Implications of changes (structural and market) on farm management and marketing research

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IMPLICATIONS OF CHANGES (Structural and Market) ON FARM MANAGEMENT AND MARKETING RESEARCH

CAED Report 29  Center for Agriculture and Economic Adjustment
IOWA STATE UNIVERSITY of Science and Technology  Ames, Iowa - 1967
IMPLICATIONS OF CHANGES (Structural and Market) ON FARM MANAGEMENT AND MARKETING RESEARCH

Proceedings of a Conference held in Chicago, Ill., April 24, 26, 1967

Sponsored by the

Center for Agricultural and Economic Development, Iowa State University of Science and Technology

In cooperation with the

Farm Foundation—Chicago, Illinois the North Central Research Committee on Farm Management and the North Central Research Committee on Marketing.
Obviously pleased at the successful turn out for the conference, the program planning committee included: (from left to right) John Redman, Glenn L. Johnson, Lowell Hill, John T. Scott Jr., Peter Helmberger, A. Gordon Ball, and James Hildreth.

Notetaking was part of the conference as speakers gave the audience much "food for thought." Approximately 200 persons attended the 2 1/2 day meeting.
PREFACE

This conference was really an outgrowth of an earlier conference on Structural Changes in Commercial Agriculture (CAED Report 24) held in Chicago, April 12-14, 1965. While the earlier conference emphasized structural changes in the agricultural industry and their implications for education and extension, the 1967 conference focused on research.

The conference was developed in two stages. The first stage consisted of asking six people to prepare papers on market changes: three on the input markets and three on the product markets. These papers were presented on October 4, 1966 to a meeting of the North Central Farm Management Research Committee at the Farm Foundation in Chicago. The papers underwent critique and discussion after which they were revised. The revised papers plus the proceedings from the earlier Structural Conference then served as base papers or background information for all other papers prepared for this conference.

The objective was, given these structural and market changes (outlined in the earlier structural conference and the six base papers on market changes), to focus on their implications for researchers in farm marketing, in marketing and in agricultural policy. In that way an opportunity would be provided for researchers in these three areas from all over United States and Canada to get together and explore the periphery of knowledge, assess its impact and project its meaning for the future.

Invitations were extended, therefore, to persons involved in research in farm management, in marketing or in agricultural policy whether with academic institutions, industrial firms or departments of government. Interest in the conference far exceeded the planning committee's most optimistic estimate. Approximately 200 persons attended the conference, and enthusiasm was both high and sustained.

The full texts of papers presented at the conference are included in this volume. The planning committee thinks that in published form the value of this conference can be increased for those who attended it and expanded to include many hundreds of other people.
The conference planning committee consisted of A. Gordon Ball, Department of Economics, Iowa State University, in the capacity of Chairman and three members of N.C.R. - 20 (North Central Research Committee on Marketing) and three members of the N.C.R. - 4 (North Central Research Committee on Farm Management). The N.C.R. - 20 members were: Lowell D. Hill, Department of Agricultural Economics, University of Illinois, Thomas T. Stout, Department of Agricultural Economics, Ohio State University and Peter G. Helmerger, Department of Agricultural Economics, University of Wisconsin. The N.C.R. - 4 members (in addition to A. Gordon Ball) were Glenn L. Johnson, Department of Agricultural Economics, Michigan State University; John C. Redman, Department of Agricultural Economics, University of Kentucky and John T. Scott, Department of Agricultural Economics, University of Illinois.

Special thanks is extended to the two sponsors that covered the expenses. The Center of Agricultural and Economic Development provided much of the financial support for the conference and its publication. The remainder, in itself a substantial and important portion of the cost, was absorbed by the Farm Foundation.

R. J. Hildreth of the Farm Foundation and his secretary, Miss Esther Olson helped immeasureably in making local arrangements. The unfaltering support and advice of Earl O. Heady, Director, Center for Agricultural and Economic Development, resulted in effective planning and execution of the conference. The responsible, efficient editing of the papers by Leo Mayer, moved the publication process along to completion without delay. To him and others of the Center staff who assisted in any way we express our gratitude.

The Conference Planning and Program Committee

A. Gordon Ball, Chairman
Peter G. Helmerger
Lowell D. Hill
Glenn L. Johnson
John C. Redman
John T. Scott
Thomas T. Stout
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INDUSTRY CHANGES IN FEED, FERTILIZER, PETROLEUM, AND OTHER CHEMICAL PRODUCTS USED IN FARM PRODUCTION

by George R. Allen*

My purpose is to highlight major technological changes in manufactured feed and agricultural chemical industries which, in the next five years, or so, will have a major impact on the markets for farm inputs - affecting prices, farm practices, methods of marketing and financing, and the possible development of farm planning services from the private sector.

Petroleum products are likely to exert a completely passive influence. They appear even now in many areas to be yielding less than a normal return at retail. They may be introduced into some of the new farm service centers to extend product range and to help towards overheads. Even so, petroleum products are one of the least important influences making for change in the market situation for farm inputs. I shall not refer to them again.

Turning to the other three groups - fertilizers, feeds and farm chemicals - the market for plant nutrients will show the greatest adjustment over the next five years. Working from a base period of, say, 1962-1965, one can highlight the following:

1. Fundamental changes in the economics of the nitrogenous materials, due to lower production costs both in the new ammonia plants and in associated conversion facilities.

2. As compared with the period 1962-1965, major reduction in the price of potash, associated with new low cost mining in Canada.

3. An equally strong but upward movement in the price of sulphur, a critical ingredient in the phosphate fertilizer processes commonly used in the U.S. This is in part the consequence of the rapid move to higher analysis materials since 1962.

4. A continuation of the rapid growth in domestic consumption of fertilizers, 8.9% annually in terms of plant nutrient from 1959/60 through 1963/64, for the next four or five years. In addition, a three to fourfold increase in annual fertilizer shipments to underdeveloped countries.

*Director of Economic Planning, Agricultural Chemical Group, W. R. Grace & Co.
These changes, to which others could be added, represent the biggest shake-up of economic forces in the fertilizer economy since the agricultural recession following the Korean War. Looking back in 1970 we shall probably regard 1964 and after as one of the most rapid periods of cost reduction and technological advance in the North American fertilizer industry since 1945.

**Future Potential for Fertilizer**

The most publicized changes are occurring in the production of ammonia and potash, but they are also found in the manufacture of nitric acid, other nitrogenous materials, and in phosphates. The most striking of all is deep mining of potash in Saskatchewan. By freezing the Blairmore Layer, shafts have been sunk to reach the largest deposits currently in use and, in relation to its markets in North America and abroad, one of the lowest cost sources of potash in the world.

The optimum size fertilizer plant is becoming much larger. Whereas a few years ago units of 300 tons/day or 400 tons/day were considered to be large, the new ammonia units coming on stream range in size from 1000 tons/day to 1500 tons/day if located close to natural gas and 600 tons/day to 800 tons/day if located within the main mid-west markets. In potash, the Saskatchewan mines in 1970 will have individual annual capacities mostly ranging from around 1,150,000 tons.

The locational pattern of the fertilizer industry is changing, with manufacturing plants being located further from the main domestic markets. This new geography of the fertilizer industry is a result of new mining and manufacturing technologies and higher nutrient content of materials, as well as new attractions in the export market. Ammonia plants aiming at only the mid-west market are best situated there, but the Mississippi Delta has demonstrated its attraction for those which seek greater geographical dispersion of outlets. The phosphate industry has generally moved nearer to the source of rock, although some recent development underline the growing importance of the Delta.

The new geography of the fertilizer industry is producing many changes. One is the logistic problems in supplying the mid-west market, especially in meeting the peak spring demand. The pressures to boost fall application of fertilizers, including anhydrous ammonia, will increase. Another consequence is the increasing importance of the river network as a competitive factor in the mid-west fertilizer distribution system.
In the last year there has been much discussion on prospective oversupply in N, P and K fertilizers. These appraisals underestimate the influence of a number of factors making for a more orderly growth of supply relatively to demand. The prospective demand for U. S. produced fertilizers is frequently underestimated, as well as the industrial markets for some of these materials. This is discussed in more detail later.

In the ammonia industry, new plants are starting up behind schedule and are experiencing slower start-ups and approaches to full operating capacity than has been the earlier case with smaller plants embodying a more established technology. Finally, many of the announcements of new projects, particularly in potash, may not take place or may be deferred, especially in view of the tightening cash flows of 1966 and 1967.

Since around 1956 the average price of fertilizers to the farmer has not increased, while other inputs have become much more expensive. For example, farm machinery prices have increased over the period by around 50% - and farm land by slightly more. These relative movements in the prices of farm inputs, to the advantage of fertilizer, are expected to continue.

Other factors will reinforce the rising demand for plant nutrients. First, the fertilizer/crop price ratio for 1966-1970 is likely to be more favorable to fertilizers than in 1962-1965 - the base period of the review. By then, the opening of networks of company-owned retail outlets will increase selling efforts. Finally, the retirement of land in the mid-west under Government programs in the early 1960's has stimulated farmers to a greater awareness of the economic opportunities for substituting fertilizer for land. These opportunities are probably as great today as they were in 1960, due to new crop technologies. The pace-setters of the Corn Belt farming community now aim for 200 bushels/acre, not 150.

All this means, in my opinion, that the prospective growth in fertilizer use in the U. S. through 1970 will be much higher than indicated by most published projections. I think it is likely that by 1970 U. S. agriculture will have increased its ability to meet the food needs of underdeveloped countries and, at the same time, be utilizing not much more land than in 1964 or 1965. This will be achieved by yields and rates of fertilization not thought possible a few years ago. My estimates through 1970-71 are shown in Table 1.1.
Table 1.1. Annual Rate of Growth in Consumption of Plant Nutrients

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<tr>
<td>N</td>
<td></td>
<td>10.4%</td>
<td>12.4%</td>
<td>10.0% - 13.0%</td>
</tr>
<tr>
<td>P</td>
<td></td>
<td>5.8</td>
<td>7.0</td>
<td>6.5 - 9.0</td>
</tr>
<tr>
<td>K</td>
<td></td>
<td>4.5</td>
<td>6.1</td>
<td>6.0 - 8.5</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>7.2%</td>
<td>8.9%</td>
<td>7.9% - 10.7%</td>
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</table>

The U.S. potash industry faces competition from lower cost Canadian supplies. But otherwise, especially in nitrogenous materials, U.S. fertilizer products have the cost advantage over other major exporters, mostly in West Europe. Further, AID fertilizer exports are expected to increase four-fold in the next few years. Finally, industrial uses for nitrogen and phosphates appear to be growing at least as rapidly as in the farm market.

Sulphur is currently in short supply and is expected to remain tight through 1968. The situation thereafter is conjectural, although in my opinion an easing of the overall world supply position is to be expected. Looking through to 1970 and beyond, the most important aspect of the current sulphur shortage is not its effect on fertilizer prices, but the stimulus it may give to new fertilizer technology. Taken together with the prospective cheapening of ammonia and nitric acid, current sulphur prices are causing the economics of nitric acid as an acidulent for phosphate rock, in place of sulphuric acid, to be closely reviewed.

In the U.S. virtually all phosphatic fertilizers are produced by acidulation processes based on sulphur. In Continental Europe, in contrast, large proportions of the phosphate industry's output come from either straight nitro-phosphates, in which the only acidulent is nitric acid, or modified nitro-phosphates in which nitric acid is partially substituted for sulphuric and phosphoric acids.

Little progress is likely with straight nitro-phosphates. They are low in water solubility and unsuitable where quick release of nutrients is required, as in pre-plant fertilization of corn. Also, the by-product materials would
have much more limited value in the U. S. than they do in northwest Europe. Modified nitro-phosphates are a more serious contender, especially as they can meet required conditions on water solubility.

It seems necessary to re-evaluate the part which nitro-phosphates can play in U. S. agriculture. So far, there is no sign of action. But, the economics of nitro-phosphates needs continual and close review. To anyone who would deny them any significant role, one question can be posed. Are there not important agricultural areas in the U. S. where the agronomy and economics of fertilizer use approximate conditions ruling in those parts of Europe where nitro-phosphates are accepted completely?

Future Potentials for Manufactured Feeds

Manufactured feed do not offer the same prospects for changes as the fertilizer industry.

The opportunities for reducing manufacturing costs are extremely limited.

Scientific advances in animal nutrition generally appear to be coming forward much more slowly than in the 1950's. The use of antibiotics and micro-nutrients seem to be clearly defined. Metabolic regulators could be important, and are urgently needed if the beef industry is to avoid decreasing returns while maintaining a 3%-4% annual average increase in output. But very little progress appears to have been made.

The most important, but still partially developed, business opportunity is the substitution of urea for animal and vegetable protein, a move which is in part connected with the use of liquid supplement feeds.

In the last few years a number of trends have been established which are important to the individual feed manufacturer or farmer. However, even in the aggregate these developments will not have a large effect on meat prices. The feed industry is technologically too mature. Briefly, they are:

1. A continuing decline of mobile grind-and-mix services which are being replaced mainly by mixing units confined to a single livestock enterprise and either owned or leased by it.
2. There will probably be some recovery in the importance of factory-mixed complete feeds for hogs and cattle for sale on a long-term contract basis to large operations: say over 5,000 head capacity in the case of cattle.

3. At the same time, the growth in sales of supplement feeds in bulk relatively to bagged materials will continue.

4. Regional feed companies may grow at a more rapid rate than the national giants of the industry. This is linked with the increasing importance of market-oriented mills, serving a radius of around 50-100 miles. Some regional companies, in exceptionally close contact with the customer, have already demonstrated this point.

Related Developments Affecting Manufactured Feeds

Looking further down the road, it seems necessary to highlight three developments.

1. High lysine corn; contract growing of feed grains.

2. The use of urea, and its relation to liquid feed supplements.

3. The development of large-scale cattle and hog operations in mid-west, particularly full environment-controlled cattle fattening and dry-lot cow-calf operations.

High lysine corn is probably 6-7 years off commercialization. From the viewpoint of the economics of livestock feeding its potentiality has yet to be defined. There is present evidence still some strong doubts whether, as against existing varieties, yield will be sufficiently high to justify its extensive use as a hog feed. However, if the yields can be obtained and taking into account possible rapid increases in the average size of hog operations, the structure of the feed industry will change dramatically. The emphasis in manufacturing will switch away from supplement feeds containing the full component of proteins and other nutrients to base mixes of vitamins, antibiotics, trace minerals, and such amino acid fortification as necessary to make good deficiencies in the corn.
Base mixes require even more careful mixing than supplements and, being of higher value in relative weight, reduce the influence of freight costs. In these circumstances there would be a move away from the regional mills which have now become typical and back to larger units serving, say, 200-300 miles radius.

The quantity of urea used as an animal feed is not known, largely because fertilizer grade material are commonly employed. It was probably 250,000-300,000 tons in 1965, and rising fast. The technical literature frequently gives the impression that the recent growth in the use of urea as a feed has been the consequence of feeders finding that the toxic dangers were much less than had been thought originally. This change of attitude has been a necessary, but not a sufficient condition. More important, the economic incentive has changed in the last five years, compared with the 1950's.

Dr. George Kromer of the U. S. D. A. has prepared an approximate measure of the relative profitability of using urea and soybean, by comparing a mixture of 1715 pounds of grain plus 285 pounds of urea (priced at $100/ton) against the price of a ton of soybean meal, 44% protein. (This is obviously a very rough yardstick and should be used, as the corn/hog ratio, only as an approximate guide to profitability.)

During the period 1954-1959 the corn-urea mixture never enjoyed a cost advantage of more than $6.70/ton. Subsequently, its advantage has been:

<table>
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<th>Year</th>
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<tr>
<td>1960</td>
<td>$13.9/ton</td>
</tr>
<tr>
<td>1961</td>
<td>16.7</td>
</tr>
<tr>
<td>1962</td>
<td>22.0</td>
</tr>
<tr>
<td>1963</td>
<td>20.8</td>
</tr>
<tr>
<td>1964 (Oct.-Dec.)</td>
<td>18.2</td>
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In view of expected cost reductions in the manufacture of nitrogenous materials -- lower ammonia prices and economies of scale in the new large urea plants, and stronger soybean prices compared with those in 1960-1964 -- the advantage should move further in favor of urea mixture.

The role of urea has been widened by the development of liquid supplement feeds with a molasses base, such as Iowa 80 and Purdue 64. It might
be asked how soon will the expanding use of liquid supplements be limited by an ultimate inelasticity in the supply of molasses. In the foreseeable future this is unlikely, in view of the world sugar situation. Further, a pulp-wood by-product is now available as a molasses substitute and is sold commercially.

The most conjectural issue, looking out 10 years, is whether the size structure in mid-west feedlot operations will change radically. The economics of joint enterprises is normally advanced to justify the continued viability of the existing pattern of small-scale feeding. But, there are at least three factors favoring large units.

First, the ability to reduce business uncertainties, especially with the opportunities provided for hedging in the new livestock future markets.

Second, there are the opportunities for increasing TDN by harvesting the complete growth of corn, stalks and all. This, it appears, involves the ability to control either directly or by contracting, the output of around 1000 acres of average corn land if equipment is to be used efficiently.

Third, and most important of all, there is now the strong likelihood that the Corn Belt can economically overcome its climatic disadvantages and achieve the feed conversion rates of the High Plains, as well as getting around the mud problem, by introducing environment-controlled indoor feeding.

Iowa Beef Packers have, of course, aroused interest in environment-controlled feeding by their announcement about a year ago that they were considering establishing a unit, or units, near Algona (Iowa) to turn out 50,000-100,000 cattle annually. A number of small operations - 300-500 head/capacity - have already been started by other feeders. The necessary fixed investment is less than $100/head, and probably around $40/head more than in the High Plains. At a superficial glance, this seems a small price to pay to offset the Corn Belt's climatic disadvantages and to maximize its advantages of accessibility to feed and markets and, especially if it develops its grass potential, to feeder cattle.

Within the next five years environment-controlled beef production seems likely to be important within the Corn Belt. There is, however, insufficient information to develop a sound projection of its rate of growth. One thing seems certain, this issue deserves much more attention than it is currently receiving.
It is too early to say how mid-west supplement feed manufacturers would react to the development of large-scale environmental feedlots in the mid-west, should they develop. In other areas where large feeding units have emerged, as in the High Plains, feed manufacturers have not integrated into cattle feeding. It has been advantageous to all concerned for feed supplement manufacturing and for feeding to retain their separate identities. This, too, seems likely in the mid-west.

Concluding Observations

Many important developments are occurring in farm chemicals. These are not discussed here. This may seem a cavalier treatment in view of their actual and potential effects on farming methods. However, although they call for added skills on the part of dealers and managers of company-owned farm service centers, it seems unlikely that they will have any direct effect on the structure of the marketing system for farm inputs.

In net, the picture I wish to present is one in which technical change has been, and is, taking place extremely rapidly in the mining and manufacture of fertilizer materials and in farm chemicals, and also to a lesser degree in manufactured feeds. I have described some of the more important changes in order to provide a base from which anyone wishing to analyze the structure of these industries can proceed. Any appraisal of structure, of course, involves many additional considerations to those in this paper, especially governmental policy towards vertical integration in agribusiness and towards recent and possible future mergers in the fertilizer industry.

However, the main impression I wish to leave is that technical features I have highlighted, as well as some others which could have been explored, will have a much greater direct effect on the prices of farm inputs than other considerations which usually figure prominently in discussions of structure and performance of agribusiness. At the same time, any indirect effects of technical changes on the structural evolution of the industries under review is, in terms of their economic implications, a secondary issue when compared with their direct influence on prices of fertilizers, feed and farm chemicals.
CHANGING AGRICULTURE AND ITS DEMANDS FOR CAPITAL EQUIPMENT AND MANAGEMENT

by Lester S. Kellogg*

This paper -- originally listed as a technical paper -- will not treat potential technical or engineering changes in farm machinery and other agricultural capital equipment. It will treat demands for capital and management, however, from economic points of view and will, in the process, touch pointedly some probable structural changes in agriculture.

Background Information

As background for discussion, I am going to spend the first few pages briefly describing some projections to 1980 for a few major characteristics of U. S. agriculture. Projections to 1985 would be much better, since direction signs as far ahead as possible -- and 1985 is only eighteen years ahead -- are helpful.

United States Population

The total United States population, which serves as the primary market for the products of United States agriculture, will total approximately 250 million compared with 198 million now -- an increase of about 26 percent. All of North America, in fact, is growing at roughly similar rates and, as a result, continental demand for the product of our agricultural enterprise should itself be a major growth force for agricultural industries.

World Population

The so-called "population explosion," which will result in a doubling of the world's population by 2000 A.D. at current rates, has been so widely discussed that we won't go into detail about it here, except to assume -- in the light of U. S. action under the "Food for Peace" program -- that our country will act responsibly in helping to feed the rest of the world. Such assistance, of course, will show up in our exports -- and promptly. We can't wait five or ten years to get ready.

*Corporate Economist, Deere & Company
Exports of Farm Products

Exports of farm products, since the early fifties, have more than doubled, substantially as a result of government assistance. Exports without government assistance, however, since the mid-fifties, have increased by well over 50 percent, and such exports continue to account for 50 percent or more of the total -- and could account for a larger percentage.

North American plus export demands for the products of agricultural enterprise in the United States will, in the next ten to twenty years, reach record highs and provide markets never before served by United States agricultural producers.

Farm Population

Farm population has been declining steadily in the United States since its peak in the mid-thirties. It will continue to decline. In fact, as a description of a portion of our population, it will become very small or even disappear by being defined out of existence. It may become indistinguishable because of changes in address identifications -- such as urban or rural -- or vocational descriptions. It is now less than 7 percent of our total population. By 1980 -- if it is distinguishable -- it will probably be 3 percent or less of the country's expected total population. This small segment may be difficult to identify, and its problems will differ greatly from those of the past.

Total U. S. Land Area

The total U. S. land area is relatively fixed, but the total land in cities, highways, airports, urban and suburban utility requirements, and forest-lands -- much of which will be parks or greens -- will increase. As a result, land available for agriculture will decrease slowly; and croplands planted and harvested in the next fifteen years will decline, at least temporarily, as soon as the current planned crop acreage increases have been digested. It is not necessary to point out, but I shall, that crop acres harvested in the United States from about 1920 until 1956 totaled 350 million acres, plus or minus ten to fifteen million. Since then, the total declined to 290 to 300 million acres following the establishment of the Soil Bank in 1956. Keep in mind that the essentially horizontal trend, at 350 million acres, maintained for many years, while draft animal population was declining by some 17 million head and the acreage used for their feed was declining by 80 million acres. Is it any wonder that the United States had more production than it
could use? It is likely, however, that we will not for many years plant or harvest as many acres as in the years just before the Acreage Reserves were established.

Number of Farms

The number of farms, as defined by the Census, reached a peak in 1920 and then started to decline. The decline was arrested in the thirties when, during the Great Depression, people returned to farms briefly as urban employment slackened, but following the recovery, the downward trend continued. In 1964 only 1.8 million farms sold products valued at $2,500 or more; less than 900,000 sent products to market with a value of $10,000 or more. It is safe to say that the number of farms will continue to decrease, and by 1980 the total of economically productive farms probably will not exceed 500 to 600 thousand. New developments could cause this total to decline to a substantially lower total by the target date or shortly thereafter and produce our country's total needs more dependably and less expensively in terms of the ratio of inputs to outputs.

Agricultural Employment

The trend of agricultural employment has been steadily downward, except for the Depression period. In the last twenty-five years the number of farm workers has been cut in half. The trend will continue downward. Where it will level out is impossible to predict. It is probably enough to say that what we now consider as agricultural employment -- even within so short a period as fifteen years -- may be redefined and show up in nonagricultural industrial classifications. Month after month, the Farm Labor release of the Department of Agriculture drives home the fact of declining farm employment. The April 10, 1967, release -- sounding much like the monthly releases of the last few years -- indicates that the nation's farm labor force in the week of March 19-25, 1967, totaled 4.4 million persons, a record low for the date. For a number of years, agricultural employment declined relatively slowly, in the neighborhood of 3 percent per year. For the last several years, the year-to-year decline has been 7 to 12 percent.

This downward trend has been both effect and cause. Workers have been attracted to nonfarm jobs, and agricultural machines have been substituted. At the same time, the cost-saving and productivity-increasing
capacity of machines has been eagerly sought to eliminate costly, troublesome, and undesirable work. There is still a long way to go.

Recent minimum wage legislation is speeding further decreases in agricultural employment.

For people in agriculture, these trends are convincing confirmations of the rapid declines in opportunities for individuals to work in agricultural enterprises. Greater proportions of the labor formerly used in agriculture will, in the future be used in servicing agriculture and in the processing and distribution of food and fiber. The sons and daughters of long-time workers in agriculture, however, will do well -- in view of the outlook for the future -- to search for job opportunities in areas well beyond those directly or even indirectly related to agricultural operations. In the future, serving and supplying agriculture will be little different from serving and supplying other industries. If this is true, the services demanded can be provided as well by people without a farm heritage as by farm-raised people. In short, the distinctions we have credited so long to farmers or persons raised on farms are rapidly disappearing.

Average Size of Farm

The trend in the average size of U. S. farms has been continuously upward. In the years ahead, it will continue its upward course, and where it will stop nobody knows. Farms are currently being consolidated in the U. S. at the fastest rates in history. To project the average to 1980 is hazardous; more importantly, it is meaningless. It is meaningless because the trends toward industrialization and specialization of both the enterprise and labor will result in farms of very different sizes, depending upon the commodity produced.

Tractors, Combines, Pickers, Balers, and Choppers on Farms

The total number of tractors and other traditional important machines on farms increased in growth-curve fashion from their introduction early in the century into the early 1960's. Totals of most of these machines are now declining, but such totals for all of agriculture have little meaning. The important machines -- those that should be counted -- are those on highly productive agricultural enterprises. Such machines are less than ten years old and probably not more than five years old.
Income from Agriculture

The trend of cash receipts from agriculture has been steadily upward since 1940, and I believe that the trend will continue. Such income will be divided among substantially fewer recipients and will be large enough that agricultural enterprise, as an industry, can stand on its own feet — side by side with other industries — to a greater extent than at any time in our history. Many argue that some other industries don't stand on their own feet. I would answer that "along with agriculture, it's time that they did."

So much for these types of projections. We could extend them and, in fact, should prepare them in much greater detail. We don't have space here and now to do this, however, even if all the data collection and research had been done -- which, in my judgement, it has not.

Projection Methods -- Trends, Adaptation, a Philosophy

Projections of the types I have been discussing should not be considered as precise forecasts. They can be best used as general guides. As extrapolations of previous trends, all of the kinds of forces which historically have affected the trends of the factors being projected are implicitly assumed to be present in the future and, therefore, to affect the projections. Unfortunately, much of the research in agriculture has failed to take account of the changing nature of agriculture and most such projections are not borne out by experience.

If the farm machinery industry and the agricultural capital suppliers of the future provide the inputs expected of them, they must certainly make their plans with reasoned consideration of many types of projections. Let me discuss some of the projections we have made, and then I want to discuss some of the changes which may take place.

Since it takes John Deere -- or any of the major farm machinery manufacturers -- five to seven years to develop, test, and put into production a major new machine, it is important that we be as nearly right as possible in the projections of the various characteristics of these machines for as far as fifteen to twenty years ahead. As an illustration, the decision to develop and produce the new series of tractors which Deere put on the market in 1960 was made in the Fall of 1953. At that time, the new power sizes determined as essential were well in advance of anything then being produced and went only as far as the power introduced in our Model 4010, which was
approximately 84 horsepower. Our designs and our tooling, however, were such that it was possible, in a relatively short time after the introduction of the new series, to introduce the Model 5010 at 121 horsepower.

Recently, we have had to produce estimates of unit requirements of tractors by horsepower sizes for 1975 and 1980 as guides to engineering development. In making these projections, we have had to depend upon trends and the factors of change implicit in them, but we have had to go beyond this, however, and introduce new technical methods of projection as well as make some assumptions about the potential changes in the structure of agriculture, the capital requirements of agriculture, the operating characteristics of tractors and other agricultural machines and equipment and their servicing requirements. In short, we've had to develop new philosophies of the nature of change in agriculture.

The most interesting development statistically in preparing our projections has been analyses of the annual shifts in power size distributions of tractors, as reflected in log-normal curves of annual sales. It is impossible to extrapolate the trends of such distributions by usual methods. Imagination in adapting methods from other fields may pay off. Time, plus our use of confidential data, does not permit my describing detailed conclusions.

