MEGATRENDS AFFECTING AGRICULTURE: IMPLICATIONS FOR AGRICULTURAL ECONOMICS

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"There is nothing permanent except change."

Heraclitus, "Floriut", 513 B.C.

U.S. agriculture has always been susceptible to changes occurring within the agricultural sector and in other sectors of the economy. But one would be hard-pressed to identify another time period in the history of U.S. agriculture when there are so many changes occurring so rapidly with such large potential effects. Naisbitt (1984) refers to changes which are critical restructurings as megatrends. This paper is concerned with the megatrends most affecting U.S. agriculture and their relevancy to agricultural economics.

The identification of major trends affecting U.S. agriculture is largely judgemental. Furthermore, there are numerous ways in which trends in specific factors may be aggregated into broader and more encompassing megatrends. In this paper the following five megatrends are considered to be the most critical ones affecting U.S. agriculture:

1. Changes in the domestic consumption of food and agricultural products - a shift from animal to plant products.

2. Macroism and internationalism - domestic and international economic interdependencies of U.S. agriculture.

3. Technological change - accelerated dynamics in an economy in transition from an industrial to an informational economy.

4. Structural change - largeness and fewness of farms and agribusiness firms.

5. Environmentalism - concerns about resource, chemical, and pharmaceutical use of a society in transition from a representative to a participatory democracy.

The objectives of this paper are to: (1) identify selected attributes of these megatrends, (2) briefly assess selected impacts of these megatrends on agriculture, and (3) identify some implications of these megatrends for research, teaching, and extension programs in agricultural economics.

Changes in Domestic Food Consumption

In recent years international markets for U.S. agricultural products have received considerable attention. The domestic market for agricultural products has received much less attention; less than it merits. It accounts for approximately 80 percent of gross revenue for U.S. agricultural products. There are some major trends in domestic consumption of meats, dairy products, and fruits and vegetables whose impact on domestic markets for agricultural commodities is resulting in some large differential regional effects.

There is a shift from animal to plant products in domestic food consumption (ERS, AE No. 138, SB No. 694, SB No. 713, and SB No. 735). The major components of the animal products are beef, pork, poultry, and dairy products while the key components of the plant products are cereals and vegetables. The per capita consumption of animal and crop products reached a high of 1651 pounds in 1945. Since then the total pounds per capita declined approximately 14 percent. The per capita consumption of both animal and plant products declined from 1945 to 1972, but thereafter per capita consumption of animal products declined an additional 4.9 percent while the per capita consumption of plant products increased 68.2 pounds or 8.9 percent.

Beef and Pork

Beef and pork are the two major red meats consumed domestically. Peak per capita consumption of beef of 94.4 pounds occurred in 1976 and in the last decade has declined by 20 percent. In 1976 per capita pork consumption was the second lowest in the last 75 years. It increased until 1980 and since then has declined by 12.4 percent. Corresponding prices suggest something more than simply a shift in supplies of these meats. Cornell and Sorensen (1986) identified a weakening of the demand for beef in terms of increasing price flexibilities, decreasing income elasticities, and increasing substitution effects over time.

For the current U.S. population of 240 million people, the declines in per capita beef and pork consumption translate into

approximately 4.61 billion pounds of beef and 2.04 billion pounds of pork or a total of 6.65 billion pounds of red meat which are not being consumed because of the declines in per capita consumption. The decline in red meat consumption strongly affects agriculture in livestock and feedgrain producing states. For example, the decline of 6.65 billion pounds of beef and pork means that annually approximately 373 million bushels of corn are not needed for feed which is about five percent of a large (1984) U.S. corn crop. In addition, the need for soybean meal, and hence soybeans, and other feedgrains is also reduced.

Poultry

During the last 25 years the per capita consumption of poultry has increased about 90 percent (ERS, LPS-19, 1986). From 1976 to 1984 per capita consumption of poultry increased 15.2 pounds which is 3.65 billion pounds for a population of 240 million. This increased per capita consumption of poultry requires an additional 150 million bushels of corn which partly offsets the reduction in corn utilization associated with the decline in consumption of beef and pork. After adjusting for the corn needed for the increased poultry consumption, the reduction in the utilization of corn resulting from the decreased beef and pork consumption is still about three percent of the 1984 U.S. corn crop.

Dairy Products

Per capita consumption of all dairy products in milk equivalents has declined about 13 percent from 1959 to 1984 despite an

eight percent increase since the mid-1970's. Most of the decline occurred prior to the mid-1970's. Much of the increase since the mid-1970's has been due to increased per capita consumption of various cheeses and is probably not independent of the growth in consumption of "fast foods" and "convenience foods."

