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# Research Review

## Cross-Sectional Analysis of Wheat Import Demand among Middle-Income Developing Countries

By Cathy L. Jabara\*

Agricultural economists have been much interested in measuring the export demand elasticity for U S agricultural products (2, 4, 7, 10)<sup>1</sup> It is difficult to identify this parameter precisely because of its sensitivity to the import demand elasticities of other countries—the parameters of which are often unreliable In the case of wheat, a knowledge of the import demand elasticities for developing countries is especially important because these countries represent over 60 percent of the U S market for commercial wheat sales The developing-country market share of wheat, however, is characterized by many importers, each holding a relatively small share of U S exports Researchers often find it difficult to obtain reliable time-series data from which they can estimate models of import demand for individual developing countries

In this article, I utilize pooled cross-sectional and time-series data to estimate a reduced-form import demand model for wheat for 19 middle-income developing countries for the 1976-79 period These 19 countries accounted for about 40 percent of U S wheat exports in 1980 Elasticities estimated from this model are short-run, and they represent averages for the countries in the sample Provided there are no structural differences among countries, such estimates may be more reliable than those estimated for individual developing countries from time-series data because the number of time-series observations necessary for parameter estimation is reduced By extracting information about the regression parameters from the between-country and between time-period variation, the pooling procedure increases the amount of useful information that can be drawn from the available data

### Model Specification

Specification of import demand functions is discussed extensively by Leamer and Stern (8) and by Abbott (1) Following Abbott, Hall (5), and Gallagher and others (4), I estimated the reduced-form import demand equation as follows

$$WM_{it} = A + B_1 POP_{it} + B_2 IMC_{it} + B_3 WST_{it-1} + B_4 P_{mit} + B_5 WP_{it} + B_6 PROD_{it} + B_7 FAID_{it} + \epsilon_{it} \quad (1)$$

for  $i = 1 \dots n$  countries and  $t = 1 \dots 4$  years

\*The author is an agricultural economist with the International Economics Division, ERS She wishes to thank William Kost and Jerry Sharples for comments in preparing this manuscript Carol Stillwagon provided statistical assistance

<sup>1</sup>Italicized numbers in parentheses refer to items in the References at the end of this article

The variables used in the model are

- $WM_i$  = total concessional and commercial wheat imports by country  $i$ , 1,000 metric tons,
- $POP_i$  = population in country  $i$ , millions of persons,
- $IMC_i$  = real foreign exchange availability in country  $i$ , millions of 1975 U.S. dollars,
- $WST_i$  = carrying wheat stocks in country  $i$ , 1,000 metric tons,
- $P_{mi}$  = consumer price of wheat in country  $i$  (resale price to mills or wheat-equivalent price of bread or wheat in flour), deflated by the consumer price index in country  $i$ , in 1975 U S dollars per metric ton,
- $WP_i$  = world price of wheat in country  $i$ , deflated by the consumer price index in country  $i$ , 1975 U S dollars per metric ton,
- $PROD_{W_i}$  = production of wheat in country  $i$ , 1,000 metric tons,
- $FAID_i$  = concessional wheat shipments to country  $i$ , 1,000 metric tons, and
- $\epsilon_i$  = a random error term

Data are for 19 countries from 1976 to 1979.<sup>2</sup>

All countries in the sample except Venezuela and El Salvador controlled the level of the consumer wheat price during the estimation period I estimated equations using the internal price of wheat,  $P_m$ , and the world price of wheat,  $WP$ , as an alternate measure to determine the extent to which world prices affect decisions by governments and private firms to import wheat despite internal price control

### Empirical Results

Pooling of time-series and cross-sectional data assumes that structural coefficients are the same across countries How-

<sup>2</sup>Equations were also estimated by use of per capita income as an alternative measure of import purchasing power and by use of nominal (undeflated) prices (see 6)

ever, there may be differences in the country-specific intercepts over time because of socioeconomic and cultural differences. For unpooled statistical procedures, these effects are normally captured in the error term or in the coefficients of the variables which are not country-specific. Uncorrected variation of the error term may cause both bias and inefficiency in an ordinary-least-squares (OLS) estimation of the structural coefficients.

To account for differences in intercepts, I estimated import demand equations using a variance components method in which the intercept terms are treated as random variables—one a time-series variable and the other a cross-sectional variable (9, pp. 326-29). This procedure extracts information on the regression parameters from the between-country and time-period variation in the data, in contrast to the ordinary-least-squares with dummy variables procedure (LSDV) which treats cross-sectional and time-series effects as fixed parameters. I assumed that the mean effect of the random time-series and cross-sectional variables is included in the intercept terms and the random deviations about the mean are included as components of the error term. I used a weighted least-squares estimation technique in which observations were weighted in inverse relationship to their variances. Provided the intercept terms vary randomly, the corresponding generalized-least-squares (GLS) estimates are more efficient than those estimated from OLS or LSDV procedures.

Results indicated significant differences in response to economic variables among countries classified as wheat-producing and nonwheat-producing. Therefore, regression results for these two groups are shown separately. Nonwheat-producing countries are those in which wheat production is zero or minimal. Nine nonwheat-producing countries include Colombia, the Dominican Republic, Ecuador, El Salvador, Indonesia, the Republic of Korea, the Philippines, Taiwan, and Venezuela. Ten wheat-producing countries include Algeria, Brazil, Chile, Egypt, Iraq, Mexico, Morocco, Peru, the Sudan, and Tunisia. A description of these countries and the data used in the analysis can be found in (6).

Results also indicated significant differences in the parameter estimates when the Republic of Korea and Egypt are excluded from their respective samples.<sup>3</sup> Table 1 presents equations including and excluding these countries. These differ-

ences are largely attributable to the importance of food aid to these countries during the estimation period.