In general, I can say that the power of tractors will continue to increase at the drawbar but also to provide for an increasing variety of hydraulic aids, for heating, cooling, and ventilating of drivers' cabs, for powering communication equipment, etc. The resulting machines will be increasingly productive and functional. They must also be considered as being as attractive to the manpower which runs them as the newer types of machinery being installed in factories in other industries. This is a most important consideration for agriculturists in attracting the skilled labor to whom they will entrust operation of high-valued capital items.

The projections of requirements of farm machines carry with them some corollaries. The machines must be of a high degree of reliability. This requirement has led to the institution in most of the large farm machinery companies of rigorous programs of inspection, quality control, and reliability standards. It has also led to the reassessment of servicing

\footnote{Such methods are described by the Belgian, Karl Daeves, in "Vorausbestimmungen im Wirtschaftsleben," Essen. Girardet. 1951.}
requirements and the provision of spare parts. The cost of high-unit-value
machines of these types requires -- just as the high-cost capital equipment
of other industries -- maximum use on 'round-the-clock schedule when
feasible. Our projections, then, go beyond the simple statistical extrapolation
of trends to the reasoned consideration of many of the aspects of production
and distribution to which they may be related.

Since this is not a research paper or a paper reporting the results of
research -- but is rather one aimed at eliciting ideas and stimulating
imagination as a basis for developing new research directions and programs --
I'd like now to shift gears for a few minutes to raise one of the most important
questions related to changes in machinery, buildings, equipment, etc. I
want here to talk about two major problems. One of them is the objectives
or goals of agricultural enterprise in the United States, and the other has
to do with meeting these goals.

Goals of Agriculture -- Objectivity vs. Tradition

In my experience, research in agriculture traditionally has been done
with many implicit or unstated -- usually unrecognized -- assumptions.
One effect of the presence of such assumptions in research may be to min­
imize its objectivity.

To illustrate this point, suppose we were to say that in the future the
objective of agricultural policy in the United States should be to minimize
resource inputs relative to product outputs, that is, to minimize unit costs
of production, yet remain economically viable and competitive in domestic
as well as world markets.

Suppose then, we were to start from scratch and to say, "What steps
shall we take to organize an agricultural enterprise to accomplish these
goals?" If the group here today, for instance, were to decide to engage
together in such an enterprise with the goals suggested, we would be wise
to start by making -- or contracting with a professional group to make --
a feasibility study similar to those produced for groups in other industries
(or companies) when they plan to initiate new, potentially profitable enter­
prises.

Starting with this point of view, we must determine what product to
produce. We will have to take into account the location and size of the
market for the product and what specifications and qualities of the product
the markets want. We will have to determine from scratch -- without an
inventory of capital in any form -- the specifications of soils (if soils are required), weather or water conditions, buildings and equipment, etc., that we must acquire. We will have to take into account current competitive costs and terms of capital, taxes, wage rates of able people, and -- most important of all -- management.

Since all of us cannot be the managers, we will have to choose one person who is the best manager. He may not necessarily be the best agronomist, but he probably will turnout to be the best businessman we can find and afford -- however we define "businessman." To find him, we certainly will have to compete with a great variety of other agricultural and nonagricultural enterprises. Whether or not we find him on what has been a farm and whether his training will have been in a college of agriculture, a school or business, or a college of arts and sciences will be immaterial. What we will need will be the skills of management -- however or wherever developed.

We will then proceed -- if we are to get capital at minimum costs -- to go to the public to whom we will sell shares in order to get necessary funds, and our loans will have to come from institutions for long terms and at rates which will be competitive with those charged to other industries.

In the future, if we treat agriculture as an industry with the same kinds of basic objectives as are established for other industries, these are the kinds of steps we will have to take. I neither have seen in writing nor heard in oral presentations by agricultural economists more than traditional discussions of such steps. Research related to these organizational processes is the responsibility of you educators. Your research programs and curricula should be changed to move in the directions that will provide answers and training along the lines of requirements which will be essential for the future, or we ought to study the rapidly advancing work of others in financial organizations and corporation finance and advise our students to be bold in crossing disciplinary lines for exposures to such fields.

Illustrative of the need for such steps is the experience of the Midwest Farm Corporation. A group of eastern Iowa farmers, lawyers, doctors, engineers, and businessmen obtained an intra-state corporate charter in March 1965 to operate a large, straight corn production enterprise. Traditional opposition to both the corporate form of organization and to the agricultural methods proposed combined to delay the sale of shares by the local group, as well as the additional financing necessary for the start of the operation.
After long months of restudying every phase of the plans and searching for professional financial assistance, a contract was made in the Summer of 1966 for a feasibility study with Arthur D. Little, Inc. No agricultural group with experience along such lines and known to investors could be located.

The feasibility study, on explicit conservative assumptions, estimated that the potential return, after taxes, on original stockholders' equity in this enterprise was 12.1 percent for the first year, 13.8 percent for the second year, 17.5 percent for the third year, and 18 percent for the sixth and later years. Time doesn't permit reporting more details of the report. Suffice it to say these are figures of truly growth proportions. The study was presented to a group of prospective investors by a midwest financing firm early this year. The stock was completely subscribed, and the actual operation on nearly 2,000 acres is under way. This example alone suggests many questions needing research.

If I were to describe the contrast with what we have been doing in traditional agricultural economics, I would sound negative. Let me take that risk in order to make some of my points clear.

1. The word "farm" no longer can be adequately defined. To use it may be increasingly misleading.

2. Agriculture is not monolithic. It involves a great variety of activities. Many of the enterprises within agriculture are competitive. There is no common interest among all agricultural sectors or varieties which can possibly lead to a solid voting block, as at one time there was. Many activities formerly classified as farming now make up specialized industries. Hatcheries long since have moved to urban areas. The broiler industry, save for some restraining ordinances, could probably better be in the urban areas than where it originated. In the future, with the appropriate use of chemicals and knowledge of sanitation, the dairies -- and even some of the animal-feeding operations -- can be located within urban areas. Their location will depend, aside from existing restraints, largely upon the economics of the movement of milk or carcass versus the movement of feed and waste.

3. Agricultural management is not an inherited characteristic. Agricultural enterprises must seek and compete for management against other industries. Is this really possible? I was told by a most successful farmer the other day that farmers are afraid of competition. But, management is being taught with increasing effectiveness, and a great deal of research is under way in the field.
4. The continuity of good management is essential to long-term credit and low or prime interest rates. How should agriculturists organize their enterprises in the future to provide multiple-generation good management and the opportunities other industries have enjoyed for assured and economical capital costs? To accomplish such goals, freedom from restraining controls will be essential.

5. Access to agriculture is still possible but under more difficult conditions than in the past. Much has been made over the years of the importance of the sons of farmers being able to become farmers. Is there any reason why access guarantee should be provided for agriculture? It is not provided or guaranteed for any other industry.

6. Agricultural labor will receive wage, fringe benefits, and security guarantees similar to those provided by other industries.

The points I have just been making are some, but not nearly all, of those which implicitly appear to lie in the basic thought and hence to underly practically all research by agricultural economists. If United States agriculture in the period ahead is to attain the position in world agriculture and world trade which it deserves, the objectives must be changed and clearly recognized as promptly as possible.

Statistics -- Measurements Related to Objectives

Now, let me turn for a moment to another aspect of research relative to inputs of capital goods in agriculture.

Statistics on these subjects are of varied reliability. For many years, the Bureau of the Census has produced regularly figures on production and shipments, in units and values, of a great variety of farm machinery and equipment, including tractors. By certain statistical assumptions with respect to prices paid by farmers for such machinery, it has been possible to estimate farmers' annual investments in this type of equipment.

Data on farmers' investments in other types of capital equipment however, such as buildings -- including barns, silos, service shed, storage sheds, etc. -- and the equipment necessary for irrigation or conservation practices have not been easily or reliably available. In neither of these cases, however, has investment by producers responsible for major portions of production been available. In 1955 the Bureau of the Census, for the
Department of Agriculture, conducted a Farmers' Expenditure Survey, which provided some information -- but only some -- on this general subject.

Annually, the Department of Agriculture produces a Balance Sheet of Agriculture in which estimates of a variety of assets are provided. These estimates are made by a number of procedures which long since have been in need of review and, in my belief, renovation. As in the case of the production and shipments figures, the Balance Sheet figures likewise are not classified by size of enterprise so that the whole of agriculture, within which I am sure there is great waste in use of capital, is not reflected in the figures.

If it is important to know -- and I think it is -- more about changes in the future in investment in the various agricultural capital items, then it is important that new statistical programs be developed and that some of the older programs be modified. I mention this now because plans are being laid now for the Census of Agriculture of 1969.

The Census of Agriculture is a traditional instrument. It, too, ought to be brought up to date to treat agriculture as an industry. The Directors of the Census are continuously willing to listen to proposals for changes and will, in this instance, welcome suggestions about information needed to aid in measuring the degree of attainment of the objectives of a modern United States agriculture.

I listened at the recent meetings of the American Farm Economic Association to Professor Cochrane talk about gaps in agricultural data. I remember hearing no single word along the lines I have been discussing. His whole interest appeared to be having more information that will help in government programs of production control rather than in providing the information which will free agriculture -- to make it what, in my judgment, it should be. What can this group do to further the program of an improved Census of Agriculture? It is getting late, for decisions will be made within the next six to twelve months which will set the course for a new type of Census or continue it in the context of tradition.

If information relative to the capital inputs of agriculture is going to be important in the future and if its main source will be production and shipments figures, as has been the case in the past, it will be necessary for those of you who use these figures to be aware that the "Farm Machinery and Equipment" industry is probably producing a continuously declining portion of the total capital equipment used by agriculture.
The changing nature of agriculture is the reason for this, the increasing size of operations and the changing nature of methods of handling and distributing agricultural products are largely accountable. Field agriculture is becoming increasingly a materials-handling operation. This is true whether we are talking about moving soil in preparation for planting, or the harvesting, handling, and shipping of product. Increasingly, a number of these functions are being performed by equipment made by a wide variety of industries whose production and shipments figures are listed under different classification numbers and names and are not included in farm machinery and equipment. To sort out these various pieces makes the possibility of obtaining accurate, overall figures increasingly hazardous. Attention to the appropriate collection and collation of information is extremely important now if appropriate data on this subject are to be obtained in the future.

If agriculture in the future is to be treated like other businesses or industries, changes in government itself may be helpful. The Department of Agriculture may be partitioned and re-combined by some future Administration much as has been proposed for the Department of Labor and Commerce by the present Administration.

**Conclusions**

I have told you that I believe that the future of agriculture is bright in terms of the demands upon it for its product. Agriculture is in the midst of great change and bears increasing responsibility as an industry or collection of industries in helping to supply world needs. To meet these responsibilities, the most important input factors will be management and access to capital as efficiently and economically as other industries. To obtain management and capital at economical costs, agriculture, the industry, will become increasingly industrialized and specialized and will compete in the general markets for managing manpower.

The measurement of the capital requirements of agriculture will require new statistical approaches and techniques, and it is time now to do the research required. In this paper, I have not mentioned the research on the steps necessary to move from traditional agriculture to the new agriculture. To make the new agriculture most productive, broad and new approaches to production research, as well as different kinds of research on the personal problems that accompany shifts of people from agriculture, will be required.
Rapid urbanization of the U. S. economy has produced major changes in the labor market that American agriculture faces. Further changes are being imposed by legislation that is attempting, albeit somewhat belatedly, to deal directly with the poverty problems of rural America.

This paper is organized in three parts. The first part attempts to sketch out the general characteristics of and the major changes in the demographic and structural characteristics of the U. S. agricultural labor force. The second part analyzes the effect of some recent legislation that impinges directly on the agricultural labor force, and discusses other economic forces that are affecting the structure of the labor market. The third part discusses very briefly the changing nature of skills required in agriculture. And the paper ends with a brief concluding comment.

### General Characteristics of and Major Changes in the Agricultural Labor Force

The change over time in the labor force in agriculture has been one of the major resource adjustments in the industry. Having reached a peak at around 1917-18, farm employment declined from 13.4 million in 1920 to 5.6 million in 1965.1/ (Table 3.1). In addition, the rise in the price of agricultural labor has been one of the major secular changes in the relative price of an input (Table 3.2). It has risen both with respect to the prices received by farmers and in relation to the prices of other farm inputs.

If one divides the agricultural labor force into family labor (operator plus unpaid family labor) and hired labor, it appears that downward adjustments in the two components are quite similar. (Table 3.3). Measured either on a 1910-14 base or on a 1957-59 base, the employment in 1965

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1/ USDA concept, based on average monthly employment during the year.

These estimates amount to year equivalents of labor, without any account being taken of the various "qualities of the labor".

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*Purdue Agricultural Experiment Station, Journal Paper 2944, Project 1107. Helpful comments on an earlier draft of this paper were received from J. Carroll Bottum and Paul Farris.

**Professor of Economics, Purdue University

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**Professor of Economics, Purdue University

1/ USDA concept, based on average monthly employment during the year.

These estimates amount to year equivalents of labor, without any account being taken of the various "qualities of the labor".
### Table 3.1. Agricultural Labor Force Composition for Selected Years, Number and Indices (1920 = 100).

<table>
<thead>
<tr>
<th>Year</th>
<th>Hired Labor (000)</th>
<th>Unpaid Family Labor a/ (000)</th>
<th>Operator Labor b/ (000)</th>
<th>Total Agricultural Labor (000)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(index)</td>
<td>(index)</td>
<td>(index)</td>
<td>(index)</td>
</tr>
<tr>
<td>1920</td>
<td>3,391</td>
<td>3,523</td>
<td>6,513</td>
<td>13,432</td>
</tr>
<tr>
<td>1930</td>
<td>3,190</td>
<td>2,761</td>
<td>6,546</td>
<td>12,497</td>
</tr>
<tr>
<td>1940</td>
<td>2,679</td>
<td>1,950</td>
<td>6,350</td>
<td>10,979</td>
</tr>
<tr>
<td>1950</td>
<td>2,329</td>
<td>1,940</td>
<td>5,648</td>
<td>9,922</td>
</tr>
<tr>
<td>1959</td>
<td>1,952</td>
<td>1,293</td>
<td>2,097</td>
<td>7,342</td>
</tr>
<tr>
<td>1964</td>
<td>1,604</td>
<td>1,034</td>
<td>3,472</td>
<td>6,110</td>
</tr>
<tr>
<td>1965</td>
<td>1,484</td>
<td>751</td>
<td>3,374</td>
<td>5,609</td>
</tr>
</tbody>
</table>

Sources: *Farm Employment*, USDA, Statistical Bulletin No. 334; *Farm Labor*, AMS, USDA; and *Farm Income Situation*, USDA.

a/ Unpaid family labor = family labor - operator labor. b/ Operator labor = number of farms.

### Table 3.2. Index of Prices Received and Prices Paid for Selected Inputs, 1935-59. (1953-39 = 100).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Prices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>received by</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>farmers</td>
<td>100</td>
<td>144</td>
<td>231</td>
<td>252</td>
<td>221</td>
</tr>
<tr>
<td>Price of fertilizer</td>
<td>100</td>
<td>106</td>
<td>132</td>
<td>150</td>
<td>151</td>
</tr>
<tr>
<td>Price of machinery</td>
<td>100</td>
<td>102</td>
<td>130</td>
<td>173</td>
<td>191</td>
</tr>
<tr>
<td>Price of labor</td>
<td>100</td>
<td>178</td>
<td>333</td>
<td>395</td>
<td>455</td>
</tr>
<tr>
<td>Price of land (alone)</td>
<td>100</td>
<td>112</td>
<td>188</td>
<td>254</td>
<td>325</td>
</tr>
<tr>
<td>Price paid all costs</td>
<td>100</td>
<td>122</td>
<td>184</td>
<td>220</td>
<td>229</td>
</tr>
</tbody>
</table>


### Table 3.3. Indexes of Farm Employment, 1965, Expressed as Percentage of 1910-14 and 1957-59

<table>
<thead>
<tr>
<th>Year</th>
<th>1910-14 = 100</th>
<th>1957-59 = 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>41</td>
<td>75</td>
</tr>
<tr>
<td>Family labor</td>
<td>41</td>
<td>75</td>
</tr>
<tr>
<td>Hired labor</td>
<td>44</td>
<td>76</td>
</tr>
</tbody>
</table>

Source: *Farm Labor*, February 1966
expressed as a percentage of the base periods is quite similar, although it appears that hired employment is declining somewhat more slowly than family labor.

However, if one assumes that there is one farm operator per farm, the labor force can be further disaggregated. This permits the estimation of three separate components of the labor force: hired, unpaid family, and operator labor. (Table 3.1). Such a breakdown shows that there has been an important shift taking place within the family labor component. As Table 3.1 shows, there has been a larger reduction in the unpaid family labor component, compared to both hired labor and operator labor. Moreover, the operator has declined less than any one of the three components, so that it is providing an increasing percentage of the total year-equivalents of labor employed in agriculture.

Nikolitch examined the relative proportion between family and hired labor by estimating the hours worked by each component for the period 1910 to 1959. His data show that from 1910 to 1930 the number of manhours of both family and hired work on farms did not change greatly. Since 1930, however, the amount of family work has continually decreased. And since 1940, hired work has also decreased. Starting about 1948-49 hired labor decreased rapidly and during the decade of the 1950's, decreased faster, on the average, than family labor.

Nikolitch shows that the number of family workers is declining almost solely on small farms with little production, while the number of hired workers is declining on the larger farms which provide steady work. As a result the amount of work done by hired workers is decreasing faster than the amount done by family workers. And consequently, he argues, technological change is not substituting hired labor for family labor in agriculture as it did in other industries, and there is no tendency toward the elimination of the family farm.

Before probing more deeply into the shifts that are taking place in the hired labor force, we turn first to general descriptive data of the agricultural labor force. Table 3.4 presents data on the median age of the employed U. S. farm labor force by color and sex in 1960. (Based on the Census concept of labor).

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Table 3.4. Median age of employed U. S. farm labor force by color and sex, 1950 and 1960.

<table>
<thead>
<tr>
<th></th>
<th>1950 Male</th>
<th>1950 Female</th>
<th>1960 Male</th>
<th>1960 Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers and farm managers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>45.9</td>
<td>50.4</td>
<td>49.2</td>
<td>51.4</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>44.2</td>
<td>46.1</td>
<td>49.5</td>
<td>47.7</td>
</tr>
<tr>
<td>Farm laborers and foreman</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26.4</td>
<td>36.2</td>
<td>31.2</td>
<td>40.0</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>26.1</td>
<td>31.3</td>
<td>36.1</td>
<td>36.6</td>
</tr>
<tr>
<td>Unpaid family laborersa/</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>19.1</td>
<td>37.0</td>
<td>18.3</td>
<td>42.9</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>18.5</td>
<td>29.2</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
<tr>
<td>Hired workersb/</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>31.9</td>
<td>34.1</td>
<td>34.2</td>
<td>38.4</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>34.2</td>
<td>33.5</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
</tbody>
</table>


a/ Unpaid family labor and farm foreman.
b/ Farm laborers except unpaid family labor and farm foreman.
N.A. = not available.

The data indicate important differences in age among the various components. Farm operators are the oldest group with little difference on the basis of race or sex. Farm laborers in total are somewhat younger than farm operators, with the females in the category tending to be somewhat older than the males. The unpaid family labor category presents the most important departure. The median age of males is 18.3 years while that of females is 42.9 years. This would suggest that the males are most likely students who work after school while the females are probably the wives of the farm operators. This is important in that females are most important in this component of the labor force, comprising almost 45% of the total.
The general aging of the labor force can also be seen in table 3.4. All categories with exception of male unpaid family laborers were older on average in 1960 than in 1950. The increase in average age is around 3-5 years, with the exception of the nonwhite laborers, which increased in age an average of 10 years.

The breakdown of the U. S. experienced farm labor force by color and sex is given for 1960 in table 3.5. There it can be seen that females make up an important part of the unpaid labor force. They are comparatively unimportant as farm operators, but make up as much as 20% of the hired labor force.

Table 3.5. Breakdown of the U. S. experienced farm labor force (14 years and older) by color and sex, 1960 (thousands).

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
<th>% Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers and farm manager</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2,526</td>
<td>2,406</td>
<td>120</td>
<td>95.2</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>197</td>
<td>170</td>
<td>18</td>
<td>90.9</td>
</tr>
<tr>
<td>% Nonwhite</td>
<td>7.8</td>
<td>7.4</td>
<td>15.1</td>
<td></td>
</tr>
<tr>
<td>Farm laborers and foreman</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1,560</td>
<td>1,290</td>
<td>270</td>
<td>82.7</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>400</td>
<td>309</td>
<td>91</td>
<td>77.3</td>
</tr>
<tr>
<td>% Nonwhite</td>
<td>25.6</td>
<td>24.0</td>
<td>33.9</td>
<td></td>
</tr>
<tr>
<td>Unpaid family labora/</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>284</td>
<td>159</td>
<td>125</td>
<td>56.0</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>38</td>
<td>22</td>
<td>16</td>
<td>57.9</td>
</tr>
<tr>
<td>% Nonwhite</td>
<td>13.4</td>
<td>13.8</td>
<td>12.7</td>
<td></td>
</tr>
<tr>
<td>Hired workersb/</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1,275</td>
<td>1,131</td>
<td>144</td>
<td>88.7</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>363</td>
<td>287</td>
<td>76</td>
<td>79.1</td>
</tr>
<tr>
<td>% Nonwhite</td>
<td>28.5</td>
<td>25.4</td>
<td>52.3</td>
<td></td>
</tr>
</tbody>
</table>


a/Unpaid family labor and farm foreman.

b/Farm laborers, except unpaid family labor and farm foreman.
Although race is not an important part of our analysis, it is interesting to note that nonwhites are comparatively unimportant as farm operators, play a somewhat larger role as a source of unpaid family labor, and a still larger role among the hired labor force. Moreover, negroes make up a larger fraction of the female hired labor force than of any other category.

Data on the median years of school completed by the experienced U. S. farm labor force are presented in Table 3.6. These data show that for the totals, farmers and farm managers have the most schooling, with similar levels for

Table 3.6. Median years of school completed by experienced U. S. farm labor force, 25 years and older, by color and sex, 1960.

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers and farm managers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>8.7</td>
<td>8.8</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>5.2</td>
<td>6.3</td>
</tr>
<tr>
<td>Farm laborers and foremen a/</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>6.8</td>
<td>8.4</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>4.4</td>
<td>6.0</td>
</tr>
<tr>
<td>Unpaid family labor b/</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
<tr>
<td>Hired labor c/</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>6.7</td>
<td>7.1</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
</tbody>
</table>


a/ For the age group 16-21, the median years of school completed by farm laborers and foremen was 10 for males and 9.5 for females.

b/ Unpaid family labor and farm foremen.

c/ Farm laborers except unpaid family labor and farm foremen.

d/ Farm wage workers 20 years and older, estimated from The Hired Farm Working Force of 1960, ERS, USDA, Ag. Information Bulletin 226, July 1962, Table 46.

N. A. = not available.
males and females. Farm laborers and hired labor have 1–2 years less schooling, although the female component of the farm laborers and foremen is almost as high as that for the farmers and farm managers. It is also clear that nonwhites in general have completed less years of schooling than the whites.

Three other aspects of the educational situation are important, although supporting data are not provided. First, it is well known that educational attainment is considerably less among the rural population than among the urban population. Second, the "quality" of education in rural areas is thought to be lower than that in urban areas. And finally, educational attainment is rising for both the urban and rural components of the population.

Changes in the Hired Farm Work Force

We now turn to a more detailed analysis of the changes taking place in the hired labor force and in hired employment. These data are taken from the series of reports on the hired farm working force, which in turn are based on sample data. Since the data in these reports relate to all persons who did some farm wage work during the year, they are not directly comparable with previous data on employment and demographic characteristics which are based on different measurement concepts.

Although the year equivalents of hired labor have been declining, it is important to recognize that this masks some important underlying shifts. For example, the number of persons who did any farm wage work during the year actually increased 3% from 1945–59 to 1960–64 (Table 3.7). Involved in this shift was an increase in the number of people working for short periods of time (+27% for those working less than 25 days a year) and a sizeable decrease in those working for longer periods of time (–31% for those working 250 days and over).

The 1964 estimate of 3.4 million persons who did farm work for cash wages at some time during the year is at about the level that has prevailed since the mid-1950's. Hence, despite the steady decline in the number of farm operators, in unpaid family workers, and in year-equivalents of hired workers, the number of people doing farm work for wages has stayed about the same.

Table 3.7 also shows that 44 percent of the people doing hired work in the period 1960–64 worked less than 25 days during the year. Only 11%
Table 3.7. Number of persons who did any farm wage work during the year, by duration of farm wage work, average 1945-59 and 1960-64.

<table>
<thead>
<tr>
<th>Year</th>
<th>Duration of farm wage work</th>
<th>Total workers</th>
<th>Less than 25 days</th>
<th>250 days</th>
<th>250 days and over</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Thou.</td>
<td>Thou.</td>
<td>Thou.</td>
<td>Thou.</td>
</tr>
<tr>
<td>Average:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1945-59</td>
<td></td>
<td>3,454</td>
<td>1,225</td>
<td>1,296</td>
<td>354</td>
</tr>
<tr>
<td>1960-64</td>
<td></td>
<td>3,554</td>
<td>1,558</td>
<td>1,275</td>
<td>318</td>
</tr>
<tr>
<td>Percentage change</td>
<td></td>
<td>+3</td>
<td>+27</td>
<td>-2</td>
<td>-10</td>
</tr>
</tbody>
</table>

Percentage distribution

<table>
<thead>
<tr>
<th>Year</th>
<th>Percentage distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pct.</td>
</tr>
<tr>
<td>Average:</td>
<td></td>
</tr>
<tr>
<td>1945-59</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>17</td>
</tr>
<tr>
<td>1960-64</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>11</td>
</tr>
</tbody>
</table>


Figures for workers are rounded to the nearest thousand without being adjusted to group totals.

Men have always made up the major part of the hired farm working force. However, over the years there has been a gradual shift so that women now make up a larger proportion of the total than formerly. (Table 3.8). The proportion of women has risen from 25% to 29% in the postwar period.

Another change in the hired labor force has been a decline in the proportion of the hired farm work force that spends most of the year doing farm wage work. The proportion of time spent doing farm wage work has declined from roughly 55% in 1947-49 to around 40% in 1962-63. This has been offset by an increase in the fraction of time unemployed and an increase in the time worked 250 days or more. The biggest relative shifts from the immediate post war period have been the increase in percentage of people working for short periods of time, and the decrease in the percentage of those that are year-round labor.
Table 3.8. Number of persons who did any farm wage work during the year, by duration of farm wage work and sex, average 1945-49 and 1960-64.

<table>
<thead>
<tr>
<th>Duration of farm wage work</th>
<th>Total workers</th>
<th>25 days or more</th>
<th>Less than 25 days</th>
<th>25 days or more</th>
<th>Less than 25 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>Total Male Female</td>
<td>Total Male Female</td>
<td>Total Male Female</td>
<td>Total Male Female</td>
<td>Total Male Female</td>
</tr>
<tr>
<td>Average:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1945-49</td>
<td>3,454 2,585 869</td>
<td>2,229 1,812 417</td>
<td>1,225 772 452</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1960-64</td>
<td>3,554 2,535 1,020</td>
<td>1,996 1,542 455</td>
<td>1,558 993 565</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage change</td>
<td>+3 -2 +17</td>
<td>-10 -15 +9</td>
<td>+27 +29 +25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Percentage distribution

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1945-49</td>
<td>100</td>
<td>75</td>
<td>25</td>
<td>100</td>
<td>81</td>
<td>19</td>
<td>100</td>
<td>63</td>
<td>37</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1960-64</td>
<td>100</td>
<td>71</td>
<td>29</td>
<td>100</td>
<td>77</td>
<td>23</td>
<td>100</td>
<td>64</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Figures for workers are rounded to the nearest thousand without being adjusted to group totals.

---

not in the work force. Among casual workers, two-thirds are not in the labor force most of the year. Housewives and students make up the majority of this group.

But even among noncasual workers, many are out of the labor force most of the year. The proportion of students among noncasual workers more than doubled since 1951. Together housewives and students now comprise almost one-third of the noncasual workers.

