

Future Directions for Agricultural Policy Analysis

Luther Tweeten

My task is to summarize briefly some highlights of the conference and suggest future directions for agricultural policy analysis. I define policy analysis here to include policy problems or issues and econometric models to address them. The term "econometric models" is used broadly herein to include not only those combining economic theory, statistics, and mathematics, but also models such as simulation and linear programming which contain no statistical component. After discussing issues of economics as a predictive science, including the institutional environment for econometric modeling, I relate modeling efforts to selected policy issues likely to be prominent in the 1980s.

Economics as a Predictive Science

Economics has progressed from a science of classification and explanation to include prediction. The economy, like the weather, influences people's lives each day. The public's appetite seems to be insatiable for weather and economic forecasts, despite their frequent imperfections. George **Meany** said that economics is the only profession where a person can gain great eminence without ever being right. (Soviet economist Nikolai Kondratieff was an exception; he was executed for his long-term growth cycle theory which, to his misfortune, predicted an oscillating rather than a truncated future for capitalist economies.) This issue is not whether but how well and by what means economists predict the future.

Econometric models are here to stay in part because they have become to prediction what mathematics earlier had become to economic theory — a systematic way of dealing with complex situations while allowing scrutiny of assumptions and logical processes.

Yet many of the symposium participants seemed to agree with S. R. Johnson's conclusions, presumably based on his own perceptions as well as a dozen reviews he cited of the performance of various sector and economy-wide models, that "the record of economics in developing policy models for decisionmaking purposes at the sector and more aggregate levels is anything but distinguished; . . . performance of economic models has not met the claims by their architects or the anticipations of policymakers."

At least one conference participant expressed a different view. L. R. Klein stated that, "As forecasting devices, the Wharton Model and similar mainstream econometric models have stood the test of time." However, Stephen McNeese (reference 6) found that average judgmental forecasts of the economy collected from a panel of members of the American Statistical Association were no worse than mainstream econometric model forecasts. An evaluation by Richard Just and Gordon Rausser (4) revealed that forecasts of agricultural commodity prices were on the average no more accurate from econometric models than from the futures market. At the July 1981 meeting of the American Agricultural Economics Association, Cornelius (1) presented results showing that judgmental livestock price predictions by agricultural outlook specialists were as accurate as those from mainstream econometric models of private firms. The econometric models have advantages, however, in providing a rich and systematic source of forecasts on a wide range of economic outcomes, including alternative policy scenarios. Mainstream models are powerful educational devices that have enlarged the audience for econometric analysis. They have encouraged decision-makers to think in terms of what-if questions of sensitivity analysis, economic interactions, critical factors to monitor, and opportunities for further application of alternative types of econometric models. Furthermore, the mainstream econometric models have the advantage of continuity in contrast to what Earl Heady called the "one night stand" frequently characterizing policy models originating in universities, which are abandoned following completion of the thesis or journal articles of the graduate student who constructed the model.

The Institutional Setting

Without doubt, a major innovation in the institutional environment of economic modeling is the emergence of the mainstream

econometric models of the Wharton type. The disadvantage of relying on such models alone is that they are built to respond to the short-term political horizon of the federal government, as noted by Dale Hathaway. The federal government can respond to pressures to increase national income and employment much more quickly by stimulating aggregate demand than by stimulating aggregate supply through incentives for savings, investment, and economic efficiency. Accordingly, emphasis in mainstream economic modeling is on demand-side rather than supply-side economics. The result of pursuing a series of short-term, demand-side expedients for an extended period is a chronically underachieving economy (14). The point is that the institutional framework for economic modeling sometimes must provide an environment for educating the public by answering questions policymakers are not asking. These questions, which need to become part of the national public dialogue, deal frequently with distributional and long-term economic impacts of current or potential policies. Economic models need to present a vision of what could be as well as what is or what will be.

