

Modeling Agriculture for Policy Analysis in the 1980s

By Marvin Duncan and Ann Laing Adair

Agricultural policy issues, in both the public and the private sectors, have become increasingly complex and intertwined with other economic and political issues. In the years ahead, these issues will be of considerable importance to farmers and to nonfarmers alike. Yet the methodology used by economists to support decisionmaking in these areas has not kept pace with the emerging issues.

In an effort to identify the shortfalls in policy analysis methodology and to contribute to proposed solutions, the Federal Reserve Bank of Kansas City brought together a distinguished group of participants at a symposium held on September 24 and 25, 1981, to examine the issue of "Modeling Agriculture for Policy Analysis in the 1980s."¹ This article summarizes the papers and the discussant remarks presented at that symposium.

THE VALUE OF MODELS IN POLICY ANALYSIS

The conference's keynote address examined the role of models in policy analysis. In that address, Lawrence Klein identified models as ap-

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proximations of reality, noting there is no single model for all purposes. Rather, the design of the model chosen for a purpose is in large part determined by the objectives for that model's use. While some models are very general in design and can be used in a variety of applications, special-purpose models are probably best for use in dealing with specialized problems.

¹ Participants at the symposium were Lawrence R. Klein, chairman of the professional board, Wharton EFA, Inc., and 1980 Nobel laureate in economics; Richard L. Feltner, consultant and former president, Federal Intermediate Credit Bank of Louisville; Don Paarlberg, professor emeritus, Purdue University; Lynn M. Daft, senior associate, Schnittker Associates; Dale E. Hathaway, principal member of Consultant International Group; John B. Penson, Jr., professor, Texas A&M University; Dean McKee, director of market economics, Deere & Co.; G. Edward Schuh, head of the Department of Agricultural and Applied Economics at the University of Minnesota; D. Gale Johnson, chairman of the Department of Economics and Eliakim Hastings Moore distinguished service professor, University of Chicago; Stanley R. Johnson, professor, University of Missouri-Columbia; Earl O. Heady, director of the Center for Agricultural and Rural Development and Charles F. Curtiss distinguished professor, Iowa State University; Gordon C. Rausser and Richard E. Just, department head and professor of agricultural and natural resource economics, respectively, University of California-Berkeley; Kenneth R. Farrell, senior fellow and director of the Food and Agricultural Policy Program, Resources for the Future; Bruce L. Gardner, professor, University of Maryland; William E. Kibler, deputy administrator for statistics in the Economic and Statistics Services, U.S.D.A.; and Luther G. Tweeten, Regents Professor of Agricultural Economics, Oklahoma State University.

Klein reported that the increasing capacity of computers to handle large amounts of data and to solve complex mathematical problems has led to the emergence of a number of large econometric models, such as those of Wharton Econometric Forecasting Associates, Data Resources, Inc., and others. These models typically are used for a variety of purposes, the most common being for forecasting the macroeconomy or significant parts of it. While the forecasting application is important and occupies a great deal of a modelbuilder's time, the largest use of econometric models in the policy process is for the study of economic alternatives.

In examining alternatives, a baseline solution that reproduces the actual economic outcome for a given time period is computed. Then policy targets are chosen, and policy controlled variables within the model are used to move the solution toward the policy objective. By examining various scenarios, the policymaker can examine the impact of a particular policy alternative on all sectors of the economy without actually having to implement the policy. In this manner, the best method for achieving a particular policy objective can be chosen. However, determining optimal policy outcomes still involves the use of the search and experimentation process.

Models of the agricultural sector have some distinctive features that are important to their applicability for policy analysis. They represent one sector of a total economy model and hence are an incomplete system. In the United States, agriculture does not dominate the country's economy as might be the case in some less developed countries. Yet, agriculture plays a major role in determining a politically sensitive component of the price level in the U.S. and is a major net contributor to the country's trade balance. In addition, agricultural models are distinctive in their incorporation of uncertainty, mainly due to weather variation, as a

major factor. By drawing on the expertise of meteorologists and combining this with economic relationships, one can use models in ways that take account of uncertainty, in a quantitative sense, even though one is unable to make precise point estimates of the variables affected by uncertainty.

Modelers and policymakers alike argue that credibility in model performance must be built on the basis of their *ex ante* forecast record. Klein asserted that as forecasting devices, mainstream econometric models have stood the test of time. The challenge is to improve that track record in the even more dynamic and interconnected environment of the future.