The place of residence of hired farm workers has also changed significantly in the last 15 years. From 1945-49 approximately two-thirds of the hired farm workers lived on farms at the time the hired farm working force surveys were

3/"Casual" workers are those who did less than 25 days of farm wage work, and "noncasual" workers are those who did 25 days or more of farm wage work during the year. Where the distinction is appropriate, noncasual workers are further classified as "seasonal" (those doing at least 25 but less than 150 days), "regular" (those doing 150-249 days), or "year-round" (250 days or more).
made, and the remainder lived in rural-nonfarm areas or in urban places. By 1963 this situation had almost exactly reversed. 4/

Migrant workers have been an important factor in meeting seasonal labor demands. In recent years, domestic migratory workers have comprised about one-tenth of the hired farm work force, with foreign workers making up a much smaller fraction of the total. However, the significance and importance of this labor goes much beyond its numerical size because of its relative importance in certain crops and its contribution in handling seasonal peak work loads.

Additional perspective on the seasonal work force can be found in Table 3.9, which shows the composition of the seasonal farm labor force during the peak month annually from 1953-65. The rather stable level of the total hired seasonal employment over the 12 year period can be clearly seen. In addition, the major fraction of this seasonal labor force has come from domestic sources, with this fraction also remaining relatively stable.

Within the domestic labor force it appears that those coming from interstate movement have remained relatively constant, while those coming from intrastate sources have declined. On the other hand, local sources have provided somewhat more in recent years, while the Puerto Rican supply has dropped off.

Of the foreign workers, the major fraction has come from Mexico. The peak use of foreign workers was attained in 1956, which was also the peak year in employment of Mexicans. In recent years the use of foreign labor dropped off in anticipation of the termination of the bracero program. And in 1965 Mexicans were brought in only in response to critical situations.

An Aging Population of Farm Operators

The changing age structure of our agricultural labor force is perhaps the major structural change in terms of demographic characteristics. This problem is becoming of increasing concern to both policy makers and researchers. The implications in terms of farm management research are important.

4/ Part of this is due to the changes in farm residence definition which were made in 1960. However, even allowing for this, significant differences have occurred.
Table 3.9. Composition of U. S. seasonal farm labor force, peak month annually, 1953-65.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total hired</th>
<th>Domestic</th>
<th>Intra-state</th>
<th>Inter-state</th>
<th>Puerto Rican</th>
<th>Total Mexican</th>
<th>Total foreign</th>
</tr>
</thead>
<tbody>
<tr>
<td>1953</td>
<td>763,095</td>
<td>123,689</td>
<td>1,318,002</td>
<td>135,689</td>
<td>172,902</td>
<td>1,065,263</td>
<td>89,262</td>
</tr>
<tr>
<td>1954</td>
<td>1,361,401</td>
<td>150,026</td>
<td>1,377,143</td>
<td>170,026</td>
<td>198,711</td>
<td>1,178,902</td>
<td>127,711</td>
</tr>
<tr>
<td>1955</td>
<td>1,496,814</td>
<td>182,449</td>
<td>1,618,064</td>
<td>202,449</td>
<td>236,438</td>
<td>1,358,816</td>
<td>146,438</td>
</tr>
<tr>
<td>1956</td>
<td>1,362,438</td>
<td>129,745</td>
<td>1,532,083</td>
<td>179,745</td>
<td>218,482</td>
<td>1,411,958</td>
<td>167,482</td>
</tr>
<tr>
<td>1957</td>
<td>1,438,006</td>
<td>163,734</td>
<td>1,581,440</td>
<td>203,734</td>
<td>246,428</td>
<td>1,630,940</td>
<td>176,428</td>
</tr>
<tr>
<td>1958</td>
<td>1,488,006</td>
<td>167,287</td>
<td>1,655,293</td>
<td>217,287</td>
<td>252,875</td>
<td>1,713,175</td>
<td>182,875</td>
</tr>
<tr>
<td>1959</td>
<td>1,402,910</td>
<td>167,367</td>
<td>1,560,473</td>
<td>207,367</td>
<td>241,842</td>
<td>1,662,322</td>
<td>181,842</td>
</tr>
<tr>
<td>1960</td>
<td>1,240,529</td>
<td>111,319</td>
<td>1,351,548</td>
<td>161,319</td>
<td>198,457</td>
<td>1,410,347</td>
<td>197,457</td>
</tr>
<tr>
<td>1961</td>
<td>1,284,330</td>
<td>100,469</td>
<td>1,384,799</td>
<td>190,469</td>
<td>181,634</td>
<td>1,466,434</td>
<td>171,634</td>
</tr>
<tr>
<td>1962</td>
<td>1,219,433</td>
<td>871,471</td>
<td>1,048,006</td>
<td>159,471</td>
<td>310,535</td>
<td>1,358,541</td>
<td>241,535</td>
</tr>
<tr>
<td>1963</td>
<td>1,119,621</td>
<td>822,056</td>
<td>974,877</td>
<td>166,056</td>
<td>8,539</td>
<td>1,239,048</td>
<td>237,056</td>
</tr>
<tr>
<td>1964</td>
<td>1,293,439</td>
<td>771,835</td>
<td>966,813</td>
<td>164,835</td>
<td>8,539</td>
<td>1,323,852</td>
<td>237,835</td>
</tr>
<tr>
<td>1965</td>
<td>2,895,678</td>
<td>237,626</td>
<td>3,133,202</td>
<td>304,626</td>
<td>4,543</td>
<td>3,440,728</td>
<td>529,626</td>
</tr>
</tbody>
</table>


Note: Peak employment by classifications do not coincide monthly, so that the components do not add up to the total employment figures.
The aging of the labor force has been studied through the use of cohort analysis. Kanel\(^5\) pioneered in this analysis, although his published work was restricted to the North Central States. Marion Clawson\(^6\) has made perhaps the most comprehensive analysis for the total labor force, and it is to this study that we turn for the analysis which follows.

Cohort analysis essentially involves following a given age group through successive censuses and examining what is happening to it. Briefly, the number of farmers in any age group at any census date is the number in the age group 10 years younger at the census 10 years earlier, plus an entries into the group, minus any withdrawals. Entries into the "farmers" category normally exceed withdrawals up to the age group 35 to 44 years; after that age, withdrawals normally exceed entries and the number of farmers in the older age groups declines.

This type of analysis necessarily measures only net changes; the available census data do not show total entries into farming or total withdrawals therefrom. Moreover, it shows net changes in numbers of farm operators, not changes in total farm population.

A given cohort is characterized by the census year in which the farmers are less than 25 years of age - that is, when each age group is first caught by a census as farm operators. And each cohort will show up in six successive census, as it ages.

It turns out that the only complete cohorts in 70 years of census are those for 1890, 1900 and 1910. But as Clawson points out, these are more modern than they appear at first glance, since they terminated in 1940, 1950 and 1960, respectively. Moreover, in a very real sense, the censuses of 1910 and 1920 were the only ones in our total national history when cohorts were at a normal maximum; in earlier censuses, several cohorts still reflected the smaller farm numbers during the earlier growth periods of the U. S.; and in later censuses, the decline in farm numbers, and particularly the reduction in new entries, had begun to change the relationships among age groups.


In analyzing the decline in farm numbers since 1920, Clawson finds that changes in farm numbers have been due primarily to changes in the numbers of younger farmers -- to reduced entry into the newer cohorts. Actual withdrawals, above a normal rate, of those already in farming is a minor factor. This has led to a considerable aging of our farm operators -- and what is important here, will lead to still further aging in the future. The pattern found is a very stable one, and projections of existing cohorts into the future take us well past the year 2000.

Clawson follows the existing cohorts through and makes projections of the numbers of farm operators to the year 2000. The implications of this in terms of an age distribution of farm operators is summarized in Table 3.10. The average of the 1890-1910 cohorts provides the approximate proportions in a farm operator population when farm numbers remain about constant, and deviations from them measure the degree to which a given population is abnormal in age. Note that in the cohorts for these three decades roughly one fourth of the farmers are "young" (under 35), roughly one half are in the middle years (35 to 54), and roughly one fourth are "old" (55 and older).

In turning to the current situation and the projections into the future, we note first that the age distribution in 1960 was already abnormal by these standards. And it appears that the situation will both get worse in the future, and last for a considerable period of time. The percentage of older farm operators rises to over 50 percent by 1980 and then declines somewhat, but


<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Young (under 35 years)</td>
<td>25</td>
<td>13</td>
<td>10</td>
<td>15</td>
<td>14</td>
<td>17</td>
</tr>
<tr>
<td>Middle (35-54 years)</td>
<td>47</td>
<td>48</td>
<td>44</td>
<td>33</td>
<td>37</td>
<td>43</td>
</tr>
<tr>
<td>Older (55 years and older)</td>
<td>28</td>
<td>39</td>
<td>46</td>
<td>51</td>
<td>49</td>
<td>40</td>
</tr>
</tbody>
</table>

Source: Clawson, op. cit. page 26.
even in 2000 it is nearly a half higher than in the base period. The percentage of young operators, under the same assumptions, declines to 1970 and then rises slightly, but still remains only about half its level in the base period.

In summary, then, relatively large numbers of aging farmers will be with us for this generation and longer. The prospects of moving them at anything approaching an accelerated rate will be difficult because they are not, in general, good prospects for retraining for other jobs. Research programs should focus both on facilitating the adjustment process, and in helping older people to be effective farm managers.

The magnitude of the adjustment-out-of-agriculture problem can be seen when we turn the coin around and ask what the labor needs will be, given our rapidly changing level of technology. Ruttan points out that if total agricultural production were concentrated on farms such as those with sales of $20,000 or more, the total U. S. farm output could be produced on 750,000 farms. He further argues that the technological capacity already exists that would permit production of 80-90 percent of the value of total U. S. farm outputs on between 50,000-100,000 production units.

When we compare this to Clawson's projection of 985,000 farm operators by the year 2000, it is clear that the gap is quite large if we want to efficiently utilize our existing level of knowledge. Even a more rapid rate of outmigration predicted by Clawson still leaves us with 610,000 farm operators in the year 2000.

The Effect of Recent Legislation and Other Economic Forces that Affect the Labor Market

Minimum Wages

The effect of minimum wages depends on the nature of the situation in which they are imposed, and on the nature of the minimum wages themselves. In theory, if the minimum wage is set above the equilibrium wage rate, and effectively enforced, it leads to an increase in the wage rate paid by the farmer, but at the same time creates some unemployment. Presumably more workers

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will be willing to offer their labor to the industry than can be employed, and the institutional wage thus imposed introduces a rigidity into the labor market. Under these circumstances both the farmers and certain members of the labor force bear the costs of the legislation in the short run, although in the longer run the costs tend to be passed on to the consumer. The farmer may benefit somewhat, since the higher wage may attract a higher quality labor force to the industry, and the firm will in general be able to select from the pool of labor made available.

On the other hand, the minimum wage may be rather innocuous. It may be set at such a level that it is below the going wage and thus have no employment or wage effects. Some have argued that much of our minimum wage legislation in the past has been of this kind. As wages have continuously moved upward, the legal wage has come along behind, more in the nature of consolidating the previous gains than of actually pushing wages higher.

A third possibility is the classical case where the employer is a monopsony purchaser of labor. In this case the minimum wage can actually raise the wage rate that is paid while at the same time increasing the level of employment. This comes about through reducing the marginal supply price of labor. Hence, the firm has incentive to use more labor.

A final possibility is that frequently cited by proponents of minimum wage legislation. The argument is that the imposition of the minimum wage will force the firm to adopt a higher level of technology, which in turn raises the productivity of the labor, and in the end enables the firm to pay the higher wage while at the same time not being forced to reduce the level of employment.

Opponents of this argument have pointed out that it basically assumes that the firms were irrational in the first place, since they were not on their highest possible production function. If they were not rational there is no reason to expect this kind of response. And if they were rational, and currently using the highest level of technology available, then there will be no possibility of such a response.

\[8\] More specifically, the positively sloped supply curve of labor to the firm is replaced by a perfectly elastic supply curve, and the divergence between the marginal supply price and the average supply price is eliminated.
It would appear, however, that there is a possibility of an economically induced adoption of technology, but the consequences of this may be quite different in the case of agriculture than that suggested by the proponents of the minimum wage. Let's suppose that new technology tends to be imbedded in capital goods of capital inputs. If this is the case, and the minimum wage is effective, then it will lead to the substitution of capital for labor. But this substitution actually leads to the use of higher level of technology since the technology is imbedded in the new capital items purchased. So far the argument is consistent and holds up.

What tends to be ignored, however, is the ultimate market effect of the adoption of the new technology. If the adoption of the new technology leads to a shift in the supply curve of agricultural products to the right more rapidly than the demand curve is shifting, the relative price of agricultural products will decline. In this case the product market effect may be greater than the increase in physical productivity that comes with the new technology, and the net effect will be a decline in the demand for labor.

We have argued elsewhere\(^9\) that this is the way in which technology in agriculture has contributed to the downward adjustment in the labor force experienced in U.S. agriculture. Wallace and Hoover\(^10\) show how this could come about in their recent work. In a cross sectional analysis of the demand for labor they show that the effect of the adoption of higher levels of technology is to increase the demand for labor, so long as product market effects are ignored. However, once the product market effects are allowed to work themselves out, the effect of the higher level of technology is to reduce the demand elasticity is inelastic.

The problem of empirically assessing the magnitude of minimum wage legislation in each of these four cases is rather complex, largely because of our lack of knowledge concerning the econometric structure of the labor markets. However, the following comments seem pertinent:

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1. It seems clear that labor scarcity and higher wage rates can force or induce the adoption of a higher level of technology. Two factors are important: (a) the substitution of capital for labor does tend to bring with it a higher level of technology – especially that which is embodied in capital goods, and (b) Land Grant Colleges and private companies are responsive to the needs of farmers, such that rising wages and labor scarcity provides the incentive to extend both the mechanical and the biological research necessary to speed the process of mechanization. Both points (a) and (b) work toward reducing the demand for labor, and can reduce the costs to the farmer associated with effective minimum wage legislation.

2. It would be my judgment that the monopsony purchase of labor in American agriculture is not a widespread phenomenon. Hence, we would not expect a situation in which both wages and employment would rise as a response to the minimum wage legislation.

3. The direct effect of the legislation, especially in the short run, can be seen in broad lines from a more comprehensive analysis made by Robert Rudd. In capsule form, his conclusions are as follows:

   a. The main impact of a minimum wage extension to agriculture will fall on Class I (over $40,000 sales) and Class II ($20,000–$40,000 sales) farms which employ more than 70 percent of the hired farm work force. Class I farms pay more than half the annual commercial farm hired wage bill.

   b. The South will be the area most affected by higher wage rates. This is because farm wage rates in this area are lowest and because the South uses nearly 50% of the nation's hired farm work force.

   c. Cotton and tobacco will be the most affected crops since they are the most labor-intensive crops in areas of low hired farm wage rates. Both of these are high seasonal users of hired farm labor.

\footnote{Robert Rudd, "Minimum Wages and Farming," Presented at the Regional Farm Policy Conference on Labor and Agriculture, Co-sponsored by Virginia Polytechnic Institute and the Agriculture Policy Institute of North Carolina State University at Roanoke, Virginia, March 15, 1966.}

\footnote{Rudd's analysis assumed that the legislation would apply to farmers using 300 mandays of labor in a given quarter, when in fact the law passed applies only to those using 500 mandays of labor in the peak quarter. Hence the effect of the law will be somewhat less than indicated here.}
d. Based on a 1965 enumerative survey, a minimum wage of $1.00 per hour for hired farm workers applied to all farms in the United States would raise the hourly wages of half the hired farm workers in the nation and would increase the wage bill 19 percent. If a minimum wages of $1.00 were applied only to workers on large farms (300 mandays of labor in the peak quarter of the year), 44% of the hired farm workers on such farms would receive increases and the wage bill would rise 15% on affected farms.

e. A minimum wage of $1 applied to farms using more than 300 mandays of labor in the peak quarter would affect 69% of the hired farm workers, and raise the wage bill by a third.

So clearly the minimum wage legislation that has been extended to agriculture is not innocuous. It is likely to have sizeable effects on the pattern of production in the South as farmers shift away from labor intensive crops, and these shifts will have spillover effects in other parts of the country as the competitive forces play themselves out. In other words, the minimum wage legislation may make the South a much stronger competitor of midwestern agriculture.

A secondary effect may be to shift somewhat the proportions between family labor and hired labor. Since the major impact of the legislation would be on farms in which family labor is relatively important, we would not expect this effect to be very large.

On the other hand, it does appear that the legislation will create some unemployment. Although it appears that the demand for labor is relatively inelastic, it is greater than zero, and appears to range between $-0.2$ and $-0.4$.\textsuperscript{13} Our estimates of the supply elasticity of labor to agriculture, holding constant the size of the labor force, are also in the vicinity of $0.25$ to $0.50$.\textsuperscript{14} Hence, there would be more workers willing to supply their labor to agriculture at the higher wage rate. This problem would be further compounded by


\textsuperscript{14} Ibid, Schuh.
the entrance of new workers into the labor force in response to the higher wage rates. Hence, the minimum wage legislation may introduce a considerable imperfection or discontinuity into the agricultural labor market.

In the longer run, however, minimum wages, plus more intensive retraining programs, may speed up the migration rate from agriculture. The person who becomes unemployed may be more prone to utilize available retraining programs than if he were employed, but at a low salary.

**Housing Legislation**

The Housing Act of 1965 (Public Law 89-117) provides a subsidy for housing by assisting in the construction of low-rent housing for American farmworkers.\(^{15}\) Under this Act, the Farmer's Home Administration is authorized to make grants up to two-thirds of the costs of providing low-rent housing. The funds may be used to pay part of the costs of building, buying, or repairing housing and related facilities.

The grants are made to states or other political sub-divisions and essentially provide a means of creating public housing for farm workers. Although the appropriations for this Act are not large, in general the effect of the law is to reduce the cost of labor to the individual farmer. The provision of low cost housing, at the expense of the state and federal governments, provides a means whereby the farmer can attract a given amount of labor at a lower direct wage cost, other things being equal. In essence the government and the farmers are sharing in the cost of the labor. The longer run effect of such programs is of course to slow down the rate of change into a more capital intensive agriculture, and also to shift the product mix to more labor intensive products. (Shift it from what it would be in the absence of such programs.)

Other Federal Grant in Aid Programs

Two other laws have been passed in recent years which make funds available for the improvement of working, living, and health conditions of domestic agricultural workers. These are the Migrant Health Act of 1962 (Public Law 87-692) and the Economic Opportunity Act of 1964 (Public Law 88-452). The latter authorizes migratory labor programs in education, child daycare, sanitation and housing. Both laws are implemented through grants-in-aid to political entities, and provide social services to the agricultural labor force.

As with the Housing Act of 1965, these programs should enable the farm sector to obtain a given supply of labor at a lower direct cost (increased supply at the same price) to themselves than would be possible in the absence of the programs. To this extent they would have similar resource allocation effects.

It should be recognized that these programs provide an extension of public services to the rural areas that are already available in urban areas. To this extent they do not represent a discrimination in favor of rural areas, but rather a catching-up with services available in other areas. It would appear that such programs increase the supply of labor to agriculture, other things being equal, with exception of the educational aspects of the Economic Opportunity Act, which may have a longer run affect of speeding up the rate of out-migration. It is also our guess that we will see an expansion of such public service programs for agriculture in the future.

Social Security

The Social Security Act was extended to farmers on January 1, 1955. Presumably this extension would help alleviate the problem of an aging farm operator population by facilitating the retirement of a larger fraction of farm operators when they reached 65 years of age.

16/ Ibid, pp. 27-29.
17/ See below.
However, Kane found that up to 1959 the availability of Social Security had not affected the withdrawal rates of farmers in the North Central states. Using cohort analysis he studied farm adjustments by age groups. More widespread retirement would have been shown by a larger rate of withdrawal in the 1950's of those who were 55-64 years of age at the beginning of the decade. But these age-specific withdrawal rates were practically identical in the 1950's (38.3 percent) and the 1940's (37.3 percent). Thus the proportion of farmers who completed their retirement upon reaching 65 years of age has apparently not increased.

Admittedly this is rather limited evidence. The program may not have been available long enough for this to be a true test, or it may be a measurement problem since many farmers who retire continue to earn some income. Moreover, step-ups in the benefits from the program may make this a more important factor in the future.

The Effect of Educational Programs

It is very likely that educational expenditures will not only increase in the aggregate, but increase on a per capita basis. The returns from investment in the human agent are being increasingly recognized, as is the disparity in educational opportunities among various groups in society. As a consequence we are very likely to see increasing amounts of federal aid to education, particularly at the elementary and secondary levels, with a relative upgrading of those groups that have been bypassed at the present time.

It would also seem that the changes that are taking place in the South, where major fractions of the agricultural labor force are found, will lead to increased educational expenditures. The industrialization that is taking place not only is effective in changing value positions, but also provides a stronger tax base for the support of educational institutions.

A recent study by Micha Gisser provides a basis for analyzing the effect of increased educational expenditures on the agricultural labor force. He argues that education affects both the demand for and the supply of labor. Its effect on the demand for labor is to increase it, other things


being equal, since it leads to an increase in the productivity of that input. It is expected to have a negative effect on the supply of labor offered to agriculture, however, since it provides the individual with a wider range of marketable skills, and makes him more aware of his employment opportunities.

What is of more interest, however, is the way in which these counteracting influences resolve themselves in the market place. That is, the net effect in terms of wage rates and employment. Gisser examines this through the reduced forms of the structural equations, and shows that the net effect of education is to reduce the employment in agriculture and to raise the agricultural wage or the price of labor. More specifically he found that an increase in the level of schooling in rural farm areas of 10 percent will induce a 6 to 7 percent additional migration out of agriculture and raise the farm wage rate 5 percent, other things being equal.

In summary, the educational programs act to reduce the employment of labor in agriculture and to raise the agricultural wage rate. And although we have not similar research available on the effects of less formal educational programs such as the training programs of the Job Corps, etc., it would be our judgment that they would have similar effects. Further expansion of these will act to further reduce the supply of labor available to agriculture.

Unionization

The unionization of agricultural labor has been and will continue to be difficult, largely because of the geographic distribution of the industry and the attendant difficulties in policing. Despite this, I think that most students of the problem would agree that eventually it will come. Unionization will become increasingly feasible as total production becomes increasingly concentrated in fewer firms, and if operators and family labor should make up a smaller fraction of the labor force on the individual farm unit.

The effect of unionization will depend in large part on the form it takes, and on the individual situations of the employers. Lewis\textsuperscript{20} makes a distinction between competitive unions and monopoly unions. Competitive unions tend to organize the labor of an individual firm, and provide a systematic basis for establishing the rules of employment. Such unions provide a

\textsuperscript{20}Lewis, H. G.
service to the firms in that they make for economy in hiring personnel, in establishing rates of pay, and in establishing the other conditions of employment. Moreover, they do not in general restrict the supply of labor as a means of exploiting a monopoly position.

Monopoly unions, on the other hand, in addition to establishing work rules, are also in the position of restricting the supply of labor offered, and thus gain a monopoly return. Such unions are typically organized on an industry wide basis, and generally ration the supply of labor offered through some licensing procedure, generally with the explicit or implicit support of the government - the latter obtained through some guise of protecting the public, such as housing codes, safety codes, or health.

Clearly, the relative wage or employment effects of unionization in agriculture will depend on which of these forms it takes. The creation of an industry-wide union with power to ration job opportunities would have a larger wage effect than a competitive union established to facilitate the establishment of work rules and conditions of employment.

However, the individual situations of the employers are also important in evaluating the impact of unionization. If the employer is a monopsony purchaser of labor, and is thereby purchasing less labor and at a lower wage than if he were hiring in a competitive market, the creation of either a competitive or a monopoly union could have sizeable wage and employment effects, either one tending to move toward the position of a competitive solution.

If the firm is hiring labor in a competitive market, the formation of competitive unions will have little or no effect on relative wages and employment, but will lead to standardization of hiring and firing procedures and other rules of employment. The formation of a monopoly union will destroy the competitive market in which the firms hire labor, and by definition would lead to higher wages and the availability of less labor.

The third possibility for the firms is that they be monopoly sellers of their product. This situation lends itself especially well to the establishment of a monopoly union, and the fruits of the product monopoly are shared, then, between the firm (or firms if it is a cartel) and the labor union.
By way of summary, it would appear that there is very little monopsony purchase of labor among agricultural firms (abstracting from discrimination against Negroes - which is beyond this paper). Hence there is very little potential for raising wage rates from this source. On the other hand, we may see some tendency toward the formation of cartels, particularly among specialty crops. This could lead to somewhat more of a tendency for the creation of monopoly unions.

Independently of these effects the unionization of the agricultural labor force will have an additional effect. Agricultural wages have traditionally been one of the more flexible in the total economy. This flexibility has been both upward and downward and probably has been responsible for the appearance of very little measured unemployment among agricultural employees, although underemployment has probably been rather widespread.

The establishment of labor unions will probably lead to a great deal more rigidity in agricultural wages, especially on the downward side, and may lead to the appearance of somewhat more unemployment among farm employees as weather and product demand fluctuations shift the demand for labor. This effect will be in addition to the upward pressure on wage rates which the union will exert.

The Level of Aggregate Economic Activity

Although not specifically assigned as a topic to be covered by this paper, this is perhaps one of the most important factors determining the stock of labor in agriculture. A number of studies\(^\text{21}\) have shown the role of unemployment in the nonfarm sector in determining the migration rate from agriculture. A high level of aggregate demand, with unemployment down to around 4% makes for a rapid outflow of labor from the agricultural sector, whereas a higher level of unemployment keeps the labor dammed up in agriculture.

We can see the effects of this most especially in 1965 when average farm employment declined 3 percent from 1964, the largest decline of record for

any one year. 22/ Farm wage rates, on the other hand, increased 5% from 1964. 24/ A year to year advance of this size has been recorded in only one year since 1951-52, when pressures of the Korean war contributed to considerable increases.

Adjustments of this magnitude continued into 1966. 24/ The number of workers on farms during the survey week of April 17-23 was 7% below what it had been in the same period of the previous year. And farm wage rates were 10% above those of the same period in the previous year. The reduction in the labor force for the first 3 months of 1966 was also 7%.

If we have in fact learned to manage the economy in such a way as to maintain a high level of aggregate demand, and are able and willing to do so despite political exigencies and balance of payments problems, we may soon find ourselves in a rather unique situation. Through much of the period since 1930 the agricultural labor force has had a considerable amount of slack in it. Rapid expansion of production to meet wartime needs was always possible because of the sizeable amounts of under-employed labor in the sector, and because of the availability of potential new entrants into the labor force from the farm population. However, we may soon find ourselves in a situation where this slack no longer exists. Expansion of agricultural employment will then come about in large part by bidding the labor away from other employments. This has important implications both from the standpoint of shortrun adjustments and in terms of the manpower policies necessary in case of a war time emergency, for example.

On the other hand if balance of payment problems and/or other considerations should force us to return to a 5-7% level of unemployment, or higher, the effect of this will outweigh many of the other developments in the labor market previously discussed. Continued mechanization and the increased use of purchased inputs will require a continued downward adjustment in the farm labor force. If the level of unemployment rises, labor will once again be dammed up in the rural areas, and wage rates will rise more slowly.

22/ Farm Labor, USDA, Selected Issues.
23/ Ibid.
24/ Ibid.
In this respect it is also important to recognize another major shift in the structure of the agricultural labor market. The agricultural labor force is now reaching a point where it makes up only a relatively small fraction of the total labor force. In itself this would tend to make relative adjustments in the labor force somewhat easier, since on the outmigration side it involves a relatively small flow feeding into a larger base, and vice versa. On the other hand, however, this is counter-balanced by the fact that the drain out of agriculture has involved a shift of the population base from rural areas to urban areas. If in the future we should have to expand agricultural employment because of a national emergency or the increasing demand for food and fiber products, we may encounter the same serious difficulties that we had in reducing the agricultural labor force. Employment in agriculture will involve moving perhaps long distances, the development of skills that the labor force does not have, plus the provision of a product mix that was learned in urban areas, but which is not widely available in rural areas.

The Changing Nature of Skills Required in Agriculture

We have very little research to draw on in this very important area, so we will have to depend primarily on conjecture. But it appears that we may be reaching a significant turning point concerning farm skills. This can perhaps be best seen by considering some background.