The per capita consumption of butter has increased slightly since the mid-1970's. From 1959 to 1984 the per capita consumption of fluid milk and cream declined 26 percent and cottage cheese 10 percent. The per capita consumption of lowfat milk has been increasing but has been offset by the decline in consumption of plain whole milk. This declining trend in fluid milk consumption has persisted since the mid-1970's; however, recently the consumption of fluid milk and cream appears to have stabilized.

Fruits and Vegetables

The per capita consumption of all fruits, fresh and processed, in fresh weight equivalents increased about 17 percent from 1959 to 1981[1/]. Much of this increase is attributable to the increase in the consumption of citrus. The per capita consumption of noncitrus fruit has remained unchanged.

The per capita consumption of all fresh fruits decreased about six percent from 1959 to 1984. This trend is due mainly to a 30 percent decline in the per capita consumption of fresh citrus for that period. During the same period the per capita consumption of fresh noncitrus fruit increased about seven percent; however, the

decline in the consumption of citrus exceeded the increase in consumption of fresh noncitrus fruit.

Per capita consumption of all fresh vegetables increased nine percent from 1959 to 1984. The per capita consumption of lettuce increased 40 percent, dark green and deep yellow vegetables 21 percent and tomatoes seven percent. These three fresh vegetables account for over half the total fresh vegetable consumption. Most of the increase in the consumption of fresh vegetables occurred after the early 1970's concurrent with improved transportation, improved post-harvest technology, increased eating out, and the decline in the per capita consumption of red meats.

The per capita consumption of processed vegetables, canned and frozen, declined slightly during the 1959-84 period. The per capita consumption of frozen vegetables increased nearly 26 percent during this period but was more than offset by a decline in the per capita consumption of canned vegetables. Since the early 1970's the per capita consumption of frozen vegetables has continued to increase while the per capita consumption of canned vegetables has continued to decline and exceed the increase in the consumption of frozen vegetables.

The per capita consumption of potatoes increased nearly nine percent from 1964 to 1984. Casual observation suggests that "fast foods" and "convenient foods" are largely responsible for the increase in per capita consumption of potatoes. The fast food industry does have an influence on what we eat.

Some Factors Affecting Consumption

Income and relative prices are critical economic factors influencing food demand and consumption. Since 1960 the per capita disposable income in constant dollars has increased steadily but during the last 10 years only at a rate of about 1.5 percent per year. Using Huang's (1985) estimated income elasticity for beef and veal of 0.45, it would take over 28 years of the recent rate of income growth to offset the 20 percent decline in per capita beef consumption. Beef and pork prices were high relative to poultry and non-meat food prices in the late 1970's. During the 1980's these prices were not high relative to prices of other foods yet the decline in red meat consumption persisted.

Historically, agriculture has relied on a growing population to shift the demand for foods and hence agricultural products. But since 1970 the U.S. population has been growing at a rate of only about one percent per year which is far different from the late 1950's and 1960's. At this rate of growth it would take approximately 20 years of population growth to offset the 20 percent decline in per capita beef consumption. Furthermore, there are changes in the demographic characteristics of the population such as an increasing proportion of older people and regionally changing distribution (U.S. Bureau of the Census, 1986). Quantities consumed and preferences differ regionally and by age of population (Capps, Tedford, and Havlicek, 1983; Capps and Havlicek, 1984; Buse, Cox, and Glaze, 1986; and Tedford, Capps and Havlicek, 1986).

The U.S. population has become more health conscious in recent years and this has affected the demand for food. Health considerations include nutrition, weight, consumption of chemical and pharmaceutical substances, and consumption of substances associated with blockages of the circulatory system, heart conditions and strokes. This health consciousness will persist in the future and as it spreads throughout the U.S. population and populations in other parts of the world, the impact on food consumption patterns will be substantial and cannot be ignored.

The number of meals and amount of food eaten away from home is continuing to increase and is an important factor influencing the types of food consumed. The number of single person households is increasing and consumption and food expenditure patterns are different for these households than for multiple person households (Sexauer and Mann, 1979). The number of households with working spouses or household managers is increasing and is an important factor influencing the types of foods consumed in the household as well as the frequency of meals eaten away from home (Capps, Tedford, and Havlicek, 1985; Redman, Barbara, 1980). These changing lifestyles are critical forces affecting food consumption patterns and their impacts on food demand and consumption need to be better understood.

