticipated demand and supply disturbances. The econometric results also reveal very consistent government responses to these constraints across the four countries.

THE CONTRIBUTION OF EDUCATION TO AGRICULTURAL PRODUCTIVITY, EFFICIENCY, AND DEVELOPMENT IN NEPAL

Som Prasad Pudasaini

The literature concerning the contribution of education to agricultural productivity, efficiency, and development suggests that education has a higher payoff in the areas characterized by changing technology and that its contribution to productivity emanates from the worker, allocative, and input-selection effects.

In light of the above findings, this research was initiated with the major objective of testing the hypotheses that (1) education and extension have a positive contribution to productivity (marginal) in the technologically dynamic region as well as the relatively static hilly region, (2) its contribution to productivity revealed through the worker, allocative, and input-selection effects is much stronger in the dynamic terai than in the static hilly region, (3) education and extension are substitutes in the farm decision-making process, and (4) the educated farmers in both regions are more efficient relative to the illiterates. Additional objectives such as studying relationships between education, income, modern input use, and estimating output supply and input demand elasticities were also stipulated.

Bara District, situated in the central terai, was chosen to represent the terai region, the Gorkha District, located in the western hills, was selected to represent the hilly region. A sample of 205 farm households from Bara and 149 households from Gorkha[1] were randomly selected and interviewed to gather data necessary for this study.

Three types of production functions--engineering, gross sales, and value added--were estimated to determine the contribution of education to productivity and the extent of the different effects. The issue of economic efficiency differences between educated and illiterates was accomplished by the joint estimation of the restricted normalized profit function and input demand functions.

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[1] The terms Bara District and terai region and Gorkha District and hilly region are used interchangeably in this study.

The contribution of education to productivity revealed through the worker, allocative, and input-selection effects was positive in both districts (regions). The allocative effect was more dominant than the worker effect in both Bara and Gorkha. As hypothesized, all the three effects of education were much stronger in technologically dynamic Bara relative to static Gorkha. Extension had no significant impact on productivity in either district. Education and extension were weak substitutes in the farm decision-making process of both districts.

Educated farmers of both districts were able to attain higher economic efficiency relative to illiterates. The higher economic efficiency of the educated in Gorkha resulted from having higher technical and price efficiency than the illiterates, while the higher economic efficiency of the educated in Bara emanated from their being more technically efficient than the illiterates.

The level of modern input use was also directly and positively related to the level of operator's education in both districts. Operators with higher education earned higher income, and child mortality declined with the increased level of operator's education in both areas.

Output supply and input demand were more responsive to price changes in Bara relative to Gorkha. Elasticities of output supply and input demand with respect to fixed inputs were also larger in Bara than in Gorkha.

Unavailability of suitable modern innovations, lack of knowledge about modern inputs, high transportation cost, low capital formation and limited credit availability, and less political influence of hill farmers appeared to be main factors responsible for technological and educational stagnation of the hilly region relative to the terai.

OPTIMAL PRICING POLICIES FOR ECONOMIC DEVELOPMENT

Eiji Tajika

In the course of economic development many developing countries have been ridden by artifically created distortions: tariffs, quotas, overvaluation of domestic currencies, undervaluation of agricultural goods, etc. The aim of this research is to find optimal pricing policies for these economies. It consists of two parts.

In the first part, the pricing policies for projects in a tariff-ridden economy are discussed. This problem has been treated independently in the context of the theories of international trade and public finance (optimal taxation). This research tries to give a rigorous definition to shadow prices and characterize them. The aforementioned two approaches are then compared and it is shown that the former treats a special class of problems in the latter.

In the second part, the structures of optimal taxation for economic development are discussed. A static analysis is extended to a dynamic one. The main concern of the dynamic analysis is to invent fiscal policies which achieve the optimal development path through agents' individual optimization. In the absence of a lump-sum tax the optimal development path is shown to be unachievable and the second best fiscal policies are derived.

IMPACT OF TRADE POLICY ON SIX AGRICULTURAL EXPORTS OF THAILAND

Tipaporn Lokaphadhana

The main objective of this dissertation was to examine the effect of Thai government intervention in the determination of prices of six major Thai agricultural export commodities: rice, sugar, maize, cassava, kenaf and rubber. A second objective was to evaluate the economic efficiency of producing the six commodities and to measure the social opportunity cost of earning a net marginal unit of foreign exchange through exporting the six commodities.

Rice and rubber were affected the most by government intervention, mainly through the imposition of export taxes. The government subsidized sugar exports when world prices were low and taxed sugar exports when world prices were high. Maize trade intervention consisted of bilateral agreements with the Japanese and Taiwanese governments and export quotas designed to fulfill those agreements. Cassava trade has long faced quality control, and an import tariff by the EEC. Kenaf was free traded most of the time under study.

The imposition of export taxes and/or quotas (and EEC import duties on cassava) depressed the domestic prices, favoring domestic consumers and discriminating against producers. Exports were less than otherwise would have been. The empirical results showed that government interventions imposes a deadweight loss upon the Thai society.

An implicit trade distortion was the overvaluation of the Thai currency in the range of 6 to 14 percent prior to the historical July 1981 devaluation. Overvaluation further depressed producers' price and exports and imposes a higher social loss.

The results of the domestic resource cost calculation indicated that the expansion and export of all commodities under study except kenaf was economically justified. Regardless of the efficiency of production and exports, the government interventions explicitly discriminated heavily against rice, maize and rubber and implicitly discriminated against all agricultural exports through overvaluation of the baht.

The results suggest a policy of freer trade and an exchange rate closer to the equilibrium rate. Emphasis should be put more on research programs, which would lead to a higher growth rate.

RISK, ALLOCATIVE ERROR AND VALUE OF PERFECT INFORMATION AMONG THAI RICE FARMERS IN CHANNASUTR LAND CONSOLIDATION AREA

Somnuk Tubpun

This study focuses on the problem of farmers' subjective risk attitudes and farmers' misperception (or extent of knowledge) of the physical production relationship (and hence, allocative errors) so that the policy makers might want to know how to formulate and to implement programs that help to accelerate the growth of rice output in the wet season.

This research is designed: (a) to obtain insights into rice farmers' knowledge of the production functions of both local varieties (LV) and high yield varieties (HV); (b) to explain how farmers' knowledge of those production relationships affect the efficiency of resources allocation; (c) to ascertain farmers' risk attitudes and whether they perceive the HV to be riskier to produce than LV; and (d) to obtain insights into the association between these attitudes towards risk and some farm and farmers characteristics.

Therefore, a behavioral decision model, using data from 144 rice producers in Channasutr Land Consolidation Project, was tested. The results indicate that: 1) the wet season rice output cannot be increased significantly through the adoption of available HV's, and/or through increasing the level of fertilizer application. The output may even decline if the labor shortage during the transplanting period is still persistent, since farmers will be forced to adopt the broadcasting technique. 2) the adoption of HV is largely affected by the location of the farms on the irrigation canals. This implies that the "new variety" cannot be rapidly adopted if the irrigation system has not been improved. 3) misallocation of resources due to the certainty about production relations was substantial. If the producer knew the true input-output relationships with certainty, the optimal output produced would be about 20 tang per rai higher than the observed output. (This is obtained from assuming the price level of 30 baht per tang and the calculation showed that average value of perfect knowledge is 604 baht per rai.) 4) analysis of the sources of allocative error showed that an increase in paddy land size decreases the allocative error. It also indicates that better water control reduced the allocative error. 5) the value of perfect knowledge increases as the proportion of land planted to HV increases but decreases as the percentage of land planted by broadcasting technique increases.

There are several implications of these findings for agricultural development policy. It is important that efforts be continued to develop new rice varieties that are responsive to the inputs that can be controlled by the rice producer. In addition, investments to improve water control are not only conducive to the adoption of new varieties, but also result in more effective uses of the resources devoted to rice production.

ECONOMICS OF TANK IRRIGATION PROJECTS IN NORTHEASTERN THAILAND

Yuavares Tubpun

Both the distribution and the amount of rainfall contributed to the low productivity of agriculture in Northeastern Thailand. In order to increase agricultural production and farm income, the government embarked on a program to construct small reservoirs or tanks.

The primary objectives of this study are to:

(1) examine past investment strategies and the development of the tank irrigation.

(2) estimate the economic cost and benefit of the tank projects.

(3) determine whether or not the distribution of tank benefits conforms with the government's concern for improving the distribution of income.

(4) determine the factors that have caused failure and/or success of the strategy.

