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AGRICULTURAL ECONOMICS: A CRITICAL REVIEW OF THE STATE OF THE SCIENCE

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The title of this paper provides almost unlimited latitude for discussions of the contributions, or lack thereof, of the scientists engaged in the application of a body of knowledge commonly referred to as agricultural economics. Because a complete review of the field of agricultural economics would exceed the scope of a paper, this discussion will be oriented to selected issues. The issues discussed are related primarily to empirical analyses. Selected definitions are used to provide a basis for the arguments presented.

SELECTED DEFINITIONS

Agricultural economics may be defined as the application of the social science of economics to the field of agriculture. This definition, however, does not limit the discussion. Definitions of the "social science of economics" and of the "field of agriculture" are needed.

The social science of economics may be defined, in its broad context, as that body of knowledge applicable to the study of how goods and services are produced, distributed and priced. This body of knowledge can be subdivided into the areas of micro-economics and macro-economics, depending upon the context of the analysis. Considerations of factor-factor, factor-product, and product-product relationships within a firm are included in micro-economics. Considerations of market prices, employment, income distribution, and related issues are included in the macro-economics area. Each of these areas of economic thought, and the subsets of assumptions and theories contained therein, can be applied to specific production, distribution, marketing, policy, and related issues in agriculture.

Unlike the definition of economics, which has remained fairly constant since the time of Adam Smith, the generally accepted definition of the "field of agriculture" has changed dramatically during the latter half of the twen-

tieth century. The word "agriculture" was derived originally from the Latin to mean "field cultivation" and included the raising of plants and animals for food, clothing, and other needs of man. However, the more modern usage of the term has expanded this meaning to include a host of firms and activities involved in supplying the inputs utilized by farmers for the production of plants and animals. Also included in the modern definition of agriculture are those activities and firms engaged in further processing, packaging, distributing, and marketing the food and fiber products produced by farmers. Thus, the breadth and scope of modern agricultural subject matter have increased. A growing interdependence has developed between the agricultural and non-agricultural sectors of a modern society.

More recent developments in transportation and storage technology have permitted the expansion of international markets for food and fiber products. As a result, decisions of foreign governments concerning food purchases and oil sales, unusual weather patterns and other events affecting non-domestic food supplies have begun to have significant impacts on the domestic agricultural production sector of the economy. New dimensions to the growing complexities associated with empirical economic analyses of the agricultural sector of the economy have been contributed by these international relationships.

For the purposes of this paper, agricultural economics will be defined as the empirical application of economic theory to the field of agriculture as defined in this expanding context. A brief review of the conditions under which economic theory has been applied empirically should facilitate subsequent discussion.

EMPIRICAL APPLICATION OF ECONOMIC THEORY

Economic theory is based upon certain assumptions concerning man and his behavior,

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society and its institutions and a limited set of resources. Given these assumptions, various theoretical relationships have been postulated to explain the actions of individuals and groups for a given state of technology and a known distribution of the limited resources. In practice, economists have been forced to make selected, restrictive assumptions in empirical analyses. These assumptions have been used to reduce the economic relationships and variables involved to an economical and manageable number. The limited availability of empirical data and high costs of computational equipment have also contributed to the use of more restrictive assumptions in empirical analyses.

A BRIEF CHRONOLOGICAL REVIEW

For the purposes of this presentation, three chronological periods have been selected. These periods are:

The 1920's through the 1940's Period

During the early years of this period, the agricultural economics profession was in its infancy. Nevertheless, the profession and its practitioners established an identity and made important practical contributions through analyses of agricultural production efficiency and early agricultural policy alternatives.

In the 1920's, farmers operated primarily self-sufficient and relatively independent production units. They purchased few production inputs, operated diversified crop and livestock production plans, and in many cases engaged in direct marketing of their products to the ultimate consumer. During the 1940's, rapid developments began to occur in the development of an agricultural supply and service sector as farmers increased their purchases of production inputs. By this time, developments in the processing, distribution, and marketing sector had already removed the farmer from most of the markets involving the final consumer. The domestic producer was affected little by non-domestic food and fiber supplies and markets.

