PART VI

Summary

Chapter 17

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Summary and Conclusions

A SUMMARY of this nature can only attempt to interpret the proceedings and conclusions of this workshop as they are presented in the various chapters. No attempt has been made to prepare a detailed documentary summary.

The workshop topic, "Estimating and Interpreting Farm Supply Functions," was formidable. Established approaches were reviewed rather exhaustively, and new ideas and new approaches were presented. Some concepts and approaches were accepted, others were largely rejected. Probably most important of all are those ideas which will be developed further in the months ahead.

An important factor contributing to the success of this workshop was the consistent conscious orientation to supply analysis as it applies specifically to the problems of change and adjustment which currently face agriculture. The objectives of supply response analysis as established clearly at the outset of the workshop were: (1) to provide guidance for general policy formulation and (2) to indicate how much relevant variables need to be manipulated to effect specific changes.

The requirements for the fulfillment of these two purposes differ considerably. The latter purpose is quite demanding with respect to our knowledge and understanding of the structure of supply response and, in fact, requires a working model which explains (or at least characterizes or empirically represents) human behavior or the decision processes of farm firms. Most of the discussion is worded in terms of prediction rather than manipulation, but for our purposes these are essentially equivalent. Prediction of future supply responses based on changes in both the influencing variables and the supply structure is analytically the same problem as how to manipulate supply outcomes. The operational requirement that a variable used in prediction must be subject to exogenous manipulation is not of concern in our discussion.

Several of the approaches considered can fulfill the first objective of general guidance. This objective involves primarily conclusions of probable aggregate changes in output and direction of necessary changes in resource inputs and firm reorganization. This amounts, essentially, to problem recognition and definition. The major difficulties arise in the application of all approaches to the second more

demanding objective of supply response analysis — to understand behavior or predict it with sufficient accuracy to know how to effect specified quantitative changes in input patterns, firm organization, and output.

ANALYSIS OF AGGREGATIVE TIME SERIES DATA

The discussions of alternative methods of analyzing aggregative time series data pointed up the need for developing a better theory of aggregation for supply response analysis. This need arises from two general sources: (1) the problem of aggregating several variables under a single measurable common denominator to derive a single (average) relationship when in fact the relationship between the components aggregated may be quite different; and (2) the problem of aggregating data for firms from estimates for individual firms or firms representative of strata within a defined population. The first problem is that of using aggregative time series data as we ordinarily use the term. The second is the problem of "adding up" estimates derived at what is commonly called the micro level.

Regression

Much of the supply analysis of time series data has been in the form of regression analysis. Exhaustive review of regression applications indicated that regression has rather limited usefulness in supply analysis.

The major single limitation is that it cannot be used for prediction in light of new variables and structures. Regression models based on time series data reflect historic relationships and at best describe present relationships. Although explanation of variations in supply is important, it is not directly predictive, and in supply response analysis, prediction is more important than the record of the past.

Our present concern in supply analysis as it relates to adjustment in agriculture is the incorporation of future structural change into the predictive model. The standard regression model can take into account the effects of changes in the values of strictly shift variables but can never completely take into account the effects of changes in structural variables. Since the regression model cannot adequately take into account structural variables, such as changes in technology, managerial ability, and institutions, it is unsuitable for supply analysis in the present transitional era in American agriculture. Even if we could adequately handle structural changes of the past, we still are faced with the problem of predicting future structural change. The regression model is not likely to serve this purpose, since the current rate of change is so rapid.

Modifications of Standard Regression Approach

While the problems of aggregation were recognized as very serious, major emphasis was placed on the development of better theoretical economic models to accommodate uncertainty and investment in fixed factors.

If we assume that an uncertain variable can be reduced to a certainty equivalent and that group behavior can be treated as the behavior of a single representative and hypothetical decision maker, who acts to maximize profit, we are faced squarely with the initial ground rules of much of the conventional regression of aggregative time series data. Thus, the answer lies in the development of economic theory which will modify the standard regression model and make it more useful in dealing with supply responses in agriculture.

Alternative models were developed to deal with the problems of uncertain expectations and investment in fixed factors and how they affect supply response. These models are presented in Chapter II. While their significance is treated with great modesty, they are worthy of careful study for their detailed specific content.

However, as the author indicates, this consideration of modifications points up the need for more effective economic theory.

Other Techniques

Chapter V explains and discusses the application of recursive programming to the problem of supply response. This technique is a synthesis of time series analysis and linear programming to apply the optimizing principle of production theory without grossly misrepresenting the simple decision processes that govern farmer behavior. It makes its basic modification in the realm of decision making, which in turn determines the process of farm change.