Brewster argued in 1950 that mechanization in agriculture has been quite different than mechanization in the industrial sector. In the industrial sector it led to a higher degree of functional specialization in the use of labor, and the laborer became essentially an extension of the machine, performing highly routinized tasks, with little or no skills other than manual skills required. On the contrary, many of the skills previously required were replaced by the machines themselves. In agriculture, however, mechanization has not led to such functional specialization. There has been little or no use made of assembly line techniques in agriculture, and the laborer has essentially the same range of functions to perform as he did prior to mechanization. And a major contribution of mechanization has been to lighten work loads and improve the timeliness of farming operations, rather than to perform previous skills involving manual dexterity more efficiently.

In a recent paper I have argued that the nature of the technical change (or change in technique) in agriculture is such that an increase in skills is necessary for farming. Given the rather limited degree to which functional specialization has developed within agriculture, so that assembly line techniques can be used, it would appear that the change in technology, which involves either changes in the quality of other inputs or the introduction of new inputs into the production process, requires increasing skill levels. The substitution of commercial fertilizers for organic fertilizers, for example, increased the range of alternatives available to the farm decision maker, and made his decision making process much more complex. The same applies as a general rule to the other chemical and biological developments. In general they tend to be more specific in their application, and require a much greater skill level on the part of their user. Hence, there would appear to be a highly complementary relationship between the quality of labor and the quality of other inputs, thereby leading to increasing demands for skills in the labor force as the quality dimensions of other inputs changes. The impact of this will be felt most strongly among the farm operators or the decision makers.

On the other hand, we have seen a considerable amount of specialization in the production of farm products. This trend is likely to continue, especially if we maintain public policies designed to transfer a fraction of the risk and uncertainty associated with farming to the nonfarm sector. The trend toward specialization does reduce the range of production knowledge and skills which the farm operators must have, although it may well increase the necessity of his being more highly skilled with respect to market opportunities and market conditions. It is difficult to evaluate the relative magnitude of these forces.

However, if and when total U.S. farm output is produced on between 50,000 - 100,000 production units, as Ruttan suggest, it would appear that farm firms will become much more like similar sized nonfarm firms. In the past, farm firms have not had serious problems of labor management and labor coordination, with the exception of the limited number of exceptionally large farms. However, if we produce our food and fiber needs on


50,000 - 100,000 farms, a substantial fraction of them will have sizeable staffs of employees, both to handle routine functions and to provide technical assistance of various forms.

The need for personnel relations will be greatly expanded, the need to carefully select prospective employees will be much larger, and the need for coordination will be great. In addition individual farms may well have their own staff of highly trained technical people, either as full time employees or on a retainer basis. It is conceivable that a large feeding operation, for example, would have need for a nutritionist, a veterinarian, and an economist to do the market analysis. Such developments are already taking place in some cases.

The implications of this to the future function and role of schools of agriculture is great. It is conceivable that farm firms will be doing their own applied research, much as the larger firms in the nonfarm sector do, and the public universities will be given a greater opportunity to do the basic research in the biological and physical sciences and the overall functioning of the economy, plus the training of the technicians to do the applied research for the firms.

In Conclusion

The quality of social services provided by local, state, or federal government is a major factor over the long run in determining the capacity and quality of the human factor in the community. In recent years we have seen an increasing concern with these problems, and with the extension of the programs to people in rural areas. For the first time we have a set of policy instruments which potentially can make a significant attack on the poverty problem in agriculture.

The Poverty Program attempts to improve the quality and employability of the human factor. The Economic Development Administration, Appalachia, and other physical investment programs attempt to create economic activity and jobs. Programs such as these probably will reduce the supply of labor.

offered to agriculture. The basic premise behind this statement is that a good fraction of the labor in agriculture is trapped there - trapped by a lack of opportunity or alternative. To the extent that these programs do improve the quality and employability of the human factor, they will probably speed up the migration rate from agriculture. It is true that a few of these will remain in agriculture, and that as a result of the program, they will be more productive in agricultural pursuits. However, given the relative wage structure, the major fraction of them will probably seek nonfarm employment. And to the extent that the new Federal programs reduce the amount of poverty in the rural areas, they by definition raise the price of labor - either indirectly by speeding up the migration rate, or directly by increasing the reservation price of much of the labor in rural areas.
CHANGES IN MARKETING OF LIVESTOCK AND LIVESTOCK PRODUCTS

by Vernon W. Pherson*

The objectives of this paper are:

1. To look briefly at historical trends of key factors related to livestock and livestock products marketing;

2. To reflect on the unique characteristics of meat;

3. To propose a long-term objective of the Livestock and Meat Economy; and

4. To suggest some implications for future activities.

I will not attempt to make specific forecasts based upon historical data. Others are much better equipped to do this. In fact, I hope to challenge the usefulness of this over-exploited activity.

Review of Major Industry Trends

To review most trends in the livestock and meat industry, it is necessary only to read Technical Study No. 1 of the National Commission on Food Marketing, June 1966. Since each of you has ready access to that report, I will duplicate only a few of the data series.

1. Total red meat production has had an upward trend during the recent years with beef increasing and hogs decreasing slightly. (See Table 4.1)

2. These livestock passed through a variety of marketing channels and institutions. You are aware of the increasing relative importance of direct and general country buying activities at the expense of terminal markets. (See Table 4.2)

3. Cooperatives have been a decreasing factor in cattle marketing and a slightly increasing factor in hog marketings since 1950 (See Table 4.3). This can probably be explained by the co-ops' reluctance to change.

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activities from terminal markets in the case of cattle, and their willingness to operate country buying stations plus their backward integration into feeder pig marketing in the case of hogs.

4. Concentration in meat packing declined markedly after World War II. The decline was greatest for cattle slaughtering. The largest four firms produced 35% of commercial beef and veal in 1947 and 24% in 1964 (See Table 4.4). The next group of four held their relatively small 4% share. For hog slaughter, the largest four declined from 41 to 34% but the next four rose from 10 to 14%.

5. Surplus slaughter capacity exists in abundance - particularly for hogs. It was estimated that F.I.S. was only 63 percent of a 39 hour week capacity for hogs and 90% for cattle in 1965. Most plants can economically slaughter much more than 39 hrs./wk. - even up to a double shift of 78 hrs./wk.

6. Imported meat has accounted for a relatively small share of total consumption. Beef imports hit a peak of 9.0% of the U. S. commercial supply in 1963, but dropped to 4.7% in 1965. Pork imports were at a high of 3.0% of the U. S. commercial supply in 1965 in response to high pork prices (See Table 4.5).

Other industry trends include the following:

7. Livestock production concentrated in fewer - but larger units.

8. Increased specialization in production units.

9. More specification in livestock purchasing.

10. Greater emphasis on "quality" in livestock production.

11. An apparent increased demand for all meats during past several months.

12. Larger proportion of meats sold under brand names - big increase in retailers' brands.

13. An increasing share of beef is being semi-processed before reaching the retail store.
14. Meat packers' expenditures for research and development have been increasing, but are still much below competitive industries.

This listing is neither exhaustive nor definitive in a cause-effect relationship. It is intended only as a brief review.

Should we be encouraged by these trends or should we be alarmed? You say, "Some of each, some are good and some are bad." And I'm sure that we could argue through gallons of coffee about which of the trends should go into each category.

But that would be a waste of time. The only reason for identifying trends at all is to help isolate the causes. Then to project the impact of its continuation, but most important, to initiate action to control both the direction and rate of change of the key factors.

For example, let's take a look at the Industry segment that feeds my family. Concentration in the meat packing industry among the large packers has declined significantly during the past 2 decades. There could be many arguments regarding whether this has been good or bad such as "It has benefitted the farmers because it has increased competition for the livestock." But, the important point is "Why has this trend occurred?" Certainly one reason was that the large packers did not keep up with technological changes in either production or marketing so that new firms were encouraged to enter the business and could grow. This has resulted in over-capacity which in the sign of a high-cost, inefficient industry. Now, we can all agree that this is bad and over a period of time will have a negative effect on all segments of the livestock and meat industry.

But you say, "You're stretching a point, people have to eat and as long as they have money they're going to eat meat." Let's reflect a few minutes on the uniqueness of meat.

Reflection on Uniqueness of Meat

What is different about meat that makes it so valuable? It must have some special characteristics since it is a relatively inefficient source of food.
Meat has been one of the chief foods of man for thousands of years. The caveman ate meat because he liked the taste and because it satisfied his hunger better than fruits and plants. Today most of us eat meats for these reasons, but also because we know it is one of the most complete foods available. Meat is an energy food, rich in proteins, minerals and vitamins in addition to fats and carbohydrates.

These characteristics in combination with affluence have brought us to the present developed state of our Livestock and Meat Economy. Will it continue?

Until recent years, there has been relatively little success in duplicating these characteristics in other products, but that appears to be changing. There are many products currently marketed I'd like to show you that are considered to be "meat substitutes" in every sense - including consumer taste and appearance. They can be purchased at a store here in the area. They are both canned and frozen and have names such as Prime, Wham and Prosage.

Additional meat competitors on a world-wide basis are discussed in an article by Ray Goldberg in the September - October "Harvard Business Review." He mentions three vegetable products that may be an answer to protein malnutrition in developing countries.

I have no doubt that we in the United States will continue to consume large quantities of meats. However, these developments indicate to me that members of the Livestock and Meat Industry need to seriously re-evaluate some basic assumptions on which future plans are laid.

**Basic Objectives**

I believe it is necessary to begin with a statement of Objective for the entire Livestock and Meat Industry complex - then to write objectives for each segment or group within the industry. If we had time today, I'd like to see if this group could agree upon a set of objectives. But since we don't, I'd like to suggest the following long-term objective:

The objective of the Livestock and Meat Industry is to sell an increasing quantity of food manufactured from red meat raw
materials in an efficient manner that will yield a reasonable return on invested capital in all segments of the industry.

The long-term sub-objectives for industry segments must concentrate on efficiency:

The objective of livestock producers is to provide raw materials for manufacturing food from meats - efficiently.

The objective of the livestock marketing system is to concentrate and allocate raw materials (livestock) -- efficiently.

The objective of meat processors is to manufacture food from meat raw materials and to distribute to retail outlets -- efficiently.

These objectives for specific segments could be expanded to include profits and they certainly should be for individual firms. However, survival and growth will not be possible without increased efficiency in all industry segments. Over the long pull we will rise and fall together.

Competition will not be among segments of the livestock industry. It will be with meat substitutes. How well meat products compete will depend on the accumulative efficiency of all segments of the industry.

In order to drive for efficiency, several already existing trends must continue.

1. Livestock production units must become larger and more specialized.

2. Increasing numbers of livestock must go directly from farm to slaughter.

3. Increasing numbers of livestock, particularly hogs, must be sold on the basis of carcass grade and weight.

4. There must be more long-term arrangements between livestock producers and packers that will help eliminate supply fluctuations and uncertainty.
5. Larger share of meats must be processed to some degree before reaching consumer - mostly sold under brand names.

6. There must be an accelerated drive to develop new products to efficiently utilize meat raw materials.

7. Cost reducing activities must receive increased attention from meat processors.

It is my opinion, that as an industry, we are making only a feeble effort toward accomplishing the proposed objectives. It's a tough job and there are many roadblocks.

Specific Roadblocks to Objective Accomplishments

I'll list only a few specific roadblocks as examples, many more could be added:

1. Pre-occupation on "quality" by livestock production and marketing specialists.

This problem is most easily seen for hogs, but it also exists for beef. How many times have we heard the statement (or made it ourselves) that the pork industry needs to produce higher quality pork and to keep it identified so that it can be merchandised as "quality" pork to consumers? The implication is that this action would solve the Hog and Pork Industry's problems.

The fact is that less than one-fifth of a hog is sold in a form recognized by consumers as pork. The remainder is processed to some degree. The problem is compounded by the confusion of meat yield with quality characteristics.

Fortunately, there is a positive correlation of high quality with meat yield so that many of the conclusions regarding production and marketing practices are right for the wrong reasons. This confusion, however, results in an inflexible production system because influential people continue to treat the symptoms rather than to attack the basic problems.
The result will be that if, (no not if), WHEN consumers dictate through the marketing system the meat change in the best type of hog to provide raw materials in the most efficient manner, the hog production system will take years to adjust - years that may cost the life of the hog and pork industry.

2. Great concern for Income Equity among Industry Segments.

This probably has its most sophisticated approach among students of "market structure." In other forms, we see the organization of new farm organizations and emphasis on bargaining cooperatives. I believe the principle danger of this great concern is the tendency to assume that the only competition is within the industry rather than to recognize the real competition coming from other industries.

3. Reluctance by Meat Processors to Invest in Research and Development.

Because of the profit squeeze, only small investments have been made in Research and Development. As a result, relatively few cost reducing innovations and new product concepts have been produced. The processors also have ignored the threat of substitute products.

Other roadblocks include:

4. A generally negative attitude of Farm Management Specialists in the Midwest toward Specialized Large-Scale Livestock Production Units.

5. Fear of Private Firms to Cooperate in any manner with Government agencies.

This may be justified because of a feeling by Government Personnel that Private Industry (particularly the large firms) attempts in every way possible to cheat all other segments of the industry, including consumers.

Can the industry insure a profitable future by moving rapidly and in the proper direction? I believe the answer is yes - if - we get started immediately.

First: The first step to a profitable future is to reach agreement on the primary objective of the industry among key segments of the industry - namely Government, University and Industry Spokesmen. This task should be to reach agreement on "what" should be done rather than "how" to do it. No attempt should be made to recommend or set Public policy.
At this point I should suggest another Roadblock, and that is the tendency to call large conference meetings for the purpose of problem solving. Seriously, such a group as suggested here must be kept small. The individuals should be selected because of their broad insight into the total livestock and meat economy.

Second: After objectives are determined, how to accomplish them becomes the problem.

It is my opinion that the study of past trends is useful but only for isolating and understanding their causes. They should not be blindly projected to the future. It is time to change the emphasis from backward looking research and policy research per se to creative research. Responsible researchers must use a normative approach. Many of the factors that will influence the future can be changed with creative leadership.

Dr. Thomas Stout in his discussion of basically this same paper says that "we may expect an industrial revolution in agriculture of unprecedented proportions. We may expect it to be engineered as much by non-traditional thinkers with backgrounds and training unrelated to agriculture as by less-inspired products of the existing agricultural establishments."

I'm afraid that Dr. Stout may be correct, but I hope for the good of all here today, that he is wrong. We have the talent among our existing agricultural establishments. If we can get the inspiration, we will provide the creative leadership that can change the future of the Livestock and Meat Industry.
Table 4.1. Commercial Meat Production, 1946 - 1965

<table>
<thead>
<tr>
<th>Year</th>
<th>Beef</th>
<th>Veal</th>
<th>Pork&lt;sup&gt;a/&lt;/sup&gt;</th>
<th>Lamb and Mutton</th>
<th>Total Meat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Million pounds</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1946</td>
<td>9,010</td>
<td>1,329</td>
<td>9,220</td>
<td>946</td>
<td>20,505</td>
</tr>
<tr>
<td>1947</td>
<td>10,096</td>
<td>1,493</td>
<td>8,811</td>
<td>779</td>
<td>21,179</td>
</tr>
<tr>
<td>1948</td>
<td>8,766</td>
<td>1,323</td>
<td>8,486</td>
<td>728</td>
<td>19,303</td>
</tr>
<tr>
<td>1949</td>
<td>9,142</td>
<td>1,240</td>
<td>8,875</td>
<td>587</td>
<td>19,844</td>
</tr>
<tr>
<td>1950</td>
<td>9,248</td>
<td>1,137</td>
<td>9,397</td>
<td>581</td>
<td>20,363</td>
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<tr>
<td>1951</td>
<td>8,549</td>
<td>972</td>
<td>10,190</td>
<td>508</td>
<td>20,219</td>
</tr>
<tr>
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<td>9,337</td>
<td>1,080</td>
<td>10,321</td>
<td>635</td>
<td>21,373</td>
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<tr>
<td>1953</td>
<td>12,055</td>
<td>1,451</td>
<td>8,971</td>
<td>715</td>
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<td>12,601</td>
<td>1,551</td>
<td>8,932</td>
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<td>23,805</td>
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<tr>
<td>1955</td>
<td>13,213</td>
<td>1,487</td>
<td>10,027</td>
<td>744</td>
<td>25,471</td>
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<tr>
<td>1956</td>
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<td>1,541</td>
<td>10,284</td>
<td>728</td>
<td>26,643</td>
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<tr>
<td>1957</td>
<td>13,852</td>
<td>1,442</td>
<td>9,579</td>
<td>694</td>
<td>25,567</td>
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<tr>
<td>1958</td>
<td>12,983</td>
<td>1,103</td>
<td>9,618</td>
<td>674</td>
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<tr>
<td>1959</td>
<td>13,233</td>
<td>929</td>
<td>11,131</td>
<td>724</td>
<td>26,017</td>
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<tr>
<td>1960</td>
<td>14,374</td>
<td>1,025</td>
<td>10,863</td>
<td>754</td>
<td>27,016</td>
</tr>
<tr>
<td>1961</td>
<td>14,930</td>
<td>960</td>
<td>10,730</td>
<td>818</td>
<td>27,438</td>
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<tr>
<td>1962</td>
<td>14,931</td>
<td>936</td>
<td>11,229</td>
<td>795</td>
<td>27,891</td>
</tr>
<tr>
<td>1963</td>
<td>16,049</td>
<td>847</td>
<td>11,863</td>
<td>757</td>
<td>29,516</td>
</tr>
<tr>
<td>1964</td>
<td>18,037</td>
<td>928</td>
<td>12,019</td>
<td>703</td>
<td>31,687</td>
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<tr>
<td>1965</td>
<td>18,325</td>
<td>936</td>
<td>10,736</td>
<td>639</td>
<td>30,636</td>
</tr>
</tbody>
</table>

Source: Livestock and Meat Statistics, USDA.

<sup>a/</sup>Excludes Lard and Rendered Pork Fat.
Table 4.2. Percent of packer livestock purchases through different market outlets, selected years.

<table>
<thead>
<tr>
<th>Year</th>
<th>Cattle</th>
<th>Calves</th>
<th>Sheep</th>
<th>Hogs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terminal markets</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1930(a/)</td>
<td>88.3</td>
<td>81.8</td>
<td>84.7</td>
<td>59.9</td>
</tr>
<tr>
<td>1940(a/)</td>
<td>75.1</td>
<td>50.9</td>
<td>63.8</td>
<td>46.7</td>
</tr>
<tr>
<td>1950(a/)</td>
<td>74.9</td>
<td>56.7</td>
<td>57.4</td>
<td>39.9</td>
</tr>
<tr>
<td>1960</td>
<td>45.8</td>
<td>25.4</td>
<td>35.4</td>
<td>30.3</td>
</tr>
<tr>
<td>1961</td>
<td>42.3</td>
<td>23.1</td>
<td>36.8</td>
<td>29.2</td>
</tr>
<tr>
<td>1962</td>
<td>42.6</td>
<td>23.3</td>
<td>35.4</td>
<td>29.3</td>
</tr>
<tr>
<td>1963</td>
<td>39.1</td>
<td>18.2</td>
<td>30.1</td>
<td>26.5</td>
</tr>
<tr>
<td>1964</td>
<td>36.5</td>
<td>18.8</td>
<td>28.6</td>
<td>23.8</td>
</tr>
<tr>
<td>Direct, country dealers, etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1960</td>
<td>38.6</td>
<td>42.5</td>
<td>54.0</td>
<td>61.0</td>
</tr>
<tr>
<td>1961</td>
<td>38.0</td>
<td>37.5</td>
<td>52.3</td>
<td>59.6</td>
</tr>
<tr>
<td>1962</td>
<td>38.6</td>
<td>31.0</td>
<td>49.4</td>
<td>59.6</td>
</tr>
<tr>
<td>1963</td>
<td>43.1</td>
<td>35.4</td>
<td>56.0</td>
<td>60.7</td>
</tr>
<tr>
<td>1964</td>
<td>44.6</td>
<td>31.7</td>
<td>57.7</td>
<td>63.1</td>
</tr>
<tr>
<td>Auction Markets</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1960</td>
<td>15.6</td>
<td>32.1</td>
<td>10.6</td>
<td>8.7</td>
</tr>
<tr>
<td>1961</td>
<td>19.7</td>
<td>39.4</td>
<td>10.9</td>
<td>11.2</td>
</tr>
<tr>
<td>1962</td>
<td>18.8</td>
<td>45.7</td>
<td>15.2</td>
<td>11.1</td>
</tr>
<tr>
<td>1963</td>
<td>17.8</td>
<td>46.4</td>
<td>14.0</td>
<td>12.7</td>
</tr>
<tr>
<td>1964</td>
<td>18.9</td>
<td>49.5</td>
<td>13.7</td>
<td>13.1</td>
</tr>
</tbody>
</table>

Source: U. S. Department of Agriculture, Consumer and Marketing Service, Packers and Stockyards Division.

\(a/\)Percentages for these years based on federally inspected slaughter purchased at terminal public markets. Percentages for 1960–64 from annual reports of packers filed with Packers and Stockyards Division, C&MS-USDA.
Table 4.3. Percent of farm livestock marketings handled by cooperatives, United States, by species, selected years.

<table>
<thead>
<tr>
<th>Year</th>
<th>Cattle</th>
<th>Calves</th>
<th>Hogs</th>
<th>Sheep and Lambs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1949</td>
<td>15.0</td>
<td>11.6</td>
<td>10.7</td>
<td>24.6</td>
</tr>
<tr>
<td>1954</td>
<td>15.0</td>
<td>10.3</td>
<td>11.7</td>
<td>22.6</td>
</tr>
<tr>
<td>1959</td>
<td>14.8</td>
<td>8.5</td>
<td>11.3</td>
<td>20.5</td>
</tr>
<tr>
<td>1964</td>
<td>12.6</td>
<td>10.0</td>
<td>12.1</td>
<td>17.3</td>
</tr>
<tr>
<td>1965</td>
<td>12.6</td>
<td>11.0</td>
<td>13.0</td>
<td>16.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YEAR</th>
<th>Beef and Pork</th>
<th>Lamb and Total</th>
<th>percent of U.S. commercial production</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-4 5-8</td>
<td>1-4 5-8</td>
<td>1-4 5-8</td>
</tr>
<tr>
<td>1947</td>
<td>35.0 3.9</td>
<td>41.0 10.1</td>
<td>63.3 7.2 38.7 6.9</td>
</tr>
<tr>
<td>1948</td>
<td>32.4 4.0</td>
<td>39.4 10.2</td>
<td>60.9 5.9 36.8 7.1</td>
</tr>
<tr>
<td>1949</td>
<td>35.1 3.9</td>
<td>40.6 10.4</td>
<td>64.6 7.2 38.7 7.2</td>
</tr>
<tr>
<td>1950</td>
<td>33.5 3.5</td>
<td>40.6 10.6</td>
<td>64.9 6.9 37.9 7.2</td>
</tr>
<tr>
<td>1951</td>
<td>30.8 3.5</td>
<td>39.1 10.6</td>
<td>62.2 6.7 36.2 7.5</td>
</tr>
<tr>
<td>1952</td>
<td>32.1 3.7</td>
<td>40.2 11.3</td>
<td>61.7 6.3 37.3 7.9</td>
</tr>
<tr>
<td>1953</td>
<td>32.8 4.5</td>
<td>40.6 14.8</td>
<td>84.9 6.7 37.7 9.1</td>
</tr>
<tr>
<td>1954</td>
<td>32.9 4.7</td>
<td>37.8 14.9</td>
<td>63.5 6.2 35.8 9.1</td>
</tr>
<tr>
<td>1955</td>
<td>31.4 4.7</td>
<td>38.2 15.0</td>
<td>61.4 6.6 35.2 9.3</td>
</tr>
<tr>
<td>1956</td>
<td>30.7 4.7</td>
<td>38.8 15.4</td>
<td>62.5 7.1 35.1 9.5</td>
</tr>
<tr>
<td>1957</td>
<td>29.9 4.6</td>
<td>38.7 15.7</td>
<td>60.1 7.1 34.4 9.4</td>
</tr>
<tr>
<td>1958</td>
<td>27.9 4.2</td>
<td>35.3 15.2</td>
<td>56.5 6.5 31.9 9.2</td>
</tr>
<tr>
<td>1959</td>
<td>25.1 4.2</td>
<td>32.2 14.4</td>
<td>53.9 6.6 29.3 9.2</td>
</tr>
<tr>
<td>1960</td>
<td>24.2 4.2</td>
<td>33.7 15.8</td>
<td>54.1 7.0 29.3 9.2</td>
</tr>
<tr>
<td>1961</td>
<td>24.4 4.0</td>
<td>33.4 14.5</td>
<td>53.9 6.1 29.2 8.7</td>
</tr>
<tr>
<td>1962</td>
<td>24.2 4.2</td>
<td>33.7 14.1</td>
<td>54.0 4.4 29.3 8.6</td>
</tr>
<tr>
<td>1963</td>
<td>23.1 4.0</td>
<td>33.2 13.9</td>
<td>53.1 4.4 28.3 8.4</td>
</tr>
<tr>
<td>1964</td>
<td>23.7 4.2</td>
<td>34.1 14.2</td>
<td>55.8 4.3 28.7 8.4</td>
</tr>
</tbody>
</table>


Rank according to red meat sales in 1963. Largest 4 companies include Armour, Morrell, Swift, and Wilson. Companies in second group of 4 include Hormel, Hygrade Oscar Mayer, and Rath.
Table 4.5. U. S. imports of red meat in relation to commercial supply, by type of meat, 1958-65.

<table>
<thead>
<tr>
<th>Year</th>
<th>Beef and Veal</th>
<th>Pork, excluding Lard</th>
<th>Lamb and Mutton</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In Million Pounds, Carcass Weight</td>
<td>U. S. Imports</td>
<td>Carcass Weight</td>
</tr>
<tr>
<td></td>
<td>Carcass Weight</td>
<td>U. S. Commercial supply</td>
<td></td>
</tr>
<tr>
<td>1958</td>
<td>909.0</td>
<td>14,962.4</td>
<td>6.1</td>
</tr>
<tr>
<td>1959</td>
<td>1,063.2</td>
<td>15,190.8</td>
<td>7.0</td>
</tr>
<tr>
<td>1960</td>
<td>775.5</td>
<td>16,138.7</td>
<td>4.8</td>
</tr>
<tr>
<td>1961</td>
<td>1,037.1</td>
<td>16,891.1</td>
<td>6.1</td>
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<tr>
<td>1962</td>
<td>1,440.0</td>
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<tr>
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<td>18,540.9</td>
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<td>19,985.4</td>
<td>5.4</td>
</tr>
<tr>
<td>1965</td>
<td>941.8</td>
<td>20,148.9</td>
<td>4.7</td>
</tr>
<tr>
<td>1958</td>
<td>193.1</td>
<td>9,749.3</td>
<td>2.0</td>
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<tr>
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<td>186.0</td>
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<td>10,972.7</td>
<td>1.7</td>
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<tr>
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<td>10,844.9</td>
<td>1.7</td>
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<tr>
<td>1962</td>
<td>215.9</td>
<td>11,378.0</td>
<td>1.9</td>
</tr>
<tr>
<td>1963</td>
<td>225.0</td>
<td>11,946.3</td>
<td>1.9</td>
</tr>
<tr>
<td>1964</td>
<td>267.4</td>
<td>12,148.1</td>
<td>2.2</td>
</tr>
<tr>
<td>1965</td>
<td>333.0</td>
<td>11,013.7</td>
<td>3.0</td>
</tr>
<tr>
<td>1958</td>
<td>41.2</td>
<td>712.8</td>
<td>5.8</td>
</tr>
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<td>1959</td>
<td>104.2</td>
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<td>1960</td>
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<td>1961</td>
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<td>1964</td>
<td>79.0</td>
<td>780.1</td>
<td>10.1</td>
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<tr>
<td>1965</td>
<td>72.6</td>
<td>709.6</td>
<td>10.2</td>
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Table 4.5. (Continued)

<table>
<thead>
<tr>
<th>Year</th>
<th>Imports</th>
<th>U.S. Commercial supply</th>
<th>Total red meat</th>
<th>Percent of US Commercial supply represented imports</th>
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</thead>
<tbody>
<tr>
<td>1958</td>
<td>1,143.3</td>
<td>25,424.5</td>
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<td>4.5</td>
</tr>
<tr>
<td>1959</td>
<td>1,353.3</td>
<td>27,254.6</td>
<td></td>
<td>5.0</td>
</tr>
<tr>
<td>1960</td>
<td>1,048.1</td>
<td>27,129.7</td>
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a/ U.S. Commercial production minus exports plus imports.
GRAIN MARKETS, MARKETING, AND FARM POLICY

by Reynold P. Dahl*

More than a half century ago Dr. L. D. H. Weld, head of a young Department of Agricultural Economics at the University of Minnesota made a study of grain marketing in the upper midwest. A principal conclusion of that study was the following: "Taken all in all, and considering the number and variety of services that are necessary between producer and consumer, grain is probably marketed more efficiently and more economically than any other farm product."