Five sample tanks were chosen in the three low income provinces. 123 sample farms with irrigation and 63 farms without irrigation were randomly selected for the interviews. Benefit cost analysis and sensitivity analysis were conducted. Agricultural benefits includes benefit from wet season supplemental irrigation (WS), and from dry season irrigation (DB) benefit from domestic water uses, included time saved in collecting water for human consumption (CB), time saved from driving animal to water (AB) and fish production (FB).

On the basis of total benefits, all five tanks are economically acceptable when relatively optimistic alternatives are used in the sensitivity test. Benefits from domestic water uses and fish production are very important in all tanks but particularly in the small tank where they make up over 75% of total benefits.

Among three different farm sizes, the results show that as a class, the middle size farm (15-20 rai) have the highest net present value of

net project benefits. The small farms (less than 15 rai) have the next highest, and the largest farms (more than 30 rai) had the lowest net present value of net project benefits. However, the net present value of benefits per rai is highest in the small farm group and declines as farm size increases (1 hectare = 6.25 rai).

The distribution of projects benefits among the irrigated farms is more equally divided than distribution of income from rice production among the non-irrigated farms. Thus, the benefits of the tank projects appeared to favor the medium and small farmers over large farmers.

There are two major factors which caused such a distribution of benefits. First, small and medium sized farms have higher paddy yield than the large farms. The higher yields on the smaller farms is the result of more intensive farming. Farmers with a small holding use much higher quantities of labor and other inputs. Second, farmers on small holdings use their land more intensively in the dry season than the other two groups.

This pattern of distribution conforms with the Thai government objective of improving income distribution.

VARIETAL CHOICE AND INPUT DEMAND IN RICE PRODUCTION IN INDONESIA

Gunawan Sumodiningrat

Understanding the decision-making processes of farmers in developing countries is very important when designing policies to influence their behavior. Most studies which test the economic rationality of resource allocation decisions by farmers use the Cobb-Douglas production function. The restrictiveness of this functional form is well known, and the Cobb-Douglas seems particularly inappropriate given the nature of the biological production process. Aside from the weaknesses of the functional form used, most previous studies did not treat rice variety as a choice variable and, therefore, tended to underestimate the price elasticity of input demand.

This study adopts the framework of Hayami and Ruttan in postulating that cultivators respond to prices along a meta-production function rather than an individual production function. The main procedure was to derive the total elasticity of input demand, in which the sources of demand were disaggregated into farmers who had adopted the HYV and farmers who had not. In approaching this problem, the total factor demand was disaggregated into two components, namely, the variety choice response and the input demand response. First, a logistic equation is used to estimate the adoption response as a function of economic and environmental factors. Second, the translog cost function is employed to estimate the derived input demand for both HYV adopters and non-

adopters. Third, the total response is then computed by combining the adoption response calculated from logistic function with the input demand response derived from the translog cost function. The overall results are satisfactory in that both the adoption rate and the input demand elasticities are estimated with precision.

From the logit estimation, price variables are shown to be important factors determining the adoption rate, as are farmers' resource endowments and the socio-economic variables. HYV rice tends to be adopted the higher is the price of rice and the smaller are the price of seed and fertilizer. Education and the operators' age as a proxy of the farmers' experience have a positive and significant effect on the adoption rate.

From the translog cost function, in both HYV and TV the partial elasticities of input demand satisfy the regularity conditions and are significant at the 1 percent level. With respect to cross prices, most elasticities of variable inputs show a substitute relationship, indicated by negative sign coefficients.

Fixed factors output and area operated have an important influence on the demand for variable inputs at 1 percent significance level in both HYV and TV. The education and age variables are only a somewhat significant influence on the demand for variable inputs in the HYV group.

Due to the fact that the majority of farmers are HYV cultivators, the total elasticity of input demand is not significantly different from the partial elasticity of input demand derived from the HYV group. This finding suggests that within the range of the data observed, the HYV input demand closely reflects the total elasticity of input demand with respect to a meta-production function as well. The main reason is due to the fact that both farmers in HYV and TV use similar inputs with only a small variation (differences in quantity) between the groups.

In conclusion, the estimates of the logit equation suggest that the HYV rice will be further adopted if relative output to input prices are higher than currently. With respect to the exogenous fixed inputs, an improvement in irrigation at the farm level will induce farmers to adopt HYV. Furthermore, farmers with relatively large size of area operated are most likely the first to adopt HYV. Finally, the improvement of formal and non-formal education of farm operators, in particular the knowledge of better cultivation methods, results in HYV becoming more attractive.

The estimated parameters of the cost function suggest that fertilizer is a very important determinant of costs. An improvement in the relative price of rice to fertilizer will induce farmers to use more fertilizer and therefore, increase their rice production.

EFFECTS OF AGRICULTURAL POLICY ON EFFICIENCY, GROWTH, AND EQUITY IN THE TAIWANESE RICE ECONOMY: A CROSS-SECTIONAL TIME-SERIES ANALYSIS

Shun-Cheng Lee

To maintain a country's agricultural development path, agricultural policies should be reviewed to cope with changing socio-economic structure and conditions. In the case of Taiwan, a review of the economic implication of land and water policies have been delayed.

The objectives of this study are (1) to obtain insights into the efficiency, growth, and equity implications of the development policies (fertilizer, water, and land) in Taiwan; (2) to identify restraints to efficient use of resources within the agricultural economy; and (3) to suggest economic policy and program guidelines designed to remove these restraints and improve agricultural productivity, farm income, and agricultural production.

Factor demand relationships can be specified to measure the cumulative impacts of development policies, factor endowments, and changing technical conditions. Empirically, variation in factor demands can be explained by changes over time in Allen partial elasticities of factor substitution (AES) and price elasticities of factor demands (PES) and represents changes in the output, price, and technical change effect of factor inputs.

The analytical framework includes the short-run analysis, investigating the economic impacts of the fertilizer policy, and the long-run analysis, examining the economic impacts of the land and water policies. Both analyses employed empirical application of a translog cost function fit to both cross-sectional and time-series data at farm level. Zellner's seemingly unrelated regression method was employed for the estimation.

This study investigated whether changes in the long-run and short-run AES and PES were related to the development policies concerned; and measured the extent of changes in resource productivities, technical change, and pattern of resource allocation. And, relevant statistical tests are employed to verify our proceedings.

Our results show that significant variation in the factor demands directly related to the development policies and induced varying degrees of efficiency, growth, and equity impacts on various farm sizes. The institutionalized land and water policies lowered the potential for agricultural production. The choice of appropriate technology for future development rests heavily on future policy changes. The research identifies the relevant restraints and suggests policy guidelines to resolve the development problems for the 1980s.

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5650 ECONOMICS OF NATURAL RESOURCE POLICY. (3 cr)
Application of economic analysis, including project evaluation, to current natural resource issues. Emphasis on conservation and resource scarcity, environmental quality, population growth, and resource use issues and their implications for public policy.

5670 ECONOMICS OF AGRICULTURAL TRANSPORTATION. (3 cr)
Application of economic analysis to current issues in agricultural and rural transportation policy. Relationship between transportation infrastructure, economic development, and regional and national trade.

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

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

5790 WORLD FOOD SUPPLY PROBLEMS. (4 cr)
A multidisciplinary examination of social, economic, and technical problems of feeding the world's growing population. Principles sought from the economics and social sciences, plant sciences, and animal sciences for their application to food problems.

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

8364 SEMINAR: RESOURCE ECONOMICS AND POLICY. (3 cr)

8378 SEMINAR: AGRICULTURAL DEVELOPMENT. (3 cr)

STAFF
(June 1982)

Economics

Regents' Professor

John S. Chipman
Walter W. Heller
Leonid Hurwicz

Visiting Faculty

Professor - T.N. Srinivasan
Assoc. Professor - Raymond Riezman
- Nancy Stokey

Professor

O.H. Brownlee, Director of Graduate Study
Edward Coen
Edward M. Foster
James M. Henderson
Clifford Hildreth
John H. Kareken
Anne O. Krueger
Herbert Mohring
Edward C. Prescott
Marcel K. Richter
Mark R. Rosenzweig
Vernon W. Ruttan
Thomas J. Sargent
G. Edward Schuh
Norman J. Simler, Chairman
Christopher A. Sims
Harlan M. Smith
Neil Wallace

Associate Professor

Roger D. Feldman
Charles A. Holt
James S. Jordan
Lung-Fei Lee
Craig E. Swan
William Thomson

