

# Capturing the Linkages Between Agriculture and the Domestic Economy

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There are signs of an increasing recognition among agricultural economists that agriculture is a fully integrated partner in the nation's economy and should be treated as such when modeling aggregate outcomes in this sector. While early attempts to model outcomes in agriculture ignored many of the major linkages between this sector and the general economy, a move has been underway for several years now to explicitly account for many of these linkages in one fashion or another. These efforts generally can be differentiated by their recognition of the transmission mechanisms through which events outside the sector affect agriculture and by the timing of agriculture's effects on the rest of the domestic economy.

My assignment today is to discuss the interface between agriculture and the domestic economy and the importance of endogenizing these linkages when modeling events in agriculture. More specifically, I shall (1) briefly review the major interdependencies between agriculture and the rest of the economy, (2) review the mechanisms through which these interdependencies are transmitted, (3) identify the particular channels through which government actions directly affect agricultural outcomes, (4) discuss a few specification issues that affect the size and timing of "feedback effects" in the economy, and (5) assess the value of modeling the linkages between agriculture and the domestic economy in a fully simultaneous fashion.

## **Sources of Interdependency**

Two sectors in an economy are said to be interdependent if they rely directly on each other — or indirectly through a third sector — for the supply of a particular good or service used in their production processes. Thus, if agriculture both supplies inputs to, and

purchases products from, another sector, these sectors are said to be interdependent. The interdependencies between agriculture and the rest of this nation's economy essentially can be grouped into two categories: (1) Those dependencies that others have upon agriculture, and (2) those dependencies which agriculture has upon others.

### *Dependency of Others on Agriculture*

Perhaps the most obvious example of a dependency that others have upon agriculture in the domestic economy is the dependency of a growing population upon food and fiber products. For example, the processing and distribution sectors in the domestic economy are dependent on the supply of raw agricultural products as an input to their business operations. Today, these sectors serve as an important intermediary between agriculture and consumers, who are increasingly demanding more highly processed foods. Rural commercial banks and thrift institutions, as well as those nonfinancial firms that supply physical goods and services to farmers and their families, are also dependent upon a growing and prosperous agriculture. Finally, agriculture plays an important role in the U.S. balance of trade by partially offsetting the trade deficit in nonagricultural products.

### *Dependency of Agriculture on Others*

Agriculture has historically been rather self-sufficient, producing many of its input needs and financing much of its growth with internal equity capital. Over the post-World War II period, however, agriculture has become much more dependent on the manufactured production inputs supplied by other production sectors in the economy. One example is energy. Not only does agriculture need energy in its production process, but it also needs such inputs as fertilizer and chemicals which are also highly dependent on energy for their production.

The dependence on the goods and services supplied by other sectors is not limited to physical goods. For example, the percentage of annual farm business capital accumulation financed with external capital has increased dramatically over the post-World War II period (Penson). Off-farm employment also has become an increasingly important source of funds in financing additions to investment portfolios for specific groups of farm families. Thus, the growing dependency agriculture has upon the health of the general economy shows up in financial and nonagricultural labor markets as

well as in manufactured production input markets. Finally, agriculture is dependent upon viable demand for its products and upon the government sector in periods of physical and economic emergencies.

As a result of these dependencies on other sectors, agriculture today is increasingly subject to events taking place elsewhere in the economy. For example, an increase in export demand for agricultural products — for whatever reason — bids up both the price of these products and domestic farm incomes. The uncertainties associated with these markets, however, often translate into greater variability in domestic agricultural product prices and exposure to business risk for farmers. The cost, availability, and technology of the goods and services supplied to agriculture also have an effect on net incomes in agriculture and on the expansion of this sector's productive capacity. The costs of these goods and services, while rising over the post-World War II period, have been much easier to predict than agricultural product prices. One area where this has not been true is obviously energy. Another is the loan funds market, where the difficulty of forecasting their future cost of loanable funds has led many lenders to adopt instruments and policies that allow them to lower their exposure to interest rate risk. For borrowers, however, this may mean lower net incomes in periods of rising interest rates and increased exposure to financial risk.

With these generalizations in mind, I would like to initially focus on the channels through which events elsewhere in the domestic economy are transmitted to agriculture. Ed Schuh will be examining how events outside the domestic economy affect agriculture.