A strong case can be made for a pluralistic institutional setting for econometric modeling. Modeling is an emerging science; some trial and error is unavoidable with an opportunity for the most successful systems to survive based on accuracy of predictions and other norms of performance. A mixed system offers advantages including checks and balances on each system. Universities are frequently in a position to innovate and exercise academic freedom in making sometimes unpopular results available to the public with a minimum of political interference. Basic research at universities on use of optimal control theories and procedures and of marginal utility of income to ascertain impacts of income redistribution offer potential for improved policy analysis, but bugs will have to be worked out before such approaches will be adopted by federal and private agencies providing day-to-day inputs to policymakers.¹

The Economic Research Service (ERS) of the USDA has continuity and can direct considerable professional resources to data collection and monitoring and to analysis using models designed at ERS or elsewhere to respond to pressing policy issues raised by the execu-

1. A case can be made for diverting resources from construction of new models to maintaining and improving existing models. But concentration of a few "good" models in a few locations also has drawbacks — there is no evidence that monopoly induces innovation.

tive or legislative branches of government. Private firms are in a position to provide continuity, quick turnaround, and results from complex and tested models for those who can afford to pay. The system is further enriched by models of other institutions such as Federal Reserve Banks.

The advantages of each contributor can sometimes be joined in cooperative efforts between, say, universities and the federal government. As part of a U.S. General Accounting Office survey, questionnaires were sent to developers of agricultural models asking, "Excluding your model, what model would you consider best for evaluating federal food policies on national and international levels?". The four most frequently mentioned models were POLISIM, the Iowa State Programming Models developed by Earl Heady and associates, NIRAP, and the USDA Cross Commodity Forecasting System. The observation of interest from an institutional perspective is that each of these models either originated in or received financial support from ERS.² Although at least three of the above models had origins in land grant universities, the models would have had less continuity and usefulness without USDA support. At issue is whether, in the face of budget cutbacks and personnel reductions, ERS can continue to provide the environment for data quantity and quality and for econometric model construction and maintenance; and whether universities and private companies can fill voids in the event of less ERS support.

Efforts to Improve Econometric Modeling

Conference participants offered generous and sometimes conflicting observations concerning shortcomings of models and how to remedy them. S. R. Johnson expressed concern that complex models manipulated by "curve fitting" to obtain good *ex post* "predictions" in fact provide exaggerated estimates of statistical significance, narrowness of confidence intervals, and *ex ante* ability to predict.³ He called for "relatively uncomplicated" models, not

2. It is also notable that three of these models are not very complex. Of course, simple models are not necessarily small models. In the 1960s, ERS developed a large linear programming model (Aggregate Production Analysis System or APAS) to forecast farm commodity output in detail. Addition of complex recursive components and other constraints so complicated the model that it mercifully sank of its own weight.

3. One can obtain a perfect *ex post* fit simply by adding enough parameters. But such methods do not insure *ex ante* ability to predict.

"aggressive in theoretical content", and containing only well-developed theoretical specifications. Yet the reasoned imperatives cited by John **Penson** to make the national economy endogeneous and by **G. Edward Schuh** to make the international economy endogeneous in agricultural sector models translate into much expanded model specifications.

One is sorely tempted to side simultaneously with the conflicting counsel of Johnson, Schuh, and **Penson**. Small is beautiful; so is realism. But one must choose. Disputes over the magnitude of basic parameters, such as the price elasticity of U.S. export demand (see reference 8) and the tendency for a complex model to become a "black box" even to its architect, dictate that basic research on parameters and other aspects of specifications is required as we expand models. Construction of complex models guided only by how well equations "predict" the past often leaves little time for attention to the structural validity of coefficients. This lack of attention can lead to serious problems especially when attempts are made at structural analysis of the impact of untried policies or changes in the magnitude of one or a few explanatory variables. Of special importance is recognition of differences between short-term and long-term behavioral responses, a lack of which has generated some of the disagreement over the parameters magnitude, such as export demand elasticities. Time series may not contain the long-term response information needed to estimate long-run parameters and other approaches (2, 9) may be necessary. The issue is not trivial because the magnitude of the price elasticity of export demand is critical in determining the economic merits of policies such as a unilateral U.S. cartel in wheat or export subsidies.