The early pioneers in agricultural economics were hampered by their inability to estimate parameters of economic relationships involving more than a very limited number of variables because of the clerical costs and limited computational capability available during this period. Rotary calculating equipment and statistical clerks provided the computations for empirical analyses.

Farm management analyses received a great deal of attention from agricultural economists. These micro-economic analyses made

extensive use of partial-budgeting and budgeting techniques. Empirical data were collected and used in factor-factor, factor-product, and product-product economic models and relationships. Leading institutions involved in these analyses included the USDA and Cornell and Harvard Universities.

The macro-economic analyses undertaken during this period tended to be oriented toward cyclical price analyses. These analyses resulted in the identification of cattle and hog cycles. Early investigations of aggregate supply and demand relationships were undertaken. These analyses produced the early estimates of price and income elasticities of supply and demand. Policy issues related to parity prices, acreage allotments, and other forms of supply control received important consideration by the profession. Thus, despite computational limitations and restrictive assumptions, results of empirical studies were beneficial to farmers and policy makers. Although the analyses were relatively simple and straightforward, domestic agricultural relationships and parameters began to be quantified. These estimates were useful because the agricultural economy had developed only a partial interrelationship with the non-agricultural sector of the economy and was relatively independent of the non-domestic food and fiber markets.

The 1950's through the 1960's Period

During this period, the agricultural economics profession probably made its greatest intellectual growth. The profession established itself as a respected member of the economics community and attracted numerous new economists to its ranks.

The farm sector of the economy continued to change rapidly during the early 1950's as new technology moved from the laboratories and research plots into actual production practices. Hybrid corn and other new crop varieties which responded to commercial fertilizers began being produced on a broad scale. New, more powerful and expensive production equipment was substituted for labor and the average farm size grew rapidly. Genetic improvements in livestock and poultry as well as improved rations and livestock management systems have contributed to an increased specialization of the individual production unit.

These and other forces contributed to the development of an agricultural supply and service sector to provide seed, fertilizer, equipment, chemicals, and capital inputs to the farmer through the marketplace. The production sector became more dependent upon this new supply and service sector and almost totally dependent on the processing, distribu-

tion and marketing sector of the economy. The agricultural sector became so intertwined with the historically non-agricultural sectors of the economy that it became difficult to define where the agricultural sector began and where it ended. Agricultural surpluses arising from the introduction of new technology tended to isolate domestic producers from international market conditions throughout most of the 1960's.

New frontiers of empirical analyses began to be explored in the late 1950's as computer technology and new econometric techniques were developed. With the introduction of this technology, economists began to make fewer restrictive assumptions, made greater use of empirical data, and produced numerous studies of statistically-derived economic parameters and relationships. New analytical techniques involving optimization procedures were introduced into the profession during this period. As a result, empirical economic analyses could be conducted, for the first time, utilizing hundreds of economic relationships and variables.

Given these new analytical tools, agricultural economists undertook micro-economic farm and firm management studies involving detailed budgets and statistical estimates of production functions. These data and relationships were incorporated into linear programming analyses. Factor-factor, factor-product, and product-product economic relationships were investigated within the context of economies of scale and intertemporal analyses.

In the area of macro-economic analyses, aggregate and regional demand and supply functions were estimated utilizing simultaneous equation techniques. Interregional and regional activity analyses involving input or factor use studies, market price analyses, and income distribution studies were undertaken. Various forms of adjustment models were developed and analyses conducted involving short-run and long-run estimates of demand and supply parameters and relationships. Results of these types of analyses played a significant role in management decisions at the farm, firm, industry, and national levels.

The profession also investigated income distribution, area resource development, and employment issues through empirical analyses designed to provide guidelines for national policy. The attempts to quantify economic parameters and thereby estimate the magnitude of change at various levels in the industry of agriculture contributed significantly to the growth and prestige of the profession during this period.