### **Transmission Mechanisms**

There is a wide variety of mechanisms through which events elsewhere in the domestic economy are transmitted through to agriculture. I have grouped these transmission mechanisms into two groups: (1) those mechanisms which transmit the indirect effects that events elsewhere in the domestic economy have upon agriculture, and (2) those mechanisms which transmit government actions that have a direct effect upon agriculture.<sup>1</sup>

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<sup>1</sup> In the short run, both prices and quantities transmit the effects events outside agriculture have upon this sector. This point will be emphasized at specific points in this section.

### *Indirect Effects of Nonagricultural Events*

In focusing on this group of transmission mechanisms, we are interested in the opposite side of those markets in which agriculture participates, or in those supply-related factors which affect markets where agriculture buys goods and services and in those demand-related factors which affect markets where agriculture sells goods and services. For example, the relative prices for other goods and services and the level of real disposable income have an effect on the prices farmers receive for their products in the raw agricultural products market. Farmers, of course, can eliminate much of the uncertainty about the effects these factors will have on the prices they receive by entering into a production contract or hedging their market position in the futures market.

In the manufactured inputs market, the prices manufacturers pay for their own inputs and their manufacturing capacity can affect both the availability of manufactured farm inputs and the prices farmers must pay when acquiring these inputs. In the case of durable inputs like farm tractors, an increase in the purchase price of the input will be just one of many factors influencing the implicit rental price to agricultural producers. Other factors include the effective ordinary income and capital gains income tax rates, tax depreciation rates, and the cost of debt and equity capital.<sup>2</sup> Previous studies by Hall and Jorgenson, Coen, and Penson, Romain, and Hughes show how an increase in the rental price of capital will decrease desired stocks of durable inputs.

The wage rates farmers pay for hired labor services will be affected by such factors as wage rates paid to comparably skilled workers in other sectors of the economy as well as strike actions taken by hired farm laborers.

Several mechanisms transmit the effects that events outside agriculture have upon the interest rates farmers either pay loans or

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2 Penson, Romain, and Hughes have expanded the specification of the implicit rental price of capital originally advanced by Hall and Jorgenson and by Coen to explicitly account for the cost associated with the capital structure specifically followed by farmers. This implicit rental price,  $X$ , is given by  $X = (QP/(1-F)) \cdot (A-C-T(G/(G+P)))/(1-T) + ((Z-TRW)/(1-T))$  where  $Q$  is the purchase price of the asset,  $P$  is the real after-tax cost of equity capital,  $F$  is the present value of the stream of capacity depreciation of the asset,  $A$  is the fraction of the purchase price financed with equity capital,  $C$  is the investment tax credit rate,  $T$  is the ordinary income tax rate,  $G$  is the tax depreciation rate,  $Z$  is the value of the periodic loan payment,  $R$  is the real rate of interest on debt capital, and  $W =$

receive on financial assets. The yields on securities offered by financial intermediaries and non-financial businesses, for example, will be affected by the demand for loanable funds and outside capital by these firms, except in those cases where yields are constrained by existing regulations. The cost and availability of loanable funds and the risk and returns on alternative uses of funds available to specific private financial intermediaries will affect the interest rates farmers must pay for loan funds. Both the yields on financial assets and the interest rates on loan funds will affect the weighted average cost of capital relevant to farmers, their implicit rental price of capital, the desired level and balance of their total investment portfolio, and their desired capital structure. Finally, the attractiveness of alternative uses of funds and the availability of funds to finance leasing operations will affect the cost and availability of lease-financing services to farmers.

This list of transmission mechanisms identifies many of the major — but certainly not all of the influences originating outside the sector that affect prices and quantities in markets where agriculture participates. In general, any variable representing an event occurring elsewhere in the economy which has an impact on (1) the supply of production inputs, financial assets, and loan funds to agriculture, or (2) the demand for raw agricultural products, represents a transmission mechanism through which events — regardless of where they originate — are made known to agriculture.

### *Direct Effects of Governmental Actions*

There are a variety of governmental actions that can directly affect the performance and growth of agriculture and the economic well-being of its participants. The monetary policy actions taken by the Federal Reserve System to meet its stated objectives, of course, affect all sectors of the economy through the cost and availability of money and credit and the purchasing power of current savings and wealth. While certainly of major importance, the transmission mechanisms through which monetary policy influence agriculture have already been largely covered. So have the effect that fiscal policy has upon other sectors of the economy. I am interested here in identifying those governmental actions that (1) support raw agricultural products prices and/or influence production, (2) affect the implicit rental price of capital and the desired portfolio balance in agriculture, and (3) affect the cost of estate transfers and the retire-

ment planning of farm families.