The equations appear to fit the data well, most of the estimated parameters are significant at the 10-percent level or higher. Wheat imports of nonwheat-producing countries appear to respond to world price signals despite internal government control, and estimated responses to world and internal wheat prices are not significantly different. The significance of the world price declines with the inclusion of the Republic of Korea, which suggests that the wheat price stabilization fund operated in that country permits a lag in response to world price levels compared with the other countries. Wheat imports of wheat-producing countries do not appear to respond to world price signals. This implies that wheat import demand elasticities are close to zero for these countries, and it indicates a greater concern for importing target quantities of wheat regardless of price.

## Elasticities

Elasticities shown in table 2 indicate that the response of wheat imports by middle-income developing countries to world price, foreign exchange, and quantity changes is quite low. Calculated price elasticities are shortrun, that is, they represent the response to world wheat price changes at fixed production. The finding that wheat imports by nonwheat-producing countries respond to world price signals is in contrast to the results of Abbott (1) who found, using time-series data from 1951 to 1973, only three developing countries—Egypt, Mexico, and Thailand—responsive to world wheat price movements.

Low response to world price movements by middle-income developing countries suggests that the shortrun export demand elasticity for U.S. wheat is also quite low. Bredhal, Meyers, and Collins (2) estimated the foreign demand elasticity for U.S. wheat was between 0 and -1.67, depending on the assumptions made about the degree of price insulation among developing countries. Gallagher and others (4) estimated the export demand elasticity for U.S. wheat to be -0.41. They assumed that foreign demand elasticities for wheat in Western Europe, in Japan, and in the Soviet Union and other centrally planned countries are zero, so that their domestic elasticity depended on the aggregate import demand elasticity estimated for the developing countries (-0.71).

These results indicate that developing countries which import about 20 percent of U.S. wheat respond to world price signals, but the response is low—about -0.2. Wheat-producing countries, which also import about 20 percent of U.S. wheat, do not appear to respond to world price movements. Final determination of the elasticity of export demand for U.S. wheat depends on the estimated response of other developing countries which accounts for the remaining 20 percent of U.S. sales.

<sup>3</sup>I conducted a series of preliminary F tests using results from LSDV estimation to test for structural differences among countries within the two samples. This procedure tested whether the observations for each country came from the same population as the observations for the other countries in the sample (3). The addition of observations for the Republic of Korea and Egypt significantly changed the parameters of the estimated equations. These tests used the LSDV procedure because tests of equality of slope coefficients are rarely done using the variance-components framework, and the results are valid only if the samples are sufficiently large (9, p. 329).

Table 1—Wheat import demand equations, variance components estimates

Samples and variables	Regression coefficients (with t-ratios)									
	A	POP	IMC	WST <sub>t-1</sub>	P <sub>m</sub>	WP <sup>1</sup>	PRODW	FAID	RMSE <sup>2</sup>	PRMSE <sup>2</sup>
<b>Nonwheat-producing countries</b>										
Eight country sample <sup>3</sup>										
Real internal price	287.4 (2.72)	6.327 (3.46)	0.0296 (3.43)	-0.6217 (-2.07)	-0.5391 (-2.03)		-1.015 (-66)	0.1095 (.52)	37.14	0.068
Real world price	283.8 (2.76)	6.386 (3.51)	0.328 (3.71)	-64.78 (-2.15)		-0.7333 (-2.13)	-1.000 (-66)	0.893 (.43)	36.91	0.67
Nine-country sample <sup>4</sup>										
Real internal price	392.6 (2.40)	6.020 (2.11)	0.301 (2.61)	-94.98 (-2.48)	-7.790 (-2.13)		2.941 (1.79)	5.884 (3.01)	54.27	0.79
Real world price	377.3 (2.38)	6.082 (2.13)	0.341 (2.92)	-98.93 (-2.51)		-9.893 (-2.00)	3.184 (1.87)	6.074 (3.05)	55.60	0.80
<b>Wheat-producing countries</b>										
Nine-country sample <sup>5</sup>										
	829.1 (1.88)	33.88 (4.33)	0.641 (4.17)	-63.98 (-1.97)		-1.373 (-.89)	-5.707 (-4.80)	1.292 (.08)	154.36	1.22
Ten-country sample <sup>6</sup>										
	653.31 (1.63)	29.94 (3.88)	0.710 (3.57)	-43.57 (-1.14)		-1.046 (-.63)	-4.803 (-3.26)	2.466 (5.95)	202.38	1.28

Blanks indicate not applicable

<sup>1</sup> World wheat price<sup>2</sup> RMSE denotes root mean square error, and PRMSE is RMSE divided by the mean of the dependent variable<sup>3</sup> Colombia, the Dominican Republic, Ecuador, El Salvador, Indonesia, the Philippines, Taiwan, and Venezuela<sup>4</sup> Eight-country sample and the Republic of Korea<sup>5</sup> Algeria, Brazil, Chile, Iraq, Mexico, Morocco, Peru, the Sudan, and Tunisia<sup>6</sup> Nine-country sample and Egypt

Table 2—Wheat import demand elasticities computed at means, middle-income developing countries

Variables	Country equations			
	Nonwheat-producers (with Republic of Korea)		Wheat-producers (with Egypt)	
POP	0.38*	(0.29)*	0.84*	(0.60)*
IMC	37*	(34)*	32*	(25)*
WST <sub>t-1</sub>	-10*	(-14)*	-15*	(-10)*
WP	-18*	(-18)*	-11	(-07)
PROD <sub>W</sub>	-02	(07)*	-57*	(-40)*
FAID	01	(06)*	01	(30)*

\*Significant at the 10-percent level or greater

## Conclusions

Pooling may not greatly advance import demand estimation, however, it may be particularly helpful and cost-efficient when there is little information about a group of small importers, such as the developing countries. More important, reliable time-series data often do not exist for developing countries so that parameter estimates from pooled data may be more reliable than estimates from single-country estimation, provided structural differences do not exist among countries.