Assistant Professor

Takatoshi Ito
Mark M. Pitt
Robert H. Porter
Joel Slemrod

Agricultural and Applied Economics

Professor

Fred J. Benson
O. Uel Blank
Boyd M. Buxton
Martin K. Christiansen
Dale C. Dahl
Reynold P. Dahl
K. William Easter
Kenneth E. Egertson
Vernon R. Eidman
Earl I. Fuller
Hans M. Gregersen
Jerome W. Hammond, Dir. of Graduate Study
Paul R. Hasbargen
Richard O. Hawkins
John D. Helmberger
Clifford C. Hildreth
James P. Houck
John S. Hoyt, Jr.
Wilbur R. Maki
Lee R. Martin
Willis L. Peterson
Malcolm J. Purvis
Philip M. Raup
Terry L. Roe
Gordon D. Rose
Vernon W. Ruttan
G. Edward Schuh, Head
Francis J. Smith, Jr.
W.B. Sundquist
Kenneth H. Thomas
John J. Waelti
Arley D. Waldo
Delane E. Welsch

Associate Professor

Bud G. Crewdson
Jerry E. Fruin
Jean L. Kinsey
Glenn Nelson
Benjamin H. Senauer
Robert W. Snyder
Thomas F. Stinson
Carole B. Yoho

Assistant Professor

Jeffrey D. Apland
Jerry L. Thompson

Research Associate

Ronald J. Dorf
Carl E. Pray

Visiting Professor

Michael Martin

Economic Development Center

Executive Committee

K. William Easter
James M. Henderson
Robert Holt
James P. Houck
Anne O. Krueger*
Mark Pitt
Vernon W. Ruttan*
Norman J. Simler**
G. Edward Schuh**

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* Co-Directors
** Ex-Officio

CENTER RELATED STAFF DEVELOPMENTS AND ACTIVITIES
July 1979 - June 1982

Okan Akton of the University of Hacettepe (Ankara, Turkey) spent the 1980/81 and 1982/83 academic year at the University of Minnesota Department of Economics. He received partial support from the Ford Foundation and taught several courses on economic development.

O. H. Brownlee, was a visiting scholar at the Centro de Estudios Macroeconomicos de Argentina, Buenos Aires, Summer, 1979.

O. H. Brownlee was a participant in a seminar sponsored by the Universidade Nova, Lisbon, July 12-16, 1982 on "Portugal after Socialism."

John S. Chipman, is Editor of the Journal of International Economics.

John S. Chipman was on leave without salary, March 16 to June 15, 1983 to accept a fellowship from German Marshall Fund to carry out research on international economic disturbances.

K. William Easter presented papers at the following seminars and workshop: 1) the seminar on Water Pricing Alternatives for Irrigation in Cairo, Egypt, January 1980; 2) the ADC workshop on Mobilizing Local Resources for Irrigation in Sri Lanka, August 1980; and 3) the seminar on Modernization of Tank Irrigation: Problems and Issues, February 1982 in Madras, India.

Hans Gregersen has been a member since 1980, of the International Coordinating Team of the Joint Activity on Forestry carried out by some 18 of the OECD member countries.

Hans Gregersen has been advisor to the Inter-American Development Bank for the past two years, preparing a set of basic studies on technical assistance and investment potentials for the forest-based sector of Latin America.

James Henderson was on sabbatical leave during the 1981/82 academic year. He spent the fall quarter as Visiting Professor in the Department of Economics at Manash University (Clayton, Victoria, Australia). He spent the winter quarter at the Swedish Industrial Institute for Social and Economic Research (Stockholm) where he conducted research on compatible multi-country models of production and trade.

Vitor Hoeflich was a visiting professor in the Department of Agricultural and Applied Economics while on leave from the Brazilian Enterprise for Agricultural Research (EMBRAPA). His work centered on the economics of technical change. He was with us from August 1, 1981 - June 30, 1982.

James Houck has been named to the Board of Directors of the Agricultural Development Council. He will continue to serve as a member of the council's Fellowship Awards Committee.

Yoav Kislev has been Visiting Associate Professor in the Department of Agricultural and Applied Economics from August 1978 to September 1979 while on leave from Hebrew University at Rehovot, Israel. His work centers on the economics of technological change and scale in agriculture.

Katsuma Kita, Professor in the Department of Economics, Hosei University, Japan, spent the period May 1979 to January 1980 in the Department of Agricultural and Applied Economics.

Anne O. Krueger has been named a Vice President of the World Bank. Krueger, a faculty member since 1959, will be the first female Vice President in the 36-year history of the World Bank. She has been a long-time advisor to the institution and is a leading authority in international trade and economic development. She has studied the economics of Turkey, Brazil and South Korea and has directed a number of studies on international trade, economic development and employment. Professor Krueger has been Co-Director of the University of Minnesota Economic Development Center.

Anne O. Krueger and Craig Swan serve as the editors of Portfolio.

Willis L. Peterson spent two weeks with Yoav Kislev in Rehovot, Israel during March 1982 to review ongoing research and to plan future research for new BARD proposal.

Willis L. Peterson is Associate Editor of the American Journal of Agricultural Economics from June 21, 1982 to 1983.

Mark M. Pitt was a consultant to the planning agency of the Ministry of Agriculture of Bangladesh from October 1979 to February 1980, and in Indonesia for the World Bank during March 1980 and February to April 1981. From June 1980 to February 1981, Pitt was a visiting fellow at the Australian National University.

Carl E. Pray returned from position in Bangladesh with ADC to become the Research Associate on the Asian Agricultural Research Project. He led Minnesota Reconnaissance team which conducted a three-week evaluation of the Pakistan agricultural research system in December 1982. In February he was part of a World Bank team which examined foodgrain policy and crop diversification in Bangladesh.

Malcolm Purvis was Acting Assistant Dean for International Agricultural Programs in the College of Agriculture, University of Minnesota, during 1978-81 and since October 1981 the Assistant Dean for International Agricultural Programs.

Philip M. Raup chaired the session on agriculture at the Second World Congress on Soviet and East European Studies in Garmisch Partenkirchen in Germany on September 30-October 4, 1980.

Philip M. Raup, with support from the development fund of the Office of International Programs and from the Office of International Agriculture Programs in the College of Agriculture, made a study tour in Hungary in October, 1980 including visits to the Agricultural Research Institute of the Hungarian Academy of Sciences at Martonvasar, and conducted a seminar in agricultural economics at the University of Pecs.

Philip M. Raup participated in the Sixth International Conference on Soviet and East European Agricultural Affairs, held at Schloss Rauisch-Holzhausen (University of Giessen), West Germany and chaired the concluding session on the conference, June 4-8, 1981.

Terry L. Roe participated in studies of food policy in Tanzania (November 1980), the Dominican Republic (July 1981 and January 1982) and in Egypt (June 1982). Roe served in a consulting capacity in reviewing the agricultural sector analysis project in the Dominican Republic (June 1980) and he served as a consultant to review a food policy project funded by USAID in Honduras during October 1981.

Terry Roe presented a paper on Tanzanian Food Grain Policy and External Trade at the Eighth Annual Symposium on Food Problems in Africa, at the University of Illinois, April 20-24, 1981. He also presented a paper on Government Intervention into the Market for Wheat in Four Low Income Countries at the American Association for the Advancement of Science Meetings in Washington, D.C., January 3-8, 1982.

Mark R. Rosenzweig was appointed to a four-year term on the Social Science Study Panel of the National Institute of Health in 1980.

Mark R. Rosenzweig presented papers on the determinants of child health at the Fourth World Congress at the Econometric Society in Aix-on-Provence in August 1981 and at the General Conference of the International Union for the Scientific Study of Population in Manila in December 1981.

Mark R. Rosenzweig served as Director of Research for the U.S. Select Commission in Immigration and Refugee Policy during the academic year 1979-80. During the winter and spring of 1982, he was Visiting Associate Professor in the Department of Economics and the Woodrow Wilson School at Princeton.

Vernon W. Ruttan was named to the Board of Directors of the International Service for National Agricultural Research (ISNAR), The Hague, Netherlands.

Vernon W. Ruttan served as editor of a special issue of Transaction/SOCIETY, (September/October 1980) devoted to the world food problem.

G. Edward Schuh served as President of the American Agricultural Economics Association in 1981-82. He is also on the Board of Directors of the National Bureau of Economic Research and of the Economics Institute.

G. Edward Schuh helped organize and participated in conferences sponsored by the Agricultural Development Council on Food Aid and Development in Sri Lanka in 1980 and in Abidjan in 1981.

G. Edward Schuh participated in a conference in Egypt during the summer of 1980 on the Economics of Peace, and was a member of the Presidential Mission to Egypt on Food and Agriculture in the spring of 1982.