The basic approach is to program supply response but to condition the solutions with dynamic restrictions on the rate of change. This is in contrast to standard normative programming solutions based on pure profit maximization with essentially exogenous constraints. It also permits the determination of "effective" net returns derived from uncertain anticipations. It thus generates predictive supply response estimates.

The concept accommodates many possible flexibility restraints which greatly modify the profit motive. In this system the normal constraints of programming are replaced by a set of equations which characterize the dynamics of adjustments made by farm firms. These equations can incorporate anything from general inertia to capital rationing and uncertainty.

These governing equations are derived or even synthesized from various sources of knowledge and information including a heavy reliance on standard time series analysis. They are dynamic in the sense

that they change based on time series experience and incorporate this added knowledge into equations for predicting supply response in the future once the system has been initiated.

This approach is not free of all data and aggregation problems but is based on production theory at the firm level. It is designed to synthesize existing statistical methods and other explicit choice criteria.

Whether this approach can adequately incorporate the process of change to provide accurate estimates of supply response depends largely on whether the governing equations can adequately characterize the decision processes of farmers as a modification of an optimizing model and effectively accommodate uncertainty and alternative goals. The empirical success of initial applications is of great interest but is probably not as important as the variation in approach which it represents. It represents an approach of working from the optimizing structure of supply response, as contrasted with purely empirical prediction, which conceptually at least has operational possibilities.

MICRO SOURCES OF DATA

In the face of the problems of supply analysis based on aggregative data, the next step was to examine the possibility of building upward from the micro level. This approach considerably reduces the problem of aggregation but does not completely remove it as some problems of "adding up" micro response data are encountered. The use of micro sources of data in itself does not essentially change the problems of accommodating uncertainty, alternative goals, and the need for adequately representing the decision processes of farmers.

Production Functions and Cost Functions

Conceptually production functions derived from cross-section physical data can be used for estimating supply response through the application of prices and costs, provided the production structure is not expected to change during the period for which predictions are being made and provided the usual optimizing assumption is acceptable.

Deriving production functions from cross-sectional data eliminates the main drawback of time series regression analysis, the problem of changes in production structure during the time period from which data are drawn. It has its problem, however, in that the data from individual farms in the cross sections may represent points on different production functions.

Another problem arises in attempting to use studies of the type now available for supply response estimation. Inputs and outputs have commonly been aggregated in terms of some measurable common denominator (such as dollar value) in a manner which precludes the refinement and detail of prediction necessary to our current purposes.

This leads to the conclusion that the use of production functions in estimating supply response is limited to the fairly short run. Even in this application, estimates should be restricted to groupings of components with relatively homogeneous production structures.

Cost studies based on the financial records available on farms reflect the relative economies associated with different organization and size but do not provide any empirical basis for predicting changes in supply resulting from changes in size and organization. The findings of such cost studies have relatively short-lived application, as they are based on financial summaries rather than physical production relationships

Programmed Normative Supply Response

Programming offers considerable possibilities for incorporating more micro detail into supply analysis work. In its context here it also permits disaggregation to farm groupings with relatively homogeneous resource bases. Both of these characteristics of linear programming are important although not necessarily nor exclusively associated with programming.

Programmed normative supply estimates based upon the criterion of profit maximization may have low predictive value because we lack knowledge of the constraints that modify the profit motive. Probably the biggest single problem faced in programming supply response, however, is the current inability to obtain and incorporate coefficients which adequately reflect future production possibilities. The adoption of technology in the future can materially change the production structure and resulting supply estimates. Without such coefficients relevant to the future we cannot even very well say what the supply estimates really represent. On the other hand, linear programming models can facilitate deductions from postulated change perhaps better than other approaches.

The general conclusion was reached that with the optimizing criterion, current coefficients, and only arbitrary or experimental constraints, the predictive value of programming is quite limited in respect to supply response. It can, however, be very useful in generating much so-called purely farm management information. It also is useful in identifying the nature and magnitude of the economic adjustment problem in agriculture.

Synthetic Approaches

On several occasions hope and even optimism were expressed for the development of macro supply response from micro sources. This enthusiasm, however, was prudently tempered with several considerations of prime importance.

The incorporation of alternative goals into the prediction models is very important. However, whether this can be done by imposing constraints on the profit maximizing criterion is seriously questionable.