It is not strictly valid to aggregate developing countries in modeling research. Wheat import demand behavior among middle-income countries differs by the internal policies of governments and by the importance of wheat in the economy. The finding of differences in price-response behavior between nonwheat-producing and wheat-producing countries should be tested further with analysis of wheat import demand in low-income countries.

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## In Earlier Issues

The services of many workers are required to get products from farmers to consumers in the form, time, and place desired. During the last quarter of a century workers in food marketing firms increased about 50 percent whereas workers on farms decreased about a third. The increase in physical output marketed per man-hour was equivalent to an annual average increase of around 2 percent.

Kenneth E. Ogren and Kathryn Parr  
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# Some Lessons from Wingspread: A Report on the National Rural Symposium

By J. Norman Reid\*

Rural governments are at a critical juncture. Many are faced with large population inflows that differ from any in their experience. At the same time, the Federal, State, and local government system may well be on the verge of a significant restructuring. These changes pose important challenges for local governments in meeting their responsibilities; they also present new opportunities for rural communities to shape their futures. Prospects of success for rural communities will depend on the performance of their local governments.

These were the dominant themes of the National Rural Symposium, which was organized around the topic, "Rural Governments in a Time of Change: Challenges and Opportunities." Held March 29-31, 1982, at the Wingspread Conference Center, Racine, Wis., the symposium brought local government officials together with State, Federal, and university representatives to consider major social and political changes and their implications for the future of rural America. The symposium was jointly sponsored by the U.S. Department of Agriculture (USDA) and the Rural Governments Coalition, whose members include national organizations representing the Nation's counties, towns and townships, development districts, and regional councils. The session was organized around four papers that outlined the governmental and demographic changes affecting rural communities and their governments and that considered implications for local service delivery and resource availability.<sup>1</sup>

The sweeping changes now confronting the Nation's governmental system affect all levels. Participants were not able to predict the full effects of the New Federalism on rural governments, but they were clear about several points.

They voiced little concern about the loss of Federal dollars, even though the recent cuts climax a decade of increased rural access to these funds and follow several years of decline in real revenue levels. Much greater attention centered on federally mandated service standards—especially related to drinking water and wastewater treatment—which continue to be a sore point with many localities. Concern also focused

on emerging State government roles and whether local governments—still heavily regulated by States—will get added discretion to match their new responsibilities.

The symposium focused on the "rural renaissance" of new population growth and economic activity—without precedent in this century—that much of rural America is experiencing. For newly growing places that had become accustomed to a slow but steady loss of residents, this turnaround presents the challenge of planning and financing new, needed services and coping with disruptions to their social structure. Still, many rural places continue to lose residents and, for these, the challenge is finding acceptable ways to cut some services while enhancing others.

Participants addressed several issues related to service delivery: the costs and effects of providing local services, relationships among governments and with the private sector, and local institutional capacity. In addition, they considered three areas related to governmental resources: human, organizational, and financial. From these a number of rural development research and information needs emerged. Some of the leading issues are considered below.

Among the most widely cited needs were training and information for local policymakers and for the rural public at large. Citizen-officials predominate in small governments, and lack of prior government service is common. This situation creates special training needs for rural governments that differ from the needs of large governments. In addition to training in technical skills, these officials often need general orientation to the job of governing. But, even more important than more training may be finding ways for officials to take advantage of it. And, how the training is delivered can be as significant as its content.

Researchers have an important role in addressing these needs. Social and psychological factors have important effects on whether training programs reach their target audiences and, when they do, on whether they are effective. Understanding these factors and finding ways to address them can help improve the effectiveness of training programs.

The most apparent needs are for training in specific skills, such as financial management or capital budgeting, and for information that can be applied to particular problems—revenue forecasting, for instance. Less recognized, and perhaps more needed, is guidance about issues like the productivity of alternate revenue sources and their probable effects on equity or economic growth. But, in these and other areas,

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<sup>1</sup>The papers were "Rural Governments in the Eighties: Adapting to Change," by William E. Bivens, III, "Demographic Changes in Rural America: Shaping Rural Governments," by Peter A. Morrison and Kevin F. McCarthy, "Government Service Delivery: Meeting Community Needs," by Robert Paciocco, and "Resources for Rural Governments: Finding and Using Community Assets," by Alvin D. Sokolow. Copies of the papers may be obtained from the author at USDA/ERS/EDD, Room 494-GHI, 500 12th Street, S.W., Washington, D.C. 20250. A final report and proceedings are planned.

new directed research may be required to fill specific knowledge gaps. In all areas, basic knowledge needs to be converted into forms that can be shared with community officials and the public.

Meeting these information needs will require close collaboration between researchers and extension personnel and better communication with local officials themselves. Innovativeness will be called for in structuring and achieving optimal relationships. But, it is clear from Wingspread that separate research and extension efforts will not be enough.

The continued deterioration of rural public infrastructure was another point of concern. Numerous instances were cited of decaying roads, bridges, and other capital facilities. Although they were agreed about the existence of a problem, delegates were less certain about the causes. Some cited the difficulty of obtaining adequate and affordable capital financing as a barrier to meeting community needs. Others cited regulatory problems, particularly with water and sewer systems, where Federal or State requirements forced shifts to costly or inappropriate new technologies. Capital budgeting practices appear spotty and often ineffective, and local officials lack needed information about when improvements or replacements should be undertaken. The absence of comprehensive information at State or national levels inhibits the formation of policies that could address these issues.

The new constraints on public finances prompted participants to rethink local institutional arrangements for service delivery. Major alternatives that may offer cost savings are cooperation with neighboring governments, regionalized service delivery, contracting with public- or private-sector agencies, and turning over service delivery or public facilities to the private sector. Participants questioned whether these arrangements always make the economic sense sometimes claimed for them and wondered where the proper bounds of public responsibility in providing services lie.