Halil Seyidoglu was Visiting Professor in the Department of Agricultural and Applied Economics while on leave from Ataturk University, Erzurum, Turkey. His work focused on international trade and trade policy and he was a Fulbright Scholar. He was with us from October 1, 1980 - October 15, 1981.

Baran Tuncer of Bogazici Universitesi (Istanbul, Turkey) spent the 1979/80 academic year at the University of Minnesota Department of Economics. He was co-director with Anne O. Krueger of an NSF funded project on, "Behavior of Factor Productivity in Turkish Industry."

Delane E. Welsch presented a paper, "Recent Trends in Cassava Imports by EEC Countries: The Thai Experience," at a workshop, "Progress in the Use of Cassava in Animal Feed," at the XII International Congress of Nutrition, San Diego, August 16-22, 1981. He presented a paper, "Economics of Biological Nitrogen Fixation," at the Interregional Workshop on Biological Nitrogen Fixation in Tropical Agriculture, held at the Centro International de Agricultura Tropical (CIAT) in March of 1981.

Delane E. Welsch was a member of the College of Agriculture delegation to the Peoples Republic of China, September 10 - October 2, 1980. The Beijing Agricultural University was the official host, and a memorandum of understanding on scholarly exchange was signed during the visit. The delegation also visited Jilin Agricultural University near Changchun, Jilin Manchuria, where a memorandum of conversation was signed.

Delane E. Welsch spent fall quarter, 1980, (except for 23 days in China) on Single Quarter Leave. The time was spent in Thailand working on a joint research project, "Thai Cassava: A Middleman Led Growth Industry," with Dr. Boonjit Titapiwatanakun, who received his Ph.D. at Minnesota and is now a faculty member in the Department of Agricultural Economics, Kasetsart University, Bangkok, Thailand.

CENTER PUBLICATIONS

CENTER BOOKS AND MONOGRAPHS
July 1975-June 1982

Yujiro Hayami (in association with Masakatsu Akino, Masahiko Shintani, and Saburo Yamada), A Century of Agricultural Growth in Japan: Its Relevance to Asian Development. Minneapolis: University of Minnesota Press, and Tokyo: University of Tokyo Press, 1975.

H.M. Gregersen and A. Contreras, U.S. Investment in the Forest Based Sector in Latin America. Baltimore: Johns Hopkins Press for Resources for the Future, Inc., 1975.

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

Hans P. Binswanger and Vernon W. Ruttan, Induced Innovation, Technology, Institutions, and Development. Baltimore and London: Johns Hopkins University Press, 1978.

Anne O. Krueger, Foreign Trade Regimes and Economic Development: Liberalization Attempts and Consequences. Cambridge, Mass.: Lippincott, Ballinger, for National Bureau of Economic Research, 1978.

Yujiro Hayami, Vernon W. Ruttan and Herman Southworth (eds.), Agricultural Growth in Japan, Taiwan, Korea and the Philippines. Honolulu: University Press of Hawaii, 1979.

Anne O. Krueger, The Developmental Role of the Foreign Sector and Aid. Cambridge: Harvard University Press, 1979.

Mario Lopes and G. Edward Schuh, The Mobilization of Resources from Agriculture: A Policy Analysis for Brazil. Ministry of Agriculture, Brasilia, 1979.

Anne O. Krueger, Hal Lary and Narongchai Akrasanee (eds.), Trade and Employment in Developing Countries, 1: Individual Studies. Chicago: University of Chicago Press, 1981.

Anne O. Krueger, Hal Lary and Narongchai Akrasanee (eds.), Trade and Employment in Developing Countries, 2: Factor Supply and Substitution. Chicago: University of Chicago Press, 1982.

Hans M. Gregersen, Village Forestry Development in the Republic of Korea. FAO/SIDA Forestry for Local Community Development Programme. Rome 1982.

Vernon W. Ruttan, Agricultural Research Policy. Minneapolis: University of Minnesota Press, 1982.

Anne O. Krueger, Hal Lary and Narongchai Akrasanee (eds.), Trade and Employment in Developing Countries, 3: Synthesis and Conclusions. Chicago: University of Chicago Press, forthcoming.

Mark R. Rosenzweig, C. Diaz-Alejandro, M. Gersovitz and G. Ranis, The Theory and Experience of Economic Development: Essays in Honor of W. Arthur Lewis. London: Allen and Unwin Press, forthcoming.

Hans P. Binswanger and Mark R. Rosenzweig (eds), Contractual Arrangements, Employment and Wages in Rural Labor Markets in Asia. New Haven: Yale University Press, forthcoming.

CENTER JOURNAL ARTICLES AND BOOK CHAPTERS
June 1977-June 1982

1977

M. E. Abel and D. E. Welsch, "Environmental Constraints, Commodity Mix, and Research Resource Allocation," in Resource Allocation and Productivity, edited by T. M. Arndt, D. G. Dalrymple and Vernon W. Ruttan. Minneapolis: University of Minnesota Press, 1977, pp. 461-477.

Anne O. Krueger, "Alternative Trade Strategies, Growth and Employment," in Trade and Employment in Asia and the Pacific, edited by N. Akrasanee, et al., Honolulu: University of Hawaii Press, 1977.

Anne O. Krueger, "The New World Economic Order and the Challenge to National Decision Making," in R. Dickerman and D. Obersdorfer, The Economies of the U.S. and the Federal Republic of Germany. Bonn: Eicholz-Verlag, 1977, pp. 43-52.

P. M. Raup, "French Experience with Group Farming," in Cooperative and Commune, Group Farming in the Economic Development of Agriculture, edited by Peter Dorner. Madison: University of Wisconsin Press, 1977, pp. 327-345.

V. W. Ruttan, "The Green Revolution: Seven Generalizations," International Development Review, Vol. 19, No. 4, December 1977, pp. 16-23.

V. W. Ruttan, "Induced Innovation and Agricultural Development," Food Policy, August 1977, pp. 196-216.

K. William Easter, Martin E. Abel and George Norton, "Regional Differences in Agricultural Productivity in Selected Areas of India." Reprinted from American Journal of Agricultural Economics, Vol. 59, No. 2, May 1977.

K. William Easter, "Improving Village Irrigation Systems: An Example from India," in Land Economics, Vol. 53, No. 1, University of Wisconsin Press, February 1977.

1978

John S. Chipman, "A Reconsideration of the 'Elasticity Approach' to Balance-of-Payments Adjustment Problems," in Breadth and Depth in Economics: Fritz Machlup--The Man and His Ideas, edited by Jacob S. Dreyer. Lexington, Mass.: D. C. Heath and Co., 1978, pp. 49-85.

John S. Chipman, "Towards the Construction of an Optimal Aggregative Model of International Trade: West Germany, 1963-1975," Annals of Economic and Social Measurement, Vol. 6, Winter-Spring, 1978, pp. 535-554.

Anne O. Krueger, "Alternative Trade Strategies and Employment in LDCs," American Economic Review, Vol. 68, No. 1, May 1978, pp. 270-274.

Anne O. Krueger, "Effects of Exports from New Industrial Countries on U.S. Industries," in Growth, Trade and Structural Change in an Open Australian Economy, edited by W. Kasper and T. G. Parry. Kensington, Australia: Centre for Applied Economics Research, 1978.

V. W. Ruttan, "Reviewing Agricultural Research Programs," Agricultural Administration, Vol. 5, No. 1, January 1978, pp. 1-19. (Also in Spanish in Revista Latinoamericana de Ciencias Agricolas, Vol. 13, No. 1, 1977, pp. 20-32.)

1979

John S. Chipman, "The Theory and Application of Trade Utility Functions," in General Equilibrium, Growth, and Trade, edited by Jerry R. Green and Jose A. Scheinkman. New York: Academic Press, 1979, pp. 277-296.

Anne O. Krueger, "Devaluation and Its Consequences in Developing Countries," Intereconomics, Vol. 14, No. 1, Jan./Feb. 1979, pp. 19-24.

Terry Roe and Mathew Shane, "Export Performance, Marketing Services, and the Technological Characteristics of the Malaysian Industrial Sector," Journal of Developing Areas, Vol. 13, No. 2, January 1979, pp. 175-189.

Anne O. Krueger, "U.S. Domestic Employment Impact of Growing Imports from and Trade with the LDC's," published in Proceedings of Science and Technology for Development: Organized Labor's Concerns, AAAS, Washington: May 1979.

V. W. Ruttan, "Induced Institutional Innovation," Agricultural Economic Research 31(3): 32-35, July 1979.

G. E. Schuh, et. al., "Rural Poverty in Brazil: Characterization of the Problems and Policy Recommendations," Analysis and Research Collection, Vol. 16, Commission for the Financing of Production, Ministry of Agriculture, Brazil, August 1979, 115 pages.