Actions that support raw agricultural product prices and/or influence agricultural output include (1) the CCC nonrecourse loan program and the provision of deficiency payments to producers of specific crops, (2) acreage allotments and set-aside provisions for certain crops, and (3) government purchases of agricultural products for defense, school lunches, and foreign food aid programs. These actions affect the level of farm income realized by farmers, their exposure to risk, the value of their farm assets, credit reserves, and contingent liabilities, and the growth of their firms. The Federal Crop Insurance Program — with its recently adopted all-risk features — provides farmers with the opportunity to further reduce their exposure to risk. Other governmental actions important to specific groups of farmers include the subsidized federal loan programs which make this sector a lender of last resort as well as a source of low-interest loans in periods of natural disasters and economic emergencies. These lending programs affect the cost and availability of loan funds to farmers, the ownership and control of agriculture, and the value of existing farm assets.

Actions that directly affect the implicit rental price of capital for farmers and the portfolio balance struck in agriculture include the fiscal policies of governments at the federal, state, and local levels. For example, the cost recovery deductions and limited expensing allowed under the recently passed Economic Recovery Tax Act of 1981 directly affect the implicit rental price of capital. By speeding up the rate at which the cost of personal tangible and real property can be recovered, the Reagan administration hopes to lower the implicit rental price of capital, increase retained earnings, and stimulate investment. Because the accelerated cost recovery system and other features of this new act are extended to all the production sectors in the economy rather than just to agriculture, events in other sectors (including government's need for funds) may further increase the cost of capital, and thus at least partially reduce the otherwise expected benefits from this action in agriculture. For this reason, both the direct and indirect effects of this and similar actions must be reflected in the implicit rental price of capital. Other fiscal policy actions are also transmitted directly to agriculture as well as indirectly through events elsewhere in the economy. These include investment tax credit; federal, state, and local ordinary income tax rates; the effective capital gains income tax rate; the definition of

what constitutes tax deductible expenses; and state and local property taxes. Following the line of thought expressed above for tax depreciation allowances, expansionary taxation policies reflected through these transmission mechanisms will lower the implicit rental price of capital and stimulate investment demand. As before, however, increases in the demand for external capital by firms in other sectors of the economy as well as by government may result in higher costs of capital if not its availability, and thus somewhat offset the desired expansionary effects of the government actions.

The final category of government actions discussed in this paper are those actions which affect the cost of estate transfers and planning for retirement income. The nature of federal estate and gift taxes and state inheritance taxes can affect the demand for loan funds by heirs of illiquid estates, the capital structure of their firms, and the supply of land for sale. For example, the Economic Recovery Tax Act of 1981 will no doubt substantially change the estate planning strategies of many individuals by increasing the amount of tax-free life-time gifts and estate transfers to their heirs. It also provides for the use valuation of real property if certain requirements are met, and raises the annual gift tax exclusion to \$10,000 per recipient (\$20,000 for both spouses). Because most firms in agriculture are sole proprietorships, these mechanisms are potentially much more important than they would be in sectors characterized by vastly held corporations. In addition, legislated retirement programs for self-employed individuals like farmers enables them to postpone the recognition of a portion of their current income for taxation while still earning a return on these funds. These funds are eventually recognized for tax purposes later when they are disbursed during the farmer's retirement years. The Economic Recovery Tax Act of 1981 also affects retirement planning in several ways. For example, the maximum contribution to individual retirement accounts has been increased. These and similar programs have an effect on the composition of investment portfolios in agriculture and the growth of the sector.

### **Other Specification Issues**

To assess the effects that events elsewhere in the domestic economy have upon agriculture, researchers should strive to incorporate the specific transmission mechanisms through which these events are relayed to agriculture when specifying their models. In this

section, I would like to address two additional specification issues that have a bearing on the size and timing of feedback effects in the economy.

### *Transmission Lags*

The first issue is the timing of the transmission of events elsewhere in the economy. Gordon, in an excellent survey article on the transmission of output fluctuations through prices, argues that this adjustment process is gradual in nature. Uncertainty about prices arises from the fact that markets do not clear instantaneously. During this period of disequilibrium, farmers will form expectations about prices based not only upon past prices, but on other information rationally thought to affect future prices. Thus, models which incorporate current prices when explaining outcomes in agriculture most assuredly will do poorly in forecasting future outcomes. The adaptive expectations hypothesis, used for many years, is being replaced by a variety of rational expectation hypotheses based upon the initial work of Muth in his landmark *Econometrica* article. For example, the work by Lucas, Sargent, and others — critically examined by Gordon — suggests that at least part of the forecast errors incurred by macroeconomic modelers in the past has been a result of how they modeled producer and consumer expectations.