Richard L. Feltner, commenting on Klein's paper, suggested two ways to improve the use of models for policy formulation and decisionmaking. First, further developments in both methodology and variable definition are needed. In particular, more input by decisionmakers is needed in model development, especially in the definition of variables. Secondly, there is need for much greater understanding and acceptance of models by decisionmakers. The need for decisionmakers to inject intuition and personal judgment cannot be overemphasized. In that context, an understanding of the emerging issues likely to affect agriculture is important to both modeling and decisionmaking.

EMERGING ISSUES AFFECTING AGRICULTURE

Don Paarlberg addressed the emerging farm and food policy issues of the 1980s which are likely to confront decisionmakers and policymakers. Based on his assumptions for the decade of the 1980s, he outlined six major issues:

1. Commodity programs for farmers will be of diminishing importance. Moreover, those that remain

will likely limit price increases as well as provide a floor under farm product prices.

2. Resource issues will grow in importance. Agriculture's assumed first claim on land and water will come under question.
3. Energy pricing and rationing by market or by regulatory fiat will be debated. Biomass assistance programs will come under increasingly unfavorable scrutiny.
4. Consumer interest and influence in agriculture, while it may not increase, is not likely to diminish.
5. The structure of agriculture and the fate of the family farm will continue to be an important policy issue.
6. Finally, agriculture's white male tradition will be strongly challenged by labor, ethnic groups, and others on the fringe of the industry.

Paarlberg asserted that these issues will be addressed in a policy setting in which farmers no longer have the initiative. Instead, food and fiber issues will be decided in a broader economic and social context in which the role of policy analysis in support of decisionmaking will be even more important than at present. No longer will freestanding agricultural models suffice. Rather, policy models capable of cap-

turing the interrelationships between agriculture and the rest of the U.S. economy as well as the economies of other major U.S. trading partners must be developed more fully.

Lynn Daft, in reviewing the Paarlberg paper, questioned the certainty of the assumptions underlying Paarlberg's agenda of issues. He noted that the element of surprise in history, the mistakes in identifying a central tendency underlying policy issues, and the complicated and often conflicting attitudes toward government held by Americans contribute uncertainty and complication to the policy process. Agreeing with Paarlberg's description of the prospective policymaking environment, Daft added that although government policy relies on economic analysis to a greater degree than is commonly realized, the increasingly broad array of interests involved in agricultural policymaking will result in a process that is both more difficult to manage and more prone to error.

THE INTERFACE BETWEEN POLICYMAKERS AND MODELERS

For models to be useful, they must serve as effective aids in decisionmaking; therefore, the interface between modelers and policymakers is an important facet of the policy process. To the extent that there is a productive interaction, the difficulties and errors inherent in both modeling and policymaking can be reduced.

Dale Hathaway noted that policymaking, agricultural or otherwise, does not take place in a vacuum. Rather, it occurs within a number of constraints. For policymakers, the decision time frame is typically far shorter than is desirable for good decisionmaking, making the role of policy modeling and analysis both critical and difficult. Since political reality is the backdrop against which decisions are made, the path to an objective can become as important a consideration as the objective itself. This

point is particularly relevant since most policy decisions involve both benefit to some and cost to others.

Policymakers relying on models for guidance in decisionmaking are always concerned about the problem of misplaced preciseness. That is to say, it is far more tenable to have indicated the right direction of movement in a policy variable such as export sales, even though the exact magnitude proves incorrect, than to have been wrong on the direction of movement. Even when correct about direction, policymakers understand that they control a limited number of policy variables in the U.S. economic system. However, they often fail to recognize the risk of having those variables swamped by uncontrollable factors such as weather or interest rates.

As policymakers and modelers interact, Hathaway indicated, there are two sets of questions to which they must find answers. First, what are the possible means of achieving desired results and what will be the impact on various groups of using these different means? Second, what problems may occur, what are the consequences, and what is the probability of their occurrence?

Policymakers often fail to ask these questions and sometimes disregard the answers which they are given. They tend to ask modelbuilders for answers within a prestrained philosophical framework, and modelbuilders tend to provide answers that are further constrained by the limits of their data and models. When events outside the framework of their questions intervene, policymakers are disappointed with the model results and look elsewhere for advice. Modelbuilders are likewise frustrated to find policymakers taking actions based upon inaccurate or incomplete judgments on issues they could have addressed. However, once policymakers and modelbuilders learn the answers to these basic questions, they will be

more able to work toward an acceptable solution for both parties. Achieving such a solution, however, will require improved policy models.