Macroism and Internationalism

The agricultural sector has become an integrated part of the U.S. economy, which is part of a global economy. Agriculture is

directly affected by changes in macroeconomic policies which affect factors such as interest rates, value of the dollar, exchange rates and taxes. The current financial situation in agriculture is observable evidence. The impacts of changes in some macroeconomic policies dwarf the effects of agricultural commodity policies. Two or three decades ago this would never have been considered possible. Most macroeconomic policies are exogenous forces which alter the economic environment in which agriculture must operate and introduce additional uncertainty into the agricultural sector. Agriculture has little or no influence on macroeconomic policies. This raises serious questions about the roles of land grant universities and agricultural economists. Tweeten (1985) points out two important roles land-grant university faculty can play and these seem to be equally applicable to agricultural economists. First, agricultural economists have an important role to play in providing an information base for those who influence and make macroeconomic policies so they can do a better job. Not only must we provide good evidence based on sound and rigorous analyses, but these must be communicated in understandable terms to those who influence and make macroeconomic policies. The necessity for agricultural economists to communicate with others provided by Hillman (1970) in his AAEA presidential address is apropos. Second, agricultural economists can help managers in agribusiness cope with changes in the macroeconomic environment. Recent changes in macroeconomic policies have

provided opportunities for agricultural economists to provide information about the causes, magnitudes, and distribution of impacts.

At the international level, Schuh (1981) provides a conceptual framework for understanding the economic dimensions of our global interdependence which can be used for structuring more rational international economic and trade policies. Johnson (1964) explained how critical trade was to U.S. agriculture and to the economies of developing countries. At that time the value of agricultural exports was about 16 percent of the total agricultural cash receipts. During the 1970's, low or negative real interest rates, expanding world economies, low valued dollar, expanded world credit, rising inflation, and high commodity prices were all conducive to a high rate of growth in world food demand. Although favorable to U.S. agricultural exports, it could not be sustained. U.S. agricultural exports increased to a peak in 1981 when the value of agricultural exports was nearly 31 percent of the value of total agricultural cash receipts. In the 1980's, recessions, low inflation, high real interest rates, high valued dollar, and large debts by some importing countries adversely affected U.S. agricultural exports. Since 1981 U.S. agricultural exports have declined and in 1986 the value of U.S. agricultural exports is expected to be about 21 percent of the value of total agricultural cash receipts. Export markets are critical but not a salvation for U.S. agriculture.

Being part of an international economy makes our domestic commodity markets susceptible to instability and uncertainty. Foreign supply and demand conditions and foreign macroeconomic policies affect the trade conditions between the U.S. and foreign countries. Volatility will continue; in fact it may become more intense if our export market base is expanded. Part of the development process of countries importing our agricultural products is gradual increased competition with us in world markets. It is important that we know and understand the developmental stages of trading partners and that new markets and potential trading partners be continuously identified. With the limited opportunities available for expanding domestic demand for agricultural commodities, foreign markets offer some optimism for expanding the demand for U.S. agricultural commodities.

Technological Change

Not long ago there was concern that the paucity of forthcoming technologies in agriculture would adversely impact agricultural productivity. Presently most would agree that American farmers and agribusinesses will have a wide range of new biotechnologies and informational technologies available at least until the turn of the century. Potentially, there could be more technological changes in agiculture by the end of the century than ever before in recorded history. Emerging and potential technologies could completely revolutionize animal and crop production, marketing, and decision making processes. OTA (1986) projects annual increases in bushels

per acre of 0.9, 1.2, 1.2, and 1.3 percent for rice, corn, soybeans, and wheat, respectively. They also project annual growth rates of 1.2, 0.6, and 0.2 percent of meat per pound of feed for beef, pork, and poultry, respectively. The annual growth rate of pounds of milk per cow may be as high as 3.9 percent.

Naisbitt (1984) identifies the American economy in transition from an industrial to an informational economy. Informational needs for complex decision making exist in all parts of agriculture. The generation of technology and information is being accomplished somewhat differently than in the past. Although opportunities remain for individual inventors, there is a movement away from the "crude" inventor who tended to develop technologies based on need. Biotechnologies based on knowledge rather than need are being developed by research teams in "think tank" types of environments. The research is conducted with targeted objectives and goals and with substantial supporting resources, especially in private industry. Newly developed technologies are strategically marketed with control of this technology lying almost entirely within the innovating firm. Under these conditions, new technologies are more certain to be developed than in a situation where individual inventors are trying to fulfill specific needs.

