Directions in Econometric Modeling and Forecasting in U.S. Agriculture

Editor

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North-Holland

New Directions in Econometric Modeling and Forecasting in U.S. Agriculture

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CHAPTER 1

NEW CONCEPTUAL DEVELOPMENTS AND MEASUREMENTS FOR MODELING THE U. S. AGRICULTURAL SECTOR*

Gordon C. Rausser†

The use of economic models to represent various components of the U. S. agricultural sector has a long and rich history. This history has been eloquently documented by Leontif in his 1971 Presidential Address to the American Economic Association:

> "An exceptional example of a healthy balance between theoretical and empirical analysis and of the readiness of professional economists to cooperate with experts in the neighboring disciplines is offered by agricultural economics as it developed in this country over the last 50 years. . . . While centering their interest on only one part of the economic system, agricultural economists demonstrated the effectiveness of a systematic combination of theoretical approach with detailed factual analysis. They also were the first among economists to make use of advanced methods of mathematical statistics. However, in their hands, statistical inference became a complement to, not a substitute for, empirical research."

Shortly after World War II, the systematic combination of theory with empirical analysis began in earnest at the U. S. Department of Agriculture (USDA). These early efforts were made by Frederick Waugh and Karl Fox along with numerous others and typically concentrated on demand and/or supply estimation for a particular commodity. Over the years, these single-equation representations were expanded to include simultaneous interactions between supply and demand to determine market price as well as links between one commodity system and another, e.g., feed grains and livestock. The vast majority of these models were partial equilibrium frameworks involving the straightforward empirical application of conventional microeconomic theory.

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Throughout the 1950s and 1960s, the constructed empirical models were used as an aid to the evaluation of alternative policy strategies. In addition, the models were often used to generate conditional forecasts of various elements of the U. S. agricultural sector concentrating on different types of exogenous shocks. In effect, the models provided a means of conducting laboratory experiments without directly influencing the U. S. agricultural and food economy. The development of models by experienced analysts during this period frequently involved the combination of theory and empirical facts to sharpen judgments and perceptions of policymakers (Brandow).

The above developments, however, came to a screeching halt during 1972-73. The magnitude of increases in farm product and food prices surprised almost everyone within the public as well as the private sectors. To the U. S. government officials who were struggling to contain inflation, especially in the administered price sectors of the economy, the tremendous increase in food prices was indeed a bitter disappointment. At this juncture, it became crystal clear that the constructed models of the USDA were no longer viable. The forecasts generated by these models appeared to be outliers in comparison to the actual behavior of the system.

After much academic debate and the preparation of numerous reports, the profession came to the conclusion that the models constructed prior to 1972 could no longer serve as useful aids for evaluations of alternative policies or to forecast with any degree of accuracy the future behavior of the U. S. agricultural sector. This conclusion was based on the simple observation that the U. S. agricultural sector was no longer a closed system. The move to flexible exchange rates; the rapid expansion of international markets; the decreasing barriers between the agricultural economy and other domestic economic sectors; and, perhaps most importantly, the rapid change in the implementation of U. S. agricultural sectoral policies all pointed in the direction of an open system modeling approach. Up until the early 1970s, U. S. sector policies in effect isolated the agricultural sector from the world economy as well as the general domestic economy. The major sector policies that led to this insulation included, inter alia, farm credit, land diversions, domestic price supports, subsidies offered to exporters who bought at domestic price supports and sold at the lower world prices, and the active accumulation of public stocks which were released when market prices were above support prices and were augmented when market prices were at the price support or below. With the rapid explosion in prices during 1972-73, the sector policies became temporarily unnecessary. This, combined with the significant depreciation in the value of the dollar and the huge increases in world money supplies, provided an opportunity for a signficant increase in the links between the U. S. agricultural sector and the international economy.

In the face of the above events, a number of serious questions arose with regard to the specification, estimation, validation, and effective use of economic models of the U. S. agricultural sector. In early 1975, the Forecasts Support Group of the USDA called together a number of agricultural economists for their counsel and advice. At the Chicago meeting, Wayne Boutwell and Richard Haidacher of the Forecast Support Group, USDA, outlined proposed revisions in their model specifications and their plans for the future. After much free advice from the academic contingent at this meeting, it was decided to hold a series of annual conferences sponsored by the USDA and the Farm Foundation. Each of these conferences were to focus on modeling the U. S. agricultural sector. A total of five formal conferences were held over the years 1976 through 1980. Except for the conference held in Ottawa, Canada, in 1980, all took place in Washington, D. C. The first formal conference was organized by George Judge, University of Illinois; the second, by Stanley Johnson, University of Missouri, Columbia; the third, by Richard E. Just, University of California, Berkeley; the fourth, by Gordon C. Rausser, University of California, Berkeley; and the fifth, by Oscar R. Burt, Montana State University.