A major area of concern is how the dictates of economic adjustment can be incorporated into the reorganization of farm firms. The "solutions" obtained from most adjustment models involve substantial changes in several resource inputs on individual farms. In order to predict supply response we must have better information on which of these resource categories need to be changed significantly and how these changes can be made. We cannot simply assume that resources will flow into the reorganization process in the quantity or quality and at the time that optimum solutions indicate they should or would. Some people have even argued that the way in which we reshape our institutions that regulate such resource flows could be as important in determining the nature of change as the purely profit incentives that may exist.

How resources can or will flow into farm reorganization is a major area of research investigation very pertinent to supply response which received little attention in this workshop aside from being clearly recognized. Supply response analysis must include this area if it is to measure up to the objectives accepted at the outset. This would inevitably seem to require deeper research into the decision processes of farm firms.

A Farmer Reaction Panel

The idea of predicting supply response from continued observation of the reactions and actions of a "representative" panel of farmers is a unique addition to this area of work in many ways although it is by no means new to economic research in general. It involves many problems of measurement, avoiding predetermination of the results by the manner in which data are obtained, etc., but these are not completely insurmountable problems. The direct use of a reaction panel probably only gives more explicit recognition to many of the problems associated with other data sources.

Such an approach has several important advantages. Working from the micro level and permitting considerable disaggregation allows incorporation of more detail. Such a panel can be classified into smaller groupings that are relatively homogeneous with respect to the starting resource base, a factor which will surely influence rate and nature of change in the relatively near future. This classification would probably also, at the same time, result in a considerable degree of homogeneity in reaction patterns within such groupings. This approach would avoid many problems of "hybridization and averaging" to give more precise empirical predictions.

This is essentially an empirical approach. The observations and measurements and the questions asked of such a panel would be

structured by some specific hypotheses regarding decision-making models, but the direct end product would be an empirical prediction. Nonetheless a valuable contribution to decision-making theory could very well result from the feed-back of empirical knowledge of reaction patterns.

REGIONAL COMPETITION AND SPATIAL EQUILIBRIUM MODELS

The only adequate conceptual framework of analysis for problems of adjustment which involve change in various structural variables is a general equilibrium system. Obviously the data and research resources for such a system are not available nor likely to become available soon. Short of general equilibrium, changes in regional production can still be analyzed under a variety of conditions by treating one or more of the sectors of a general equilibrium system as exogenously determined or specified at some level. Most commonly in supply applications (although not exclusively) this has been done on the demand side by taking product prices or aggregate production as given. Factor prices have also been treated in the same manner in some cases. Such models (commonly referred to as regional competition and spatial equilibrium models) can then generate production and resource use solutions from which supply functions can be derived on a regional basis.

The limitations of these models are discussed at length in their presentation. The results they generate are not presented as a blueprint of an adjusted agriculture nor as completely predictive estimates of future change. These limitations include inherent shortcomings in each model, various aspects of the data problem, and the large demands made on human and computational research resources.

Many of the reservations concerning various models are some form of discontent with a partial equilibrium model. Paramount among these is the particular reservation that the demand side is ignored in many cases. More generally, to treat any portion of the total economy as fixed defines away a major part of the purpose. Another reservation in an action form of application is that the models do not predict the process of change.

A common problem in prediction is that coefficients for the future are not known with any certainty. In addition, the impact of even existing technology on firm organization is not known nor can it easily be obtained to incorporate into the production possibilities. Models proposed so far have not adequately accounted for interproduct competition. This could be accommodated in most of the models but would greatly aggravate an already huge computational problem.

The predictive value of these models as they now stand is open to some question. The choice criterion (even with constraints in programming models) does not adequately reflect alternative goals and decision processes. The flow of resources and the impact of change in

institutions on resource flows and firm organization are not adequately reflected in some models. This might suggest that agricultural economists are awakening to the quantitative importance of space-ordered comparative advantages at the very time that technological changes are reducing their importance relative to comparative regional advantages resulting from group action not reflected in the relations so far included in the models.

Still a strong sentiment persists that the solutions generated by these models have some real significance as general guides besides their immediate empirical definition of comparative advantage and resource allocation under the specified conditions and assumptions. The meaning and application of this guiding quality was not explicitly established. In considering this approach research resources need to be weighed against not-too-well-defined results. This remains one of the major unresolved questions of the workshop. This question cannot be resolved arbitrarily — but until we can decide exactly what we have in these solutions, we do not have much empirically that we can use. The need for improving this technique, which seems still to be in the process of development and refinement, was repeatedly emphasized.