R. E. Evenson, P. E. Waggoner, V. W. Ruttan, "Economic Benefits from Research: An Example from Agriculture," Science 205: 1101-1107, September 14, 1979.

S. Gafsi, T. L. Roe, "Adoption of Unlike High-Yielding Wheat Varieties in Tunisia," Economic Development and Cultural Change 28(1): 119-133, October 1979.

V. W. Ruttan, "Inflation and Productivity," American Journal of Agricultural Economics 61(5): 896-902, December 1979.

Anne O. Krueger, "The Role of Exchange Rate Policy in Opening up the Economy," in Problems of Orienting Turkish Economy to External Markets, Ekonomic ve Sosyal Etudler Konferans Heyeti, Istanbul, 1979.

Anne O. Krueger, "LDC Manufacturing Production and Implications for OECD Comparative Advantage," in Western Economics in Transition: Structural Change and Adjustment Policies in Industrial Countries, edited by Irving Leveson and Jimmy W. Wheeler, Boulder, Colorado: Westview Press, 1979.

Anne O. Krueger, "Guidelines for the Preparation of Public Enterprise Policy in Asia for Investment, Prices, Costs and Returns - for Suitable Adoption at the National Level," in Public Enterprise Policy In Investment Pricing Returns, Prahlad Kumar Basu and Alec Nove, editors, Kuala Lumpur, Malaysia: APDAC, 1979.

V. W. Ruttan, "How the World Feeds Itself," in Critical Issues for Agriculture in the 1980's: Domestic Policy, Trade and Transportation, Special Report 79, edited by Luther Pickrel, pp. 193-200.

D. E. Welsch, S. Tongpan, C. Mock, E. Kennedy, J. E. Austin, "Case Study: Thailand," Global Malnutrition and Cereal Fortification, James E. Austin (ed.). Cambridge: Ballinger Publishing Company, 1979.

1980
Mark R. Rosenzweig, "Neoclassical Theory and the Optimizing Peasant: An Economic Analysis of Market Family Labor Supply in a Developing Country," Quarterly Journal of Economics, February 1980.

Anne O. Krueger, "Problems and Prospects of the International Economy in the 1980's," Ejecutivos de Finanzas, April 1980.

Anne O. Krueger, "Trade Policy as an Input to Development," American Economic Review Papers and Proceedings, May 1980.

S. Yamada, V. W. Ruttan, "International Comparisons of Productivity in Agriculture," New Developments in Productivity Measurement and Analysis, John W. Kendrick and Beatrice N. Vaccora (eds.). Chicago: University of Chicago Press, 1980, pp. 509-585.

V. W. Ruttan, "Bureaucratic Productivity: The Case of Agricultural Research," Public Choice 35(5): 529-567, 1980.

V. W. Ruttan, "The Social Sciences in Agricultural Research," Canadian Journal of Agricultural Economics, August 1980, pp. 1-13. (Proceedings of 1980 Annual Meeting.)

V. W. Ruttan, "Food Crisis," Transaction/SOCIETY 17 (September/October 1980).

V. W. Ruttan, "Food Strategies for Grain Deficit Countries," in The New Era in World Agricultural Trade: Perspectives for the Prairies and the Great Plains, E. W. Tyrchniewicz (ed.) (Winnipeg: University of Manitoba, Dept. of Agricultural Economics and Farm Management, September 1980), pp. 41-50.

Anne O. Krueger, "Role of Relative Prices in Economic Development," in R. Ferber, editor, Consumption and Income Distribution in Latin America, published for the ECIEL Program by the Organization of American States, 1980.

Anne O. Krueger, "Regional and Global Approaches to Trade and Development Strategy," Tenth Pacific Trade and Development Conference, Canberra, March 1979 in ASEAN in a Changing Pacific and World Economy, Ross Garnaut, editor, Canberra, ANU Press, 1980.

G. E. Schuh, "U.S. Agricultural and Trade Policy and Agricultural Development in the LDCs," in Research in Domestic and International Agribusiness Management, Vol. 1, Roy A. Goldberg (ed.), (Greenwich, Conn: JAI Press, Inc., 1980), pp. 119-158.

B. H. Sexauer, "Critical Choices in World Food Aid and Nutrition: Discussion," American Journal of Agricultural Economics 62(5): 993-994, December 1980 (Proceedings Issue).

Antonio Brandao and G. Edward Schuh, "Terms and Trade for Brazil: An Empirical Analysis," Revista de Economia Rural, Vol. 18, No. 2 (April/June) 1980, pp. 205-220.

Carl Pray, "A Review of the Accuracy of the Official Agricultural Output and Input Statistics of Bangladesh," Bangladesh Development Studies, Vol. VIII, Nos. 1 and 2, Winter-Summer 1980.

George W. Norton, K. William Easter and Terry L. Roe, "American Indian Farm Planning: An Analytical Approach to Tribal Decision Making." American Journal of Agricultural Economics, Vol. 62, No. 4, November 1980.

G. Edward Schuh, R. L. Thompson, "Assessing Agricultural Progress and the Commitment to Agriculture," in Third-World Poverty, William Paul McGreevey (ed.), (Lexington, Mass. and Toronto: D.C. Heath and Co., 1980), pp. 121-156.

John S. Chipman, "Exchange Rate Flexibility and Resource Allocation," in Flexible Exchange Rates and the Balance of Payments, John S. Chipman and Charles P. Kindleberger (eds.), Amsterdam: North-Holland Publishing Co., 1980, pp. 159-209.

1981
G. Edward Schuh, "Feeding the World vs. Domestic Agricultural Security," Minnesota Agriculture Economist 630, July 1981.

Willis Peterson, Yoav Kislev, "Induced Innovations and Farm Mechanization," American Journal of Agricultural Economics, August 1981, pp. 562-565.

Mark M. Pitt, Lung-Fei Lee, "The Measurement and Sources of Technical Inefficiency in the Indonesian Weaving Industry," Journal of Development Economics, 9, 1981.

Mark M. Pitt, "Smuggling and Price Disparity," Journal of International Economics, 11, 1981, pp. 447-458.

G. Edward Schuh, "Economics and International Relations: A Conceptual Framework," American Journal of Agricultural Economics, December 1981, pp. 767-778.

Anne O. Krueger, "The Framework of the Country Studies," Chapter One of Trade and Employment in Developing Countries, 1: Individual Studies. Chicago: University of Chicago Press for National Bureau of Economic Research, 1981.

Anne O. Krueger, "Interaction Between Inflation and Trade - Regime Objectives in Stabilization Programs," in Economic Stabilization in Developing Countries, edited by William R. Cline and Sidney Weintraub, Washington, D.C.: The Brookings Institute, 1981.

Anne O. Krueger, "Export-Led Industrial Growth Reconsidered," Eleventh Pacific Trade & Development Conference, Seoul, September 1980, in Trade and Growth of the Advanced Developing Countries in the Pacific Basin, W. Hong and Lawrence B. Krause, eds., Seoul: KDI, 1981.

Mark M. Pitt, "Alternative Trade Strategies and Employment in Indonesia," in Anne O. Krueger, Hal B. Lary, Terry Monson and Narongchai Akrasanee (eds.), Trade and Employment in Developing Countries, 1: Individual Studies, University of Chicago Press, 1981.

Vernon W. Ruttan, "Three Cases of Induced Institutional Innovation," in Public Choice and Rural Development, Clifford S. Russell and Norman K. Nicholson (eds.), (Baltimore: Johns Hopkins University Press for Resources for the Future, 1981), pp. 239-270.

Mark R. Rosenzweig, "Household and Non-household Activities of Youths: Issues of Modelling, Data, and Estimation Strategies," in G. Rodgers and G. Standing, The Economic Roles of Children in Low-Income Countries, Geneva: ILO Press, 1981.

Mark R. Rosenzweig, "Redistribution, Population Policies and Household Behavior: Implications for Population Growth and Economic Development," Proceedings of the 1981 General Conference of the IUSSP, Liege, Belgium: IUSSP and Ordina, 1981.

Anne O. Krueger, "Loans to Assist in Transition to Outward-Looking Policies," in The World Economy, Vol. 4, No. 3, September 1981, pp. 271-281.

Harold Klein and Terry Roe, "Agriculture Sector Analysis Model Design: The Influence of Administrative Infrastructure Characteristics," Planning Processes in Developing Countries: Techniques and Achievements, W. Cook and T. Kuen, editors, North Holland (1981): 273-308.