Many more questions were raised than could be answered from existing research. Cooperative agreements may generate cost savings, but delegates were uncertain whether they would provide enough incentive for local governments to enter them. Research could usefully clarify the benefit-cost threshold at which agreements will be formed and could explore noneconomic incentives and disincentives, such as political ones, that affect the use of economically desirable service delivery arrangements. Supporters claim many benefits for private service delivery, but whether these

outweigh losses in service quality and other costs is an empirical question.

The great variability among rural communities was a recurring and, in many ways, the fundamental theme of the symposium. Despite the overall trend of renewed growth in nonmetropolitan areas, broad statements can be very misleading when applied to individual settings. Many rural communities are in fact not growing. Even where growth has occurred, it is due to a variety of causes, each of which has quite different implications for local service delivery problems. Much has been written about the new population trends, but it awaits analysis of the 1980 Census of Population to learn how the trends are shared among individual communities.

The implications of these differences for rural policy are not well understood. Careful research into the importance of demographic features, as well as geography, governmental form, and public attitudes, could help better inform policy. In the present climate of change in rural areas, special attention is merited concerning the way these changes are likely to affect public finances and community structure.

Participants also agreed on the importance of educating Federal and State policymakers about differences among rural areas and between rural and urban settings. Despite the unique circumstances that define rural communities, participants viewed many rural policies as little more than warmed-over urban solutions that suffer from inappropriateness at best. Rural policies that rest on common national assumptions face the same risk of unintended and damaging effects. The research community can help by clarifying and communicating the important differences.

Attendees agreed that these rural knowledge needs could be better met by developing "ruralists" as counterparts to the "urbanists" who have become so influential in shaping public policies in recent years. At a minimum, delegates felt that increasing the status and visibility of rural studies might help attract and retain the most capable researchers in this field.

Delegates agreed, too, on the value of continuing the kind of discussions among levels of government and with universities that was begun at Wingspread. Followup activities to extend the process are planned. The spirit of cooperation in which delegates came together in Racine symbolizes the newly recognized interdependence among governments and augurs well for the emerging process of communication.

# Growth in U.S. Agricultural Capacity and Utilization: We Need to Know More about It

By Clark Edwards\*

World population is growing, and it is not certain whether world food supplies will grow in balance with population. Disparate private and public actions in the United States and elsewhere today, in situations seemingly unrelated to the world food situation a decade or two hence, can have major consequences for the well-being of what will soon be 6 billion people living on this planet. Some perceptions of the future reflect an optimistic view of continued food surplus. Others reflect a pessimistic view of Malthusian scarcity. In between are several studies which suggest that longrun prospects for balanced growth of people and food supplies are quite good. However, world balance does not necessarily imply balance by region and commodity. Regional imbalances accelerate world trade. And, longrun world balance does not preclude shortrun instability. Annual fluctuations in supplies and demands can have major impacts on prices, farmers' incomes, and prospects for efficient and equitable adjustments to meet longrun needs.

A broad range of factors affect the longrun prospects for the efficiency and equity with which U.S. agriculture will respond to a steadily rising world population, increasing but fluctuating world food supplies, and increasing levels of world agricultural trade. The equity of the distribution of food and fiber among low-income people both in the United States and in less developed countries is also at issue.

The Economic Research Service (ERS) is expanding its focus on the factors affecting these problems and is reexamining the data base used to describe the food problem and studying the theoretical framework used to explain it. The perspective is on social welfare resulting from adjustments in U.S. agriculture rather than on private profits to those making the adjustments.

The balance of this article explores the scope and complexity of the world food problem from the point of view of the response of U.S. agriculture. In so doing, it indicates why the problem admits of no easy solution. And, it serves as a guide for expanding research on the problem.

The market for U.S. farm products is partly domestic and partly foreign. The foreign component is the net between total foreign demand and foreign supply. Of the three components that describe the size of the U.S. market—domestic demand, foreign demand, and foreign supply—it is foreign supply that is most volatile and least predictable. The size of the market for U.S. farm products is also affected by

supplies of food from nonfarm sources, such as the ocean. The longrun problem is usually cast in terms of pressures of world population against food supplies. But, shortrun fluctuations in the market for U.S. farm products are more a world supply than a world demand phenomenon. U.S. agriculture will likely continue to provide an increasing proportion of the food that enters world trade. The trend and variability of net food demands to the United States need to be viewed by country and by commodity because such imbalances accelerate world trade and contribute to instability, even when the world aggregates are in balance. Domestic and world price, income, and population elasticities of demand need to be reviewed for their implications for price levels, relative prices, commodity mix, and the U.S. balance of payments.

Productivity of U.S. agriculture is high and rising. Productivity is concerned with the quality of food as well as the quantity; quantitative advances are not necessarily accompanied by qualitative progress. Whether productivity continues to rise sufficiently to meet prospective net world food needs will depend on a number of factors. Continued investment in science and research and continued extension of information and assistance are vital to continued growth in U.S. agriculture. Changes in the parity ratio reflect farm and nonfarm economic forces that affect incentives to produce and that influence the level of farm output. The balance sheet of agriculture and the farm income statement depict not only factors which describe the technical production function of U.S. agriculture but also factors which are economic incentives for farmers to produce. Other incentives, such as the quality of life on farms, also affect production. Relative prices of products and inputs affect resource allocation and enterprise combinations. Adjustments to relative price changes affect productivity through increased economic efficiency rather than technical efficiency. Changes in the structure of agriculture—such as size of farm, degree of specialization, and legal form of organization—affect productivity. The trend toward using more and more nonfarm inputs and toward adding more nonfarm value to outputs requires an assessment of changes in agribusiness. An infrastructure not controlled by farmers is important in agricultural productivity. This infrastructure includes the various levels of government and their nonfarm as well as farm programs, the market structure (including cooperative marketing arrangements), schools, experiment stations, extension services, farm organizations, hospitals, and various community facilities. Air pollution—automobile exhaust, for example—affects crops yields and reduces farm output. The infrastructure also includes the general health of the nonfarm economy.