Much of the technology in the past has required a large investment by those adopting it, and then in order to lower the per unit costs of a large fixed investment, the investment cost tended

to be spread over large acreages or large volumes of output. Emerging biotechnologies and informational technologies are being made available at relatively low per unit cost. There will not necessarily be the impetus toward large size in order to spread the fixed cost. The technologies will be affordable by all types of producers. Suppliers of these new technologies will play an important role in the adoption process which could lead to substantial regional differences in adoption and subsequent regional impacts.

Biotechnologies tend to accelerate change over a short time period. Thus, large impacts occur rapidly and economic and social impacts are likely to be substantial. Examples of technologies which appear to be emerging rapidly are growth hormones for increasing milk production, hormones for accelerating growth of meat animals, pest and drought resistant varieties, plants that produce their own plant nutrients, seeds with their own inoculants, and vaccines that stimulate natural immunity of animals. These new biotechnologies are being developed by biological scientists to achieve biological or production ends with little or no regard to economic and social objectives. The economic and social aspects of new biotechnologies are not appreciated or even understood by many biological scientists. A critical unresolved issue in the development of biotechnologies is the consideration and integration into research of economic and social science objectives along with the objectives of the biological sciences. Without this integration new

biotechnologies will be developed and likely adopted without regard to economic and social impacts.

The informational needs for complex decision making are increasing at all levels in agriculture. The use of computers for automated collection, assembling, and processing of data to provide information for control and management of agricultural production and marketing is increasing but at a lesser rate than was expected as few as five years ago. Many computers are linked to data bases throughout the world and provide instant access to a large quantity and wide range of data. Informational technologies make it possible to send and receive large amounts of data across markets throughout the U.S. and the world. It also provides the capability for using more and better data and information, but at various stages of development there is the potential of generating more data and information than human minds can use for meaningful decision making.

New technologies have to be profitable from a micro viewpoint or they will not be adopted. Hence, most technological change in agriculture tends to be cost reducing and, consequently, output increasing. The new biotechnologies and informational technologies have the potential of producing large and rapid expansions in agricultural outputs. For example Kalter (1985) indicates that the increased milk output of dairy cows to daily injections of bovine somatotropin may be as much as 40 percent. The expanded output will lead to lower prices for agricultural commodities unless there are

compensating demand increases in the domestic and/or foreign markets. These new technologies will also alter the comparative advantage of various regions in the U.S. Changes in regional comparative advantage generally result in fairly large impacts on both input and output industries and communities in those regions losing comparative advantage as well as in the regions to which production and accompanying processing of products shifts.

There will be social impacts on adopters and users of these new technologies. The new biotechnologies may produce both positive and negative environmental and health impacts. For example, biotechnologies which result in a lower use of chemicals and pharmaceuticals yield favorable impacts while those requiring the use of more chemicals, hormones and growth regulators may yield quite unfavorable impacts.

Structural Change

The number of farms in the U.S. has been decreasing since 1935 when there were 6.8 million farms and the average farm size was 155 acres. In 1982 there were 2.2 million farms and the average size was 427 acres (ERS, ECIFS4-3, 1986). From 1966 to 1982 the number of farms declined by 18%. The number of farms with constant dollar gross sales under $20,000 per year declined 39 percent from 1969 to 1982 (OTA, 1986). The numbers of farms with constant dollar annual gross sales of $20,000 to $99,999 per year increased by 57% between 1969 and 1982 but the proportion of gross farm income accounted for

by these farms remained about the same. The number of farms with constant dollar annual gross sales of $100,000 or more increased by 116% from 1969 to 1982 and the proportion of gross farm income accounted for by these farms increased by 20%. In 1982, 13.5% of the farms had constant dollar annual gross sales over $100,000 and these farms accounted for 73% of gross farm income in the U.S. OTA projections for the year 2000 indicate that about 20% of all farms in the U.S. will have constant dollar annual gross sales of $100,000 or more and will account for approximately 95% of total production.

Bullock (1986) points out that in the past few years a two tiered agriculture is emerging. In addition to the rapidly increasing number of large farms, the number of small farms, many consisting of 50 acres or less, is increasing rapidly, particularly in the more industrialized areas. Almost all are part-time farmers and output is a small part of total agricultural output. However, these farmers need economic information. Furthermore, many of these very small part-time farmers are politically important because of their primary occupations, and in the future could provide a helpful coalition for agriculture.