Carl Pray, "Transferring Technology to LDC's: Problems and Payoffs: The Green Revolution as a Case Study in the Transfer of Technology," The Annals of the American Academy of Political and Social Sciences, November 1981.

G. Edward Schuh, "Economics and International Relations," American Journal of Agricultural Economics 63 (December 1981): 767-778.

G. Edward Schuh, "The Global Macroeconomic Environment of U.S. Food and Agricultural Policy," in Symposium on Food Security in a Hungry World. Castle and Cook, San Francisco, 1981.

G. Edward Schuh, "U.S. Agriculture in an Interdependent World Economy: Policy Alternatives for the 1980's," in D. Gale Johnson (ed.), Food and Agricultural Policy for the 1980's. American Enterprise Institute, Washington, D.C. and London, 1981.

G. Edward Schuh, "Government Policy and the Production of Animal Protein: An International Perspective," in New Protein Foods, Vol. 4, Academic Press, Inc., New York, 1981, pp. 32-60.

G. Edward Schuh, "Food Aid and Human Capital Formation," in Food Aid and Development. New York: Agricultural Development Council, Inc., 1981, pp. 49-60.

John S. Chipman, "A General Equilibrium Framework for Analyzing the Responses of Imports and Exports to External Price Changes," in Methods of Operations Research, Vol. 44, 6., Symposium on Operations Research, Universität Augsburg, September 7-9, 1981, Vol. 2, Günter Bamberg and Otto Opitz (eds.), Königstein: Verlag Anton Hain, Meisenheim, GnbH, 1981, pp. 43-56.

John S. Chipman, "Internal-External Price Relationships in the West German Economy, 1958-79," Zeitschrift für die gesante Staatswissenschaft, 137 (September 1981), pp. 612-637.

H.M. Gregerson, "Environmental Constraints versus Economic Gains in Tropical Forestry." In Mergen, F. (ed.) Tropical Forests: Utilization and Conservation, New Haven: Yale University, 1981.

1982

Mark R. Rosenzweig, "Child Mortality and Fertility in Columbia: Individual and Community Effects," Health Policy and Education, (with T. P. Schultz), February 1982.

Mark R. Rosenzweig, "Educational Subsidy, Agricultural Development and Fertility Change," Quarterly Journal of Economics, February 1982.

Mark R. Rosenzweig, "Market Opportunities, Genetic Endowments and the Intra-family Distribution of Resources: Child Survival in Rural India," American Economic Review, September 1982 (with T. P. Schultz).

Mark R. Rosenzweig, "Education and Contraceptive Choice: A Conditional Demand Framework," International Economic Review, (with D. Seiver), February 1982.

K. William Easter, "Tank Development, the Northeastern Thailand Experience," Modernisation of Tank Irrigation: Problems and Issues, Centre for Water Resources, College of Engineering, Perarignon Anna University of Technology, Madras, India, February 1982.

Carl Pray, "Agricultural Research in Foodgrains and Nonfoodgrains Asia: The Colonial Heritage." Paper presented at the International Association for Agricultural Economists Meeting, Jakarta, Summer, 1982.

G. Edward Schuh, "The Impact of Foreign Students on U.S. Economic Curricula," in Higher Education in Economics: The International Dimensions. Economics Institute, Boulder, Colorado, 1982.

G. Edward Schuh, "Out-Migration, Rural Productivity, and the Distribution of Income," in Migration and the Labor Market in Developing Countries, edited by Richard H. Sabor, Westview Press, Boulder, Colorado, 1982.

G. Edward Schuh, "The Foreign Trade Linkages," in Modeling Agriculture for Policy Analysis, a symposium sponsored by the Federal Reserve Bank of Kansas City, 1982.

Mark R. Rosenzweig, "Agricultural Development, Education, and Innovation," in C. Diaz-Alejandro, M. Gersovitz, G. Ranis and M. R. Rosenzweig, The Theory and Experience of Economic Development: Essays in Honor of W. Arthur Lewis, London: Allen and Unwin, forthcoming.

Mark R. Rosenzweig, "Governmental Interventions and Household Behavior in a Developing Country: Anticipating the Unanticipated Consequences of Social Programs," Journal of Development Economics, forthcoming (with K. Wolpin).

Carl Pray (with Vinod Thomas, Gotz Schreiber and Risto Harma), "Bangladesh Food Policy and Crop Diversification," forthcoming World Bank, Summer 1982.

John S. Chipman, "Capital Movement as a Substitute for Technology Transfer: A Comment," Journal of International Economics, 12 (February 1982), pp. 107-109.

Christopher Gerrard and Terry Roe, "Government Intervention in Food Grain Markets: An Econometric Study of Tanzania," Journal of Development Economics, forthcoming, November 1982.

Brooks, K., H. Gregersen, E. Berglund and M. Tayaa, "Economic Evaluation of Watershed Projects--An Overview Methodology and Application," Water Resources Bulletin, Vol. 18, No. 2, 1982, pp. 245-250.

G. Edward Schuh, "Entrepreneurical Talent, Sharecropping, Resource Allocation, and Land Ownership," Revista Brasileira de Economia, Vol. 36, No. 1 (January-March) 1982, pp. 3-16.

CENTER STAFF PAPERS AND BULLETINS
June 1977-June 1982

1977

K. William Easter and Lee R. Martin, "Water Resources Problems in Developing Countries," July 1977 (EDC Bulletin #3).

S. Gafsi and T. L. Roe, "Adoption of Unlike High Yielding Wheat Varieties in Tunisia," August 1977 (AAE SP77-15).

T. L. Roe and M. D. Shane, "Foreign Trade, Marketing Services and the Technological Characteristics of a Developing Country," August 1977 (AAE SP77-16).

1978

Lung-Fei Lee and Mark M. Pitt, "Pooling Cross-Section and Time Series Data in the Estimation of Stochastic Frontier Production Function Models," March 1978 (Econ DP78-98).

Willis L. Peterson, "International Farm Prices and the Social Cost of Cheap Food Policies," March 1978 (AAE SP78-4).

Vernon W. Ruttan, "Structural Retardation and the Modernization of French Agriculture: A Skeptical View," May 1978 (Econ DP78-100).

1979

Willis Peterson, "Sources of Differences in Rates of Return to Agricultural Research Between Countries: Some General Observations," February 1979 (AAE SP79-4).

Mark M. Pitt, "A Theory of Smuggling With Application to Indonesia," March 1979 (Econ DP79-109).

Somnuk Tubpun, "Shadow Wage Rate for Urban Public Project Evaluation in Thailand," April 1979 (AAE SP79-10).

G. E. Schuh, "Floating Exchange Rates, International Interdependence, and Agricultural Policy," November 1979 (AAE P79-40).

T. L. Roe and D. F. Nygaard, "Subjective Production Function Parameters and Risk: Wheat Production in Tunisia," Staff Paper Series No. P79-43, Dec. 1979.

George W. Norton and K. William Easter, "Agricultural Development Planning for an American Indian Reservation: The Case of the Sisseton-Wahpeton Sioux Tribe," Department of Agricultural & Applied Economics, University of Minnesota, Staff Paper Series No. P79-22, June 1979.

K. William Easter, "A Farmer Survey and Village Comparison to Evaluate Irrigation Improvement in Sambalpur, India," Department of Agricultural & Applied Economics, University of Minnesota, Staff Paper Series No. P79-25, July 1979.

H.M. Gregersen and A. Contreras, Economic Analysis of Forestry Projects. FAO Forestry Paper No. 17, FAO of the United Nations, Rome, Italy, 1979.

1980

T. L. Roe and D. Nygaard, "Wheat, Allocative Error and Risk: Northern Tunisia," March 1980, EDC Bulletin V.

Anne O. Krueger, "U.S. Economic Policy in Support of Growth in the Developing Countries," in Papers and Proceedings of a Colloquium held in Washington, D.C., October 3-4, 1980, National Science Foundation.

Anne O. Krueger and Baran Tuncer, "Estimating Total Factor Productivity Growth in a Developing Country," World Bank Working Paper 422, October 1980.

Anne O. Krueger, "The Newly Industrializing Countries: Experience and Lessons," in An International Economic Agenda: Major Issues for the 97th Congress, for the Congressional Research Service, November 1980.

G. E. Schuh, "The Economics of the Sunflower: An Example of the Dynamics of Comparative Advantage," November 1980 (AAE P80-27).

Anne O. Krueger, Lung-Fei Lee, "Some Aspects of Efficiency in Turkish Industries," December 1980.