The participants of each conference included representatives from the Forecast Support Group of the USDA, academic representatives from U. S. and Canadian universities, representatives of the Economics Branch of Agriculture Canada, and model analysts from a number of commercial vendors of large-scale agricultural sector econometric models. As a result of the special blend of practitioners, applied research economists, and econometric theorists, a cross-fertilization occurred at these various conferences which, at times, was insightful and, at other times, meaningless. On the whole, however, the benefits to most participants at these conferences far outweighed the associated costs.

During the period that these conferences were held, the commercial vendors made major advancements in the construction and effective use of large-scale agricultural sector econometric models. The Forecast Support Group of the USDA, however, achieved far less success due, in part, to personnel turnover and uncertain funding commitments. Nevertheless, each of these two efforts provided an empirical background for the debate and discussion that took place at each conference. This empirical perspective imposed a degree of practicality that otherwise would not have existed.

Across the various conferences, the same issues continued to arise. As one would expect, these issues related to the entire process of model construction and use. Some agreement was achieved while many differences remained. For example, it was agreed at the first conference that the model purpose, whether forecasting, policy impact analysis, explanatory analysis, or simply descriptive analysis, was crucial in structuring the research strategy for model construction and use. Formally, the research strategy is determined by the model architect's view of the trade-off between complexity and inaccuracy or, equivalently, simplicity versus accuracy.

In terms of model specification, views of the simplicity-accuracy trade-off can result in widely different treatments of the U. S. agricultural sector. Only by defining the model purpose is it possible to evaluate quantitatively the trade-off between accuracy and complexity (Faden and Rausser). Many conference participants argued for all-purpose models or at least models that were able to forecast with accuracy and could also be used simultaneously for policy impact analysis. Other participants argued that it was only possible to construct single-purpose models, i.e., forecasting models or policy impact models but not both could be simultaneously embedded in the same representation. Of course, it was readily accepted by all participants that the ultimate model of the U. S. agricultural sector should be able to perform satisfactorily as both a forecasting tool and as a tool for evaluating alternative policies.

In determining the appropriate model specification, the major issues that arose related to the appropriate level of aggregation, the selection of endogenous and explanatory variables, and the distinguishing features of model representations for U. S. agriculture. The issue of aggregation assumed many different forms. For example, how many commodities should be included in the representation, which links must be treated with tender loving care (e.g., feed grain-livestock links), and which links can be treated superficially (fruits and vegetables-food grains)?

Each commodity system comprising the agricultural sector is composed of a number of components. These components include the input suppliers, the producers, the assemblers, the processors, the wholesalers, the distributors, and the utlimate consumers of the commodity in question. The treatment of each of these components must reflect a view about the appropriate level of aggregation and the selection of endogenous and explanatory variables. For example, can an appropriate degree of accuracy be achieved by endogenizing prices only at the farm level? Must we also endogenize prices at the retail and wholesale level? Should margin relationships be estimated along the vertical marketing chain from producer to ultimate consumer? The answers to these questions imply a particular specification of the endogenous variables as well as the level of aggregation. The vertical marketing chain for each commodity system can be represented by a single price point or be disaggregated across various components and, thus, be represented by numerous price points.

Spatial and temporal levels of aggregation also assume much importance in the U. S. agricultural sector. In terms of supply response, a spatial disaggregation is presumed to achieve greater accuracy in forecasting and policy impact analysis. Land allocated to soybeans in the Midwest faces different opportunity costs than land allocated to soybeans in the Southeast. On the food consumption side, the demographics and tastes in the Southeast may be quite different for some commodities than in, say, the West. In terms of temporal aggregation, a number of specifications are possible including annual, semiannual, quarterly, monthly, and, in some instances, even weekly time periods. Originally the forecast support group of the USDA specified an annual time period for their agricultural sector model. As a result, they were unable to model, with any degree of reliability, the stockholding behavior in the food and feed grain sector or the behavior of breeding stocks in the livestock sector.

The distinguishing features of model representations for the agricultural sector pertain to its stochastic/nonstochastic, dynamic/static, recursive/interdependent, decomposable/nondecomposable, linear/nonlinear, and interactive/noninteractive dimensions. In the case of agricultural and food commodity systems, uncertainty and large fluctuations are the rule rather than the exception. Hence, it is not expected that the U. S. agricultural sector could be represented by nonstochastic or deterministic models.