The trend toward largeness and fewness will continue with both farm and nonfarm firms. Much of this is occurring through consolidation. Some of the transition in farms has been accelerated by the current financial stress in agriculture. The large capital requirements in farming will persist. Enterprise and regional specialization arising from technological change has been a major factor

responsible for the increase in the number of large farms. As specialization is further fostered by technological advance farm and nonfarm firms will continue to get larger. Tax laws have also been an important factor in facilitating the trend toward largeness of firms. More capital from outside of agriculture and vertical integration or contracting are likely to grow and open markets for intermediate products including many agricultural commodities. However, the demand for some agricultural commodities may further shrink or disappear altogether as it did in the broiler industry.

Some of the emerging biotechnologies may have some mixed effects relative to farm size. Some of the low cost biotechnologies do not especially favor large farms but might foster the growth of small farms. Some of the biotechnologies may substitute for land and have a depressing effect on land prices as well as induce a shift of land from agricultural to other uses. Nevertheless, most biotechnologies will tend to favor bigness in agribusiness.

Employment in the farm sector and total food and fiber sector continues to exhibit a slight decline (U.S. Bureau of Census, 1985). Employment in the farm sector and in the total food and fiber sector as a percent of employment in the total domestic economy has decreased slightly during the last 10 years. During the same time employment in transportation, trade, retailing, and dining has exhibited a slight upward trend. The employment trends do not provide an optimistic picture relative to future employment in the farm sector.

These trends suggest that our traditional agricultural clientele will continue decreasing in number but will probably be more sophisticated. Other potential clientele such as various agribusinesses and small part-time farmers may emerge. The rural farm population will continue to decline and adversely affect enrollments in colleges of agriculture. Finally the agricultural political base will continue to erode.

Environmentalism

In Megatrends, Naisbitt (1984) identifies the transition from a representative to a participatory democracy as one of the ten most important trends in our society. Bonnen (1984) analyzed the effects of the shift from representative to participatory democracy on instability in agriculture and the change in the influence which various national political institutions had on agricultural commodity programs. In a participatory democracy individuals have a say in how things are done and those that are affected by a decision want to be part of the decision making process.

There has been a growing concern by the public about the use of chemicals and additives in food and about environmental degradation (Batie, 1985). The public is insisting on foods that are free from pesticides, insecticides, herbicides, antibiotics, hormones, feed additives, and other chemicals and pharmaceuticals. There is a changing attitude of the public relative to responsible stewardship of land, water, air, and other natural resources. These concerns and attitudes combined with individual and local group behavior in a

participatory democracy may result in guidelines and limits for resource use, conservation, and permissible agricultural production and management practices. The public is growing less tolerant of certain types of erosion and sedimentation, farming of marginal lands, location of feedlots in residential areas, and agricultural activities which lead to water pollution or endangerment of wildlife. There is a growing concern about animal rights both in commercial agricultural production and in research. The influence of these concerned parts of our society is reflected in the "sodbuster" and "swampbuster" provision of the 1985 Farm Bill.

The concerns about these issues will not diminish. Participation in political and decision making processes by those interested in these issues will create limits on permissible agricultural activities and practices. Some of these limits will impose binding constraints which will tend to increase costs of agricultural production and marketing and in some cases of agricultural research. In the short run these limits and their consequence will likely be viewed quite negatively by commercial agriculture. In the long run the influences of this part of the general public can lead to conservation and resource preservation and improved environmental quality beneficial to society.

It is easy to want to label this part of the public as "trouble makers" and attempt to ignore their questions and requests. But they are a sincere public and their requests and wishes will have to be dealt with. They may well be a new segment in the coalition that

agriculture must form in order to get desired agricultural legislation passed. Not all of their concerns entail economic issues but many do. This part of the general public needs economic educational programs and information but they can't be bludgeoned into submission. Our economic tools and analyses don't seem to deal well with many of the problems being raised. However, economic arguments will have some influence because opportunity costs always matter, but they don't always convince those wanting a new set of rights across society and representing a new view of public morality. Many of these problems stem from legal issues but have an economic component. In part this is the nature of the problems of a participatory democracy. Our economic tools and analyses of optimization tend to provide information useable for decision making by planners and architects of policies in a representative democracy. What kind of economic tools to use and how to provide meaningful economic information in a participating democracy offers challenging research and educational opportunities for agricultural economists.