K. William Easter, "Issues in Irrigation Planning and Development," Department of Agricultural & Applied Economics, Univ. of Minn., Staff Paper Series No. P80-5, January 1980.

K. William Easter, "Capturing the Economic Surplus Created by Irrigation," Department of Agricultural & Applied Economics, Univ. of Minn., Staff Paper Series No. P80-14, July 1980.

1981

Vernon Cardwell, James C. Moomaw, and Vernon W. Ruttan, "Agricultural Research in Indonesia," March 1981 (EDC Bulletin 81.1).

Vernon W. Ruttan, "The Asia Bureau Agricultural Research Review," March 1981 (EDC Bulletin 81.2).

Carl Pray, "Agricultural Research in British and Pakistan Punjab and Induced Innovation Interpretation," August 1981 (AAE SP81-21).

Chris Gerrard and Terry Roe, "Government Market Intervention: An Econometric Study of Tanzanian Food Grain Markets," September 1981 (AAE SP81-24).

Som Pudasaini, "The Use of Profit Function to Evaluate Relative Efficiency in Agriculture," December 1981 (AAE SP81-33).

Jerry Hammond, Terry Roe, Ben Senauer, et al., "An Overview of the Food System in the Dominican Republic: Planning, Policies and Constraints," October 1981.

1982
Robert H. Porter, "Tariff Policies in a Small Open Spatial Economy," February 1982 (Econ DP82-159).

Carl Pray, Vernon B. Cardwell, B. G. Crabo, Paul S. Teng, "The Agricultural Research System of Pakistan: The Report of the Minnesota Reconnaissance Team," March 1982 (EDC Bulletin 82.1).

Mr. Prahladachar, "Income Distribution Effects of Green Revolution in India: A Review of Empirical Evidences," April 1982 (EDC Bulletin 82.2).

Hans P. Binswanger and Mark R. Rosenzweig, "Production Relations in Agriculture," Woodrow Wilson School, Princeton, New Jersey, Discussion Paper #105, June 1982.

CENTER PH.D. THESES*
July 1977-June 1982

1977

Dit Sang Ho, "An Econometric Study of the Relationship Between International and Domestic Prices in the Japanese Economy," Department of Economics, University of Minnesota, 1977

Chaiwat Konjing, "Thailand's Maize Export Agreement Policy: An Economic Analysis," Department of Agricultural and Applied Economics, University of Minnesota, 1977.

Khaisri Konjing, "An Analysis of the Economic Performance of the U.S. Corn Futures Market," Department of Agricultural and Applied Economics, University of Minnesota, 1977.

William Henry Meyers, "Long-Run Income Growth and World Grain Demand: An Econometric Analysis," Department of Agricultural and Applied Economics, University of Minnesota, 1977.

Roberto Cristián Zegers Prado, "An Economic Analysis of Milk Production in Southern Chile," Department of Agricultural and Applied Economics, University of Minnesota, 1977.

Raymond Riezman, "A Theoretical Model of Customs Unions," Department of Economics, University of Minnesota, 1977.

Eugenia Muchnik Rubinstein, "The Economics of Foot-and-Mouth Disease Control and Its Associated Externalities," Department of Economics, University of Minneosta, 1977.

1978

Armeane Murzban Choksi, "A Planning Model for the Chemical Fertilizer Industry," Department of Economics, University of Minnesota, 1978.

Julio Duran, "Balance of Payments in Spain: An Econometric Study," Department of Economics, University of Minnesota, 1978.

Narciso M. Mindajao, "Smallholder Forestry and Rural Development: A Case Study of the PICOP Project in Bislig, Surigao del Sur, Philippines," 1978.

David Nygaard, "Risk and Allocative Errors Due to Imperfect Information: The Impact on Wheat Technology in Tunisia," Department of Agricultural and Applied Economics, University of Minnesota, 1978.
This thesis won the Association's Outstanding Ph.D. Thesis for 1979.

Funkoo Park, "Analysis of Labor Earnings in South Korea, 1973- , A Human Capital Approach," Department of Economics, University of Minnesota, 1978.

1979

George W. Norton, "A Model for Indian Reservation Agricultural Development: The Case of the Sisseton-Wahpeton Sioux," Department of Agricultural and Applied Economics, University of Minnesota, 1979.

Jose Leonardo Ribeiro, "Rates of Return to Agricultural Investment in the Cerrados Area in Brazil," Department of Agricultural and Applied Economics, University of Minnesota, 1979.

Boonjit Titapiwatanakun, "Analysis of Export Demand for Thai Tapioca," Department of Agricultural and Applied Economics, University of Minnesota, 1979.

Yun Wing Sung, "Factor Proportions and Comparative Advantage in a Trade-Dependent Economy: The Case of Hong Kong," Department of Economics, University of Minnesota, 1979.

Joon Hak Yoo, "An Estimate of the Welfare Changes from Formation of a Customs Union Among Some Countries in Southeast Asia," Department of Economics, University of Minnesota, 1979.

1980

Frederick Ian Johnson, "An Analysis of Brazil's Sugar Program, 1953-1975," Department of Economics, University of Minnesota, 1980.

Johannes Wahani Pieter Mandagi, "A Simulation Model for Indonesia with Economic Projections and Regional Distribution of Growth from 1972 to 1985," Department of Agricultural and Applied Economics, University of Minnesota, 1980.

Julio Jorge Nogues, "Trade, Distortions and Employment in the Argentine Manufacturing Sector," Department of Economics, University of Minnesota, 1980.

1981

Zvi Eckstein, "Rational Expectations Modeling of Agricultural Supply: The Egyptian Case," Department of Economics, University of Minnesota, 1981.

Christopher David Gerrard, "Economic Development, Government-Controlled Markets, and External Trade in Food Grains: The Case of Four Countries in East Africa," Department of Agricultural and Applied Economics, University of Minnesota, 1981.

Som Prasad Pudasaini, "The Contribution of Education to Agricultural Productivity, Efficiency and Development in Nepal," Department of Agricultural and Applied Economics, University of Minnesota, 1981.

Eiji Taka, "Optimal Pricing Policies for Economic Development," Department of Economics, University of Minnesota, 1981.

Tipaporn Lokaphadhana, "Impact of Trade Policy on Six Agricultural Exports of Thailand," Department of Agricultural and Applied Economics, University of Minnesota, 1981.

Somnuk Tubpun, "Risk, Allocative Error and Value of Perfect Information Among Thai Rice Farmers in Channasutr Land Consolidation Area," Department of Agricultural and Applied Economics, University of Minnesota, 1981.

Yuavares Tubpun, "Economics of Tank Irrigation Projects in Northeastern Thailand," Department of Agricultural and Applied Economics, University of Minnesota, 1981.

1982

Gunawan Sumodiningrat, "Varietal Choice and Input Demand in Rice Production in Indonesia," Department of Agricultural and Applied Economics, University of Minnesota, 1982.

Shun Cheng Lee, "Effects of Agricultural Policy on Efficiency, Growth, and Equity in the Taiwanese Rice Economy: A Cross-Section Time-Series Analysis," Department of Agricultural and Applied Economics, University of Minnesota, 1982.

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* Copies of Ph.D. dissertations may be obtained from Xerox University Microfilms, Dissertation Copies, P.O. Box 1764, Ann Arbor, Michigan, 48106.

WORKSHOPS AND SEMINARS
June 1981-June 1982

AGRICULTURAL DEVELOPMENT WORKSHOPS

Per Pinstrup Anderson, International Food Policy Research Institute, "Nutrition Implications of Food Policies in Developing Countries."

Zafar Ahmed, U.M. Asian Agricultural Research Project, "Agricultural Growth in Bangladesh."

Liu Zhi Cheng, Head, Institute of Agricultural Economics, Chinese Academy of Agricultural Science, "Agricultural Economics in China."

John Chipman, "Compensating Variation, Consumers Surplus and Welfare: A Review of the Issues."

Ralph Cummings, Jr., Rockefeller Foundation, "A Fresh Look at Rural Development."

Robert Deuson, "Impact of Irrigation in the Moulouya River Basin of Marocco."

Ron Dorf, "Planning for Regional Development: The Case of West Central Minnesota."

Arvonne S. Fraser, Hubert H. Humphrey Institute, "The USAID Women in Development Programs: A Retrospective View."

Duty Greene, "The Impacts of Policy Instruments on the Farm Household Welfare in the Dominican Republic."

Dr. E. H. Hartman, Director of International Institute of Tropical Agriculture, "Farming Systems in the Tropics."

Dr. Kenso Hemmi, Department of Agricultural Economics, University of Tokyo, "Japan-United States Agricultural Trade Relations."