Gordon Rausser and Richard Just, along with Dale Hathaway, stressed the advantages of involving policymakers in planning and designing models. There is no such thing as a truly general model, and it is very expensive to maintain a comprehensive model to respond to the wide range of questions posed by policymakers. Advances in computer hardware and software have reduced problems of managing large econometric models, but problems of specification as well as data remain. Maintaining capability to tailor-make special purpose models for responding to emerging policy questions is essential. Rausser and Just called for general purpose data *sets* rather than general purpose *models*. In this regard, the OASIS data base system recently made available through ERS is a

promising development for ready and widespread access to updated data. Communication of information on the conceptual basis and reliability of data has been inadequate when data were circulated in printed form. This problem could intensify as more data are disseminated electronically.

Future Policy Analysis

Two basic approaches can be taken in determining directions for agricultural policy analysis. One is to begin with analytical models, describing their faults and how to alleviate them in applying models to policy issues. The second is to begin with policy issues likely to be prominent in the 1980s, then discuss how econometric modeling can be applied to help resolve the issues.

Because the worth of econometric models derives from the information they provide to help make decisions that improve the well-being of society, it is useful to examine future agricultural policy issues in the context of what econometric models have or can contribute to their understanding and resolution. Don Parrlberg set forth a policy agenda with which I have no major quarrel. However, I agree with Lynn Daft that some of his assumptions (such as the future economic environment for agriculture) are appropriate grist for the econometric modeling mill. In my judgment, the principal economic concerns for farmers in the 1980s are instability in prices and incomes, cash-low and cost-price pressures (already apparent in the early 1980s), and concentration of economic activity in fewer farm and nonfarm firms. Consumers are concerned with production capacity, resiliency of food output in response to changing conditions, and impacts of higher energy costs, cropland losses, world population growth, and other factors in the price and availability of food.

I address these agricultural policy issues under the topics of (1) supply-demand balance for farm commodities and attendant issues of inflation and terms of trade for agriculture, (2) instability in economic outcomes, (3) the structure of the economy, especially of the agricultural industry and the agribusiness firms from which farmers purchase inputs and to which they sell output, and (4) resource limitations, including land losses to erosion, urban development, and other factors.

I do not take sides in whether the issues are best addressed by first, second, or third generation models (the latter preferred by

John Penson) or by linear programming, simulation, or neoclassical positivistic models (the latter preferred by Bruce Gardner). Each of these approaches has advantages and disadvantages and there appears to be no substitute for case by case judgment in determining when and where each model is appropriate.

Supply-Demand Balance

I have reviewed a half-dozen projections which without exception provide a glowing outlook for the farming economy in the 1980s. My own projections (12) are the least optimistic but also appear to be more favorable than the current situation warrants. Of course, the decade is only two years old, and subsequent years could validate the projections on the average. But if, as it now appears, models have gone wrong, what are the likely reasons? To examine possible reasons, we must look at the demand components (exports, inflation, and domestic population and income) and supply components (productivity and inflation) as well as at parameters.

First, considering demand, projections of domestic population and income are not a major source of projection error, in part because the income elasticity of demand is low for farm output.

Exports are an important component in their own right and also as part of the world supply-demand balance which is of humanitarian concern. A flurry of long-term projections seem to follow world food crises and some modelers confuse *need* with *effective demand* in world markets. All projections are plagued by unreliable data for developing countries and inability to deal with unpredictable weather and politics.