### *Capacity Depreciation*

Considerable space has been devoted in the economic journals to the measurement of capital stocks and flows. Yet many macroeconomic modelers continue to assume that capital wears out in a geometric decay fashion because of the relative ease of employing this assumption. Coen has shown, however, that structures in the manufacturing sector wear out in a "one-hoss shay" capacity depreciation pattern much like the decline in the capacity of a light bulb. Coen — as did Griliches before him — also seriously questioned the wisdom of using the geometric decay capacity depreciation pattern when measuring stocks and flows of equipment. In fact, both have shown that the one-hoss shay and straight line patterns do a better job of capturing the factors underlying investment behavior when it comes to equipment than does the frequently used geometric decay pattern.

Penson, Hughes, and Nelson have shown that the choice of capacity depreciation pattern can have a significant effect on the

productive value of the existing stock of tractors on farms from one year to the next. Penson, Romain, and Hughes have also shown that this choice will affect the time series data on the implicit rental price of capital, the lagged capital stock, and the lagged dependent variable used in econometric investigations of net investment behavior, as well as the derived partial production elasticities in aggregate production functions. In short, adoption of the geometric decay capacity depreciation pattern when measuring the productive value of capital, in a world characterized by much smaller annual losses of capacity in the early stages of an asset's service life, will understate the productive capacity of agriculture, overstates its productivity, and bias econometric investigations of aggregate investment behavior in this sector. Importantly, similar measurement practices in other sectors of the economy will also affect forecasts of agricultural outcomes through their effects on many of the transmission mechanisms identified earlier in this paper.

### **Classification of Existing Models**

Agricultural sector models can be categorized according to the manner in which they recognize the linkages between agriculture and the rest of the general economy. Three such generations are described in this section.

#### ***First Generation Models***

First generation models view agriculture as a separate entity. Agriculture in these stand-alone models is influenced by relatively few macroeconomic variables. Three variables normally chosen are consumer disposable income, interest rates, and a particular broadly based implicit price deflator. Disturbances originating in agriculture, however, are assumed to have no impact on the rest of the domestic economy in first generation models, no matter how long the length of the forecast horizon.

Representatives of first generation models include the aggregative income and wealth (AIW) simulator developed by Penson, the Polysim simulator reported by Ray and Richardson, the capital and credit simulation model developed by Melichar, the agricultural sector modeling of Duloy and Norton, the national crop response model maintained by the USDA during the 1960s and early 1970s, and the sector simulation model reported recently by Schutzer, Roberts, Heady and Gunjal to name a few. Single equation models

and market equilibrium models focusing on a particular agricultural commodity or group of commodities like the Yeh model of the supply and demand for raw agricultural products can also be classified as first generation models because of their stand-alone nature.

First generation models focusing on the agricultural sector generally omit many of the transmission mechanisms through which events in other sectors of the domestic economy are relayed to agriculture. Investment functions, for example, generally fail to include some of the arguments contained in the implicit rental price of capital discussed earlier. In fact, one particular model forecasting capital flows in agriculture omitted any references to the cost of capital.

### *Second Generation Models*

Second generation models are those which forecast events in agriculture in a recursive fashion. An economy-wide macroeconomic model is first used to forecast a set of macroeconomic variables which appear in the agricultural sector equations. This information is then used to solve the agricultural sector equations. Finally, the solution values for a selected number of agricultural variables are fed back to the macroeconomic model and the macroeconomic solved again. No attempt is made to iterate this feedback loop in search of a set of a general equilibrium prices and quantities. Thus, while agriculture has an impact on the general economy in these models, the impact is delayed one period.

Representatives of second generation models include the Wharton Agricultural Model as reported by Chen and the Federal Reserve-MIT-Penn econometric model. These econometric models generally focus on flows of funds (but not capital flows), with net farm income being the only measure of the economic well-being of participants in agriculture. While these agricultural sector models are linked with macroeconomic models of the U.S. economy, these linkages are recursive rather than fully simultaneous in nature. An interesting twist to this recursive linkage is offered by the Federal Reserve-MIT-Penn model, where current agricultural product prices are explained by current nonagricultural product prices.