The 1970-to-Date Period

During this period the industry of agriculture continued to become more interdependent with foreign production, foreign markets, and foreign governmental decisions. The domestic surpluses of grains which tended to isolate domestic producers from foreign markets had disappeared. Because of the increasing dependence of domestic agriculture on purchased inputs, especially foreign energy which increased rapidly in price, domestic agriculture began experiencing the influences of foreign conditions in both the input and market sectors.

Although advances in computing technology have continued to reduce the cost of making a given number of computations, relatively few new empirical tools have been developed for economic analyses since 1970. Most of the econometric models involving the agricultural and non-agricultural sectors of the domestic and international markets have been designed and maintained by general economists rather than agricultural economists. The result has been the lack of detail concerning the agricultural sector as it interrelates to the non-agricultural sectors of the economy.

From this author's point of view, it would appear that the profession has continued to move along the plateau it reached in the late 1960's in applying its expertise to these new areas of concern. Only limited progress seems to have been made in developing the increased capability needed for conducting timely empirical analyses of the industry of agriculture during the 1970's. Perhaps the additional international data requirements, the additional relationships and variables, and the added costs of such studies imply the need for a task force or consortium and new funding approaches for these larger, more complex analyses.

FUTURE CHALLENGES

Decision-makers at all levels of the economy will have a continued need for empirical estimates of agricultural production functions, input supply functions, and product demand functions. These new estimates must include the integration of the agricultural and non-agricultural sectors of the economy into models involving capital, labor, land use, water, energy, and other agricultural production factors. Empirical supply and demand studies will also be needed at the industry, regional, national, and international levels. These studies should contain sufficient internal identification to permit the results of partial analyses to be used in the more general types of analyses.

Computerized data bases need to be developed for standardized regional models to permit the efficient periodic updating of parameter estimates and the estimation of the rates of change in structural economic parameters. Modern computer technology should be utilized to generate, from selected data bases, individual firm, industry, regional, interregional, and international economic models capable of providing both short-run and long-run estimates of the likely consequences of production, price, and policy decisions on the agricultural and non-agricultural sectors of the economy.

The author is fully aware of the problems associated with model definition, data acquisition and aggregation, computational costs, and the interpretation problems associated with macro-economic types of models. These factors may explain why macro-economic models seem to have received less attention in the past than the micro-economic models. However, macro-economic models, and especially models emphasizing employment, price, and income distribution relationships, are likely to produce greater returns to the profession in the future.

SUMMARY

Agricultural economists, both collectively and individually, have served agriculture and society well for the past sixty years. The profession has made significant contributions in the application of economic theory and the empirical measurement of economic parameters affecting a broad range of production, marketing, investment, and policy decisions.

Since the 1950's, agriculture has continued

to become more heavily dependent on the non-agricultural sectors of the domestic economy and more closely interrelated with foreign markets and policy decisions. This increased interdependence has resulted in the need for a variety of empirical analyses and an increased interest in questions related to capital, land, labor, energy, and rural development and related issues.

The challenge of the 1980's will be that of developing more general economic models of agriculture for empirical analyses. These models must be capable of being updated from data bases involving national and international data. The analyses must include estimates of the impact of selected domestic and foreign policy, marketing, and production decisions on the regional supply, production, and marketing sectors of both the agricultural and non-agricultural economies.

Significant additional attention should be given to macro-economic analyses of production and marketing problems including the impacts of changing consumer demands on area resource requirements, employment, and income distributions.

Unless more general macro-economic models of the agricultural, non-agricultural, and international sectors can be developed, their parameters estimated, and their logic tested empirically, the agricultural economists' influence on economic thought and policy decisions is quite likely to diminish. If this influence does diminish, the status of the agricultural economists could become that of a highly skilled micro-economic technician rather than that of the respected scientist which the profession attained during the dynamic period from the 1950's through the 1960's.