Available evidence supports a similar conclusion today regarding the relative efficiency of grain marketing. The grain market probably comes as close to the economists: concept of a "perfect" market as any other agricultural market. There are special reasons for this, of course, such as the relative non-perishability of grain and the early establishment of uniform grades and standards. However, the organization of the marketing system plays a most important part. Organized commodity markets fostering open, competitive trading in both the cash commodity and futures developed early in the grain trade and they continue to play an important role in price discovery. Futures trading originally emerged in the grain trade where it has achieved its highest degree of development. Roger Gray has recently argued that it is fruitful to look at futures trading with the primary focus on its "market" and prices discovery aspects rather than the risk transfer aspects. According to Gray, futures markets deserve to be cast in a competitive equilibrium model and it is doubtful if any other market organization can approach a futures market in competitiveness, owing to the impossibility of achieving certain of the requirements in such a high degree.¹ These requirements are usually given as (1) large numbers of buyers and sellers, (2) a homogeneous product, (3) free entry; and (4) full information for all participants.

If Gray's analysis is correct, it is surprising that these markets have not been more studied as models of competitive behavior by economists.

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Further, we can regard the recent development of futures trading in commodities other than grain as welcome additions to our market price making machinery.

Many changes have occurred in grain markets and marketing since Dr. Weld's research 50 years ago. Some of the most significant developments in recent years are the following: (1) shifts in federal programs to support farm income and associated changes in the stock of grain owned by the government, (2) the increasing importance of the export market as an outlet for United States grain, (3) changes in transportation technology and the railroad rate structure, and (4) grain in marketing changes associated with changes in farm production technology.

We have witnessed other changes in grain markets and marketing, but, in my opinion they are of minor importance relative to the four developments listed above.

Farm Income Support Programs, Surplus Stocks, and Markets

The grain marketing industry has been affected to a greater degree by government programs to support farm income than any other part of our agricultural marketing system. Since the 1930's grain production has often exceeded market needs at prices deemed equitable to farmers. As a result public policy has been directed toward supporting farm income. Farm income was supported until 1963 principally through the support of market prices. The programs were implemented through nonrecourse loans which resulted in the government taking over and subsequently marketing substantial quantities of grain. Consequently, the government has often been the dominant firm in grain markets, influencing both prices and marketing.

Since 1963, however, we have witnessed a significant shift in the basis of supporting farm income to a greater reliance on direct income payments together with lower price support loans. This change has been accompanied by a rapid decline in government-owned grain stocks, due in part to the new program, and to increased grain exports. The shift to direct income payments in supporting farm income has important implications to markets and the performance of their traditional role in a capitalistic society as well as to marketing firms and farmers. Before attempting an analysis of these implications, they can perhaps be better
appreciated if we review the situation with respect to government grain stocks and their influence on grain markets and marketing.

During the 1950's government-owned stocks of grain were accumulated very rapidly under price-support operations reaching an all-time high in 1961. Total carryover stocks of wheat reached the record level of 1.4 billion bushels on July 1, 1961, while the carryover of feed grains also reached a record high of 85 million tons in the fall of the same year.

The Commodity Credit Corporation, the price-supporting agency of the U. S. Department of Agriculture and the principal owner of these stocks was directed by Congress to use commercial storage facilities wherever possible. Consequently, it provided incentives for commercial firms to expand their storage facilities by increasing storage rates paid. As a result, CCC approved commercial grain storage capacity in the twelve state north central region more than tripled from 805 million bushels in 1953 to 2.9 billion bushels in 1962. Increases in approved commercial storage exceeded 300 percent in Illinois, Indiana, Iowa, Nebraska, and Kansas while increases were 100 percent or less in Wisconsin, Minnesota, and North Dakota. Some of the storage expansion was in permanent vertical facilities, but a large part was in flat storage with relatively low efficiency.

Farm storage facilities were also expanded during this period due in large part to government incentive programs. From 1949 to 1962, low interest rate loans covering the construction of more than 700 million bushels of farm storage space were made or guaranteed by the CCC.

Finally, the CCC found it necessary to increase its own storage facilities. CCC-owned storage capacity rose from 45 million bushels in 1949 to 980 million bushels in 1962. These facilities were concentrated largely in the Corn Belt. Most of this was relatively inexpensive flat type storage some of which has since been sold by the CCC.

The above discussion indicates that we have a considerably larger farm and commercial grain storage capacity relative to yearly crop production today than a decade ago, so lower market returns to grain storage activities may prevail in the future.

Obviously, the federal government could not continue accumulating surplus grain stocks at the rate it did up to 1961, so a major change was subsequently made in farm income support programs. Acreage diversion programs were initiated under which farmers are required to divert acreage
to soil conserving uses as a requirement for income payments and price support loans. Farmers are also paid for diverting acreage above the minimum required for program participation.

These acreage diversion programs, together with increases in grain exports, have achieved the desired goal of reducing the level of government-owned grain stocks. By the end of the 1966-67 marketing year wheat and feed grain stocks are estimated to be 400 million bushels and 25 million tons, respectively. These carryovers are close to levels considered necessary for national emergencies. It is generally agreed that some level of grain reserves is desirable, but how much grain should we stockpile? Where should it be stored? Who should own it, the commercial trade, or the government? Under what terms and conditions should it be released? These questions merit more research attention by agricultural economists.

The decline of government-owned grain stocks will probably affect the structure and organization of the grain marketing industry. During the past decade, many grain marketing firms have grown accustomed to earning a sizeable share of their income through storage and handling grain for CCC. Opportunities to earn such income have now substantially declined or evaporated. Grain firms have entered a new era in which they can no longer rely on the CCC as a captive customer and must now compete for grain storage and merchandising income. Such elevator operators who may have forgotten how to merchandise and store grain on their own account may not be able to adjust to the change. There is good reason to believe that government grain storage and handling income may have kept some firms in business that otherwise could not have survived. It is interesting to note that in Minnesota, for example, the reduction in the number of country elevators in recent years has not been as great as the reduction in the number of creameries.

I would hypothesize that we will witness considerable adjustment in the country elevator industry in the next decade. A trend toward fewer and larger firms will be accelerated. While the initial impetus may come from the decline in government stocks, it will be reinforced by changes in transportation technology and the railroad rate structure which will be discussed later.
The grain marketing industry, as well as farmers, must also be prepared for adjustment to changes in the role of markets and market prices associated with the new farm program. The current trend in farm policy is to shift the basis of farm income support toward direct payments with lower price support loans under voluntary programs. Wheat marketing certificates that were initiated in 1964 and continued under the Food and Agriculture Act of 1965 for another four years, 1966 through 1969, represent a form of direct payment to participating wheat farmers. The wheat price support loan has been reduced from $2.24 in 1954 to $1.25 in 1966 and the Secretary of Agriculture has the authority to reduce it further under the new farm bill. The loan rate on corn was reduced from $1.62 to $1.00 during the same period with participating farmers also receiving income payments in 1966. Price support loan rates have been lowered to levels where they are much closer to competitive market prices. Consequently, the market is in a better position to determine price. This means that the price support loan has been relegated to an emergency role. While it still may be important to farmers, it is not the crucial factor in farm income that it was a few years ago.

The role of pricing, consequently, is being shifted from the government to markets which are experiencing a resurgence in activity. Sharp increases in trading volume have occurred in futures trading on the nation's principal commodity exchanges which is a reflection of greater price uncertainty and increased stock carrying by the private grain trade. The Commodity Credit Corporation is also assuming a smaller role as a marketing agency for the nation's grain. From 1953 to 1960, CCC acquired 8 to 16 percent of the corn crop each year while in 1963 through 1965 it acquired an average of 1 percent of the corn crop. From 1953 to 1960, CCC acquired an average of 27 percent of the wheat crop. In the years 1963-65, this figure fell to 4 percent. Grain marketing firms are now handling more grain on their own account and less for the CCC.

What are the implications of these changes to farmers? First, farm production decision making must now be made under conditions of greater price uncertainty. No longer will farmers be able to plan on the basis of market prices fluctuating within a narrow range around the price support loan rate. Second, market prices will likely be at levels lower than in previous years when farm income was supported solely through the support of market prices. Income payments under the current program are tied
to projected yields based on county averages not actual yields and, consequently, do not become a part of the price for decision making. To be sure, it is important in deciding whether or not to participate in the program. However, the return to marginal production is the expected market price with the lower support rates as a floor. So maximum profit is achieved at a lower output than under previous programs when loan rates were higher with no income payments. For example, the principal way in which a farmer can increase corn production on a given amount of land is to use more fertilizer, chemicals, etc. Due to diminishing returns to these inputs the marginal cost of producing corn rises as production is increased. Consequently, the

![Graph](image)

**Figure 5.1**

maximum profit output at a price of $1.62 per bushel is $OQ_1$, while at a price of $1.00 it is lower at a level of $OQ_2$ (Figure 5.1).
Economists have been slow to recognize the welfare implications of the shift to income payments. A welfare or social cost was involved under the old program when production resources were used to produce grains whose market value was less than the value of the resources used to produce them.²

Professor D. Gale Johnson criticizes the current farm program on the grounds that income transfers do directly influence output decisions. He points out that since the allocation of marketing certificates to wheat farmers is based on projected farm yields defined by the program as "the yield per harvested acre of such commodity on the farm during each of the three calendar years immediately preceding the year in which the projected farm yield is determined," a farmer's yields this year will affect the value of income payments in subsequent years. This would induce farmers to produce more wheat than if there were a single price of $1.25.³

While Johnson's point is well taken he does overlook an important factor in program administration which makes it less relevant. Projected yields are not exactly calculated for individual farms but are actually determined by township committees. They are subject to considerable error and therefore, the linkage between actual and projected yields is a good deal less direct than implied by Johnson's paper.

Marketing decisions by farmers also become more complex under a market-oriented farm policy. Decisions regarding when to sell and when to store grain were relatively simple under price support programs of previous years. Often the principal decision to be made was whether or not to take a price support loan. After a loan was obtained, the market price often did not rise above the loan rate so the grain was automatically delivered to the CCC. Farmers who did not take out loans found that prices fluctuated over a narrow seasonal range because the CCC usually was a seller when prices reached 105 percent of the price support loan rate or at lower rates when necessary to maintain the quality of its stocks. Greater price variability can be anticipated under the new farm programs.


These changes have important implications for research in farm management and production economics. Since the end of World War II, research workers have usually considered grain prices as a constant at the price support loan. Consequently, marketing decisions were not important and had relatively little effect on farm earnings. With greater price variability, however, marketing decisions become more important relative to production decisions as a variable in farm earnings.

Grain is a seasonally produced commodity while consumption is spread more evenly over the year. Consequently, someone must own and store it from the time of production to consumption. The private grain trade has traditionally performed this role in a free market because farmers are typically heavy sellers at harvest time. However, with the expansion of farm storage facilities in recent years more farmers may want to store grain when it is profitable to do so. Farmers, like grain merchandising firms, can use cash-futures price relationships as a guide to storage operations. When cash grain is at a discount to the future, often at harvest time, the market indicates that it is profitable to store. At such times farmers can store their grain and sell a future contract as a temporary substitute for the sale of cash grain later in the cash market. This is hedging--a device through which a return on storage can be earned. On the other hand, when cash grain is at a premium to the future, usually in periods of short supply relative to demand, it is probably unprofitable to store.

In order to take advantage of profitable storage opportunities when they arise, the farmer must thoroughly study the relationship between his selling price for cash grain and the futures price over time. This is his local cash-basis. He must be a careful student of the cash-basis if he is to utilize the futures market to earn a return on storage through hedging.

Farmers might also consider using the futures market to sell their crops in advance of the completion of production when futures prices are regarded as favorable. This procedure has been described by Working as anticipatory hedging. The anticipatory hedge, as the storage hedge described above, also serves as a temporary substitute for a later sale of his grain in the cash market.

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In a discussion of an earlier draft of this paper, Professor Havlicek raised a question as to whether the above described uses of futures markets were really hedging. Is not hedging simply an "insurance policy" which protects the holder of stocks against a price decline? Several excellent research studies have presented convincing evidence that most hedging is not undertaken with risk aversion being the primary motive.\(^5\) Hedging is usually done in the expectation of a change in the cash-future price relationship -- a change that can reasonably be predicted at the time the hedge is placed.

The over-emphasis of risk aversion in discussions of hedging has diverted attention from the more important economic contributions of futures markets. Since farmers are beginning to raise more questions about the use of futures markets in their marketing decision making, production economists may find it worthwhile to analyze the potential use of these markets in greater depth.

The Expanding Export Market

A second significant change in grain marketing is the increasing importance of the export market as an outlet for United States grain. The total value of U. S. agricultural exports increased 29 percent from 1960 through 1965 reaching $6.2 billion in the later years. Almost all of the increase has been in commercial sales which were 77 percent of total exports in 1965. Exports under Government-financed programs made up 23 percent of total exports -- the smallest proportion since the beginning of the P. L. 480 program in 1954.

Exports of grains and oilseeds have increased more rapidly than other agricultural exports in recent years and, as a result, now make up a larger percentage of the total. Combined exports of wheat, feed grains, oilseeds and their products totaled $3.5 billion in 1965 or 56 percent of our total agricultural exports.

The importance of exports to United States grain farmers is dramatically illustrated by comparing exports with domestic production. In fiscal 1965-66, wheat exports were 65 percent of our domestic production. Over two-fifths of our soybeans, one-third of our grain sorghums, and 16 percent of our corn were marketed overseas.

What has been responsible for our significant increase in agricultural exports? Most of the increase can be attributed to the increased world demand for U. S. farm products. Commercial exports of feed grains and soybeans to industrial, developed countries have increased as they have intensified animal agriculture. Livestock and poultry production in Western Europe and Japan have gained sharply in recent years as higher income has strengthened the demand for meat. While the commercial demand for our wheat has remained relatively constant in recent years, we have increased our exports of wheat under P. L. 480. Over two-thirds of our wheat exports last year were government financed under the Food for Peace Program.

What is the outlook for our agricultural exports? First, industrial countries, especially in Western Europe and Japan, will probably continue to increase their purchases of United States feed grains and soybeans as economic growth continues. It is significant to note that income elasticities of demand for meat are higher and per capita meat consumption is lower in the rest of the developed world than in the United States. In the six countries of the European Economic Community, for example, per capita consumption of beef and veal was 51 pounds in 1963-64 while the United States it was 106 pounds. Per capita consumption of poultry was 15 pounds in the EEC compared to 37 pounds in the United States.

Second, the need for food in the less developed regions of the world is increasing faster than food outputs. Population in many parts of Asia, Latin America, and Africa is rising more rapidly than the food supply. To help meet these increased food needs, a modified and expanded Food for Peace bill has been passed Congress. One of the changes is that U. S. food aid will now be contingent upon efforts in the recipient countries to increase their own food output. This is recognition of the fact that expanded food aid is not a permanent solution to food shortages in the developing countries because the day is not far off when the United States will not be able to fill the food gap. The long-run solution lies in helping these countries improve their own agricultural productivity.
Expanded United States food aid will have a larger impact on our wheat production than other grains. Indications are that our wheat exports will continue to be heavily dependent upon food aid.

In the past we have had a tendency to look upon foreign markets as a residual claimant to our domestic agricultural production. In other words, crops and food products have been produced mainly for our domestic market with foreign markets considered only when production exceeded our domestic needs. But the day has past when we could gear our agricultural production and marketing practices to the domestic market only. We cannot overlook the fact that the needs and demands of foreign consumers may be different than our own. Recognizing special tastes and preferences of foreign buyers and gearing our farm production and marketing practices to these demands is essential.

**Transportation Technology and the Railroad Rate Structure**

Changes in transportation technology and the railroad rate structure have also had a significant impact on grain marketing in recent years. Changing transportation patterns and rates have altered commodity price relationships among markets within a region as well as between producing and consuming regions. The competitive position of both producers and processors of farm products among regions has also changed.

Advances in transportation technology have been particularly rapid since the end of World War II. The construction of interstate highways has enabled trucks to become more competitive. Improvements to inland waterways have made it possible for barges to capture an increasing share of the long-haul grain movements. Railroads, while still important, have experienced stiff competition for agricultural traffic. Their rate structure that was developed during the early thirties when railroads had monopoly power has been under pressure in the new era of competition. This rail rate structure was originally designed to enable processors and merchandisers at different market to compete equally with respect to transportation charges for raw materials and products, even though they did not have equal geographical advantages. In other words, it was not based on costs of providing the service.
Railroads have responded to increased competition by selectively reducing rates on grain. The trend has been for them to offer new "mileage" and "multiple-car" rates for grain based on costs of providing service. The new grain rates provide fewer transportation services such as transit and routing privileges than the old rates. In general, the effect has been to reduce the rates on grain relative to grain products. This has worked to the disadvantage of many midwest grain processors that are heavily dependent upon the old rail rate structure.

Agricultural economists probably have not devoted enough research effort to analyzing the impact of changes in transportation rate structures that alter rate differentials between grain and grain products or between grain and livestock products. Changes in transportation that reduce rates on grain relative to grain products and livestock products affect the competitive position of midwest livestock producers as well as agricultural processors. The reduction of rates on feed grains into the southeastern United States through low cost barge traffic on inland waterways certainly was one factor in the rapid growth of the broiler industry in that area. More recently there has been discussion of a possible decline in the competitive position of cattle feeding in the corn belt relative to the plains states and the far west. Population on the west coast is increasing relative to other areas in the U. S. so we can anticipate greater movements of farm products from the midwest to the west coast. Consequently, changing transportation rates between feed grain, livestock and livestock products take on added significance.

Spatial equilibrium models are useful tools to analyze the consequences of changes in transportation costs on the spatial distribution of prices and movements of commodities. The usefulness of the results of these models, however, is often no better than the quality of the data going into them. The latter deserves more attention.

We will probably see a trend toward the increased use of special mileage, multiple car railroad rates on grain at the country level. This will give an advantage to country elevators that can accumulate grain in sufficient volume to qualify for these rates. Some elevators are already offering price premiums to farmers who can deliver grain in large quantities. Here we have an interesting parallel between economies of scale in marketing and farm production. Increasing economies of scale in grain marketing may become an important contributing factor to economies to scale in agriculture.
Changes in Farm Production Technology and Marketing

Interrelationships between changes in farm production technology and marketing are well illustrated in the case of feed grains. We used to think of our feed grains being fed mostly on the farms where they were produced. In the 1930's farmers fed 75 percent of the feed grains they produced to livestock on their farms. In recent years, however, only one half of our feed grains have been fed on the farms where they are produced while the other half has moved into marketing channels. This is a reflection of increased specialization and commercialization in agriculture. The increased movement from farms also reflects an increase in the use of feed grains for food, industry, and export.

U. S. exports of feed grains reached 29 million tons in 1965-66, more than double their level of 5 years ago. Exports of corn, our principal feed grain, were 700 million bushels in 1965-66 which was a third of the farm sales of corn.

One of the more significant developments in farm production technology affecting corn marketing in recent years has been the increased harvesting of corn with field shellers, particularly combines with corn heads. This has caused substantial changes in corn marketing patterns which have important implications to both country grain dealers and farmers.

The rapidity of the shifts to corn field shelling has been dramatic in the eastern part of the Corn Belt. In Indiana, for example, 52 percent of the 1964 corn crop was field shelled -- up from 18 percent for the 1960 crop. The proportion of Iowa corn field shelled is lower, 18 percent of the 1964 crop, but up substantially from 10 percent of the 1960 crop.

Many expect that field shelling of corn will continue to increase and account for substantially all of the corn crops in certain states within a few years.

Some of the marketing implications of the changes in corn harvesting methods have been discussed by Professor L. F. Stice. First, a much larger proportion of field-shelled corn than ear corn moves direct from the field to market. In 1963, 40 percent of the field shelled corn in Illinois was marketed direct from the field in constrast to only 3.5 percent of the corn harvested as ear corn. Second, field shelling causes the corn harvest to start earlier and to be completed in a shorter time. Third,
field shelled corn has too high moisture to permit storage without drying or heavy aeration. All of these factors tend to increase the pressure on country elevators at harvest time.  

Farmers' decision making in marketing high moisture, field shelled, corn is more complex than when ear corn was harvested. The farmer can decide to sell high moisture corn directly from the field at harvest and accept a moisture discount. Otherwise, he can dry the corn and sell it immediately or store it for sale later. If he dries his corn he must decide whether to purchase his own drying equipment or have it done commercially at the elevator. Similarly, he can either store his corn at the elevator or on his own farm. Increased price variability and price uncertainty associated with the new farm program will further complicate his marketing decision making.

If the present trend of marketing a high proportion of field shelled corn at harvest continues, one would expect greater price depressions at harvest and a greater seasonal price rise in corn. Consequently, farmers will have to be careful students of seasonal price movements to maximize profits. As argued previously, the corn futures market can serve as a useful guide to corn storage with returns to storage earned through the mechanism of hedging.

Conclusions

In summary, I have argued that grain market structure and organization have been affected by government price support operations and surplus stocks owned by the CCC during the past two decades. The recent shift in farm income support to income payments and lower price supports will mean that the government will play a smaller role in grain marketing in the future than in the past. Markets will be relied on more extensively in price discovery and grain firms will again carry more stocks under private ownership. Grain firms as well as farmers will find decision making more complex with greater price uncertainty. These changes will hasten adjustments in market structure -- particularly at the country level.

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The export market will become increasingly important as an outlet for United States grain. Commercial exports of both feed grains and soybeans to the developed world will continue to expand as these countries intensify animal agriculture in response to increases in the demand for meat. Income elasticities of demand for meat are higher in most of these countries than in the U. S. Wheat exports will continue to be heavily dependent upon food aid. The increased importance of the export market calls for more marketing and demand and price studies beyond the continental boundaries of the U. S.

Changes in transportation technology and the railroad rate structure have altered relationships between grain and grain products and between grain and livestock products. Such changes affect the competitive position of midwest producers and processors of agricultural products. Analyzing such problems through spatial equilibrium models with better data will prove fruitful.

Finally, the increase use of corn combines in harvesting is altering marketing patterns. Farmers' marketing decisions are more complex with high moisture corn. As the harvest period is advanced and shortened the seasonal variation in corn prices may increase. Therefore, decisions as to when to sell and store will become more important. Farmers may find it advantageous to use the futures market in making these decisions.
AGRICULTURE: PROJECTED DEMAND, OUTPUT AND RESOURCE STRUCTURE

by Rex F. Daly*

Revolutionary changes have taken place in farming and they will continue in the years ahead. Demand growth and rapid advances in technology have combined to release workers from agriculture, greatly increase productivity, increase the size of farms, change cultural practices, and modify output and relative prices for many major farm products.

This paper is in part methodological, though the major objective is to sketch probable changes in agriculture during the next 10 to 15 years under alternative sets of assumed conditions. The projections are based on a simple analytical framework in which projected results were rather mechanically determined under alternatives assumed. The projection framework consists of demand-supply response functions for the crop and livestock product sectors, a feed demand function, and other relationships. Projected output, yields, domestic food and feed use, prices, and cash receipts are determined in the framework outlined in the Appendix.

The general problem setting in agriculture has changed in recent years from one characterized by burdensome stocks to one in which stocks (except for cotton) approach minimum desirable levels. This generally improved supply-use balance, concern about world hunger, and related programs, may be moving U. S. agriculture into a new era.

The Agricultural Act of 1965, despite its similarity to previous legislation, embodies some important changes. The shift toward greater flexibility and pricing of grains and cotton around world market levels moves the Government toward a role of referee rather than an active participant in day-to-day operations in the market place.

*Chairman of the Outlook Board, United States Department of Agriculture. Views expressed are those of the author and do not necessarily represent those of the U. S. Department of Agriculture. The author wishes to recognize the assistance and advice of W. J. Layng, J. D. Ahalt and A. C. Egbert of the Economic Research Service.
The new Food for Peace legislation also emphasizes some important changes from previous programs. It explicitly recognizes that the U. S. cannot feed the world and emphasizes the need for self help in the recipient nation. With grain surpluses gone, the new legislation requires positive action to gear production to domestic markets, aid requirements, and commercial export prospects rather than simply exporting available surpluses. Farm product exports will depend to a considerable extent on the administration of this legislation and how rapidly self-help provisions can bring about increased production in the hungry nations. Because of the range of possibilities, much of the appraisal in this paper is built around three export assumptions rather than specific projection. Under these and a number of other assumptions, let us examine prospective demand-supply balances and related prices, income implications, probable changes in the number and size distribution of farms, and the projected organization and resource structure of agriculture.

Agriculture's Projected Profile In Perspective

Dramatic changes have taken place in agriculture in postwar years, particularly in the organization and structure of agriculture. Technological advances and adjustment possibilities suggest that changes in the organization and structure of agriculture may be even more rapid in coming years.

Domestic markets for farm products will continue to expand around 1 1/2 percent a year, possible a bit more rapidly than population as diets are upgraded to include more meats and convenience foods. Growth in consumer incomes and changes in relative prices will continue to modify the diet, but overall use of food and farm products in general is very inelastic in response to price and income changes. Diet changes may slightly reduce per capita intake of calories and pounds of product. However, an upgraded diet will likely result in more resources being used per person for food production, though most of the increase may be in nonfarm resources.

Domestic use of farm products in 1964-66 totaled nearly 30 percent above the 1949-51 average. Population accounted for most of this increase with only a small gain in per capita use. Although overall per capita use was very stable, food use of crops declined 10 percent from the 1949-51 average, reflecting downturns in per capita use of wheat and in fresh uses of most fruits and vegetables. Per capita use of livestock products increased about a tenth over the period as big gains in consumption of beef and poultry more than offset declines in per capita use of milk, pork, eggs and animal fats.
Although the domestic market grew only slightly more than population in the past 15 years, the volume of exports more than doubled, rising about 5 percent per year. In 1949–51 crop exports were equivalent in volume at the farm level to less than 14 percent of crop output. By 1964–66 this ratio had risen to 22 percent. Exports take more than half of the wheat and rice crops and a very substantial share of other grains, fats, oils, oilseeds, tobacco and cotton. (Table 6.1).

Growth in overall demand, as in the past, will depend heavily on exports of farm products. The general uptrend in crop exports is expected to continue. How rapidly they rise will depend on U. S. availabilities and relative prices, the operation of food aid programs, and a host of economic and institutional forces. Because of uncertainties about possible effects of self-help programs, population control, and world-wide participation in food aid, this analysis explores the impacts of three assumed alternatives for crop exports—export I assumes crop exports increase 4 1/2 percent per year; export II, 6 percent per year; and export III, 3 percent. They are also modified to reflect projected prices (See the Appendix).

Farm output increases over the past 15 years met the expansion in domestic use and exports without strain. Increases in productivity in agriculture—output per unit of input—were sufficiently rapid that total resource inputs in 1964–66 were about the same as in 1949–51. But this stability overlooks some big changes in the types of resources used. Use of labor was down nearly 50 percent, and cropland used for crops declined about 13 percent from the 1949–51 average. The volume of production assets increased about a tenth. Inputs of mechanical power and machinery were up 17 percent, miscellaneous inputs increased 41 percent, and use of fertilizer materials more than doubled. These changes were due largely to the rapid advance of technology in agriculture and to shifts in the relative cost of major inputs. Output per man-hour increased about 2 1/2 times over the period, rising nearly 6 1/2 percent per year. Crop output per acre averaged in 1964–66 some 41 percent above 1949–51. Accompanying these changes, the number of farms declined by about 2 1/4 million from 1950 to about 3.4 million in 1965. The larger-size classes were the only farms that increased in number. In 1965 there were an estimated million farms—30 percent of the total—with sales above $10,000 per farm. These farms apparently accounted for more than 80 percent of total cash receipts (Table 6.2).
Table 6.1. Demand for farm products: Domestic use, exports and output requirements, selected periods, 1950 to 1966 and projections to 1980 (Billion 1957-59 dollars).