OBSERVATIONS OF NEEDED DEVELOPMENT

Several problems, limitations, and needed developments were mentioned throughout the formal presentations and the subsequent discussion. The consideration of alternative approaches pointed up questions of how to meet deficiencies, particularly in the following areas:

1. Aggregation
2. Uncertainty
3. Alternative goals
4. Investment at the firm level — particularly related to fixed assets
5. Data which would reflect changes in production structure
6. Decision process — particularly related to change
7. Empirical estimates from readily observable variables

These needs could probably be summed up in three words: "data," "theory," and "prediction." These are time-honored needs that characterize most problems encountered in economic research. We are not, however, back where we started. A great deal of progress has been made in developing and bringing together theoretical models relevant to supply analysis. This, in turn, enriches empirical prediction with many important ideas.

While major gaps in our research approaches still stem from problems of data, theory, and prediction, much that is new has been added. Important contributions have been made in the attack on these areas. Many ideas have been presented on how we might provide the "missing links." A considerable contribution has also been made in spelling out data requirements and in establishing exactly what needs to be done in

each of these areas in addition to actually doing some of it in many areas.

Fortunately, research is underway in the North Central region and more is contemplated using some of the alternative approaches discussed. The USDA, in cooperation with five Midwest states, is completing the pilot phase of a dairy adjustment study designed to estimate supply parameters and production response alternatives on dairy farms. Another study, essentially similar in approach, is in the planning stages for hogs and beef cattle in the Corn Belt.

IMPLICATIONS AND IMPACT

We have complete agreement that no one method of approach will provide all the answers and that no one tool is perfect. The needed information on supply response can probably be obtained most effectively through the use of several approaches. This information, in turn, can be applied to the problems of economic adjustment in agriculture.

An important implication is that we must be careful not to be drawn into the sometimes inviting dichotomy between "model building" and "empiricism." In some isolated contexts we might assume that to obtain a solution we have to choose between the development of theory to make our models more complete and the use of more purely empirical prediction and problem-solving approaches. Actually we need both.

"Theoretical" and "empirical" approaches can be complementary in successive phases of development, provided each is duly oriented to the problems of supply response and economic adjustment rather than to their intrinsic satisfactions. The theoretical developments sought and the empirical predictions discussed and urged are very similar. Even the purest form of empirical prediction is not without an implicit model, and if successful, it can greatly contribute to the development of more adequate theoretical models. One example of this possibility has already been noted in regard to the empirical estimates of producer reactions and decision-making theory. Similarly, developments in theoretical model building can lead to the incorporation of new variables, equations, and procedures to improve empirical estimates. We need to pursue both and continue to exchange and incorporate the findings of each into the other.

Much of the impact of the deliberations at this workshop will be diffused, untraceable, and unmeasurable. We might also recognize that much of the apparent impact on research may well be the direct result of the same thinking that led to this workshop. It is still impressive, however, to see a large number of research projects and research committee activities devoted to the problems discussed at this workshop and employing the techniques and approaches considered. Many of these studies explicitly recognize the benefits of combining theoretical and empirical approaches and plan to use both.

EXPANDING RESEARCH EFFORTS

Governmentally sponsored agricultural programs involving supply control aspects have been in operation more than thirty years. No serious continuing effort has been made to determine the economic effects of these programs on farm production, farm prices, or farm income. Sporadic studies have been made, usually long after initiation of the program. Thus, we have practically no reliable historical documentation of the effects of past and current programs to guide future changes.

In contrast, research programs are included by law in many government projects. For example, the interstate highway program authorizes the use of a fixed percentage of the appropriated federal funds for research relevant to highway projects.

Increased allocation of research resources to supply analysis by agricultural experiment stations and the USDA is encouraging. Much of the burden of the agricultural adjustment problem falls within the area of estimating and predicting agricultural supply functions. More and more, the economist is being asked to estimate agricultural output under differing circumstances, such as various levels of price supports, differential pricing, free prices, direct payments, etc. Expanded research efforts are long overdue in this area.

Existing research resources may not be adequate considering the scope of the problems involved. Consideration needs to be given to additional resources for research to enable more precise forecasts. Perhaps a small percentage of all agricultural price-support program funds should be allocated to qualified research agencies to determine the economic effects of the program and to provide data for increased research on agricultural supply functions. Limited amounts of this research can be done on a national or state basis. However, much of it requires regional and interregional coordination to insure optimum results.