Because these models generally ignore capital stocks and flows in agriculture as well as the composition of farmers' investment portfolio, such transmission mechanisms as the implicit rental price of capital and market interest rates and yields are excluded from the

agricultural equations. One exception is the use of average interest rates to determine current interest expenses. Interestingly enough, some second generation models which project interest expenses in agriculture so that they can project net farm income do so without projecting period-to-period fluctuations in farm debt outstanding.

### ***Third Generation Models***

The linkages between agriculture and the general economy have been discussed in a number of invited papers and discussions presented at American Agricultural Economics Association (AAEA) meetings by King, Popkin, Roop and Zeitner, Johnson, Just, Penson and Hughes, and Gardner. Just, for example, summarized his concerns regarding partial equilibrium analyses by concluding that "both general and agricultural forecasters may benefit by pooling their models" (p. 137). Johnson criticized models designed to capture the linkages between agriculture and the rest of the general economy by recursively linking agricultural sector models to established macroeconomic models, concluding that "there must be more to the connection between economic sectors of the economy" (p. 134).

In response to calls for endogenization of the linkages between agriculture and the rest of the general economy, several econometric models of the U.S. economy determine agricultural outcomes simultaneously with outcomes in other sectors have been developed in the last few years. The first model, discussed in a contributed paper presented by Shei and Thompson at the 1979 AAEA meetings, was extremely aggregate, capturing the entire economy in fewer than 40 equations. Lamm later reported an even more aggregate model of the U.S. economy which included only 28 equations. By condensing the coverage of the economy to such a small number of equations, both models mask many useful economic relationships. For example, there are only three inputs to agricultural production in the Lamm model: (1) the real annual capital flow in agriculture, (2) the size of the agricultural labor force, and (3) time. While other issues about the specification of this function can be raised, certainly further disaggregation can be justified to at least capture the input substitution brought about by the changing relative costs of fuel and capital.

Prentice has recently developed a macroeconomic model which consists of more than 100 equations. This model thus provides more

detailed information than those reported by Shei and Thompson and by Larnrn. This model lacks any reference to credit markets, however. Because farmers finance a large share of their expenditures with external capital, the linkages between agriculture and the financial markets in the economy should be endogenized.

A fourth multi-sector macroeconomic model containing a fully simultaneous agricultural sector was recently reported by Hughes and Penson. Their model captures the linkages between (1) agriculture and the suppliers of manufactured production inputs, (2) agricultural output, wholesale purchases of food items, and the final consumption of agricultural goods at the retail level, (3) agriculture and the U.S. balance of trade and exchange rates, (4) agriculture and the government sector, and (5) agriculture and the nation's financial markets.

This model contains eight economic transactors: farm operator families, hired labor families, nonoperator landlords, nonfarm production units, other domestic consumers, governments, financial intermediaries, and the rest of the world. While there are too many goods in the model to list individually, they essentially can be classified as either physical goods or financial obligations. Physical goods in the model include primary inputs (land, labor, and crude petroleum), secondary inputs (equipment and structures, other manufactured production inputs, and raw agricultural products), and final consumption goods (consumer durables, food, and other consumer goods and services). Financial obligations include bank deposits, bonds, equities, and debt. Supplies and demands for each of these goods and services converge to a set of general equilibrium prices and quantities in the Hughes-Penson model.

In addition to these econometric representatives, the general equilibrium modeling efforts of Plessner and Heady, the linear programming input-output modeling of Penn, McCarl, Brink, and Irwin, and the quadratic programming input-output modeling of Harrington, Penson and Fulton, Penson and Webb, and Talpaz and Penson, have all led to models that can be classified as third generation models. The linkages between agriculture and the general economy in each of these models are treated in a fully simultaneous fashion, although only the intermediate demand for goods and services is treated in a fully simultaneous fashion in linear programming input-output models.

## **The Value of Endogenization**

In an invited paper at the recent AAEA meetings, Gardner, while recognizing the need to simultaneously account for the interrelationships between agriculture and the rest of the economy, concluded that it is "preferable to use the macroeconomist's model for the economy-wide variables, and **sectoral** models with deflated prices for agricultural variables" (p. 16). Gardner is essentially asking whether it is really worth the effort to solve agricultural and **non**-agricultural outcomes simultaneously. This is a valid question since it takes considerably more time and money to develop third generation models. The value of endogenizing the linkages between agriculture and the rest of the economy can be addressed in terms of its effect on forecast errors for agricultural and nonagricultural variables of questions the model can address.

