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AGRICULTURAL SECTOR MODELS AND THEIR INTERFACE
WITH THE GENERAL ECONOMY

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by

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AGRICULTURAL SECTOR MODELS AND THEIR INTERFACE WITH THE GENERAL ECONOMY*

Chen points out that macroeconometric forecasters have done very poorly in predicting inflation rates, etc., for the general economy because they have failed to predict changes in their exogenous prices, many of which pertain to the agricultural sector. But it can also be said that agricultural forecasters have done very poorly in predicting the recent large variations in agricultural prices; and again the reasons lie in the lack of inclusion or difficulty in prediction of exogenous variables, some of which pertain to the general economy. It thus appears that both general and agricultural forecasters may benefit by pooling their models.

In a sense, the above arguments indicate that the predictive power of econometric models may be increased by increasing endogeneity. The notion is plausible because, as exogenous variables are converted to endogenous ones, the econometrician is forced to identify more basic underlying forces which may lead to more useful predictions. This argument further suggests that the dynamic predictive performance of an econometric model in tracking certain variables should be evaluated not only in terms of the standard statistics, such as the root-mean-squared error, but also according to the degree of endogeneity of the model from which they are generated. If one continually "plugs in" values of a closely related but simultaneously determined variable throughout the period of simulation for another variable, then the predictive performance should obviously be much better than if closely related variables are also determined endogenously. The latter approach is also often more sensible for predictive purposes since measurements for simultaneously determined variables are not available in applied forecasting situations.

Before discussing the three papers of this session in this context, it is necessary to consider first what is an appropriate degree of endogeneity? Which variables in the general economy are determined simultaneously with or as a

result of variables in the agricultural economy and vice versa? How important are these simultaneous or feedback relationships?

Interaction Between the Farm and Nonfarm Sectors

The interface between the agricultural sector and the general economy includes at least three classes of relationships: (1) the interaction of general price and income levels, agricultural marketing costs, and agricultural prices in domestic demand for agricultural products; (2) the interaction of agricultural input markets, which are influenced by other economic sectors, with the supply side of the agricultural sector; and (3) the interaction of international trade in agricultural and nonagricultural goods in determining trade balances, exchange rates, and export demand. Traditionally, agricultural sector models have emphasized mainly the first class of relationships and, to a limited extent, the second. The third class of relationships has been almost universally ignored.

The paper by Heien, which provides a nice summary of many classical causal and theoretical arguments in agricultural models, typifies the traditional approach (at least in those parts of his paper which deal with the interface of agricultural and general econometric models). General price and income levels and marketing costs are considered, but the supply and trade interfaces with the general economy are disregarded. The degree of endogeneity in the econometric models produced by Heien is, indeed, very low.¹ For example, the farm-retail price spread for hogs and cattle is explained by using retail price as an exogenous variable.² Economic theory, however, indicates a high degree of simultaneity between farm and retail prices, and both can easily be treated endogenously in the same model. In his later regressions of retail beef, pork, and chicken prices on consumption of beef, pork, and chicken (Heien, table 1), it can again be argued that a great deal more endogeneity is possible and, perhaps, necessary. Within the mixed demand system approach Heien uses, the specifications of his equations

imply that consumption of all three commodities are determined prior to the corresponding prices. This possibility certainly seems unlikely, and exactly the reverse seems to hold on a day-to-day basis in grocery stores.

Turning to the Roop and Zeitner paper, one finds the second class of interface relationships relating to supply of agricultural inputs is also included. Hence, a feedback relationship is completed by linking both the input and output sides of the agricultural sector to the Wharton Mark IV econometric model of the general economy. However, the third class of interface relationships relating to international trade is absent. In fact, agricultural exports are apparently not considered endogenously by Roop and Zeitner at all. Such a practice may have been acceptable prior to the 1970's, but recent events too clearly point to the importance of trade and export demand in agricultural price determination. Although Roop and Zeitner's discussion suggests that "farm prices received enter directly into the determination of the unit value index of food exports" (p. 3), recent developments imply that a more likely possibility is exactly the opposite--that export demand and prices have been a major determinant of farm prices received--or that the two are determined simultaneously. Roop and Zeitner, in fact, admit their lack of confidence "that the important interactions between the agricultural sector and the macroeconomy are being captured" (p. 8).

Roop and Zeitner conclude that agriculture "is but a very small sector of the total economy" (p. 12). If this is true, then one can argue that there is no simultaneity or feedback between agriculture and the general economy; and, hence, an interface is only important from the standpoint of including general economic variables exogenously in the agricultural sector. Both of the other papers in this session, however, argue that this is not true and that agriculture does have an important impact on the general economy. Based on their arguments and the ones developed below, one must at least conclude that Roop and Zeitner's assertion

is unwarranted since their model specification precludes many of the economic relationships which lead to a strong impact of agriculture on the general economy.

Interaction of Agricultural and Nonagricultural Sectors Through Trade Balances and Exchange Rates

Before proceeding further, a brief review of some of the events of the early 1970's may be useful. In this context, one can then proceed to suggest ways in which agricultural, as well as general econometric models, have tended to be inadequate--especially in the interface.