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<th>Period</th>
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<td></td>
<td>Livestock</td>
<td>Crop</td>
<td>Total</td>
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<tr>
<td>1949-51 average</td>
<td>24.3</td>
<td>93.3</td>
<td>66.8</td>
<td>160.1</td>
</tr>
<tr>
<td>1059-61 average</td>
<td>28.9</td>
<td>100.0</td>
<td>60.4</td>
<td>160.4</td>
</tr>
<tr>
<td>1964-66 average</td>
<td>31.5</td>
<td>102.0</td>
<td>60.0</td>
<td>162.0</td>
</tr>
<tr>
<td>Change from 1949-51 (%)</td>
<td>29.6</td>
<td>9.3</td>
<td>-10.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Annual rate</td>
<td>1.7</td>
<td>0.6</td>
<td>---</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Projected:

1970

| Export IA/       | 34.3  | 105   | 60.0 | 166 | 6.9 | 36.8 |

1975

| Export IA/       | 37.3  | 107   | 60.0 | 167 | 8.6 | 41.2 |
| Export IB/       | 36.8  | 106   | 59.0 | 165 | 9.7 | 41.8 |
| Export II/       | 37.8  | 109   | 61.0 | 170 | 7.3 | 40.3 |

1980

| Export IA/       | 41.0  | 109   | 60.0 | 169 | 10.5 | 46.3 |
| Change from 1964-66 (%) | 30.2  | 6.9   | 0    | 4.3 | 87.5 | 42.5 |
| Annual rate      | 1.8   | 0.5   | 0    | 0.3 | 4.3  | 2.4  |
### Table 6.1. (Continued)

<table>
<thead>
<tr>
<th>Period</th>
<th>Total</th>
<th>Export</th>
<th>Net total output</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Per Capita</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Livestock</td>
<td>Crop</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>Dol.</td>
<td>Dol.</td>
<td>Dol.</td>
</tr>
<tr>
<td>Export I&lt;sup&gt;a&lt;/sup&gt;</td>
<td>40.3</td>
<td>108</td>
<td>59</td>
</tr>
<tr>
<td>Change from 1964-66 (%)</td>
<td>27.9</td>
<td>5.9</td>
<td>-1.7</td>
</tr>
<tr>
<td>Annual rate</td>
<td>1.6</td>
<td>0.4</td>
<td>-0.1</td>
</tr>
<tr>
<td>Export II&lt;sup&gt;b&lt;/sup&gt;</td>
<td>41.7</td>
<td>111</td>
<td>61</td>
</tr>
<tr>
<td>Change from 1964-66 (%)</td>
<td>32.4</td>
<td>8.8</td>
<td>1.7</td>
</tr>
<tr>
<td>Annual rate</td>
<td>1.9</td>
<td>0.6</td>
<td>0.7</td>
</tr>
</tbody>
</table>

<sup>a</sup> Export I -- Crop export volume rises at 4 1/2 percent per year.

<sup>b</sup> Export II -- Crop export volume rises at 6 percent per year.

<sup>c</sup> Export III -- Crop export volume rises at 3 percent per year.
Farm output increases projected to 1980 range from an increase of about 40 percent from the 1964-66 average, for the low export assumption, to an increase of 50 percent, for the high export assumption. These increases and productivity trends imply small increases in resource inputs. Labor use in agriculture continues to decline. Employment may decline to around 3 to 3 1/2 million workers by 1980, from 5.7 million in 1964-66 (SRS concept). Rising output and resource shifts would suggest a continued moderate rise in capital inputs.

Rapid consolidation of small farms into larger units is expected to lead to fewer and more efficient commercial family farms. They likely will be better managed and more responsive to changing economic conditions. By 1980, if recent trends continue, farm numbers could be down to around 2 million compared with 3.4 million estimated for 1965. About half these farms may account for perhaps 95 percent of total cash receipts, 90 percent of total production assets, and 75 to 80 percent of total labor inputs. For the larger commercial farms, with larger bundles of efficiently used resources, returns will likely move rapidly toward those earned on resources used in nonfarm industries. The remaining farms would consist of small farms, including part-time and part-retirement farms, many of which would be largely rural residences.

This appraisal demonstrates the importance of exports to the growth and prosperity of U.S. agriculture. The rate of export growth can materially influence prices and incomes as well as the problems of adjusting the output potential of agriculture to growth in markets. The appraisal also illustrates the relatively inelastic response of resource use and production to price change. These characteristics complicate the problems of gearing output to market expansion.

Methodology, Data, and Assumptions

Analytical techniques used in this study appraise simultaneously projected increases in aggregate output and demand for crops and livestock. The domestic demand functions reflect the relatively inelastic response of consumption to changes in prices and consumer income (See the Appendix).
Table 6.2. Productivity and resource use, selected periods, 1950 to 1966 and projections to 1980.

<table>
<thead>
<tr>
<th>Period</th>
<th>Output per acre (1957-59-100)</th>
<th>Output per man-hour (1957-59-100)</th>
<th>Output per input</th>
<th>Total inputs (1957-59-100)</th>
<th>Labor</th>
<th>Cropland/ (Mil. acres)</th>
<th>Production assets/ (Bil.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1949-51 average</td>
<td>85</td>
<td>60</td>
<td>86</td>
<td>102</td>
<td>146</td>
<td>382</td>
<td>194</td>
</tr>
<tr>
<td>1959-61 average</td>
<td>108</td>
<td>114</td>
<td>104</td>
<td>101</td>
<td>93</td>
<td>351</td>
<td>212</td>
</tr>
<tr>
<td>1964-66 average</td>
<td>120</td>
<td>152</td>
<td>112</td>
<td>103</td>
<td>75</td>
<td>334</td>
<td>212</td>
</tr>
<tr>
<td>Change from 1949-51 (%)</td>
<td>41.2</td>
<td>153.4</td>
<td>30.2</td>
<td>1.0</td>
<td>-48.6</td>
<td>-12.6</td>
<td>9.3</td>
</tr>
<tr>
<td>Annual rate</td>
<td>2.3</td>
<td>6.4</td>
<td>1.8</td>
<td>---</td>
<td>-2.7</td>
<td>-0.8</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Projected:

1970 Export I^a/  
131 200 125 104 65 360 218

1975 Export I^a/  
142 270 137 106 54 380 224
Export II^b/  
145 270 137 107 55 380 ---
Export III^c/  
144 270 137 104 53 360 ---

1980 Export I^a/  
162 360 152 107 45 380 242
Change from 1964-66 (%) | 35.0 | 136.8 | 35.7 | 3.9 | -40.0 | 13.8 | 14.2 |
Annual rate | 2.0 | 5.9 | 2.0 | 0.2 | -2.3 | 0.9 | 0.9 |
Table 6.2. (Continued)

<table>
<thead>
<tr>
<th></th>
<th>Output per acre</th>
<th>Output per man-hour</th>
<th>Output per input</th>
<th>Total inputs</th>
<th>Labor</th>
<th>Crop-land</th>
<th>Production assets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1957-59-100)</td>
<td>(1957-59-100)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mil. acres</td>
<td>Bil.</td>
</tr>
<tr>
<td>(1957-59-100)</td>
<td>169</td>
<td>360</td>
<td>152</td>
<td>110</td>
<td>47</td>
<td>380</td>
<td>---</td>
</tr>
<tr>
<td>Change from 1964-66 (%)</td>
<td>40.8</td>
<td>136.8</td>
<td>35.7</td>
<td>6.8</td>
<td>-37.3</td>
<td>13.8</td>
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</tr>
<tr>
<td>Annual rate</td>
<td>2.3</td>
<td>5.9</td>
<td>2.0</td>
<td>0.5</td>
<td>-2.1</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>Export III</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1957-59-100)</td>
<td>162</td>
<td>360</td>
<td>152</td>
<td>104</td>
<td>44</td>
<td>360</td>
<td>---</td>
</tr>
<tr>
<td>Change from 1964-66 (%)</td>
<td>35.0</td>
<td>136.8</td>
<td>35.7</td>
<td>1.0</td>
<td>-41.3</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td>Annual rate</td>
<td>2.0</td>
<td>5.9</td>
<td>2.0</td>
<td>0</td>
<td>-2.4</td>
<td>0.5</td>
<td></td>
</tr>
</tbody>
</table>

a/ Export I -- Crop export volume rises at 4 1/2 percent per year.

b/ Export II -- Crop export volume rises at 6 percent per year.

c/ Export III -- Crop export volume rises at 3 percent per year.

d/ Cropland used for crops including fallow.

e/ Farm production assets estimated in 1965 dollars.
The output functions illustrate the tendency for output to increase as prices rise with very little response in the short-run and a larger response in the long-run. Technological advance, which is to some extent a proxy variable for the uptrend in inputs, is a major determinant of output growth. Accordingly, the crop output function as well as projections into the future assume a continuation of past trends in technology in agriculture. The output function for livestock products reflects prices and feed costs as well as the advance in technology, which has been comparatively slow for major livestock, other than poultry. A technological breakthrough affecting production costs and feeding efficiency for cattle and hogs could accelerate output and affect relative prices for livestock and products.

**Economic Environment**

Developments in the general economy are importantly interrelated with agriculture since they influence markets for farm products; the availability and cost of capital, labor, land and other inputs; and off-farm employment opportunities for farm people.

Population growth will continue to be the major factor affecting the domestic market for farm products as long as buying power continues to expand. In the 1950's population grew at about 1.8 percent per year and from 1960 to 1965 annual growth was around 1 1/2 percent. Population growth has slowed. It is expected to grow around 1.3 percent per year in the next decade. Although overall population growth is slowing, increases in age groups 20 to 34 years will be rapid. The labor force is expected to increase about 1.9 percent a year into the 1970's (Table 6.3). The current population bulge is in those age groups which put more pressure on demand for higher education facilities, housing, and many other goods and services.

Rapid growth in the labor force presents an opportunity and a challenge to the economy. Can jobs be created rapidly enough and schools and housing increased fast enough to meet the challenge? If investment is forthcoming, labor force growth and trends in productivity suggest an increase in the output potential of the economy of possibly 4 to 4 1/2 percent a year extending well into the 1970 decade. The real gross national product projected for 1980 is up about 85 percent from the 1964-66 average—a growth in real output for the period of over 4 percent per year. A similar increase in real disposable income results in an annual gain in per capita income of 2 1/2 percent for an overall increase of 45 to 50 percent in real consumer buying power per person from 1965 to 1980.
Table 6.3. General economic growth and agriculture, selected periods, 1940 to 1966 and projections for 1980.

<table>
<thead>
<tr>
<th>Period</th>
<th>Population</th>
<th>Labor force</th>
<th>Employment</th>
<th>Output per man-hour</th>
<th>Gross National Product</th>
<th>Disposable income</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mil.</td>
<td>Mil.</td>
<td>Mil.</td>
<td>Mil.</td>
<td>Dol.</td>
<td>Dol.</td>
</tr>
<tr>
<td>Actual</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1940</td>
<td>132</td>
<td>56.2</td>
<td>48.1</td>
<td>9.5</td>
<td>2.08</td>
<td>0.72</td>
</tr>
<tr>
<td>1950</td>
<td>152</td>
<td>64.7</td>
<td>61.8</td>
<td>7.5</td>
<td>2.72</td>
<td>1.03</td>
</tr>
<tr>
<td>1959-61 average</td>
<td>181</td>
<td>73.1</td>
<td>68.7</td>
<td>5.4</td>
<td>3.51</td>
<td>1.79</td>
</tr>
<tr>
<td>1964-66 average</td>
<td>195</td>
<td>78.5</td>
<td>75.0</td>
<td>4.4</td>
<td>4.07</td>
<td>2.24</td>
</tr>
<tr>
<td>Change from 1950 (%)</td>
<td>28.3</td>
<td>21.3</td>
<td>21.4</td>
<td>-42.9</td>
<td>49.6</td>
<td>117.5</td>
</tr>
<tr>
<td></td>
<td>1.7</td>
<td>1.3</td>
<td>1.3</td>
<td>-3.6</td>
<td>2.7</td>
<td>5.3</td>
</tr>
<tr>
<td>Projected:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export fC/</td>
<td>207</td>
<td>86</td>
<td>82.7</td>
<td>3.8</td>
<td>4.65</td>
<td>3.05</td>
</tr>
<tr>
<td>Change from 1964-66 (%)</td>
<td>6.2</td>
<td>9.6</td>
<td>10.3</td>
<td>-13.6</td>
<td>14.3</td>
<td>36.1</td>
</tr>
<tr>
<td>Annual rate</td>
<td>1.3</td>
<td>1.9</td>
<td>2.0</td>
<td>-2.6</td>
<td>2.7</td>
<td>6.3</td>
</tr>
<tr>
<td>1975</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export fC/</td>
<td>223</td>
<td>93.5</td>
<td>90.0</td>
<td>3.3</td>
<td>5.30</td>
<td>3.95</td>
</tr>
<tr>
<td>Change from 1964-66 (%)</td>
<td>14.4</td>
<td>19.1</td>
<td>20.0</td>
<td>-25.0</td>
<td>30.2</td>
<td>76.3</td>
</tr>
<tr>
<td>Annual rate</td>
<td>1.4</td>
<td>1.8</td>
<td>1.8</td>
<td>-2.3</td>
<td>2.7</td>
<td>5.8</td>
</tr>
</tbody>
</table>
Table 6.3. (Continued)

<table>
<thead>
<tr>
<th>Period</th>
<th>Population</th>
<th>Labor force</th>
<th>Employment&lt;sup&gt;a/&lt;/sup&gt;</th>
<th>Output per man-hour&lt;sup&gt;b/&lt;/sup&gt;</th>
<th>Gross National Product&lt;sup&gt;b/&lt;/sup&gt;</th>
<th>Disposable income&lt;sup&gt;b/&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>Farm</td>
<td>Total</td>
<td>Farm</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mil.</td>
<td>Mil.</td>
<td>Dol.</td>
<td>Dol.</td>
<td>Dol.</td>
</tr>
<tr>
<td>1980</td>
<td>242</td>
<td>101.5</td>
<td>97.5</td>
<td>2.8</td>
<td>6.10</td>
<td>5.10</td>
</tr>
<tr>
<td></td>
<td>3,250</td>
<td>3,250</td>
<td>3,250</td>
<td>3,250</td>
<td>3,250</td>
<td>3,250</td>
</tr>
<tr>
<td>Change from 1964–66 (%)</td>
<td>24.1</td>
<td>29.3</td>
<td>30.0</td>
<td>-36.4</td>
<td>49.9</td>
<td>127.7</td>
</tr>
<tr>
<td>Annual rate</td>
<td>1.5</td>
<td>1.7</td>
<td>1.8</td>
<td>-2.1</td>
<td>2.8</td>
<td>5.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Per capita</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mil.</td>
<td>Mil.</td>
<td>Dol.</td>
<td>Dol.</td>
<td>Dol.</td>
</tr>
<tr>
<td>1980</td>
<td>790</td>
<td>83.9</td>
<td>47.2</td>
<td>4.1</td>
<td>4.1</td>
<td>2.6</td>
</tr>
</tbody>
</table>

<sup>a/</sup>Bureau of Labor Statistics series.

<sup>b/</sup>Gross national product, productivity, and disposable income in constant 1958 dollars.

<sup>c/</sup>Export I -- Crop export volume rises at about 4 1/2 percent per year.
Output and Capacity

The technology variable—output per unit of resource input—is projected to rise almost 2 percent per year. This is largely an extension of past trends and thus could be conservative. Technological advance often exceeds the expectations of the most imaginative. In like manner, output per man-hour is largely an extension of past trends in productivity. Since the level of cropland used for crops is assumed, projected yields are determined in the framework.

Both crop and livestock exports are assumed as a basis for the appraisal. In order to examine differential impacts, crop export volume was assumed to increase at 3 percent, 4 1/2 percent, and 6 percent per year. Although these are not projections, they fall in the plausible range relative to past expansion and some projections into the 1970's. Demand impacts, of course, are very different under a 3 percent growth in exports than under 6 percent growth.

No attempt is made to specify some fixed capacity of U. S. agriculture. Output potential is not a fixed quantity, except under very specific conditions. It varies with changes in technology and the relative cost of inputs; and it varies with demand pressures and returns to producers. The land input does not rigidly limit crop output. Increases in crop output in recent decades have resulted from technological advances and increased use of fertilizer and other inputs. In addition to these inputs, there is a substantial acreage of land considered suitable for regular cultivation and other uses which might be brought into cultivation if demand pressures and returns to farmers warrant. A recent inventory of land capability and use reported more than 250 million acres of land in capability classes I, II and III—suitable for regular cultivation—in addition to around 450 million acres now used as cropland.1/

Small changes in land use, both into and out of production, are continuously underway. If demand pressures and prices built up under rapid demand expansion, some of the additional land resources as well as nonfarm inputs would expand the output potential of agriculture. Although no attempt was made to analyze the conditions under which new lands would come into production, indicated prices and incomes, under the highest demand projection in this study, would be moderated if additional land came into production.

---

and stepped up the output potential of agriculture. Likewise, the low
demand projection implies relatively low prices and incomes at the
acreage level specified.

The Next Few Years

Farm output will likely increase more rapidly in the last half of
the 1960 decade than in the first half, when accumulated grain stocks
were being worked off. Advancing technology, together with larger crop­
land use and price supports around those scheduled for 1967 crops, steps
up the projected rise in farm output. If depleted grain stocks are re­
built gradually over the next few years and exports continue to rise,
prospective output increases are not expected to be so large as to seriously
depress prices.

Projections for the next few years are based on the short-run adapta­
tion of the model framework. In it output, domestic use, and prices are
built up recursively year-by-year from 1966 to 1971. The demand–output–
price balances projected for the next few years assume, on the demand
side, the population and income growth projected above and an increase
of about 4 1/2 percent per year in the volume of crop exports (adjusted to
reflect the effect of projected price change). The supply response depends
importantly on the projected advance in technology, a continuation of grain
and cotton programs about as scheduled for 1967, and cropland use at 360
million acres, some 25 million above the 1964–66 average.

Crops

Crop output projected for 1968--roughly the 1967–68 and 1968–69
marketing years--totals 12 to 14 percent above the 1964–66 average, a
much more rapid gain than during the past 5 to 6 years. By 1970, projected
crop output is around a sixth larger than the 1964–66 average. These
increases reflect assumed advances in technology, larger acreage used
for crops, and the relatively favorable price and income levels projected
for the next few years (Table 6.4).

There is no good basis for appraising probable export demand. The
alternative used for this exercise assumes that the volume of crop exports
Table 6.4. Farm output, domestic use, exports, prices, productivity and resource use, 1959-61 1964-66 and projections to 1971.

<table>
<thead>
<tr>
<th>Item</th>
<th>Average 1959-61</th>
<th>Average 1964-66</th>
<th>Average 1968</th>
<th>Average 1963-71</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supply:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm output (Bil. 1957-59 dol.)</td>
<td>29.6</td>
<td>32.3</td>
<td>35.3</td>
<td>36.7</td>
</tr>
<tr>
<td>Farm output (1957-59-100)</td>
<td>104.0</td>
<td>113.6</td>
<td>124.4</td>
<td>128.8</td>
</tr>
<tr>
<td>Livestock products (1957-59-100)</td>
<td>103.3</td>
<td>113.3</td>
<td>119.1</td>
<td>123.0</td>
</tr>
<tr>
<td>Crops (1957-59-100)</td>
<td>105.4</td>
<td>112.7</td>
<td>127.3</td>
<td>132.8</td>
</tr>
<tr>
<td>Imports (Bil. 1957-59 dol.)</td>
<td>4.0</td>
<td>4.0</td>
<td>4.2</td>
<td>4.4</td>
</tr>
<tr>
<td>Total (Bil. 1957-59 dol.)</td>
<td>33.6</td>
<td>36.3</td>
<td>39.5</td>
<td>41.1</td>
</tr>
<tr>
<td><strong>Utilization:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic use, excluding feed and</td>
<td>28.9</td>
<td>31.5</td>
<td>33.1</td>
<td>34.1</td>
</tr>
<tr>
<td>seed (Bil. 1957-59 dol.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per capita (Dol.)</td>
<td>160.4</td>
<td>162.2</td>
<td>164.2</td>
<td>164.8</td>
</tr>
<tr>
<td>Livestock (Dol.)</td>
<td>100.0</td>
<td>101.9</td>
<td>103.6</td>
<td>104.1</td>
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<tr>
<td>Crops (Dol.)</td>
<td>60.4</td>
<td>60.3</td>
<td>60.6</td>
<td>60.7</td>
</tr>
<tr>
<td>Feed and seed (Bil. 1957-59 dol.)</td>
<td>8.98</td>
<td>9.3</td>
<td>10.2</td>
<td>10.6</td>
</tr>
<tr>
<td>Exports (Bil. 1957-59 dol.)b/</td>
<td>4.3</td>
<td>5.5</td>
<td>6.2</td>
<td>6.9</td>
</tr>
<tr>
<td>Total net use (Bil. 1957-59 dol.)c/</td>
<td>33.2</td>
<td>37.0</td>
<td>39.3</td>
<td>41.0</td>
</tr>
<tr>
<td>Net stock change (Bil. 1957-59 dol.)</td>
<td>0.4</td>
<td>-0.7</td>
<td>0.2</td>
<td>0</td>
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<tr>
<td>Livestock production units (Mil.)</td>
<td>175.4</td>
<td>212</td>
<td>224</td>
<td>231</td>
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<tr>
<td>Concentrates fed (Mil. ton)</td>
<td>122.9</td>
<td>157</td>
<td>168</td>
<td>175</td>
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<tr>
<td>Feeding rate (Ton)</td>
<td>.70</td>
<td>.74</td>
<td>.75</td>
<td>.76</td>
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<td>Prices received (1910-14-100)</td>
<td>239</td>
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<td>261</td>
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<tr>
<td>Livestock (Pa)</td>
<td>253</td>
<td>263</td>
<td>282</td>
<td>291</td>
</tr>
<tr>
<td>Crops (Pc)</td>
<td>224</td>
<td>235</td>
<td>224</td>
<td>225</td>
</tr>
<tr>
<td>Feed grains and hay (Pf)</td>
<td>153</td>
<td>173</td>
<td>165</td>
<td>168</td>
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<tr>
<td>Ratio Pa/Pf</td>
<td>1.65</td>
<td>1.52</td>
<td>1.71</td>
<td>1.73</td>
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<td>Price support leveld/</td>
<td>---</td>
<td>265</td>
<td>248</td>
<td>249</td>
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<td>Parity index</td>
<td>300</td>
<td>323</td>
<td>339</td>
<td>344</td>
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<tr>
<td>Cash receipts (Bil. dol.)</td>
<td>34.1</td>
<td>39.7</td>
<td>43.5</td>
<td>46.2</td>
</tr>
<tr>
<td>Livestock (Bil. dol.)</td>
<td>19.0</td>
<td>22.1</td>
<td>24.9</td>
<td>26.5</td>
</tr>
<tr>
<td>Crops (Bil. dol.)e/</td>
<td>15.1</td>
<td>17.6</td>
<td>18.6</td>
<td>19.6</td>
</tr>
</tbody>
</table>
Table 6.4. (Continued)

<table>
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<tr>
<th>Item</th>
<th>Average 1959-61</th>
<th>Average 1964-66</th>
<th>Average 1968</th>
<th>Average 1969-71</th>
</tr>
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<tr>
<td><strong>Productivity:</strong></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Crop output per acre (1957-59-100)</td>
<td>108</td>
<td>120</td>
<td>126</td>
<td>132</td>
</tr>
<tr>
<td>Output per man-hour</td>
<td>114</td>
<td>152</td>
<td>182</td>
<td>201</td>
</tr>
<tr>
<td>Output per unit of input (1957-59-100)</td>
<td>104</td>
<td>111</td>
<td>119</td>
<td>125</td>
</tr>
<tr>
<td><strong>Resource inputs:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cropland used for crops (Mil. acres)</td>
<td>351</td>
<td>334</td>
<td>360</td>
<td>360</td>
</tr>
<tr>
<td>Labor (SRS concept) (Mil.)</td>
<td>7.1</td>
<td>5.7</td>
<td>5.1</td>
<td>4.9</td>
</tr>
<tr>
<td>Total inputs (1957-59-100)</td>
<td>101</td>
<td>102</td>
<td>104</td>
<td>103</td>
</tr>
</tbody>
</table>

a/ Assumes current programs for grains and cotton with direct payment in 1968 and 1969-71 of about $2 billion compared with $3 billion in 1966.

b/ Crop exports assumed to increase 4 1/2 percent per year to 1971.

c/ Feed and seed are deducted out of gross production to avoid double counting in total output.

d/ Market prices for crops adjusted upward by percent direct payments are of cash receipts for crops.

e/ Does not include direct payments on grains and cotton of about $2 1/4 billion in 1964-66 and an estimated $2 billion in 1967 and 1969-71.
will increase about 4 1/2 percent a year. This compares with the relatively rapid increase of more than 5 percent per year in the 5-year period 1959-61 to 1964-66. In addition to the above assumption, the commercial export function for crops attempts to take into account changes in relative prices as well. Total exports assumed for the 1969-71 period average a fourth larger than in 1964-66.

With a very inelastic domestic demand for crops, other than for feed, per capita use is projected to change little in response to price and income variations. This overall stability reflects prospects for further declines in per capita use of cereals and fresh use of fruits, vegetables, and potatoes, but further increases in per capita use of processed foods from crops. Thus, domestic food use of crops increases about 7 percent, only slightly more than population. But feed use, which depends largely on livestock production and product-feed price relationships, is projected to rise twice as rapidly as food use.

**Livestock**

Production of livestock products is projected to increase possibly 10 percent by 1970, about the same as the gain in the first half of the 1960 decade. The projected supply-demand balance, based primarily on growth in the domestic market, points to a continued relatively strong price and income situation for livestock products as a whole.

Domestic use increases a bit more rapidly than population. Per capita use projected for 1969-71 averages around 2 percent above 1964-66. The impact of a continued rise in consumer income is partly offset by higher average prices projected for livestock products. Further increases are likely in per capita consumption of beef and poultry and some pickup in per capita use of pork is likely during the next few years from reduced levels in 1965 and 1966. Downtrends may continue in per capita use of dairy products, eggs, and some animal fats; but these declines will likely slow in the next several years.

Product-feed price relationships and the rate of feeding continue high under the relatively favorable conditions projected for livestock products. However, projected concentrate feeding increases about the same as livestock production from the relatively high 1965-66 utilization.
Demand and Output Alternatives Projected For the Next 10 to 15 Years

Prospective demand expansion and the output potential of U. S. farms point to little pressure on resources during the next decade or so. The projected demand–output balances for the years beyond the mid-1970's, in the framework and assumptions of this appraisal, point to some upward pressure on prices assuming crop export volume increases by 6 percent or so per year. Big demand increases and favorable prices and incomes would likely attract new land and other resources into production and moderate accordingly prices indicated for the high demand projections. On the other hand, if crop exports are assumed to increase around 3 percent per year, projected demand and output, assuming cropland use at the 1967 level, would imply some downward pressure on prices and incomes. The low demand projection suggests a continuation of programs designed to limit resource used in agriculture.

While the short-run model used for the near-term projections built up projections recursively year–by–year, the long–run framework permits one–jump projections to 1970, 1975 and 1980 (See the Appendix). Projections in this framework represent an approximate balance between a schedule of demand and a supply response projected for each target date. The demand shifters are population growth, consumer income, and assumed export levels. The supply response reflects primarily technology, the level of land use, and for livestock products, the cost of feed as determined in the crop sector.