Terry Hickenbotham, "Social Profitability and Risk, Application to Project Analysis."

Glenn Johnson, Michigan State, "Equity and Technology on Agricultural Development."

Shun Lee, "Agricultural Development and Land Policy in Taiwan: A Cross-Section Time-Series Analysis."

Judy Maxwell, "The Impact of Irrigation on Regional Development: The Case of West Central Minnesota."

Alan Miner, "Sources of Change in Experiment Station and Farm Yields of Soybeans."

Mark M. Pitt, Department of Economics, University of Minnesota, "Estimating Farm Level Fertilizer Demand in Java with Respect to a Meta-Production Function."

Leo Polopolus, University of Florida, "New Directions on Research on Agricultural Markets."

Dr. Roy Powell, Australian Wheat Board and joint Editor, Australian Journal of Agricultural Economics, Melbourne, Australia, "Australia's Participation in the International Wheat Market and Implications for Wheat Exporters."

M. Prahladachar, "Distributional Implications of Technical Change in India."

Carl Pray, Bo Crabo, Vern Cardwell, Paul Teng, "Reviewing the Pakistan Agricultural Research System."

Carl Pray, "Planning Agricultural Research in Bangladesh."

Chairil Rashan, "Government Demand for Imported Food: The Case of Indonesian Rice Economy."

Carlisle Ford Runge, North Carolina State University, "The Assurance Problem, Application to the Problem of Managing the Commons."

Vernon Ruttan, "Reforming the Global Agricultural Support System."

Maurice Schiff, University of Chicago, "On the Theory of Futures Markets and the Determination of Futures Prices: Insurance, Gambling and Liquidity Services."

Halil Seyidoglu, "Economic Development Strategy and Foreign Trade Regime in Turkey."

Ishay Sharin, United States, Israel Agricultural R&D Fund (BARD), "Public and Private Sector Research, Management in Israel and the United States."

Sherin Sherif, "Energy Pricing and Irrigation Development."

G. Edward Schuh, "A Market Perspective to the International Dimension of Economic Education and Research."

G. Edward Schuh, "The Literature on Agricultural Development in Latin America."

G. Edward Schuh, "Celso Furtado on Agriculture."

Inderjit Singh, World Bank, "Models of Household Behavior."

R. P. Singh, India, Agricultural Research Institute, New Delhi, "Impact of New Technology in Indian Agriculture."

S. R. Subramanian, Tamil Nadu Agricultural University, India, "The Impact of Water Policy on Agriculture--A Hybrid Model Approach Using Linear Programming and Simulation."

Gunawan Sumodiningrat, "Varietal Choice and Input Demand--Rice in Indonesia."

Mitoshi Yamaqushi, Department of Economics, Kobe University, "Growth Accounting for the Japanese Economy: An Analysis of the Competition Between Population Growth and Technical Change."

P. Wibronchutikula, "Industrial Productivity Growth in Thailand."

TRADE AND DEVELOPMENT WORKSHOPS

Okan Aktan, "The Second Enlargement of the EEC: Probable Effects on the Participating Countries," (Hacettepe University, Turkey and the University of Minnesota, visiting.)

Hans Binswanger, World Bank, "Agricultural Development and Non-farm Activities in Rural Thailand."

Michael Bruno, Harvard University, "Short-Term and Long-Term Effects of Supply Shocks."

Mark Gersovitz, Princeton University, "A Theory of Expropriation: Deviations from Perfect Capital Mobility."

Anne O. Krueger, "The 'Dutch Disease' and Exchange Rate Determination."

Jose Machinea, Central Bank, Republic of Argentina, "The Relative Price Behavior Under Alternative Trade Liberalization Attempts."

Mark M. Pitt, "Food Preference and Nutrition in a Poor Developing Country."

Mark M. Pitt, "The Demand for Energy in Indonesian Manufacturing."

Robert Porter, "Tariff Policies in a Small Open Spatial Economy."

Mark R. Rosenzweig, "Schooling, Search and Spouse Selection: Testing the Economic Theory of Marriage."

Andre Sapir, University of Wisconsin, "Foreign Competition, Immigration and Structural Adjustment."

T. N. Srinivasan, Yale University, "The Welfare Consequences of Directly-Unproductive Profit-Seeking (DUP) Activities: Price Versus Quantity Distortions."

Peter Timmer, Harvard University, "China and the World Food System."

Sweder von Wijnbergen, World Bank, "Inflation, Employment and the Dutch Disease in Oil Exporting Countries: A Short Run Disequilibrium Analysis."

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 — $ 50,000
Allocation to the EDC by the Office of International Programs from a 1964 Ford Foundation institutional development grant to the University of Minnesota.

U.S. Agency for International Development, July 1, 1971 — $800,000
A 211(d) grant for Research on the Policy Problems of Agricultural Development. Funds were 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

Cargill, Inc., July 1, 1977 — $ 1,500
For support of a lecture-seminar series in the fields of trade and development.

University of Minnesota Institute of Agriculture, Forestry and Home Economics
For support of the seminar and workshop program of the Center.

1977/78	$ 3,000
1978/79	$ 3,000
1979/80	$ 3,000
1980/81	$ 2,500

University of Minnesota College of Liberal Arts

1981/82	$ 2,500

U.S. Agency for International Development, June 15, 1983 — $ 90,575
Support of a research project of "The Development Impact of Economic Assistance to Less Developed Countries," (Anne O. Krueger and Vernon W. Ruttan, co-principal investigators.)

Additional support for the Center program has been through funds made available directly to the two cooperating departments or to individual staff members and graduate students. The following were among the active projects of Center staff members in 1978-1982:

Anne O. Krueger	National Science Foundation for research on productivity growth in Turkish industry October 31, 1980	$150,000
R. Holt Terry L. Roe Malcolm Purvis	USAID--Research on changes in production, productivity, income distribution and selected determinants of household welfare in the Moulouya irrigation project. Completion date: Fall 1979	$290,000
Terry L. Roe	MUCIA/Ford Foundation--Technical change and risk in cereals production in Tunisia Completion date: Fall 1982	$ 27,000
Terry L. Roe Benjamin Senauer	Title XII--Food Grain Project Completion date: October 1981	$ 25,000
Terry L. Roe	USAID--Planning and technical change in Tunisian agriculture Completion date: Sept. 1979	$100,000
	--A study of the Haitian agricultural marketing system Completion date: Winter 1978	$ 8,000
Terry L. Roe Benjamin Senauer Jerry Hammond	USAID--Food Grain Policy Completion date: July 1981 - Sept. 1982	$ 99,000
Craig Swan	International Communications Agency--editing Portfolio, a periodical compendium of important literature in the area of economic interdependence circulated to a large overseas audience - Ongoing project	$203,625
Vernon W. Ruttan and Carl Pray	USAID--Asian Agricultural Research Review - July 1, 1980-December 30, 1983	$357,960
	Initial grant	$275,000
	Supplementary grant	$ 82,960

K. William Easter & Delane E. Welsch	USAID--Economics of Irrigation in LDC's October, 1979 - September 1983	$450,000
G. Edward Schuh	U.S. Agriculture in an Interdependent World Economy Station Project: 1981-1986 USDA Agreement: 1981-1985 (with current funding through 9/30/82)	$ 20,000
John S. Chipman	Econometric Research in International Trade - National Science Foundation July 1980 - December 1982	$114,535
Mark R. Rosenzweig	National Science Foundation--Research on the determinants of child health in developing countries Completion date: February 1984	$ 44,405
Mark R. Rosenzweig	USAID--Interrelationships between family planning, fertility and child mortality in Colombia Completion date: March 1982	$ 26,769
Mark M. Pitt	World Bank Research Program--"A Statistical Analysis of the Efficiency of Indonesian Manufacturing." May 1, 1980-May 1, 1983	$112,000
Mark M. Pitt & Lung-Fei Lee	Alfred Sloan Foundation--"Transactions Costs and the Subjective Equilibrium of Family Farm." September 15, 1981-June 30, 1983	$ 18,137
Delane E. Welsch	IDRC--partial support for study on "Thai Cassava: A Middleman Led Growth Industry." Completion date: December 1982	$ 5,000
Delane E. Welsch	University of Minnesota Title XII Strengthening Grant for the Project, "Economic Evaluation of Biological Nitrogen Fixation." Completion date: October 1982	$ 16,450

John S. Chipman	Quantitative Research in International Trade--National Science Foundation July 1978 - December 1980	$143,600
John S. Chipman	Theoretical Development and Econometric Application of a Model of International Trade--John, Simon Guggenheim Foundation September 1980 - June 1981	$ 18,000