Implications for Research, Teaching and Extension in Agricultural Economics

The five megatrends affecting U.S. agriculture suggest several implications for research, teaching, and extension programs in agricultural economics. Although these implications apply mainly to land grant universities and government agencies, firms and institutions in the private sector interested in research and educational programs may also find them useful.

Research

Given the importance of the domestic market for agricultural commodities research on food demand should receive more attention. More emphasis is needed on research that will help us better understand changing consumer behavior, emerging consumption patterns, and to trace both the magnitude and distributional impacts of such changes through the marketing system to the farm level. We need to better understand the impacts on food demand of the working household manager. What will be the impacts of decreased cooking skills of women and increased cooking skills of men? More and more it appears that agriculture and the food system is being called upon to deliver "health foods," e.g. foods that are good for you, that minimize the aging process, that don't cause heart conditions or other ailments. These demands need to be better understood and how to produce and market such products offer some challenging research opportunities.

Additional research is needed on the economic feasibility of product diversification in agricultural production and markets for these products. In feedgrain and livestock producing areas there is considerable interest in alternative crops and enterprises. However there is little information available regarding potential markets and limitations of such markets for the potential outputs in various geographical areas.

Producing more efficiently for standard markets has some severe limitations. Expanding the demand for or increasing the consumption

of one food may result in nothing more than a substitution for some other food. More emphasis needs to be placed on new products and new markets, domestic and foreign, and on marketing strategies to penetrate such markets. Domestic and foreign industrial non-food markets would seem to offer considerable potential; however, these may not be markets for corn, wheat, soybeans, etc. but rather markets for attributes embodied in agricultural products such as energy lubricants, absorption capacity, adhesive capacity, etc. Extending some of Lancaster's (1966) concepts to industrial input markets, and assessing the demand potentials for various attributes embodied in agricultural commodities, merit serious consideration. This type of research will require multidisciplinary efforts.

Foreign markets are important to U.S. agriculture and international trade research merits greater consideration. More and better information to improve the U.S. posture in trade negotiations is desperately needed, as is information about trade policies, marketing strategies, and trade institutions which might enhance market outlets for U.S. agricultural products. More attention needs to be focused on identifying appropriate markets for foreign consumers. Identifying unique demands of consumers and producing to meet that demand is far different than dumping surplus production on international markets. Biotechnology may provide opportunities to efficiently produce or manufacture food products for various cultures.

It has been only recently that agricultural economists have become concerned about the impacts of macroeconomic policies on the agricultural sector of the economy. More information is needed regarding the impacts of both domestic and foreign macroeconomic policies on our commodity, financial, other input markets, farms, and agribusiness firms operating in diverse local economic conditions.

Agricultural economists and other social scientists have an important role to play in assessing the economic and social aspects of new technologies. Almost all of the research in biotechnology has been aimed at developing the new technologies with little or no consideration to economic and social goals. With the rapid rate of development in biotechnologies and informational technologies, and the potential impacts of thee technologies, more attention needs to be devoted to assessing the magnitude and distribution of impacts of these technologies, if and when they are adopted. There are critical questions to be answered about releasing various technologies and whether release and sales should be strictly the prerogative of entrepreneurship, or whether release and adoption should be restricted and controlled. Agricultural economics research could contribute to determining appropriate rates of release and adoption which would reduce the severity of resource adjustments. Also, information is needed about the benefits and costs of these new emerging technologies and about the income

distribution effects because of differences in access and adoption by different wealth groups.

As farms and agribusinesses continue to diminish in number and increase in size, it is safe to assume that the quality of management and the need for information will increase. It would seem that there will be a greater need for information about aggregate market behavior, general economic conditions, and policy and outlook information which tend to explain the economic environment in which the farms and firms operate. Higher quality and more timely firm level data will also be needed. The complexity of decision making in large firms suggests that more micro oriented research will be needed. The economies of size research needs to be revisited with more emphasis placed on the importance of family goals, management ability and risk. The structural change in number and size of farms and agribusinesses suggests that more research is needed to assess the impacts of this change on the structures of rural communities, and the services needed to serve both the people that remain in farming and those who must locate alternative employment somewhere else in agriculture or outside of agriculture.

The concerns of the public about resource and chemical use and the quality of our environment have to be addressed. More research is needed to address the economic aspects of these problems. This research will need to be oriented to the community or region rather than being national or international in scope. Some research effort needs to be devoted to developing and modifying our economic tools

to better handle these social choice types of problems. Perhaps those in our profession who have devoted their efforts to natural resource use and environmental quality problems can help us with these problems.