IMPROVING THE MODELS

A major portion of the symposium agenda was allocated to examining ways to improve the models used for policy analysis. The following set of papers explored this issue from a number of perspectives.

Linkages to the Domestic Economy

John B. Penson, Jr. explained the need for models to capture the linkages between agriculture and the general economy if models are to be of maximum use to policymakers. He argued, as did Paarlberg and Daft, that agriculture is increasingly linked to the general economy through its needs for capital and manufactured inputs, for off-farm employment opportunities, and for a viable market for its products. He added that the linkage can be made in the other direction as well. The U.S. economy with a growing population depends on agriculture for food and fiber; and as U.S. farm export markets expand, processors, handlers, and marketers of farm products depend on a reliable source of supply. Agriculture makes a positive contribution to the nation's balance of trade, partially offsetting the continuing U.S. trade deficit.

Among the transmission mechanisms between agriculture and the general economy that need to be better specified in policy models are the indirect effects on agriculture of nonagricultural events. These include supply related factors affecting agricultural input markets and demand related factors affecting agricultural product markets. The direct effects of government actions such as monetary and

fiscal policy, farm policy, or other actions affecting the cost of capital to the farm sector or the mix of asset holdings for agriculture should also be specified in policy models, according to Penson.

Three generations of policy models are currently in use by policymakers. First generation models represent agriculture as a separate entity influenced by few macroeconomic variables, omitting the transmission mechanisms through which events in other sectors of the economy are relayed to agriculture. Second generation models forecast events in agriculture in a recursive fashion, taking current period outputs from macroeconomic model solutions as input into the agricultural sector model solutions. Such models represent the most commonly used policy models. Penson asserted that a third generation of models, which incorporate the desired linkages between agriculture and the rest of the economy simultaneously solving for desired values, offers the greatest promise as a policy analysis tool. That is because they have been demonstrated to lower forecast error and to have the capacity to answer a broader range of policy questions.

Dean McKee, while agreeing with Penson on the potential usefulness of such third generation models, noted that for many applications, second generation models have thus far proved adequate when measured against cost and data limitations.

Foreign Trade Linkages

As important as the U.S. domestic market is to agriculture, export markets exhibit greater growth and for a number of important commodities are already larger than domestic markets. Consequently, to be of increased usefulness to policymakers, future policy models must incorporate foreign trade linkages.

The ability of currently used trade models to perform effectively in light of changing international financial markets and government policy interventions was examined by G. Edward Schuh. He emphasized that monetary policy has had an increasingly important effect on world trade. Shifts to flexible exchange rates have permitted underlying comparative advantages to reveal themselves to a greater extent than under a fixed rate regime. Moreover, in the presence of well integrated international capital markets, flexible exchange rates force trade sectors to bear the adjustment of changes in monetary policy. Thus, Schuh argued, the impact of exchange rate change must now be incorporated into foreign trade models. Indeed, the increasingly well integrated international capital market itself has implications for agricultural markets and hence must be reflected in trade models.

Commodity markets need to be linked directly to domestic and international financial markets if models are to be of optimal use to policymakers in the future policy environment. To do so, agricultural sector models must be components of general equilibrium models of the economy—an argument frequently made at this symposium. Finally the policymodeler examining trade questions must model world agriculture, and must account for the interaction between agriculture and government policy.

D. Gale Johnson, responding to Schuh's analysis, cautioned policymodelers that the long-run effects of monetary policy on trade may be quite different from the short-run effects. Hence, the linkage of monetary policy to the trade sector promises to be far more complex than at first realized. Moreover, Johnson raised questions about the capacity to predict trade flows and about the importance of doing so, except as it reflects the trade policies of either exporter or importer. Indeed, price differentials within a commodity which reflect dif-

ferences in quality may be more important to policymakers. Johnson concluded that understanding the role of government decisions in policy analysis is complex and at the same time very desirable. For example, the impact on world commodity markets of the Russian decision to expand meat production has been very substantial.

Evaluating Alternative Model Designs

Stanley R. Johnson examined alternative statistical designs for policy models of the agricultural sector. Emphasizing the role of econometric models in support of decision-making, he argued that models ought to be both theoretically sound and have predictive accuracy. All too often, however, models, particularly large scale ones, have specifications that possess only a weak or perhaps nonexistent basis in economic theory. Thus, model performance has sometimes broken down when predictions have depended on environmental variables that were not, or could not be, adequately projected. The suggested solution for such a problem is twofold: include these variables in the model and have them predicted with the rest of the system; and provide better theoretical support for model specification.