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The availability and utilization of resources are key determinants of farm output. If you want to make U S agriculture grow, one way is to provide it with more land, labor, capital, and management. Markets for farm resources have unique features based on characteristics and location of the resource supplies and on the derived demands that reflect imperfect resource substitution in the production process. Some resources are not renewable and change character irreversibly under certain kinds of use. The threat of resource degradation arouses concern for conservation of natural resources and for environmental quality. Some resources used by farmers supersede into what society appears to value as higher uses, while others are moved into agriculture from lower uses. The intensity of land use affects the operation of these markets. Many resources are seldom on the market and are committed to fixed uses by farms, or even by enterprises. Resource fixity affects the responsiveness of agriculture to changing food needs. Rising net worth, increased flows of funds, capital accumulation, and creditworthiness affect farmers' decisions to invest in added resources. The supply response of agriculture is affected by rising capital-to-land ratios, increasing value of human capital, increased use of nonfarm inputs, rising real energy costs, and limits to the availability of natural resources. Past trends have resulted in relatively stable agricultural land requirements, increasing capital requirements, and decreasing labor requirements. Our ability to increase food supplies depends on the extent to which the land, labor, and capital available to agriculture are used to capacity and also on the prospect for change in the trends of availability of resources to farmers. For example, land now in U S farms is used far less intensively than it might be, and far more land is suitable as crop and pasture land than is now being used by farmers.

A number of institutions enhance or limit the efficiency and equity associated with U S agriculture. Farm product markets are often said to be examples of nearly perfect competition. That may be so, but monopolistic elements are common in the agricultural processing and distribution sector and in many of the input markets. The land market, for example, is treated by location economists as a perfectly discriminating monopoly. Cooperative marketing and vertical integration have modified some farm product and factor markets. Market institutions, including the interference in the markets by governments for purposes of domestic or foreign policy, affect the supply response of U S agriculture. The tax struc-

ture affects farm income distribution and incentives. Regulations and various legal constraints override free market forces. Legal constraints include legal form of farm organization, ownership of resources, tenancy contracts, private property rights, and access to public lands. Financial institutions, credit availability, and interest rates affect farmers' decisions to invest. Inflation and concomitant changes in institutional arrangements, relative prices, and levels of uncertainty affect farm production incentives. Perceptions of farming as a way of life in a decentralized economy affect the decisions of many families to enter or remain in farming. Institutional arrangements are important in determining the capacity of U S agriculture to remain efficient and equitable as it is confronted with increasingly volatile world markets. Fluctuations in final product markets lead to variation in farm prices, carryover stocks, land values, and enterprise combinations. Various institutions need to be in place to protect farmers and to help them absorb fluctuations.

The geographic location of farms relative to resource supplies and product markets affects the supply response of U S agriculture. Certain types of farms need to be located on certain types of soil and to have immediate access to extensive supplies of water. The location of farms relative to resource supplies or to product markets affects the type of farming in a region and its profitability. Efficient access to transportation and communication facilities leads to increases in the supply of farm products. Commercial farms have vital economic links to cities through forward (product market) and backward (purchased input market) linkages. The linkages tend to be most effective for farmers located within the matrix of an urban center. Links to the nearby rural economy are strongest through competition for local resources, particularly land and labor. Links to foreign markets are through national institutions associated with imports, exports, and the balance of payments. World geography influences whether or not world balance of aggregate population and food supply is accompanied by regional, inefficient, and inequitable imbalances.

The prospects for growth in the capacity and utilization of U S agriculture to meet increasing and fluctuating net world demands for food in coming decades depends on private and public actions taken during the eighties with respect to markets, productivity, resource availability, institutional arrangements, and geographic relationships.

# Mexico's Agricultural Dilemma

P. Lamartine Yates Tucson University of Arizona Press, 1981,  
291 pp., \$19.95 (cloth), \$8.95 (paper).

Reviewed by D. H. Roberts\*

In 1975, as Dr. Yates was writing his extensive two-volume profile of the Mexican agricultural sector, *El Campo Mexicano* (The Mexican Countryside), Mexico exported \$1.1 billion of agricultural commodities while importing \$911 million of farm products, the most positive agricultural trade balance that the country had enjoyed since anyone had started compiling statistics. By 1980, Mexico's import bill had tripled, but the value of agricultural exports grew only slightly to approximately \$1.5 billion. In this 5-year interval, the number of seminars, hearings, and consortiums which attempted to explain why Mexico had suddenly emerged as the United States' second largest customer for agricultural commodities grew in direct proportion to Mexico's import bill. Many studies focused on the implications of this development for U.S. purchases of Mexican oil (the "food for crude" issue), others either noted the impact on migration or damned the transnational corporations. Most studies failed to address the central question, "Why can Mexico no longer produce enough food for her people?"

Yates traces the evolution of Mexico's current agricultural crisis over the past 15 years and, along the way, provides one of the most comprehensive, unbiased analyses in print on either side of the border. Yates' position as an advisor on economic and social matters to both the Government and the National Bank of Mexico over the past 8 years gave him access to data available only in internal documents and out-of-print sources. Professionals charged with analyzing Mexico's agricultural sector who have struggled with conflicting data published by various official sources or who have encountered nonsensical numbers in livestock or land use series will appreciate the author's invaluable guidance in deciphering Mexican data. For this reason alone, Yates' book qualifies as an indispensable reference. But, *Mexico's Agricultural Dilemma* is more. Yates examines agricultural prices, credit expansion, extension services and land tenure—among several other topics—with policy reorientation in mind. He asks what sort of agriculture will be appropriate for Mexico when there are nearly 100 million Mexicans, all more prosperous and demanding than the 68 million of 1980, and he proceeds to suggest measures that will be needed to satisfy the social and economic aspirations of Mexican society during the eighties and beyond.