The megatrends discussed in this paper increase the need for research. However, all indications are that traditional sources of funds and resources for research will fail to keep pace with the need. This means that the suggested research will have to be done with existing resources and hence individual research units, private and public, will have to carefully evaluate their research priorities. If these new research opportunities are to be addressed, each research unit needs to decide which existing research efforts to de-emphasize or drop. There is a temptation to do what can most easily be funded. No meaningful general prescription identifies what research should be de-emphasized in individual research units. Much of the suggested research is applied and problem solving in nature. As Schuh (1986) points out in his recent article in Choices, land grant universities have not given sufficient priority to generating and applying knowledge to solve current social and economic problems. There is a rapid emergence of alternative research and educational organizations in the private sector who stand ready to do this type of research if researchers at land grant universities don't take advantage of these opportunities.

Teaching

The megatrends discussed in this paper have implications for numbers of students in agricultural economics and curricula changes needed to produce graduates for which there is a demand in the future. Some decrease in size and number of both our undergraduate and graduate programs may be needed. The need for some decreased enrollments is clearer for colleges of agriculture than it is for the discipline of agricultural economics. More information is needed about the supply and demand for our B.S., M.S., and Ph.D. graduates. There is a lot of concern about declining enrollments in colleges of agriculture and consideration is being given to ways of increasing enrollment. Certainly modifying courses and curricula to appeal more to non-agricultural students, especially non-farm and non-rural students, merits serious consideration from a numbers viewpoint. Before much effort is put into attempting to increase enrollments in colleges of agriculture and agricultural economics specifically the demand for our undergraduates and graduates needs to be analyzed.

We may need fewer but better trained and higher quality graduates. The demand for graduates in various specialty areas needs to be analyzed. Erven's (1985) analysis of the short-term demand for Ph.D.'s in academia indicates an excess supply. Based on a survey of agricultural economics departments in the U.S. his analyses indicate that for the 1984-86 period there will be about three times as many Ph.D.'s available as there will be positions

available in land grant universities. This is a short-term analysis and does not consider non-academic opportunities. Schrimper (1985) has shown that the number of institutions awarding Ph.D.'s in agricultural economics has been stable but the total output of Ph.D.'s in agricultural economics is increasing about 1.5 percent per year. Huffman and Orazem (1985) indicate that graduate enrollment and Ph.D.'s produced in agricultural economics are highly sensitive to changes in expected costs and returns and the most important demand shifter for advanced degree holders in agricultural economics is aggregate state nonfarm income. These kinds of results reinforce the need for comprehensive analyses of the markets for undergraduate and graduate degree holders in agricultural economics.

The megatrends offer some implications for courses and curricula for undergraduates in agricultural economics. Our undergraduates will need a good foundation in biological and physical sciences. They will need to be strong in both microeconomics and macroeconomics. To be sure, they will need to know microeconomic and macroeconomic theory but more important is that they have the skills to apply those economic tools to solve practical, but ever increasingly complex, economic problems. The teaching of the skills to apply both microeconomic and macroeconomic principles and concepts to economic problems and to think like problem solving economists will continue to be the responsibilities of our courses in agricultural economics. It is problem solving and applications to agriculture that makes agricultural economics different from

economics, identifies it as a discipline, and attracts students to our program. The megatrends suggest even greater opportunities and challenges in the future for applying microeconomic and macroeconomic principles and concepts to solve more complex economic problems related to agriculture. To facilitate the application and analysis skills, the students will have to acquire good quantitative and computer skills. Those that employ our undergraduates indicate the need for more communication skills and this need will increase in the future. Training in technical fields in agriculture will need to be more focused and limited to a number of carefully selected technical agricultural courses. Finally, developing more skills in various aspects of business management may expand employment opportunities for our undergraduates.

In terms of course subject matter and curricula for graduate programs in agricultural economics, the megatrends suggest several areas of subject matter which need additional emphasis. Among the areas needing more emphasis are: (1) consumer behavior, demand, and consumption, (2) developing new markets and marketing new products, (3) risk management, (4) macroeconomics, (5) international trade, and (6) economic, social, and welfare impacts of technological change. The intent is not to suggest a proliferation of new courses. In some cases new courses may be needed to handle the subject matter while some topics may be incorporated into existing courses. In some cases the subject matter may be covered by giving more emphasis and expanding topics in existing courses. Some of the

topics may be taught in other parts of the universities and graduate students in agricultural economics need to be counseled into these courses.