The domestic use levels projected for 1980 range around 28 to 33 percent above the 1964–66 average. The range reflects primarily the influence of variations in projected prices under the three assumed crop export alternatives. These demand increases compare with prospective population growth of from 29 to 25 percent. Livestock products would account for the small overall gain in per capita domestic use. Among the crops, increased feed concentrate use for an expanding livestock industry as well as exports would account for most growth in demand, as they have in past years (Table 6.5). Crop export volume increased about 5 percent per year between 1959–61 and 1964–66 and some published projections extend this rate of gain to 1970.2/

<table>
<thead>
<tr>
<th>Item</th>
<th>Average 1949-51</th>
<th>Average 1964-66</th>
<th>PROJECTED&lt;sup&gt;a/&lt;/sup&gt; 1975</th>
<th>1980</th>
<th>Exp. I</th>
<th>Exp. II</th>
<th>Exp. III</th>
<th>Exp. I</th>
<th>Exp. II</th>
<th>Exp. III</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supplies:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm output (Bil 1957-59 dol.)</td>
<td>---</td>
<td>32.5</td>
<td>41.2</td>
<td>41.8</td>
<td>40.3</td>
<td>46.3</td>
<td>47.7</td>
<td>44.9</td>
<td></td>
<td></td>
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<tr>
<td>Farm output (1957-59=100)</td>
<td>88</td>
<td>113</td>
<td>145.0</td>
<td>147.2</td>
<td>141.9</td>
<td>163.0</td>
<td>168.0</td>
<td>158.1</td>
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<tr>
<td>Livestock (1957-59=100)</td>
<td>86</td>
<td>113</td>
<td>136.2</td>
<td>134.5</td>
<td>138.3</td>
<td>150.6</td>
<td>148.3</td>
<td>153.1</td>
<td></td>
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<tr>
<td>Crops (1957-59=100)</td>
<td>90</td>
<td>113</td>
<td>150.6</td>
<td>154.2</td>
<td>145.0</td>
<td>172.3</td>
<td>179.8</td>
<td>163.5</td>
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<td></td>
</tr>
<tr>
<td>Imports (Bil. 1957-59 dol.)</td>
<td>3.3</td>
<td>4.0</td>
<td>4.6</td>
<td>4.7</td>
<td>4.8</td>
<td>5.1</td>
<td>5.1</td>
<td>5.1</td>
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</tr>
<tr>
<td><strong>Utilization</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic excluding feed and seed (Bil. 1957-59 dol.)</td>
<td>24.4</td>
<td>31.5</td>
<td>37.3</td>
<td>36.8</td>
<td>37.8</td>
<td>41.0</td>
<td>40.3</td>
<td>41.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per capita (1957-59 dol.)</td>
<td>160.8</td>
<td>162</td>
<td>167</td>
<td>165</td>
<td>170</td>
<td>169</td>
<td>167</td>
<td>172</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Livestock (1957-59 dol.)</td>
<td>93.6</td>
<td>102</td>
<td>107</td>
<td>106</td>
<td>109</td>
<td>109</td>
<td>108</td>
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<td>Crops (1957-59 dol.)</td>
<td>67.2</td>
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<td>60</td>
<td>59</td>
<td>61</td>
<td>60</td>
<td>59</td>
<td>61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feed and seed (Bil. 1957-59 dol.)</td>
<td>8.8</td>
<td>9.3</td>
<td>11.9</td>
<td>11.6</td>
<td>12.1</td>
<td>13.4</td>
<td>13.1</td>
<td>13.7</td>
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<td></td>
</tr>
<tr>
<td>Exports (Bil. 1957-59 dol.)</td>
<td>2.7</td>
<td>5.6</td>
<td>8.6</td>
<td>9.7</td>
<td>7.3</td>
<td>10.5</td>
<td>12.5</td>
<td>8.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total net use&lt;sup&gt;b/&lt;/sup&gt;</td>
<td>27.1</td>
<td>37.1</td>
<td>45.8</td>
<td>46.5</td>
<td>45.1</td>
<td>51.4</td>
<td>52.8</td>
<td>50.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inventory change</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prices received (1910-14=100)&lt;sup&gt;c/&lt;/sup&gt;</td>
<td>270</td>
<td>250</td>
<td>264</td>
<td>284</td>
<td>246</td>
<td>276</td>
<td>307</td>
<td>252</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Livestock (Pa)</td>
<td>296</td>
<td>263</td>
<td>287</td>
<td>305</td>
<td>266</td>
<td>297</td>
<td>319</td>
<td>276</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crops (Pc)</td>
<td>241</td>
<td>235</td>
<td>238</td>
<td>259</td>
<td>226</td>
<td>252</td>
<td>297</td>
<td>226</td>
<td></td>
<td></td>
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</tbody>
</table>
Table 6.5. (Continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Average 1949-51</th>
<th>Average 1964-66</th>
<th>Projected¹⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1975</td>
<td>1980</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exp. I</td>
<td>Exp. II</td>
<td>Exp. III</td>
</tr>
<tr>
<td>Cash receipts (Bil. dol.)</td>
<td>29.7</td>
<td>39.7</td>
<td>52.6</td>
</tr>
<tr>
<td>Livestock</td>
<td>17.0</td>
<td>22.1</td>
<td>29.1</td>
</tr>
<tr>
<td>Crops</td>
<td>12.7</td>
<td>17.6</td>
<td>23.5</td>
</tr>
</tbody>
</table>

¹/Export I assumes crop exports increase at 4 1/2 percent per year; Export II assumes crop exports increase at 6 percent per year and Export III assumed crop exports increase at 3 percent per year.

²/Feed and seed are subtracted from total production in order to avoid double counting in the total.

³/Projected prices reflect real income growth and a relatively stable general price level.
The range in crop export increases assumed for this appraisal—3 percent, 4 1/2 percent, and 6 percent—were chosen to illustrate possible impacts on agriculture.

Total farm output projected for 1980 ranges some 40 to 50 percent above 1964-66. With assumed exports increasing at 4 1/2 percent per year (I), domestic use (excluding feed and seed) increases around 30 percent and feed uses increase about 45 percent. The assumed 1980 export volume, under this assumption, rises almost 90 percent from the 1964-66 average. This would be about as large as the gain over the past 15 years. A farm output increase of some 45 percent would match this demand projection at prices averaging around 1966 levels. These comparisons, of course, make no allowance for big changes in the general level of prices. Under the slower crop export assumption (III)—3 percent per year—a total farm output increase of about 40 percent from 1964-66 would meet projected demand with about 20 million fewer acres than for export I and little change in average prices received.

Crops

Crop output projected for 1980 varies from 45 to 60 percent above the 1964-66 average. This relatively wide range reflects the three assumed levels of crop exports, the major variable element in demand. Under the high export assumption, the increase in domestic use is the smallest and prices are the highest of either alternative. But domestic demand is very inelastic relative to price. Accordingly, use varies little under the three alternatives (Table 6.6).

Combined domestic use of crops, assuming an annual increase in exports of 4 1/2 percent (I), is projected to increase a third from the 1964-66 average. The increase in total use would include an approximate doubling in crop exports by 1980. With such an increase, crop exports would equal about 29 percent of crop output compared with 22 percent in 1964-66. In order to match projected demand, under this alternative (I), output needs to increase around 55 percent and projected prices might average around 5 percent above the 1964-66 average. A price change this small could hardly be considered significant in the simple analytical framework used for these projections.

<table>
<thead>
<tr>
<th>Item</th>
<th>Average 1949-51</th>
<th>Average 1964-66</th>
<th>PROJECTED&lt;sup&gt;a&lt;/sup&gt; 1975</th>
<th>PROJECTED&lt;sup&gt;a&lt;/sup&gt; 1980</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Exp. I</td>
<td>Exp. II</td>
<td>Exp. III</td>
<td>Exp. I</td>
</tr>
<tr>
<td>Supplies:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production (1957-59=100)</td>
<td>90</td>
<td>113</td>
<td>154.2</td>
<td>172.3</td>
</tr>
<tr>
<td>Production (Bil. 1957-59 dol.)</td>
<td>17.4</td>
<td>21.7</td>
<td>29.6</td>
<td>33.1</td>
</tr>
<tr>
<td>Imports (Bil 1957-59 dol.)</td>
<td>2.8</td>
<td>3.1</td>
<td>3.5</td>
<td>3.9</td>
</tr>
<tr>
<td>Total (Bil. 1957-59 dol.)</td>
<td>20.2</td>
<td>24.8</td>
<td>32.4</td>
<td>37.0</td>
</tr>
<tr>
<td>Utilization:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic (Bil. 1957-59 dol.)</td>
<td>17.8</td>
<td>20.5</td>
<td>24.7</td>
<td>27.4</td>
</tr>
<tr>
<td>Feed &amp; seed (Bil. 1957-59 dol.)</td>
<td>7.6</td>
<td>8.8</td>
<td>11.4</td>
<td>12.9</td>
</tr>
<tr>
<td>Other, total (Bil. 1957-59 dol.)</td>
<td>10.2</td>
<td>11.7</td>
<td>13.4</td>
<td>14.5</td>
</tr>
<tr>
<td>Per capita (Dol.)</td>
<td>67.2</td>
<td>67.2</td>
<td>60.56</td>
<td>58.7</td>
</tr>
<tr>
<td>Exports (Bil. 1957-59 dol.)</td>
<td>2.4</td>
<td>4.9</td>
<td>6.4</td>
<td>9.6</td>
</tr>
<tr>
<td>Total (Bil. 1957-59 dol.)</td>
<td>20.2</td>
<td>25.5</td>
<td>32.4</td>
<td>37.0</td>
</tr>
<tr>
<td>Net stock change</td>
<td>0</td>
<td>-0.7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cropland used&lt;sup&gt;b&lt;/sup&gt; (Million acres)</td>
<td>382</td>
<td>334</td>
<td>380</td>
<td>380</td>
</tr>
<tr>
<td>Yield per acre (1957-59=100)</td>
<td>85</td>
<td>120</td>
<td>145</td>
<td>162</td>
</tr>
</tbody>
</table>
Table 6.6. (Continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Average 1949-51</th>
<th>Average 1964-66</th>
<th>PROJECTEDa/</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1975</td>
<td>1980</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exp. I Exp. II Exp. III</td>
<td>Exp. I Exp. II Exp. III</td>
<td></td>
</tr>
<tr>
<td>Prices received (1910-14=100)</td>
<td>241</td>
<td>235</td>
<td>238  259  226</td>
</tr>
<tr>
<td>Cash receipts (Bil. dol.)</td>
<td>12.7</td>
<td>17.6</td>
<td>23.5  26.2  21.0</td>
</tr>
</tbody>
</table>

a/ Export I assumes crop exports increase at 4 1/2 percent per year--about 95 percent from 1964-66 to 1980; Export II assumes crop exports increase at 6 percent per year--140 percent from 1964-66 to 1980 and Export III assumed crop exports increase at 3 percent per year--56 percent from 1964-66 to 1980.

b/ Cropland used for crops which includes fallow and crop failure.

c/ Projected prices reflect real income growth and a relatively stable general price level.
Projected demand-output-price balances under the half dozen alternatives explored in this appraisal are illustrated for crops in figure 6.1. Demand alternatives reflect the effect of projected population and income on domestic demand for each target date. The domestic demand projection and the export assumptions provide the basis for the three demand projections for each target date. The supply response reflects the advance in technology (in part a proxy for nonfarm inputs) and alternative assumptions for land use.

The figure effectively illustrates the relatively inelastic demand and output responses in the analytical framework. It is clear that the low demand level implies some downward pressure on prices with cropland use specified at 360 million acres, approximately the same as the use level estimated for 1967. Only the highest demand projection points to some price pressures developing around the mid-1970's. It is easy to visualize the possible impact of adding another 20 to 30 million acres to the cropland base or a step-up in the rate of technological advance—from about 1.9 percent to 2.1 percent per year—reflected in the output function $S_{380T}$. Crop output per acre projected for 1980 ranges 35 to 40 percent above the 1964-66 average. These gains compare with an increase of around 40 percent over the past 15 years.

Livestock

Increases in per capita use of livestock products expand domestic use more rapidly than population. Per capita use projected for 1980 is 6 to 8 percent above 1964-66, due primarily to rising consumer income. Increased consumption would reflect a strong consumer preference for beef and the likelihood of further increases in per capita use of meats and poultry. Further declines in per capita use of animal fats and possibly eggs, in line with past trends, would be partly offsetting.

With livestock product output geared primarily to growth in the domestic market, projected demand increases would be matched by production increases ranging some 30 to 35 percent above 1964-66. Such increases compare with a gain of 38 percent in the previous 15 years. Unlike for crops, the higher production is projected under the low export assumption and the corresponding low crop price alternative. Under the high export and high grain price
Figure 6.1. Projected production and prices for crops 1970, 1975 and 1980 with three assumed levels of export demand.

CROP EXPORT ASSUMPTIONS:

- $D_1 = 41/2\% \text{ PER YEAR}$
- $D_2 = 6\% \text{ PER YEAR}$
- $D = 3\% \text{ PER YEAR}$
assumptions, livestock product prices run around 15 percent higher than under the low export assumption. These variations projected for production and prices are due primarily to differences in feed costs and in domestic demand for livestock products under the 3 export assumptions (Table 6.7).

Feed concentrate use is projected to increase 45 to 50 percent under the low export assumption and 40 to 45 percent under the high export alternative. The increase reflects the rise in production of livestock products as well as some further increase in the feeding rate, particularly under the low crop price alternative.

The demand–output balance for livestock in this highly aggregated framework points to relatively strong prices in the next 10 to 15 years. Gradually declining costs for feed are implied for the projection framework if upward price pressures are to be avoided. With prices for corn (and comparable prices for other feed grains) holding around $1.10 per bushel by 1975 and $1.00 by 1980, the analytical framework suggests considerable upward pressure on prices (Figure 6.2). The assumption of a gradual downtrend in feed costs implies that technological advances will continue to be more rapid for feed grains than for most livestock products. Technological breakthroughs in the production of cattle and hogs, such as those in poultry in the past two decades, however, could materially alter the supply response for livestock products.

**Prices and Incomes**

Output and demand projections for the next decade or so, assuming an annual increase of 4 1/2 percent in the volume of crop exports, point to average prices received around the levels of recent years. Because of the very low price elasticity of demand for crops, there is a rather large price range--around 25 percent--from the high to the low export assumption. This variation influences feed costs, livestock production and prices of livestock products, though the projected range in livestock product prices for 1980 is only about half as large as that for crops.

The higher price projections for crops are associated with the higher export assumption and the larger output projection. Since the effect of prices on domestic use is relatively small, projected crop receipts under the high export (I) assumption are 45 percent larger than those for the
Table 6.7. Livestock production, feed use, utilization, price and cash receipts, averages 1949-51 and

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplies:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production (1957-59=100)</td>
<td>86</td>
<td>113</td>
<td>136.2</td>
<td>134.5</td>
</tr>
<tr>
<td>Imports (1957-59 dol.)</td>
<td>0.5</td>
<td>0.9</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Total (Bil. 1957-59 dol.)</td>
<td>15.7</td>
<td>21.0</td>
<td>25.3</td>
<td>25.7</td>
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<td>Utilization:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic (Bil. 1957-59 dol.)</td>
<td>15.4</td>
<td>20.3</td>
<td>24.4</td>
<td>24.1</td>
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<tr>
<td>Feed &amp; seed (Bil. 1957-59 dol.)</td>
<td>1.2</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Other, total (Bil. 1957-59 dol.)</td>
<td>3.6</td>
<td>102</td>
<td>107</td>
<td>97</td>
</tr>
<tr>
<td>Per capita (Dol.)</td>
<td>9.3</td>
<td>102</td>
<td>107</td>
<td>97</td>
</tr>
<tr>
<td>Exports (Bil. 1957-59 dol.)</td>
<td>0.3</td>
<td>0.7</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Total (Bil. 1957-59 dol.)</td>
<td>15.7</td>
<td>21.0</td>
<td>25.2</td>
<td>24.9</td>
</tr>
<tr>
<td>Production united (Million)</td>
<td>175.4</td>
<td>212</td>
<td>254</td>
<td>258</td>
</tr>
<tr>
<td>Concentrates fed (Mill. ton)</td>
<td>122.9</td>
<td>195</td>
<td>200</td>
<td>205</td>
</tr>
<tr>
<td>Feed use per unit (Ton)</td>
<td>0.70</td>
<td>0.74</td>
<td>0.79</td>
<td>0.80</td>
</tr>
</tbody>
</table>
Table 6.7. (Continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Average 1949-51</th>
<th>Average 1964-66</th>
<th>PROJECTED&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1975</td>
<td>1980</td>
<td>Exp. I</td>
</tr>
<tr>
<td>Prices received:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Livestock &amp; products (1910-14=100)</td>
<td>296</td>
<td>263</td>
<td>287</td>
</tr>
<tr>
<td>Feed grain and hay (1910-14=100)</td>
<td>199</td>
<td>173</td>
<td>150</td>
</tr>
<tr>
<td>Ration Pa/Pr&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.49</td>
<td>1.52</td>
<td>1.91</td>
</tr>
<tr>
<td>Cash receipts (Bil. dol.)</td>
<td>17.0</td>
<td>22.1</td>
<td>29.1</td>
</tr>
</tbody>
</table>

<sup>a</sup> Export I assumes crop exports increase at 4 1/2 percent per year—95 percent from 1964-66 to 1980; Export II assumes crop exports increase at 6 percent per year—140 percent from 1964-66 to 1980 and Export III assumes crop exports increase at 3 percent per year—56 percent from 1964-66 to 1980.

<sup>b</sup> Projected prices reflect real income growth and a relatively stable general price level.

<sup>c</sup> Ratio of livestock product prices to prices for feed grains and hay.
Figure 6.2. Projected production and prices for livestock products 1970, 1975 and 1980 with three alternative levels of feed grain prices.

*SUPPLY SUBSCRIPTS REFER TO FEED PRICES BASED ON CORN AT $1.20, $1.00, $0.80 PER BUSHEL, ETC.
low export (III) assumption. The level of cropland use was assumed at 380 million acres, but returns under the high alternative may well attract additional land into the production of crops. This would narrow the difference in projected prices and cash receipts between the high and low alternatives. The range in market receipts projected for livestock products is much narrower than for crops--around a tenth from the low alternative (III) to the high alternative (II)--reflecting mainly the impact of variations in crop exports on the cost of feed.

Under the assumption that crop exports increase about 4 1/2 percent per year, projected livestock receipts for 1980 are about 50 percent above the 1964-66 average. Combined receipts for both crops and livestock products, under this assumption (I), are projected to increase by 50 to 60 percent. With declining farm numbers, cash receipts per farm rise much more sharply than total receipts (Table 6.4).

During the 1960-65 period, one of rapid rise in farm income, realized net income per farm in real terms (adjusted for price level increase) rose more than 6 percent per year. Median income per family for the nonfarm population, similarly adjusted, rose around 2 1/2 percent per year in this period. Although the farm-nonfarm income gap was substantially narrowed, per capita farm incomes still average only about two-thirds nonfarm incomes.

The output-demand balance projected under the middle export assumption (alternative I) would push up net income per farm by possibly 3 1/2 to 4 percent per year in the next 10 to 15 years, well above the increase projected for real income per family in the nonfarm sector. If these farm and nonfarm rates continued, it would take about two decades to close the income gap.

Farm Organization and Resource Inputs

The most rapid changes in agriculture have been in resource adjustment and associated changes in numbers of farms, farm population, and productivity. Shifts in resource use associated with technological advances and changes in the relative cost of inputs have in general resulted in the replacement of labor and, to some extent, land with inputs such as machinery and equipment, fertilizer, and other nonfarm inputs. Resource adjustments are expected to continue at a rapid clip and could accelerate in coming years. These adjustments will bring further declines in the number of farms, extensive shifts in the labor-capital resource mix, and rapid advances in the productivity of agriculture.
Farm consolidation and the sharp decline in farm numbers have been associated with rapid changes in the resource structure of agriculture. There were about 3.4 million farms in 1965, about 2 1/2 million fewer than in 1950. Projected farm numbers, based largely on changes between the 1959-to-1964 Census years, decline to around 2 million by 1980. About half of these would be the larger commercial family farms with sales above $10,000 per farm. Remaining farms would include part-time and part-retirement farms and a sizeable number of units with sales per farm below $10,000. Under the current definition of a farm, many people will live in rural areas on places considered farms. Many of these may be largely rural residences.

Technical possibilities exist for an even more rapid decline in farm numbers than in the past. It would not be unreasonable to visualize an organization of agriculture in which a half million farms would carry out the production job. This may be possible if all farms were in general organized like those with sales of more than $40,000 per farm. These farms would have average sales around $110,000 per farm with average net incomes of about $25,000 and production assets around $400,000 per farm. A commercial agriculture made up of fewer and more specialized units probably would be more responsive to economic forces and possibly would be a stronger influence in the market.

**Labor Input**

Labor requirements are expected to decline further in coming years. The projected decline assumes that output per man-hour will rise, much as in the past, with further extensive shifts in resource use. An uptrend in output per man-hour of 5 1/2 to 6 percent per year and the projected output-demand balance for 1980 points to labor requirements around 40 percent below 1964-65. This decline compares with a drop of nearly 50 percent in the past 15 years (Table 6.2).

Labor requirements projected for 1980 would suggest 3 to 3 1/2 million workers (SRS concept) compared with 5.7 million in 1964-66. The comparable Census concept would imply fewer than 3 million workers by 1980. These declines reflect the downtrend in farm numbers as well as projected output and productivity trends. Labor input per farm is projected to decline little, through the average size of farm as well as capital inputs per farm and average labor productivity rise rapidly.
Labor requirements and projected farm numbers, assuming no big changes in the definition of a farm, imply a farm population by 1980 of around 7 1/2 million, down from about 12.4 million in 1965. Such a decline would be slower than that during the past 15 years. But projected farm population would drop from around 6 1/2 percent of total population in 1965 to around 3 percent for 1980.

Capital Requirements

Total resource inputs have changed little in the past decade or so and may increase only slightly in the next 10 to 15 years. This projection assumes no big acceleration from the recent relatively rapid growth in domestic and export demand for farm products. Projected demands and productivity trends do not point to great pressure on available land resources.

There are around 1,150 million acres of land in farms. Around 450 million acres are classified as cropland and some 300 million acres have been harvested in recent years. The remaining acreage of cropland in farms was either pasture, fallow, idle or diverted under Government programs. An inventory of land capability and use taken in 1962 reported, in addition to the above cropland, more than 250 million acres of land in capability classes (I to III) considered suitable for regular cultivation. Undoubtedly, much of this land would come into production if demand expansion, prices, or public investment provided the inducement.

Crop output per acre is projected to trend upward much as in the past. However, the increase may be a little slower, if additional acreage of cropland is brought into production.

Production assets used in agriculture, after adjustment for price level change, have increased around a tenth in the past 15 years. However, capital of nonfarm origin and inputs of intermediate nonfarm products used in farm production increased around 50 percent. The latter include big increases in the use of fertilizer and other chemicals, fuels, services, and many other operating inputs.

The uptrend in use of many nonfarm operating inputs will continue and may accelerate in coming years. Total capital use in agriculture, is also expected to rise further and possibly more rapidly than in the past. Changes in the general capital-land-labor mix in agriculture are not easy to anticipate even
under simplifying assumptions relating to technological advances, productivity, and costs of various inputs. A continuation of past growth in capital inputs appears conservative and implies some acceleration in the advance in technology (Table 6.8). A slower, but still plausible, technological advance would imply an increase of perhaps as much as 50 percent from 1965 to 1980 in the volume of productive asset use. But the latter increase seems unreasonably large. In any event, capital likely will play an increasingly more strategic role in determining farm output and the output potential of U. S. agriculture than will land and labor.

Number and Size Structure of Farms

As indicated above, farm numbers are projected to decline to around 2 million farms by 1980. The adjustment surely could be more rapid and it may be slower. Around a million of the 2 million farms projected for 1980 would fall into sales classes with more than $10,000 per farm; about 350-400 thousand would be in the $2,500 to $10,000 per farm sales groups; and about 700 thousand farms would be in sales groups under $2,500 per farm. Around two-thirds of the latter would be part-time and part-retirement farms.

These projections rest heavily on trends of the past decade. They are based on a matrix of changes by economic class derived primarily from changes between 1959 and 1964. The size distribution of farms is chained forward by 5-year intervals on the basis of recent trends by economic class. After about two decades, projected farm numbers are down to around 1 1/2 million units and declining slowly. This technique is neater, but probably no better than a simple appraisal of trends by size class.

The reasonableness of the projected size distribution of farms was checked by using distributions projected for 1970, 1975 and 1980 to compute total land in farms and cash receipts, i.e., the product of number of farms and average receipts in each size class, etc. Receipts based on the projected demand-output balance are expressed in 1965 prices and the income-expenditure relationships reflect primarily ratios based on 1959 and 1965 (Table 6.8). Changes in the number and size distribution of farms based on this approach yields some interesting implications and questions about productivity gains and the labor-land-capital mix.
Table 6.8. Income and resources of farms by economic class, estimated 1965 and projections to 1980.

<table>
<thead>
<tr>
<th>Farm sales class and year</th>
<th>Number of farms</th>
<th>Land in farms</th>
<th>Cash receipts(^a)/</th>
<th>Production assets</th>
<th>Labor used</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>Per farm</td>
<td>Total</td>
<td>Per farm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mil. acres</td>
<td>Mil. Acres</td>
<td>Mil. dol.</td>
<td>Mil. dol.</td>
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<tr>
<td>1965 Estimated</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$40,000 and over</td>
<td>170</td>
<td>385</td>
<td>2,265</td>
<td>17,369</td>
<td>102,171</td>
</tr>
<tr>
<td>20,000 to 39,999</td>
<td>300</td>
<td>209</td>
<td>697</td>
<td>9,000</td>
<td>30,000</td>
</tr>
<tr>
<td>10,000 and over</td>
<td>990</td>
<td>798</td>
<td>806</td>
<td>34,169</td>
<td>34,514</td>
</tr>
<tr>
<td>50 to 9,999</td>
<td>1,360</td>
<td>245</td>
<td>180</td>
<td>6,252</td>
<td>4,597</td>
</tr>
<tr>
<td>Other(^b)/</td>
<td>1,025</td>
<td>108</td>
<td>150</td>
<td>1,218</td>
<td>1,188</td>
</tr>
<tr>
<td>All farms</td>
<td>3,375</td>
<td>1,151</td>
<td>341</td>
<td>41,639</td>
<td>12,337</td>
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<tr>
<td>1970 Projected</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$40,000 and over</td>
<td>215</td>
<td>478</td>
<td>2,223</td>
<td>23,784</td>
<td>110,623</td>
</tr>
<tr>
<td>20,000 to 39,999</td>
<td>325</td>
<td>227</td>
<td>697</td>
<td>9,750</td>
<td>30,000</td>
</tr>
<tr>
<td>10,000 and over</td>
<td>1,000</td>
<td>885</td>
<td>885</td>
<td>40,434</td>
<td>40,434</td>
</tr>
<tr>
<td>50 to 9,999</td>
<td>1,025</td>
<td>182</td>
<td>177</td>
<td>4,626</td>
<td>4,513</td>
</tr>
<tr>
<td>Other(^b)/</td>
<td>785</td>
<td>84</td>
<td>107</td>
<td>940</td>
<td>1,197</td>
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<tr>
<td>All farms</td>
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<td>1,151</td>
<td>410</td>
<td>46,000</td>
<td>16,370</td>
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<tr>
<td>1975 Projected</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>$40,000 and over</td>
<td>270</td>
<td>550</td>
<td>2,037</td>
<td>28,838</td>
<td>106,807</td>
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<tr>
<td>20,000 to 39,999</td>
<td>340</td>
<td>237</td>
<td>697</td>
<td>10,200</td>
<td>30,000</td>
</tr>
<tr>
<td>10,000 and over</td>
<td>1,020</td>
<td>948</td>
<td>929</td>
<td>45,188</td>
<td>44,302</td>
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<tr>
<td>50 to 9,999</td>
<td>780</td>
<td>137</td>
<td>175</td>
<td>3,478</td>
<td>4,459</td>
</tr>
<tr>
<td>Other(^b)/</td>
<td>610</td>
<td>66</td>
<td>109</td>
<td>734</td>
<td>1,203</td>
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<tr>
<td>All farms</td>
<td>2,410</td>
<td>1,151</td>
<td>477</td>
<td>49,400</td>
<td>20,498</td>
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</table>
Table 6.8. (Continued)

<table>
<thead>
<tr>
<th>Farm sales class and year</th>
<th>Number of farms</th>
<th>Land in farms</th>
<th>Cash receipts&lt;sup&gt;a&lt;/sup&gt;/ assets</th>
<th>Labor used</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mil. Acres</td>
<td>Mil. dol.</td>
<td>Mil. dol.</td>
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<tr>
<td>1980 Projected</td>
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</tr>
<tr>
<td>$40,000 and over</td>
<td>335</td>
<td>602  1,796</td>
<td>36,023</td>
<td>107,531</td>
</tr>
<tr>
<td>20,000 to 39,999</td>
<td>355</td>
<td>247  697</td>
<td>10,650</td>
<td>30,000</td>
</tr>
<tr>
<td>10,000 and over</td>
<td>1,060</td>
<td>994  938</td>
<td>52,223</td>
<td>49,267</td>
</tr>
<tr>
<td>50 to 9,999</td>
<td>590</td>
<td>103   174</td>
<td>2,621</td>
<td>4,442</td>
</tr>
<tr>
<td>Other&lt;sup&gt;b&lt;/sup&gt;</td>
<td>490</td>
<td>54    110</td>
<td>591</td>
<td>1,206</td>
</tr>
<tr>
<td>All farms</td>
<td>2,140</td>
<td>1,151 538</td>
<td>55,435</td>
<td>25,904</td>
</tr>
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</table>

<sup>a</sup>Cash receipts plus Government payments in 1965 and 1970.