Estimates are also troubled by failure to account for interactions between international markets and monetary-fiscal policy. A policy of domestic monetary-fiscal restraint decreases the money supply and aggregate demand. The initial impact is to lower domestic prices relative to foreign prices of goods and services, thereby increasing exports, reducing imports and improving our trade balance. On the monetary side, higher interest rates cause dollars to flow into this country, improving the cash trade account while adding to the domestic money supply.

The improvement in balance of trade and financial reserves causes the value of the dollar to rise in international exchange, making our exports more expensive and imports less expensive, the reverse of the first round effects. General prices fluctuate through

the periods of stabilization and expansion called the inflation cycle, but what happens to farm prices paid and received, *ceteris paribus*? The demand for our agricultural exports is buffeted by these circumstances but the impacts have not been quantified.

Monetary restraint that is successful in slowing inflation reduces the cash-low squeeze (13) on the farming industry, but this benefit may be offset by loss of agricultural export markets as balance of payments improve and the value of the dollar rises in world markets. Expansionary macroeconomic policies produce results opposite those above.

The impact of national inflation on nominal demand and prices received by farmers for farm output is a major potential specification error on the demand side. If passthrough is low (a 1 percent increase in the general price level causes farm output prices to rise but by less than the increase in farm input prices), the immediate impact of inflation is to reduce directly the domestic terms of trade but improve the international terms of trade in U.S. farm products. While average estimates of inflation passthrough have been quantified (11), the extent of such passthrough has not been related to demand-pull, cost-push (e.g. from tight energy or food supplies), and wage-price inflation sources. It makes a great deal of difference to the farm sector if inflationary pressures come from a world food shortage rather than from the wage-price spiral.

The principal source of error is estimating intermediate and long-run prices and incomes for the farming industry appears to come from inaccurate estimates of shifts in supply rather than in demand. On the supply side, the specifications of productivity and inflation pose problems. Measures of productivity confound weather, capacity idled by government programs, and technology. Although weather cannot be forecast except in the short run, separation of the past effects of weather and technology on productivity would give helpful information on whether productivity gains are the result of unusually favorable weather or technology. Underestimation of productivity gains from technology in the 1980s may originate from the observed small real increases in resources for public research and extension which modelers expected to translate into low levels of productivity growth. Perhaps the lag between output and input will vindicate productivity projections in time, but an alternative explanation is that private domestic research and extension along with foreign imports of technology are having a larger impact than

expected. Specifications need to be improved but are severely hampered by lack of time series data on weather and private investment in farming technology.

Inflation is also a factor on the supply side, with inadequate accounting for the impact of the general price level on nominal supply at the farm level and hence on the ratio of prices received to prices paid by farmers. In short, the evidence suggests (11) that projections of real demand and supply (based on deflated price series) overestimate income by failure to account for the depressing effect of inflation on the ratio of prices received to prices paid by farmers.

Instability

Instability is a perennial farm problem and may become more prominent with a declining federal support of commodity programs (including disaster payments), growing cash costs relative to receipts, and rising share of demand from volatile exports.

Introduction of producers' risk into economic policy models has significantly improved specifications. Just's research (3) indicates that output induced by greater economic security under commodity programs may have offset production controls. Li et al. (5) found strong support for Friedman's permanent income hypothesis with a given average farm income inducing more investment as the transitory component enlarges relative to the permanent component. It is premature to say that finding of the Just and Li et al. studies contradict one another because they do not deal with the same resources.

It has long been public policy to assist farmers by providing outlook information to improve decisions and increase economic efficiency of benefit to the firm and society. Forecasts from numerous sources, including mainstream econometric models and outlook specialists, tend to bunch together and consequently err somewhat uniformly when underlying conditions change. Although unforeseen and perhaps unforeseeable changes in weather and political decisions such as export embargoes or an OPEC oil price adjustment are factors, an emerging problem may be self-defeating forecast feedback. Some outlook specialists contend that enough producers took optimistic beef and pork price outlook seriously the last few years so that production increased and prices fell. If self-defeating forecast feedback is the source of error, it represents a new

challenge to specification of price prediction equations. Of course, part of the forecast error may come from more conventional shortcomings such as failure to account for broiler and pork supply in projecting beef prices. Also the income elasticity of demand for beef may have fallen with slow growth or decline in consumers' incomes.