With the changes occurring in agriculture, the area of agribusiness management may offer some new and expanded employment opportunities for individuals with graduate training, particularly at the Master's level. New or expanded agribusiness graduate programs are being considered at several places. There is a potential of developing several mediocre agribusiness Master's programs across the country at one time. Agribusiness graduate programs require substantial resources not only from the home department but other parts of the university such as colleges of business. Some consideration needs to be given to cooperation among universities, especially those in adjacent states and those located in close proximity to each other. It is possible to draw on each other's strengths and serve each other's students. This kind of cooperative arrangement may not be as convenient as each university entirely servicing its own program, but the potential gains in quality might offset the inconvenience.

Extension

The megatrends affecting agriculture have implications for outreach (extension) programs in terms of changing clientele, contents of educational programs, and delivery systems to be used. There will be fewer, more sophisticated clientele in commercial agriculture seeking more detailed and higher quality information and

answers to more complex economic problems. The commercial agricultural clientele will be large producers and some large agribusinesses who traditionally may not have been clientele of our outreach programs. Some of their service needs will be of a consulting nature. They will tend to bypass extension and go to private firms unless extension can complement their educational programs with these kinds of services. Technology and a changing domestic and international economic environment suggests the need for continuous managerial training and skill refinement for the managers to remain effective in the dynamic environment they will be facing. Consideration needs to be given to developing extension educational programs more in a curriculum framework with courses and other educational activities planned and coordinated on a continuous basis overtime.

More attention will need to be devoted to educational programs for those exiting from agricultural production to make way for the larger farms and ranches and agribusinesses. During the past few years, the need for educational programs focusing on adjustments to alternative employment opportunities in other parts of agriculture and outside of agriculture has escalated to the forefront.

Extension has clientele other than those directly concerned with commercial agriculture, but an important question is who will be the clientele in the future? Will the clientele include large scale fully integrated food production operations, rural community officials, home gardeners, small part-time "hobby" farmers, organic

farmers, and the general public who are concerned about agricultural production methods, resource and chemical use and the quality of the environment? All have needs for educational economic programs and extension will have to decide if and how they will service these groups. Some of these groups are politically powerful. Their information and educational needs will be serviced by someone, and if extension does not encompass them as part of their clientele, some private firm or institution will provide educational services to them.

The major changes affecting U.S. agriculture suggest that in the future a closer linkage between research, outreach programs, and program thrusts dealing with the causes and potential consequences of the megatrends will be needed. Some educational programs suggested by the megatrends are: (1) changing consumption patterns, underlying causes, and impacts on producers and marketing firms; (2) opportunities and limitations of alternative enterprises to livestock and feed grain production; (3) macroeconomic and international trade policies and their impacts on domestic commodity markets and farm revenues; (4) retooling for alternative employment opportunities and required individual and family adjustments; (5) micro and aggregate economic and social impacts of technological changes, especially biotechnologies and informational technologies; and (6) economic and welfare consequences of the use and non-use of chemicals, feed additives, hormones, and other pharmaceuticals in food production. The latter program area may be one of the most

difficult to deal with since many of the key issues that arise in this area may require the use of non-traditional economic analysis.

Serious consideration must be given to alternative delivery systems in outreach programs. The effectiveness of current extension field staffs to handle the complex problems of the more sophisticated clientele of the future has to be questioned. Clientele will want to work directly with state specialists or other personnel of that caliber, as is the case in the broiler industry. The outreach delivery system will utilize more computer based information, and will need to utilize audio and video communications so that clientele can interact directly with the scientists or specialists. Careful thought needs to be given to what kind of field staff can facilitate a program delivery system of this nature and what kind of organizational modifications are needed to facilitate extension specialists working across state lines to coordinate education activities and utilize available expertise.

Closing Remarks

The selected megatrends discussed in this paper will change agricultural economics. The trends will lead us to new problems. Agricultural economists must be able to identify and take advantage of the opportunities presented by these problems. Ignoring them could make agricultural economists a curiosity of history. Alternatively, if we attack the problems in an orderly and efficient manner, agricultural economics can continue to be viewed as the

useful applied social science. To lament the megatrends is to lose opportunity. To move with dispatch, imagination, and pragmatism maintains the finest tradition of the profession.

FOOTNOTES

Presidential Address

Joseph Havlicek, Jr. is Professor and Chairperson of the Department of Agricultural Economics and Rural Sociology at The Ohio State University.

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1/ Data on total noncitrus fruit consumption is not available beyond 1981.

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