The book's thoroughness, a strength from the viewpoint of academic scholarship, is a weakness as regards readability. Yates writes in a simple, declarative style, but only devotees

of the study of Mexican agriculture will find the author's detailed comparisons of data sources and explanations of derived data interesting. For those students of the economic development of Latin America or of the energy-rich nations, a reading of the first and last chapters would probably suffice. Indeed, Yates does not pretend to have written this book as a guide or text with implications for all, emphasizing as he has Mexico's agricultural idiosyncrasies.

Yates begins with Mexico's "golden years" during which its agricultural sector by any standards was a success. Annual production from 1940 to 1965 rose at the astonishing rate of 5.7 percent, far faster than in any other Latin American country. During this period employment increased, incomes rose, and the nation began to march the first few miles along the road toward generalized human welfare. As Yates points out, Mexico was one of the few developing countries in which the agricultural sector was sufficiently viable and dynamic to underpin advances in the social and economic well-being of the population as a whole. Beginning in 1965, a number of physical, technical, social, and economic factors began to converge that slowed growth in the sector "from a glorious gallop into a temperate trot." The single greatest brake on growth in Mexico's agricultural economy was the slowdown in the expansion of harvested area, the result of the growing costs of bringing increasingly marginal land into production.

At the same time that growth in the production of farm commodities began to slow, demand for these products started to accelerate, stimulated at first by a population of 45 million growing by more than 3 percent a year and later by a society made more prosperous by its oil reserves. Thus, by the end of the seventies, the country had drifted into the position of becoming an importer of basic foodstuffs. It had long been assumed that Mexico had sufficient resources to feed itself, while contributing substantial amounts of exports for its import-substitution development plan. Mexican policymakers also believed that technical progress would assure a continuing growth of output and of farmers' incomes. The discovery that all these factors were no longer inevitable provoked a rather violent reaction in public opinion—and a frantic search for remedies. By the nature of the political process, most of these remedies, such as price-support increases and credit expansion, were short-term. But agriculture is inherently an activity in which situations change slowly and investments take years to achieve, as Mexican policymakers discovered during the late seventies. Hoping to counteract 15 years of benign neglect of the agricultural sector, the Government in March 1980 announced a comprehensive

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food and fiber plan, the Sistema Alimentario Mexicano (SAM) to achieve self-sufficiency in basic food and feed products by 1985

Yates next turns to the future and assesses demand prospects under two scenarios—high and low alternatives. The results of his analysis present a formidable challenge for Mexican producers. The low alternative yields an annual increase in total consumption of 4.2 percent, whereas total consumption would grow by 4.9 percent annually under the high alternative. Yates examines the implications of his demand projections and finds that, even allowing for an optimistically estimated rise in per-acre yields, Mexico would have to add something between 14 and 20 million additional acres of arable land to the present land base level within the next decade if domestic production is to maintain its share of total consumption.

The bulk of the book surveys the availability of resources—physical, technical, economic, and social—for increased agricultural production and assesses the contribution these resources could make toward this goal. Yates finds that Mexico's land tenure system is the severest constraint to production gains. The agrarian reform code has not been substantially revised in over 70 years, which has immobilized the farm population. For example, producers are limited to 200 hectares of rainfed land or to 100 hectares of irrigated land and, until 1981, were not permitted to operate a mixed enterprise (crops and livestock). Contradictory addendums have also been tacked onto the initial code over the years, leading to widespread abuse of laws by farmers and arbitrary enforcement by officials. One section of the code limits ranches to 800 hectares whereas another permits a rancher to possess the amount of grassland necessary to maintain 500 head of livestock, which would amount to 25,000 hectares in some areas.

To exacerbate the present tensions in the countryside, populist politicians propagate the myth that if the State would but divest the remaining large landowners of their holdings, there

would be plenty of productive land for the remaining 4 million landless petitioners. The result of current land tenure laws and enforcement of these laws has been uncertain farmers who are unwilling to make investments in their operations for fear of having their land capriciously expropriated later.

Yates proposes an ingenious scheme of phasing out the most anachronistic and ambiguous aspects of the land tenure system while retaining the characteristics that are clearly at the core of the Mexican populace's conception of proprietorship. Above all, Yates' proposals would add flexibility and adaptability to a system which is breaking down under the weight of its own restrictions.

Yates concludes that Mexico cannot hope to achieve self-sufficiency in basic food and feed grains, and so he tailors his recommendations for land tenure reform, price policy, credit, and extension and research to stimulate production of a wide variety of commodities and livestock. This solution, of course, opposes the prevailing policy direction of the Mexican Government, and many Mexican experts with different political perspectives would no doubt challenge Yates' conclusions. As the author recognizes, many of his proscriptions would be extremely difficult to implement, but he warns policymakers against relying on Mexico's oil export revenues to buy a solution to Mexico's growing reliance on food imports. He points out that Mexico, unlike all other major third-world oil exporters (except Indonesia) is a country with a large population. For Mexico to attain the same export value per capita as Venezuela, for example, Petroleos Mexicanos (PEMEX) would have to export 9.3 million barrels of oil a day compared with the 1.2 million it exported in 1980.

Despite any reservation that readers may have concerning the author's policy recommendations, they should recognize what a contribution to the field *Mexico's Agricultural Dilemma* represents. Yates has done a remarkable job of sifting data and evaluating Mexico's demand and supply balances for the eighties in the most comprehensive treatment of Mexico's agricultural sector available in English.