### ***Lower Forecast Error***

Information provided by economic models should improve the likelihood of making correct decisions. Obviously no model will do a perfect job of forecasting the impact of a given decision. Yet we should strive to minimize errors in forecasting economic outcomes in agriculture as well as the rest of the economy. Hughes and **Penson** recently used their general equilibrium model of the U.S. economy which emphasizes agriculture to forecast events five years into the future with all three model configurations. A forecast time period of 1971-1975 was chosen because it represented a time of unusually high variability in agricultural outcomes. If it is important to capture the linkages between agriculture and the rest of the economy, the early 1970s should demonstrate the benefits of this endeavor. The Russian wheat deal and the first OPEC oil embargo occurred during this time, contributing to a highly **volatile** set of prices paid and received by farmers.

Because individuals differ in their ability to see the interdependencies among large numbers of exogenous variables, the quality of a model's forecast is not merely a function of its specification and estimation. The artistry of accounting for the relationships among exogenous variables may be the most important aspect of forecasting. Hughes and **Penson** used actual observations for the forecasts, using the exogenous variables when forecasting with representatives of each modeling generation.

The mean absolute percentage forecast errors (MAPE) calculated over the entire five-year forecast period declined in almost every case as endogenization of nonagricultural events was increased. In some cases, the reduction in forecast errors was substantial. For example, the MAPE for constant-dollar gross farm income in third generation models over the entire forecast horizon was about 40 percent less than that associated with the first and second generation models. The value of **endogenizing** agriculture on the MAPE for nonagricultural variables was most evident in the aggregate price indices. The MAPE for the consumer price index showed a decrease of almost a full percentage point. The MAPE for gross national product, however, was not appreciably affected.

Their results also suggest that the value of endogenization increases as one forecasts further into the future. While the third generation model provided some minor improvements in forecasting one year into the future for some variables, percentage errors for most variables were roughly the same until the fourth and fifth years of the forecast period, where the third generation model achieved substantially lower percentage errors. As feedback between different sectors is more fully incorporated into the model, more of the constraints on the activities of the decisionmaker are captured, making the model's forecasts more realistic.

Finally, Hughes and Penson found that the move from a second generation to a third generation model resulted in a much greater improvement in forecast errors than the move from a first generation to a second generation model. Only marginal improvements were found in the MAPE between the first and second generation models. Most of the reductions came in the move to the third generation model. One caveat to these conclusions should be mentioned at this point, however. The model used by Hughes and Penson was an annual model, while most second generation models are solved quarterly (i.e., estimated using quarterly observations of seasonally adjusted information expressed at an annual rate). Since the feedback from agriculture to the rest of the economy is more frequent, it may be argued that their recursiveness is less of a limitation than suggested by the results reported by Hughes and Penson. This empirical question definitely merits further investigation, however.

### *Scope & Analysis*

Third generation models are obviously going to be in a better

position to respond to a broader range of questions than first generation models. However, it is probably not clear to many just how restrictive the set of questions is that can be responsibly answered by first and second generation models. The lack of feedback between agriculture and the rest of the economy embodied in first and second generation models strictly prohibits them from addressing certain questions that might substantially alter general economic outcomes. For example, Hughes and Penson reviewed the impact a major drought would have on the financial condition of farmers, as well as the rest of the domestic economy. To begin with, a major drought would mean increased prices of farm products, which in turn would mean (1) increases in the relative price of food in domestic retail and export markets, (2) decreases in the purchases of nonfood consumer goods since the demand for food is inelastic, (3) increases in government expenditures (disaster payments to farmers), (4) decreases in the value of the dollar in foreign exchange markets, and (5) inflationary pressures if the money supply is increased to finance a growing deficit. Higher inflation rates in future periods would lead to increases in the costs of farm inputs, nominal interest rates, and unrealized capital gains on farmland.

First generation models would not capture these feedback effects. Second generation models would miss much of the impact that higher current food prices would have on current price levels by overlooking the impact this change has on consumers' decisions to purchase other goods and services.

## Conclusions

Agricultural economists who hope to successfully model agriculture in the increasingly integrated economy of the 1980s will have to expand the scope at their models. Multi-sector, fully simultaneous macroeconomic models deserve further consideration as a means of addressing the issues confronting agriculture in the 1980s. This paper suggests that the benefits of taking a disaggregated view of the national economy are both measurable and substantial.

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