Never before has this country experienced the kind of instability--in both agricultural and nonagricultural sectors--that it has in the last five years. Prices of some agricultural commodities like wheat, corn, and soybeans more than tripled from 1971 to 1974 and have since fallen by about half that amount (Commodity Research Bureau, Inc.). This tremendous volatility in U. S. agriculture has almost certainly been tied to international trade as evidenced by the large increase in Soviet demand for U. S. grain. Initially, these huge price increases were attributed to production shortfalls and rising affluency in the world as a whole and, particularly, in the Soviet Union. But later, Schuh advanced the hypothesis that currency realignment (exchange rate) was largely responsible for increased U. S. grain demand. Certainly, both variables (prices and exchange rates) made unprecedented movements almost simultaneously. The U. S. exchange rate [dollars per Special Drawing Right (SDR)] which had been stable for 20 years increased by about 25 percent from 1971 to 1974 and then declined again by about 10 percent (International Monetary Fund). Schuh further argued that "exchange rate has been an important omitted variable" in U. S. agricultural models (p. 11). His hypothesis has since been tested in an econometric model for U. S. wheat specifically designed for that purpose, and the results overwhelmingly support Schuh's arguments rather than the production or income explanations (Fletcher and Just).³ But one should note that exchange rates were treated exogenously in carrying out this test.

In the context of this discussion, the Chen paper is to be commended. He has developed a model which considers all three classes of interface relationships with the general economy. Both input and output linkages to the agricultural sector are provided, but also the impact of exchange rates enters in export demand equations for agricultural crops. Furthermore, much greater commodity detail is provided, the simultaneity within agriculture is much more explicitly included, the interaction of the feed and livestock sectors is clearly indicated, and government program variables are included in more detail and, thus, with more usefulness for policy-making purposes. Chen's arguments for commodity and intertemporal disaggregation are indeed sensible. The Roop and Zeitner paper is evidence supporting Chen's statement that "because of the gap existing between the complexities of farm commodity markets and the simplified nature of the agricultural sector specification in macro models little can be expected" (p. 1). Even in a model with much greater endogeneity, Chen's root-mean-square errors are generally lower than Roop and Zeitner's.

In view of the title of this session, however, it is appropriate to consider yet a further generalization in the interface of agricultural and general models. That is, the three agricultural commodities mentioned above, for which prices more than tripled (while exports soared), represented three of the five most important commodities (in value terms) in U. S. international trade as of 1974 (Commodity Research Bureau, Inc.). Furthermore, these three commodities are almost exclusively export items while the other two commodities (crude petroleum and iron-steel) were primarily import items. Of course, trade theory would indicate that when major export items are rapidly increasing in value, *ceteris paribus*, an extreme pressure is placed on trade balances, and eventually exchange rates must be adjusted to alleviate the pressure. And as exchange rates are adjusted, domestic prices of many other internationally traded items, such as imported automobiles, also begin to change. Hence, the recent large variations in

agricultural exports may have played a major role in the high rate of inflation in the general economy not just through the resulting high domestic food prices but through the international trade interface with the general economy. For a possible example, following roughly the same pattern as agricultural trade and general exchange rates, some steel prices more than quadrupled from 1971 to 1974 and then declined to about twice their 1971 levels (Commodity Research Bureau, Inc.). This casual evidence is not at all conclusive. The true causal relationships may run in either direction or simultaneously in both directions. But at least these arguments suggest the possibility of some interesting and badly needed experiments relating to the interface of agricultural and general econometric models and the importance of agriculture in determining U. S. trade balances and exchange rates.

U. S. exchange rates have now been deregulated for more than two years; and they have been, to some extent, determined by trade conditions since 1971 since that is when exchange rates began responding to balance-of-trade pressures. It thus seems that an endogenization of exchange rates in agricultural models or in the overall models in which they are imbedded is now appropriate particularly given the importance of agricultural commodities in U. S. trade. But such a step will require that we go far beyond the usual level of interfacing agriculture with the general economy. Appropriate possibilities must also be allowed for interaction of the agricultural sector with other commodities not only domestically but also in determining trade balances and exchange rates as well as the related feedback impact of exchange rates on export demand.

Footnotes

*Giannini Foundation Paper No. 429.

¹I recognize, however, that Heien may be merely intending to suggest functional forms which could be imbedded in larger econometric models with greater endogeneity.

²One must also question this procedure on grounds of econometric theory since, if retail price is stochastic, the regression disturbance would be correlated with the independent variable, retail price. In this case, Heien's estimation methods produce biased and inconsistent estimators.

³Although there have been several attempts to show that exchange rates cannot possibly explain more than about a 25 percent movement in prices because exchange rates only moved by about 25 percent, such conclusions are not warranted in a more general model. That is, if one considers that currency realignment is more closely akin to changing national income (e.g., changing purchasing power for all traded goods) rather than a simple price change for the commodity of interest, then in a model with several commodities one can find that both real price and quantity demanded for import (of a single good) may increase simultaneously purely as a result of exchange rate adjustment. Since this argument will be a topic of discussion in another paper, it will not be pursued further here. One might note at this point that, even though Chen considers exchange rates, his model does not allow this possibility since exchange rates are used only to modify the price of the specific good(s) in question.

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