Structure

The issue of farm structure is now muted but will emerge from time to time. Economic modeling can provide helpful insight into the impact of federal monetary-fiscal policy — including income and estate taxes — on farm size, numbers, growth, and accessibility to new entrants.

The current rapid pace of industry mergers in an environment of passive federal antitrust efforts will renew farmers' and consumers' concerns over exploitation by input supply and output marketing and processing firms. Despite much rhetoric, we know comparatively little about the impact of such mergers and attendant industry concentration on economic efficiency or on farm and food prices. While evidence indicates that concentration of firms in the food marketing industry entails social costs (7), these costs need to be compared to costs from diseconomies associated with a more nearly atomistic structure of small firms. Economists are challenged to model the probable level and incidence of economic gains and losses from changes in the structure of marketing orders (e.g. termination of Class I premium and import restrictions and allowed use of reconstituted milk).

In short, considerable basic research will need to precede modeling of how the agribusiness economy operates with various degrees of concentration of industry.

Resource Constraints

Much concern is apparent today over "exporting our rich topsoil" and "urban encroachment" into prime farmlands. Serious gaps exist in our knowledge of how erosion and urban encroachment reduce cropland and farm output either in the past or for the future. Earl Heady and his associates at Iowa State University provides estimates on the impact of energy and pesticide restrictions or price increases on the location and level of farm output. Economic modeling can help to ascertain the tradeoffs between mandatory controls

on land use and exports on the one hand versus, on the other hand, economic inducements for proper land use (e.g., use of property taxes, full-cost charges for rural services, etc.) and more research and extension investments.

A related issue is the production capacity of agriculture and its resilience in responding to emerging conditions (16). A central and imponderable concern has been cropland availability in response to economic conditions. Acres of cropland available of various quantities have been identified in national soils inventories. But we lack adequate positivistic estimates of cropland supply response to prices. Our models will not adequately predict production capacity or tradeoffs between various options to increase production without improved estimates of cropland supply response to price. The public concern over exporting topsoil through erosion of soils used to produce exports does not seem to recognize that an additional bushel of corn for export provides in theory the same utility to Americans as another bushel for domestic purposes.

Again, the point of importance in this discussion of econometric modeling of policy issues is that model builders must give careful attention to specifications, including economic theory, both in formulation of models and in interpretation of results.

Summary

Econometric modeling now is an indispensable component of agricultural policy analysis. Contributors to the symposium recognized the problems of modeling both from the demand side (e.g., politicians tend to focus on short-term issues coincidental with their two-, four-, or six-year term of office) and from the supply side. On the supply side of modeling, participants appropriately emphasized problems of data and model specification more than the more narrowly quantitative concerns for statistical unbiasedness, consistency, and efficiency.

The institutional environment for policy modeling could have received more attention at the symposium. The growth of mainstream modeling in the private sector is a positive development but raises questions about the potential for crowding out modeling by universities and by the USDA which has the advantage of being close to data as well as to questions policymakers are asking. A need exists for some modeling institutions with independence to analyze with continuity policy issues of concern to the public at large. One

suggestion is for greater financial support for modeling centers from foundations or other somewhat politically neutral sources (see 10). Federal budget constraints that reduce quality and quantity of data and that interfere with continuity needed for improving successive generations of policy models are of continuing concern.

Agricultural issues of supply-demand balance, instability, structure, and resource limitations will be prominent in the 1980s. Modeling can provide basic information to help resolve the issues. But some very fundamental economic analyses relating to model structure and data are required as indicated in this paper. Some large models that perform reasonably well in predicting short-run economic outcomes lack structural integrity or contain distributed lag components that make them unsuitable for intermediate- and long-run predictions or for examining the impact of untried policies.