# Modeling and Measuring Natural Resource Substitution

Ernest R. Berndt and Barry C. Field, eds. Cambridge, Mass.,  
MIT Press, 1981, 314 pp, \$35 00

Reviewed by Michael LeBlanc and Thomas Lutton\*

The title of this book suggests that its focus is on natural resources, however, the actual content is broader. Because the authors examine resource substitution simply as another input in production, the modeling approaches they discuss can be applied to many problems of input use. The book can best be categorized as econometric applications of duality theory to input substitution and technological change.

Except for the introduction, the individual chapters are revisions of papers presented in December 1979 at a conference funded by the National Science Foundation. They are grouped by three major topics: (1) empirical results of resource substitution and resource-saving technologies, (2) problems arising from recent research, and (3) dynamic models.

The introduction provides a useful chronological survey of empirical applications of duality theory. It reviews Nerlove's (5)<sup>1</sup> estimation of electricity generating technology, McFadden's (4) and Diewert's (2) work on flexible functional forms, and Christensen, Jorgenson, and Lau's (1) analysis using transcendental logarithmic functions. The introduction indicates that in 1961 Heady and Dillon (3) had examined a second-degree polynomial logarithmic function (later known as the translog function) and had provided least-squares regression estimates of a square root transformation, which is a special case of the generalized linear production function introduced by Diewert.

The introduction sets the conceptual tone for the book. That is, scarcity of natural resources increases prices, and it causes substitution of inputs in production, technological change, higher output prices, and reduced consumption of resource-intensive goods. If substitution possibilities are limited and technological change is slow, then economic pressures from resource scarcity are likely to be significant.

The first two sections concentrate on using dual cost functions to derive factor demand relationships conducive to econometric estimation. These sections provide a valuable survey of systems estimation techniques that use flexible functional forms. The systems approach highlights the interrelatedness of all inputs in production.

Each article includes an empirical application. Industries are classified by the type of factor substitution and technological

change (Jorgenson-Fraumeni and Moroney-Trapani) and are examined for endogenous factor prices (Anderson). Single-period market equilibrium is assumed in each case. The distinctions between long- and short-run effects, based on whether the data are cross-sectional or time series, are discussed.

By focusing on econometric applications, the book neglects the potential contribution of mathematical programming to analyzing input substitution. Programming models allow researchers to analyze the effects of input price changes on factor substitution and technological change in a deterministic framework. The Kopp-Smith paper blends an econometric approach with pseudo-data generated by a programming model.

All the analyses, except for Kopp-Smith's, use aggregate data. They contain virtually no discussion of firm-level modeling. Industry- and sector-level models are specified and estimated with little theoretical justification. This limitation detracts from the quality of the conceptual models. Furthermore, the applications rely extensively on the translogarithmic function. The translog is only one example of many flexible forms that one can use to model input demand.

The third and last section of the book, dynamic models, is the most interesting. Berndt, Morrison, and Watkins present an excellent survey of dynamic models. The assumption of single-period market equilibrium is relaxed and input disequilibrium models are presented. The first generation of models assumes that firms are unable to adjust factor demands instantaneously to long-run equilibrium levels. This generation of models is represented either by generalizing a partial adjustment process to an input demand system or by utilizing a restricted cost function where one input, typically capital, is assumed to be quasi-fixed. Brown and Christensen apply a restricted, variable cost function to analyze U.S. agricultural production.

The second-generation dynamic models are an important addition to the theory and methodology of analyzing input use. These models are based explicitly on dynamic economic optimization that incorporates adjustment costs for quasi-fixed factors. Unlike first-generation models, speeds of adjustment of quasi-fixed factors to long-run equilibrium levels are endogenous and may vary through time. Short-run demand equations depend on input prices, output, and stocks of the quasi-fixed inputs. The dynamic adjustment path to long-run equilibrium is based on economic optimization.

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<sup>1</sup>Italicized numbers in parentheses refer to items in the References at the end of this review.

tion at each point in time Denny, Fuss, and Waverman provide an example of a second-generation dynamic model

In the past decade, there has been a dearth of stochastic input demand studies in agricultural economics Spinks and Dahl (6), in an extensive bibliography of economic input studies, reveal that the literature contains few input demand analyses using econometrics The lack of attention to this type of analysis can be attributed to the difficulties of formulating an agricultural input demand system which is conducive to econometric estimation and to the lack of input quantity data Yet, the effects of input prices, such as capital, energy, land, and water, are crucial to agricultural production and food supply Agricultural policy analysis is difficult without an understanding of the potential affects of input price increases on production costs, output, and input use The dynamic approaches discussed at the end of this book provide a valuable conceptual framework from which to address this problem The agricultural production process is itself stochastic, expected and actual output may differ substantially, depending on the effects of weather The assumptions used to model the manufacturing sector may be inappropriate for agriculture The dynamic disequilibrium framework offers an interesting alternative to conventional agricultural models

The book is an ambitious undertaking Although it has inadequacies, it clearly indicates the interrelatedness of input use, capital formation, productivity, and prices It provides a broad view of econometric approaches from which re-

searchers can analyze the derived demand for inputs It is an excellent state-of-the-art survey of modeling resource demand

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## In Earlier Issues

Different measures of rate of sales, such as pounds per 100 customers, pounds per store, and dollars worth of apples sold per \$100 of sales of all commodities, involve different concepts There are conceptual differences that are more than just a question of whether distance, for example, should be measured in terms of inches or centimeters Thus, the criteria for choosing a measure of rate of sales should include the utility of the different measures assuming no sampling error as well as sampling variability and biases

Earl E Houseman  
Vol 7, No 2, April 1955, pp 38-39

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# Environmental Regulation and the U.S. Economy

H. Peskin, P. Portney, and A. Kneese, eds. Washington, D C.: Resources for the Future, 1981, 163 pp, \$15 00 (cloth), \$5.95 (paper).