Policy models must be amenable to constant updating of the data base, as well as to model revisions and reestimation. Additionally, it is critically important that a model have a design that supports the policy decisions to be made. Such a model, according to Johnson, would include both those variables under the control of the policymaker and variables whose values will be determined within the model and by which the system can be evaluated. Since it is very difficult to incorporate theoretical richness in the specifications of such aggregate models, it is likely that theoretically sound models may be relatively simple in design.

To achieve the accuracy of forecasting and predictive content required by policymakers, localization of the model to the relevant problem setting is important. A number of approaches for localizing models to improve forecast accuracy and for linking of policy instruments to performance variables may be used. Such approaches include combining information derived from the pattern of the error term within the model solution or directly reestimating the model while more heavily weighting past data collected during circumstances similar to the proposed policy exercise.

Responding to the Johnson paper, Earl O. Heady added support to the importance of continuity, respecification, and updating of policy models. In this way, econometric models can be made to provide meaningful results to policymakers over time. Addressing the questions of model design, Heady noted that models must first be sufficiently complex to make useful and dependable predictions and that, as a separate step, the policy analyst must then translate the model's results into a form useful to the appropriate policymaker.

While Johnson directed his discussion toward econometric models, Heady argued that since many policy issues will involve circumstances not previously experienced, they cannot be reflected in time series or sample data. Under such circumstances, programming or simulation models will be appropriate. In fact, the linking of econometric models with programming or simulation models into a hybrid model to be solved recursively may provide the answers to some issues faced by policymakers. Because the problems of agriculture are so heterogeneous and the quantities to be analyzed so various, no single model form can meet all of these needs. Thus, Heady concluded, modelers should maintain diversity in the types of models available for policy analysis.

USING MODELS IN POLICY ANALYSIS

In examining the use of models in policy analysis, Gordon C. Rausser and Richard E. Just noted that while the costs of policy modeling have been incurred in recent years, the anticipated benefits have not yet emerged. However, adherence to a well-defined set of principles regarding model use and specifications, information use, and policy selection should enhance the anticipated payoff to modelers and to policymakers.

Modelers and policymakers alike should clearly understand the purposes and goals of a policy model. Indeed, the purposes and goals must be defined with a view to the policy decisions to be evaluated. When this is done, models can be used to conduct experiments which test the outcomes of various policy prescriptions without risking unexpected or adverse impacts on the real economy.

When constructing models, it is conceptually useful to have available as much data and information processing capacity as is possible. In a realistic policy modeling situation, data are always in short supply and sometimes of uncertain quality. Cost constraints limit the information processing capacity as well. Thus, care and judgment must be exercised in selecting a set of data that are most useful and an analytic framework—model specification—that is tractable. Moreover, the analytic framework should permit the policymaker to track and to accommodate the impact of changes in the economic systems being modeled.

Rausser and Just pointed out that designing a model which is both operationally elegant and adaptable is a demanding goal. Such a model requires a fair amount of theoretical structure, although the degree of such structure will vary from model to model depending on the amount of historical information available. In determining the structure of the policy model, em-

phasis is best placed on relationships that enable the modeler to understand an entire economic system, rather than simply one market or one side of a market within a system. The way in which information is used in a model can substantially alter the results of the analysis conducted. Policymodelers ought to use both intuition and common sense in determining when to include and when to exclude data from model estimation. More recent data, for example, may merit greater weight than older data in the estimation process.

Policymodelers have historically debated the relative merits of specialized or general purpose models. Rausser and Just suggest that attention could better be directed toward acquiring general purpose data sets which would facilitate speedy development of smaller more specialized policy models.

Finally, Rausser and Just indicate that policy models ought to be constructed in a way that permits policymakers to extract an increased amount of information by observing the model results. In this way, the "tidal wave" effect resulting from unexpected events overwhelming the effects of planned policy intervention or the examination of the path the economy takes as it moves toward a policy goal can be explored with the use of models. As a result, the probability of unexpected and undesirable consequences of policy actions occurring can be minimized.

These principals constitute a suggested code of conduct which should permit the potential value of quantitative policy models to be realized. They emphasize trade-offs to be examined as the transition from conventional models to more operational policy models is made. In the final analysis, of course, as Rausser and Just suggest, major benefits from modeling public policy problems depend critically upon the sound judgment and experience of public decisionmakers and the analyst involved.