The diversity of econometric modeling efforts that has characterized the field since its inception has frequently been wasteful. A case can be made for fewer new models and for better maintenance of the old. No single approach to modeling can address the need for information and there appears to be no alternative to a case by case application of the best judgment possible in choosing analytical tools. Competition among model designs has merit as economists, policymakers, and the public sort out the best efforts based on ability to predict consequences of actual and prospective public policies rather than based on model size or sophistication.

References

- (1) Cornelias, James, "An Analysis of AAEA Survey of Annual Outlook: 1980 and Earlier Years," presented at annual meeting of American Agriculture Economic Association at Clemson University. July 27, 1981, Corvallis: Department of Agricultural and Resource Economics, Oregon State University, 1981.
- (2) Johnson, Paul R., "The Elasticity of Foreign Demand for U.S. Agricultural Products," *American Journal of Agricultural Economics*. 59(February 1977). pp. 735-6.
- (3) Just, Richard, "An Investigation of the Importance of Risk in Farmers' Decisions," *American Journal of Agricultural Economics*. 56(February 1974), pp. 14-25.
- (4) Just, Richard. and Gordon Rausser, "Commodity Price Forecasting With Large-Scale Econometric Models and the Futures Market." *American Journal of Agricultural Economics*, 63(May 1981), pp. 197-208.

- (5) Li, Elton, Luther **Tweeten**, and Stanley Rogers, "Farm Investment Under Uncertainty: An Application of the Permanent Income Hypothesis," Mimeo, Stillwater: Department of Agricultural Economics, Oklahoma State University, 1981.
- (6) McNees, Stephen K., "The Forecasting Record for the 1970s," *New England Economic Review*, September/October 1979, pp. 33-53.
- (7) Parker, Russell, and John **Connor**, "Estimates of Consumer Loss Due to Monopoly in the U.S. Food-Manufacturing Industries," *American Journal of Agricultural Economics*, 61(November 1979) pp. 626-39.
- (8) Thompson, Robert L., "A Survey of Recent U.S. Developments in International Agricultural Trade Models," BLA No. 21, Washington, D.C.: ERS, U.S. Department of Agriculture, September 1981.
- (9) **Tweeten**, Luther, "The Demand for U.S. Farm Output," *Stanford University Food Research Institute Studies*. 7(1967), pp. 343-369.
- (10) **Tweeten**, Luther, "Econometric Models of the Agricultural Sector: Discussion," *American Journal of Agricultural Economics*, 57(May 1975), pp. 181-84.
- (11) **Tweeten**, Luther, "An Economic Investigation into Inflation Passthrough to the Farm Sector," *Western Journal of Agricultural Economics*, 5(December 1980), pp. 89-106.
- (12) **Tweeten**, Luther, "Economic Outlook for Great Plains Agriculture," *Proceedings of Great Plains Agricultural Council*, Amarillo, Texas, July 1979. Lincoln: Great Plains Agricultural Council, University of Nebraska, pp. 1-26.
- (13) **Tweeten**, Luther, "Farmland Pricing and Cash Flow in an Inflationary Economy," Research Report P-811, Stillwater: Agricultural Experiment Station, Oklahoma State University, June 1981.
- (14) **Tweeten**, Luther, "Macroeconomics in Crisis: Agriculture in an Underachieving Economy," *American Journal of Agricultural Economics*, 62(December 1980), pp. 853-65.
- (15) U.S. General Accounting Office, *Food and Agriculture Models for Policy Analysis*, Washington, D.C.: GAO Commodity and Economic Development Division, CED-77-87, July 1977.
- (16) Yeh, Chung J., Luther **Tweeten**, and C. Leroy Quance, "U S. Agricultural Production Capacity," *American Journal of Agricultural Economics*, 59(February 1977). pp 37-48.