Reviewed by Stan Daberkow\*

Regulation continues to hold the interest of producers, consumers, the Congress, the current administration, and, of course, economists. The thrust of this attention has been changing, however. We are no longer in an era of regulatory expansionism, and, in fact, some suggest that contraction either has begun or should begin. This book presents a compilation of articles that spotlight the state-of-the-art of environmental regulation policy and analysis. Although the book concentrates on the relationships between environmental regulation and the aggregate U.S. economy, agricultural economists may find the political analyses, methodological techniques, and policy design discussions stimulating.

Bosworth begins by discussing the past and present political economy of environmental regulation. During the sixties and early seventies, economic growth was taken for granted. Public policy focused on inflation, unemployment, and the distribution of income and on the protection of workers, consumers, and the environment from the externalities of an industrial society. Public policy is now focused on productivity and growth. Regulation becomes an issue because regulation implies increasing costs of production and additional competition for scarce resources. If high unemployment and foregone production are incurred to abate inflation, Government regulations which have the effect of price increases will not be tolerated. Bosworth also discusses the relationship between real income and productivity. He suggests that proposed and current environmental regulations will garner little support because individuals perceive them as reducing real income. This situation is even true if benefits of regulation exceed costs because the unquantifiable beneficial effects may be less obvious than price or output effects.

Portney discusses (1) the expenditures by consumers, industry, and Government to meet environmental regulations designed to correct market failure arising from externalities or imperfect knowledge and (2) the methods used by economic modelers. He states various caveats on the use of econometric models due to inherent limitations of mathematical systems and the use of flawed data. He compares environmental expenditure sources (for example, Bureau of Economic Analysis, Council of Environmental Quality, Environmental Protection Agency, McGraw-Hill, and U.S. Census) with respect to data collection and analysis. Environmental regulation modeling efforts typically consist of at least two simulations—one with

spending and other changes induced by regulation and one without the spending. The difference reflects the effect of regulation. Although Portney recognizes these models have weaknesses (for example, inability to adequately incorporate the benefits of regulation such as reduced risk of illness or death, reduced medical costs, reduced cleaning costs, and increased agricultural yields), he defends the use of large macromodels because of their comprehensiveness (that is, trade, unemployment, inflation, investment, price, and output effects) and their capacity to make predictions which are integrated and simultaneously determined.

Haveman and Christiansen discuss U.S. productivity growth as influenced by environmental regulation. Their discussion is threefold: (1) concepts, measurement, and status of U.S. productivity, (2) factors affecting productivity measures, and (3) the part that environmental regulation plays in productivity growth. The first part of their article concerning concepts and measurement is weak and does not properly set the stage for what follows. The changing composition of U.S. output (that is, agricultural goods to industrial goods and manufactured goods to a service economy), declining research and development as a percentage of gross national product, the dramatic increase in the proportion of unskilled women and teenagers in the labor force, declining capital/labor ratios, and rapid and large increases in energy prices are factors in addition to regulation which influence productivity. The authors produce hypotheses and review studies which attempt to quantify the impact of regulatory activity on productivity. They conclude that regulation causes measured inputs to increase whereas measured outputs change very little, hence, economic welfare may be increasing while input/output ratios increase.

Peskin elaborates on the Haveman-Christiansen hypothesis by investigating the extent to which changes in the quality of the environment resulting from regulation are captured in the national accounts. He suggests modifications in the current national accounts so they can more closely reflect the changing quality of the environment.

Harrington and Krupnick present an extensive historical perspective on pollution policy that includes the major 1977 changes in regulations. Recent procedural changes, such as marketable pollution permits, effluent charges, and other economic incentive devices, are contrasted with technology- or engineering-based standards. As current industrial air and water-pollution policies come under attack for imposing excessive costs and retarding innovation and investment, these alternatives will gain greater acceptance.

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Ridker and Watson examine the longrun effects of environmental regulation on the U S economy. Using dynamic input/output techniques and assumed levels of economic growth, population growth, and technological change, the authors make regional forecasts to the year 2025. Agricultural economists interested in nonpoint sediment and pesticide runoff from agricultural production will find both issues treated explicitly in the model. The authors conclude that "substantial control of the common mass pollutants can be achieved without undue interference with the national economy" (p. 150). This is the least documented article in the book, and, partly because of the nature and size of the research project, the reader must obtain the cited literature to determine the assumptions used.

The book's material is germane for agricultural economists interested in the environment and natural resources. Casual observers of resource policies will find the book readable because the authors keep the technical aspects of modeling to a minimum and emphasize policy and data. The book's major fault is its somewhat disjointed nature resulting from the variety of topics. One gets the impression that the book was quickly cast in an effort to report environmental policy and economic research activity at their zenith. Despite this shortcoming, it is a good reference for pollution policy, data sources, mensuration issues, and environmental modeling.

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### In Earlier Issues

With expanding use of electricity, improved roads and mechanical power, and further consolidation of institutions in the trading centers, less differential between farm and city dwellers is indicated. Government will continue to have a large role in protecting farmers from natural disasters and economic crises. Farm depressions have been forerunners of general depressions, and these are no longer viewed as acts of God, but as man-made, as such they are subject to human control. There is scarcely a farmer in the United States at mid-century who is not familiar with the appearance of a Federal Government check, in 1930 there was scarcely one who was. Migrants and other farm laborers and many small operators have received relatively little if any benefits from recent ameliorative agricultural programs. Legislation has favored the "haves" and left the "have-nots" little better off than they were before.

*Lowry Nelson*  
*As paraphrased by Arthur F. Raper*  
*Vol. 7, No. 2, April 1955, p. 56*

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