In discussing the Rausser and Just paper, Kenneth R. Farrell offered some perspectives on the use of models in the policy process. He noted the distrust many policymakers have for formal economic models and added that there are a number of valid reasons for this attitude including lack of reliability in model estimates and poor communication between policymakers and analysts. Moreover, economists may not be as sensitive as is appropriate to the fact that no one type of model suffices for all policy purposes. Additionally, since policy formulation is not a dispassionate, intellectually pure process, models must produce reliable, plausible forecasts of critical variables with rapid turnaround of the analysis—quite a challenge for most economists. Finally, echoing Rausser and Just, Farrell noted that model results should not stand alone in a presentation to policymakers. Intuition, judgment, experience, and a knowledge of institutions and markets must be coupled with model results in the policymaking process.

REMOVING OPERATIONAL CONSTRAINTS

Despite the desirability of developing agricultural policy models that are consistent with the principles laid out by Rausser, Just, and Farrell, some operational problems remain. In a paper addressing these problems, Bruce Gardner argued that answers to policy questions usually need to be quantitative—that is, to have numbers attached. In some instances, quantitative answers are required to qualitative questions. Thus, to resolve the problems modelers face, two major constraints must be resolved. The first constraint is lack of data. Often there is an absence of data needed to model past economic events empirically or the data is of low quality. Sometimes there is an absence of past economic events that allow for

assessment of proposed policy interventions. Without past experiences to provide data for modeling efforts, the modelbuilder's task becomes increasingly difficult. Additional funding for the collection and maintenance of data may be required to overcome this constraint.

The second constraint appears to be limitation of analysis. That is, economic theory is unable to properly forecast answers to questions, to guide empirical work that will do so, or to mobilize proper economic analysis in the political setting. Better theorizing by analysts could help alleviate this problem. And finally, when the chips are down in the real policy process, problems may on occasion not be resolvable because economic analysis may not be welcome.

In discussing the ways to relax constraints on modeling for policy analysis, Gardner questioned the usefulness of simulation—quantitative modeling without data—noting it is almost never a preferred analytical tool. When policy is involved, the issues in question are the unknown responses of human decisionmakers to policy options. A far more useful means to relax constraints on modeling may thus be experimentation, or using the data from the constantly occurring initiatives in agricultural policy to draw broader policy conclusions from such activities. According to Gardner, analytical shortcuts may be helpful in drawing inferences by indirect means. For example, the long-term consequences of a price-support regime in the United States are not observable, but a cross-country comparison of nations with different policy regimes might prove illuminating.

William Kibler, in response to Gardner's paper, noted the difficulty of funding data collection solely for policy analysis and suggested that data generated for production and marketing decisions might fill the gap if tapped.

Of course, more interaction between modelers and statisticians to determine what type of data should be collected for policy analysis purposes would help to assure useful data series. Kibler added that this interaction is important because due to financial constraints the ongoing problems of assuring data quality and adequate data series to support policy modeling will become more difficult to resolve in the future. Budget constraints make it necessary to carefully set priorities and standards for data collection that insure effective use of the resources available.

SUMMARY

In a closing luncheon address Luther Tweeten summarized the symposium, noting that economics has progressed from a science of classification and explanation to one that includes prediction. And while the predictive record of most models may leave something to be desired, they do provide a rich and systematic source of forecasts on a wide range of economic outcomes including alternative policy scenarios. As issues grow more complex, this source will become increasingly important in helping policymakers answer "what if" questions. Also, in part because large mainstream econometric models have educated the public and policymakers to the usefulness

of quantitative analysis, the demand for model support for policymaking appears likely to grow.

Tweeten believes that the 1980s will bring to agriculture a rich and varied array of policy issues to which economists can apply their modeling skills. Among them are the supply-demand balance for farm commodities and attendant issues of inflation and terms of trade for agriculture; the structure of the U.S. economy, especially that of the agricultural industry and of agribusiness firms; and resource issues, including land losses to various causes including erosion.

The challenge before the economics profession, and modelers in particular, will be to address these issues in terms meaningful to policymakers. This will require some fundamental research relating to model structure and data use. But in an era of greater austerity in the universities and in government, it will also require better management and development of research tools—along with identification and careful maintenance of essential data series. Finally, Tweeten alleged, it will require better communication between modelers and policymakers as to both the identification of the relevant decision variables in policy formation and the transmission to policymakers of useful output from policy models.

Proceedings from the symposium
are now available.

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