<sup>b</sup>Other is mostly part-time and part-retirement farms.
But, such highly aggregated data does not provide the best framework in which to appraise input requirements and productivity trends. Changes in the distribution of farms by dollar sales classes reflects the consolidation of smaller farms and parts of farms into larger units. But they also reflect changes in prices and many technological advances affecting productivity, capital and labor requirements, optimum size, etc.

As a basis for projection, it was convenient to assume no change in prices. This means that cash receipts and the value of output (real output) per farm must cluster around the mid-point of the size classes. But productivity advances pose some difficult questions about the labor-land-capital mix which are not easy to handle conceptually or empirically.

In order for the projected distributions to yield the labor requirement projected for 1980, it was necessary to assume that some 60 to 70 percent of the rise in labor productivity was due simply to a change in the number and size distribution of farms. It may be helpful, for the moment, to think of growth in output per man-hour as made up of technological advances and gains due to shifts in the number and size distribution of farms. The larger farms have higher output per man-hour reflecting primarily a different capital-labor mix. However, the combining of smaller and often less efficient units into fewer, larger, more efficient farms can materially increase output per man-hour in agriculture over time. In addition, productivity on all farm units is increasing over time. These projected increases in labor productivity for agriculture as a whole rise about twice as rapidly as gains projected for individual size classes (Table 6.9).

Rising productivity of labor implies considerably more capital per worker, but total capital requirements may increase little. Do these shifts with rising yields also imply some decline in acreage per farm in a given size class, or some other change in the resource mix? Are average yields in agriculture rising more rapidly than those on individual farms?

One alternative is suggested, as a basis for measuring capital requirements, by the apparent tendency in the past for a relatively constant capital-output ratio for agriculture, in total and, insofar as it can be approximated, by economic class. From a relatively constant capital-output ratio (K/O) and projected output per man-hour (O/L), we can approximate the capital-labor ratio (K/L). With projected labor requirements, capital requirements are determined. Under the high productivity alternative (Table 6.8), productive assets are projected to increase about 15 percent by 1980.
Table 6.9. Farm productivity and capital-labor ratios by economic class, estimated 1965 and projections to 1980.

<table>
<thead>
<tr>
<th>Item</th>
<th>Farms with sales</th>
<th>All farms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$40,000 and over</td>
<td>$20,000-</td>
</tr>
<tr>
<td></td>
<td>$39,999</td>
<td>$19,999</td>
</tr>
<tr>
<td></td>
<td>$9,999</td>
<td>$4,999</td>
</tr>
<tr>
<td></td>
<td>Under $2,500</td>
<td>Under $2,500</td>
</tr>
</tbody>
</table>

1965
- Output per man-hour O/L: 11.1 7.5 5.4 3.4 2.0 1.0 5.2
- Capital-labor ratio K/L: 41.1 36.8 28.4 20.7 14.2 13.9 26.3
- Technology shifter A_t: 5.3 3.6 2.7 1.8 1.2 -1.6 2.7

1970
- Output per man-hour O/L: 12.2 8.2 5.9 3.7 2.2 1.2 6.6
- Annual increase (%): 1.8 1.8 1.8 1.8 1.8 1.8 1.8 4.9
- Capital-labor ratio K/L: 45.0 40.3 31.0 22.7 15.5 15.0 33.6
- Annual increase (%): 1.8 1.8 1.8 1.8 1.8 1.8 1.5 4.9
- Technology shifter A_t: 5.7 3.9 3.0 2.0 1.3 -1.5 3.3
- Annual increase (%): 1.5 1.5 1.5 1.5 1.5 1.4 1.4 4.2

1975
- Output per man-hour O/L: 14.1 9.5 6.8 4.3 2.5 1.3 8.6
- Annual increase (%): 2.9 3.0 2.9 2.9 2.9 3.0 3.0 5.3
- Capital-labor ratio K/L: 52.0 46.6 35.8 26.2 17.9 17.2 43.4
- Annual increase (%): 2.9 2.9 2.9 2.9 2.9 2.9 2.9 5.3
- Technology shifter A_t: 6.4 4.4 3.3 2.2 1.4 -1.3 4.1
- Annual increase (%): 2.3 2.3 2.3 2.3 2.3 2.2 2.2 4.3
### Table 6.9. (Continued)

| Item                              | $40,000 and over | $20,000-39,999 | $10,000-19,999 | $5,000-9,999  | $2,500-4,999 | Under $2,500 | All farms |
|-----------------------------------|------------------|----------------|----------------|---------------|--------------|--------------|
| **1980—High Technology**          |                  |                |                |               |              |              |
| Output per man-hour O/L           | 17.2             | 11.6           | 8.3            | 5.2           | 3.1          | 1.6          | 11.6       |
| Annual increase (%)               | 4.1              | 4.1            | 4.1            | 3.9           | 3.9          | 4.0          | 6.2        |
| Capital—labor ratio K/L           | 63.5             | 56.9           | 43.8           | 31.7          | 21.7         | 21.0         | 58.5       |
| Annual increase (%)               | 4.1              | 4.1            | 4.1            | 3.9           | 3.9          | 4.1          | 6.2        |
| Technology shifter $A_t$           | 7.5              | 5.2            | 3.9            | 2.6           | 1.7          | -1.1         | 5.3        |
| Annual increase (%)               | 3.2              | 3.2            | 3.2            | 3.1           | 3.1          | 2.8          | 5.3        |
| **1980—Lower Technology**         |                  |                |                |               |              |              |
| Output per man-hour O/L           | 17.2             | 11.6           | 8.3            | 5.2           | 3.1          | 1.6          | 11.6       |
| Annual increase (%)               | 4.1              | 4.1            | 4.1            | 3.9           | 3.9          | 4.0          | 6.2        |
| Capital—labor ratio K/L           | 83.2             | 74.4           | 57.0           | 40.0          | 27.4         | 22.8         | 65.6       |
| Annual increase (%)               | 9.8              | 9.8            | 9.7            | 8.9           | 8.9          | 5.7          | 8.6        |
| Technology shifter $A_t$           | 7.1              | 4.9            | 3.7            | 2.5           | 1.6          | -1.2         | 5.0        |
| Annual increase (%)               | 2.5              | 2.5            | 2.5            | 2.5           | 2.5          | 2.5          | 4.4        |
The above projections for output and for labor and capital inputs by size class of farms were checked for implied productivity gains in the framework of a simple production function: $O = A_t L^a K^k$, in which $(a)$ is assumed equal to 0.8 and $(K)$ 0.2. The neutral technology shifter $(A_t)$, computed in the above framework for each size class and for all farms, rises 1 1/2 percent per year for each size class from 1965 to 1970 compared with an increase of 4 percent for all farms. The implied increase in the technology shifter $(A_t)$ tends to accelerate some from 1970 to 1980. For all farms, the average annual increase implied for $(A_t)$ is about 4 1/2 percent per year to 1975, about the average of the past (Table 6.9).

Suppose we assume, in the above framework, that the technology shifter $(A_t)$ rises 1 1/2 percent from 1965 to 1970, 2.0 percent from 1970 to 1975 and 2 1/2 percent from 1975 to 1980. In this case, productive assets projected for 1980 would total about 50 percent above 1965. The shift in technology $(A_t)$ for all farms suggested by this slower advance in technology would run about 4 percent per year for the next decade and a half.

Exploring the implications of productivity advances and changes in the resource mix by economic class are interesting, but the investigation does not yield solid and unequivocal conclusions. It is quite apparent that much of the rapid increase in average output per man-hour and possibly in other measures of productivity for agriculture are due directly to changes in the number and size distribution of farms. Although these observations are not new, differences in trends for individual farms and for the average for all farms may be greater than is generally realized. The optimum size firm changes constantly with technology. But if agriculture is moving rapidly toward some desired optimum size farms, do these shifts imply a slower decline in farm numbers and farm population as well as some slowing in productivity gains in agriculture and possibly in yields?
The Analytical Framework

The highly aggregated framework used as a basis for the projections in this appraisal consists of a supply response function for crops and livestock products, two corresponding demand functions and several related relationships, the most important of which is a demand function for feed.

Though greatly oversimplified, the supply relationships generally explain output trends of the past 10 to 15 years. Output in the current year is considered a function of technological advance and the output level and prices in the preceding year. The livestock function also includes feed costs. It is not complete enough to adequately explain cyclical swings in the cattle and hog cycle.

Major domestic uses are functionally determined in the analysis, but export levels were assumed as specified. In general, domestic demand is a function of population, income, and prices.

The short-run application projects output, demand, and prices year-by-year. For example, given projected technology, conditions in year (t) explain output in year (t+1). This supply estimate together with demand, projected on the basis of population and income, establishes prices in year (t+1) and provides the information to move to year (t+2), etc.

In the longer-run analysis, coefficients are adjusted to approximate long-run relationships by the technique indicated in the framework. The specific long-run projections approximate an equilibrium of supply, demand and price at alternative levels of demand, cropland use, and technology.

A. Variables:

\[ O_c = \text{index of crop output (1957-59=100)} \]

\[ P_c = \text{index of crop prices received (1910-14=100) deflated by parity index} \]

\[ A = \text{index of acreage of cropland used for crops (1957-59=100=357 million acres)} \]

\[ q_c = \text{per capita food and nonfood use of crops (other than for feed, seed and exports) (1957-59 dollars)} \]
\( P_f \) = index of prices received for feed grains and hay 1910-14 = 100 deflated by parity index.

\( C_p \) = index of competitive prices for crops based on prices for polyester fiber (1957-59 = 100)

\( O_a \) = index of livestock production (1957-59 = 100)

\( P_a \) = index of livestock product prices (1910-14 = 100) deflated by parity index

\( q_a \) = per capita food use of livestock products (1957-59 dollars)

\( L_u \) = livestock production units (Million)

\( F_c \) = feed concentrates fed (Million ton)

\( I \) = index of per capita disposable income deflated by consumer price index

\( T \) = index of total farm output per unit of input (1957-59 = 100)

B. Short-run Framework:

1. Crop Sector

\( \log O_{ct} = -1.226 + 0.2 \log P_{ct-1} + 0.333 \log A_t + 0.85 \log T_t + 0.25 \log O_{ct-1} \) (1.0)

\( \log q_{ct} = 1.7611 - 0.15 \log P_{ct} + 0.1 \log I_t + 0.05 \log C_{pt} \) (2.0)

Commercial crop exports: \( E_{ct} = 1.045 E_{ct-1} - 0.5 \frac{P_c}{P_{ct}} \)

Imports: \( I_t = \frac{AN}{N} (I_{t-1}) + 0.2 \frac{P_c}{P_{ct}} \)

Seed = f (acreage)

\( P_{ft} = f (P_{ct}) \)

2. Livestock Sector

\( \log O_{at} = 0.5701 + 0.2 \log P_{at-1} - 0.2 \log P_{ft-1} + 0.2 \log T_t + 0.5059 \log O_{at-1} \) (3.0)

\( \log q_{at} = 1.951 - 0.214 \log P_{at} + 0.2 \log I_t \) (4.0)

\( F_c = -68 + 0.878 L_u + 0.233 \frac{P_a}{P_f} \), \( L_u = f (O_a) \) (5.0)
Nonfood use = \( f(O_a) \)

C. Long-run Framework\(^a\):

1. Crop Sector

\[
(1.1) \log O^*_c = -1.635 + 0.267 \log P_c + 0.444 \log A + 1.1333 \log T
\]

\[
(2.1) \log q_{ct} = 1.7611 - 0.15 \log P_c + 0.1 \log I + 0.05 \log C_p
\]

Export I assumes increase of 4 1/2 percent per year--55 percent from 1964-66 to 1975 and 95 percent to 1980--with price adjustment as in short-run framework.

Export II assumes increase of 6 percent per year and Export III assumes 3 percent per year.

Seed = \( f(\text{acreage}) \)

\( P_t = f(P_c) \)

2. Livestock Sector

\[
(3.1) \log O^*_a = 1.1536 + 0.4048 \log P_a - 0.4048 \log P_f + 0.405 \log T
\]

\[
(4.1) \log q_a = 1.951 - 0.214 \log P_a + 0.2 \log I
\]

\(^a\) Short-run supply functions (1.0) and (3.0) adjusted to approximate long-run elasticities assuming a distributed lag model. Observed output, reflecting prices and economic conditions in past years, is constantly adjusting toward some desired equilibrium: \( O_t - O_{t-1} = B (O^*_t - O_{t-1}) \). See Marc Nerlove, *The Dynamics of Supply: Estimation of Farmers' Response to Price*, 1958.
AGRICULTURE’S STATUS AND POTENTIAL

by Dale E. Hathaway*

I thought the title assigned this paper "Status and Potential" more descriptive of the concerns of the mother of the bride toward her new son-in-law than of the issues of importance to research workers. Upon reflection, however, I have concluded we in University research have more in common with mothers-in-law than we should admit. We are jealous and suspicious of virtually all who appear interested in "our baby", the agricultural industry, and are quite certain their intentions are dishonorable. If things work out badly we are the first to say "we told you so" and; if, contrary to our expectations, they work out well we tend to take the credit for bringing them together. This attitude, in research as in families, stems, I believe, from a failure to recognize that the object of our attention changes and matures over time and that its environment is also rapidly changing. It follows, therefore, that our attitudes and analysis also should change regarding the needs of our concern. I view it as my job to sketch some of these maturing changes in agriculture that should alter the way in which we approach farm management, marketing, and policy research.

There are three areas which I will discuss. They are (1) the changing beliefs and values relating to agriculture (2) the political environment within which agriculture will operate, and (3) the level and context within which consumption and production decisions are made. Most of what I shall say is based upon scantly empirical evidence, which does not imply that such evidence is unobtainable but merely that it has not be obtained.

The Value Context Relating to Agriculture

Much of the discussion which follows relates to beliefs associated with our value structure rather than with the values of society. It appears that a majority of the society still values stability, both economic and political, growth, minimum levels of economic welfare, equal opportunity, and sharing our abundance. It appears, however, that the long-standing ideas regarding

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agriculture's special contributions to the achievement of these values is rapidly being replaced by a radically different set of beliefs. The bitter struggle over civil rights, especially in the rural South, is convincing most people that farmers have no monopoly on justice or concern for equality. The difficulties of assimilating the rural migrants to large cities has convinced many that the virtues of rural upbringing are hardly sufficient to offset poor schools. The shameful treatment of some migrant workers has confirmed these feelings. And, the enthusiasm of numerous rural areas for extreme right-wing political candidates has done little to convince the general population that farmers add greatly to the stability of our political system. The same can be said for the actions of some of our farm organizations.

With these beliefs falling away, it appears that farming is increasingly regarded by nonfarmers primarily as an economic enterprise. To be sure it is still regarded as a crucial enterprise in the economy but not as one which has special virtues that exempt it from social control or as one which should be maintained at a given size and with a special structure because of its special contributions to non-economic values.

If this assessment is correct it has important implications, some of which are evident already. One is that the general social legislation and organization which applied to hired workers in nonfarm business will be applied in some form to farms. This has significant implications for the farm manager, the way he organizes his farm, and the management task he faces. I suspect that farm management researchers in the years ahead will have to become well acquainted with the work in labor and industrial relations, if they are not already.

Concurrent with this change in beliefs on the part of nonfarm people, it appears there has been a major shift in the values of farm people. Farm people still regard the family farm as a useful social institution, but in a recent survey 69 percent of a sample of Michigan farmers agreed that "It is more important that farm people earn satisfactory incomes than it is to maintain the family farm system." Moreover, 55 percent of these farmers agreed that farmers who can't make satisfactory income from farming should plan to leave farming.

My impression is that these attitudes are significantly different from those one would have found among farmers a decade ago. Moreover, the high relative importance of income seems increasingly to push farmers toward new attitudes regarding ways to achieve their income goals. An overwhelming 90 percent of all farmers in Michigan survey agreed "Farmers must get together in bargaining associations to deal effectively with processors and retailers".2/

This rising interest in market bargaining by farmers has been obvious in recent weeks during the milk holding action of the National Farmers Organization. It would be a mistake to dismiss this interest as one representing a minority view, for while there are marked disagreements as to tactics, the bargaining approach to improvement of farm prices appears to have widespread farmer appeal. The widespread appeal of government market intervention now appears to have been replaced by an interest in bargaining, perhaps partially because of farmers increasing suspicion that the executive branch of government is now completely consumer oriented.

The curious dual values that we appear to be developing toward food and its producers may pose some interesting questions. On one hand farmers are increasingly viewed as businessmen, but at the same time many nonfarm people appear to view the withholding or even conscious planning of food supplies at levels that will produce satisfactory prices as sinful. The kind of public controls that are placed over agricultural bargaining as a result of this public value system remain to be seen. In any case, marketing researchers are going to be called on increasingly to work in new areas and on new kinds of problems.

Finally, the decline of the view that farming is a preferred industry may have implications for the ability of the industry to attract new capital, management, and labor. In my lifetime farming in the United States never has had the social status that commercial farmers and land-ownership have in England and Western Europe. Even so I think the "preferred industry" concept has helped to attract capital and people to farming in the U.S. for lower rates of return than they might have been obtained in other industries. If this "better way of life" attitude disappears it implies significant changes to be considered by farm management and policy researchers.

The Political Environment

A great deal has been written about the decline in the number of farms and the consequent decline in the political power of farmers. Much of this is misleading because of the decline in the number of farms has been largely due to the continuing disappearance of the subsistence and low-production farms. On the basis of nearly 40 years of farm legislation these groups must not have had much political power or the programs would not have been slanted so much in favor of the larger commercial farms.

Neither has the reapportionment of state legislatures apparently hurt commercial farmers.³/ This is not surprising because most state legislatures were rural dominated not farm dominated, before reapportionment and there is a difference.

There have been significant shifts in political power, especially at the national level. The farm bloc in Congress is gone forever and with it much of the independant power of the general farm organizations. But, what is rarely mentioned is the steadily rising political power of the farm-allied input producing and marketing industries. Most of these industries did not exist in their present form when our basic farm legislation was written in the 1930's, but they are a significant force now and will be in the future.

Thus, commercial farmers have potential allies in the political wars. There is a major difference, however, between the objectives of wars fought alone and those where one needs help. Under the old system the political power of the farm bloc could be used to maximize the well-being of the commercial farmers it represented. But, the new alliance must find programs which recognize the well-being of the input industries, the commercial farmers, and the marketing industries.

One can immediately see some of the implications of this change. Neither the input or marketing industries are likely to go along with production control programs that might maximize returns to farms. Indeed, they have been and are likely to be major supporters of programs to run our farm plant at full capacity, adding to the capacity when possible. Marketing industries are unlikely to support farmer-bargaining attempts, and to understate a bit, might even oppose them.

There are other groups, of course, with an interest in farm legislation. Among them are consumers who, while poorly organized as such, appear increasingly sensitive to retail food prices. The "good old days", when farm organizations could flaunt price controls on one hand and minimum wages on the other, have gone. Congress now will not pass farm programs that imply higher retail prices, and moreover, they are likely to become more concerned about the distribution of program benefits within agriculture.

Thus, the political forces as well as the changing beliefs about farming seem likely to push us toward an industry oriented toward efficiency, production, and low margins. Both forces will find "comparable returns" an acceptable income goal for the industry, but the concept is likely to apply in practice only to efficient, well-managed farms and not to all farm enterprises.

At another level, that of local affairs, prospects look less promising. The organization and financing of local services to farm people is becoming more their concern alone because increasingly our national attention turns toward the problem of the cities and suburbs. Most consumers live in these urban areas, and so do those engaged in producing farm inputs and marketing farm products. Thus, these latter groups may have little interest in how rural life is organized, unlike their predecessors who lived and worked in small rural communities. If this pessimism is justified it means we may have the incongruity of successful and prosperous farm operators lacking the amenities and social services that are common for their counterparts in other businesses.

Despite the rising chorus of questions about the wisdom of our non-policy relating to population distribution and concentration, I see little prospect for political support for a policy that would disperse our population in centers located apart from our growing megalopolises. The political pressures are where the people are and they want their problems solved there, not in some ideal community a hundred miles away. Thus, the prospect of community growth policies which would benefit both rural and urban people appear to be dim.

The Level and Context of Economic Decisions

At this point I will move to topics more directly related to our typical economic research and build further upon the papers that have preceded mine. My definitions of level and context of decision making will become
apparent as I go on. I want to discuss this issue in two parts, one international and the other domestic.

The international market for farm products has become extremely important to U. S. farmers and is likely to become even more so. Since the end of World War I we have viewed exports largely as a place to get rid of the excess over domestic needs, but this view is no longer realistic. Export demand has become a crucial factor in the demand for all of our major field crops, even including those in the midwest. While I would not argue that we completely understand domestic demand, I think that on the whole we do rather well in both our short and intermediate range outlook. When it comes to foreign demand, however, we know very little. This is not the market researchers fault, for the funds have been meager, the data are awful, and much of the demand is politically determined by decisions both in Washington and abroad.

Thus, in dealing with commercial export demand we know very little, but our farm managers will increasingly have to produce for this uncharted market. Moreover, we have a tendency to view the quality of our farm products as unbeatable, which may be true given the tastes and preferences of U. S. consumers but not always for foreign consumers. The level of development of marketing research in foreign countries does not promise to give us the needed answers very soon, so either we shall have to finance and do significant marketing research abroad or our farm operators and marketing agencies will have to continue to sell rather blindly in these markets, depending upon the government to bail them out if they are wrong. I believe it is unrealistic to assume our government can and should buy our farm products and then peddle them abroad, for I see little reason that state trading works better for the export market than for the domestic market, and we have chosen to reject it at home.

A point related to the international markets is our lack of effective political linkage with these persons making political decisions affecting international trade in farm products. Effective and workable international political organizations are a universal problem but they are especially so in agriculture. This stems partially, I believe, from the complete ignorance that most top level diplomats have regarding their own or other agricultural industries. It also stems from the relatively limited experience and view of the world which is held by U. S. farm operators and their leaders in farm organizations. Many successful nonfarm businesses which depend heavily upon export sales have long since developed an understanding of the problems they face in their
marketing abroad and some political empathy with foreign political groups too. In U. S. agriculture we have not. In fact, the largest farm organization in the United States has refused to join the International Federation of Agricultural Producers. Their reasons are private and may be excellent, but it results in isolating many of our producers from the world's major forum of farm producers.

Thus, in general, at a time when international markets have become steadily more important to U. S. farmers we are lacking both good economic analysis as to the nature of those markets and an effective international political mechanism whereby our farmer's interest can be explained and represented. This seems, to me, to add a high degree of uncertainty to these markets, perhaps even greater than we had in our domestic markets several decades ago.

Turning to the domestic scene there has been or will be a shift in the level at which decisions are made about items crucial to the management of a farm. Perhaps the most obvious example again is in the field of farm labor. Historically, a farmer employer could offer a "going local wage" and expect to have the necessary labor supply forthcoming. Already the federal government, through minimum wage legislation, has stepped in to put a floor under the wage offer regardless of labor market conditions. It is almost inevitable that farm workers will be unionized and the decision on wage levels will not be between the farm operator and the workers, but will be made at regional or national union headquarters. Concurrently, if market bargaining by farmer groups expands, production and price decisions for individual farms also may be made in an entirely new context. My remarks are neither to approve or condemn such changes, but merely to point out that farm managers will need to have far different information in this situation than they need now, and they will be called on to perform management functions that are new to most of them.

The level at which decisions are made about other input prices seems to be moving up or toward centralization too. The old local horse dealer was much closer to his customers than the management of a company producing farm machinery for the national and international market. Much of the same holds for the producers of the nationally distributed inputs—chemicals, fertilizers, feeds, etc. Among other things these large national corporations are a part of and extremely sensitive to changes in the nonfarm economy such as interest rates and nonfarm wage rates. Machinery prices, I suspect, are more nearly a function of steel prices and union wage rates.
than any factor in agriculture. The credit needs of modern commercial farms puts them squarely into the national money market, which operates with little regard to the needs of the agricultural industry and is highly influenced by general economic policy.

Similar trends seem apparent on the product market side. Large-scale specification buying by chain stores moves the pricing decision away from the classical market to the professional managers, who often have their own production facilities as an alternative for all or part of their supply.

In essence, all of the developments I have mentioned seem to run in one direction, that of subjecting the individual farm operator to greater influence from the economy at large. This is not a new trend, of course, but it seems to be likely to become fully effective in the years immediately ahead. Here again, we find the farm manager pushed more nearly into the position of managers of nonfarm manufacturing firms producing undifferentiated products. Success becomes highly related to an understanding of these outside forces as well as of the internal production processes.

Thus, both at home and abroad, in both economic and political affairs, the farm people of the future will find outside decisions made far away have a major impact upon their business. They certainly will need new and improved research in farm management, marketing, and policy to effectively adjust to these decisions.

**Summary and Conclusions**

It appears that the environment within which U. S. farms operate in the decades ahead is going to be radically different than that of the recent past. Shifts in beliefs, values, political structures, input markets and institutions, and market structures have occurred and are likely to continue. The direction of change I have pointed may prove in error but the fact of change in these elements is not likely to be.

Most of the items I have discussed are largely those that we omit from our economic models and assume as unchanged. If, however, they change markedly, it would appear to raise some questions about the validity and utility of much of our model building. Unless we can build changes in institutional parameters as well as measured economic variables into our research I am pessimistic regarding its utility. Thus, I view the need for more and better research in the areas of our concern as very great, and the task of filling these needs likely to strain both our financial and intellectual resources.
Although the parameters of the modal farm firm of 1980 or beyond remain shrouded in a modicum of uncertainty and conjecture, the clustering of current opinions, projections and estimates in a direction far removed from the extant situation indicates beyond a reasonable doubt that the farm firm of that era will function in a vastly different environment and will itself be significantly different from the farm firm of 1967. Notwithstanding the wide range of views on the precise growth and development past of the farm firm, it is quite clear that farm firms will be fewer and

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1/ In a private enterprise economy, the firm may be viewed as an autonomous administrative unit transforming inputs into outputs pursuant to some entrepreneurial objective function and consistent with a technical production function. See Harl, "Research Methods Adaptable to Legal-Economic Inquiry; Linear Programming and Simulation," p. 75, Methods for Legal-Economic Research into Rural Problems, Monograph No. 8, Agricultural Law Center, University of Iowa (1966).

2/ See Ruttan, "Agricultural Policy in An Affluent Society," 48 J. Farm Econ. 1100, 1113 (1966) (if production were concentrated entirely on farms such as those with sales of $40,000 or more the total U. S. farm output could be produced on less than 400,000 farms); Clawson, "Aging Farmers and Agricultural Policy," 45 J. Farm Econ. 13, 26 (1963) (a "high" estimate of 730,000 farms by 2,000 and a "low" estimate of 418,000); Heady & Tweeten, Resource Demand and Structure of the Agricultural Industry 481-82 (1963) (number of farms to produce the 1980 food supply with scale of operations approaching but still short of minimum cost is around 750,000); Daly, "Agriculture: Projected Demand, Output and Resource Structure," pp. 82-119 supra (if past trends continue possibly fewer than a million commercial farms by 1980).
larger\textsuperscript{3} with sharply higher amounts of capital managed per farm\textsuperscript{4}.
Moreover, it appears that the incidence of multi-member farm firms\textsuperscript{5} will increase gradually over time for a variety of reasons. Coordination of input acquisition and output marketing by contract will probably increase; some belief exists that shifts in relative bargaining power in favor of the farm firm are likely to occur.

Projections of firm size are related, of course, to the configuration of cost curves. Available data on economies of size, although not indicating overwhelming economies of very large farm businesses, at the least point

\textsuperscript{3} Whether expressed in terms of acres per farm, capital per farm or output per farm, size of firm is increasing rapidly. Gross sales per farm have grown at about 6\% per year on the average over the past 25 years. See Butcher & Whittlesey, "Trends and Problems in Growth of Firm Size," 48 J. Farm Econ. 1513 (1966). A comparison of 1959 and 1964 Census of Agriculture data indicates that substantial increases in farm size occurred for farms 500 acres or larger, particularly in the north central states, while the total number of farms decreased sharply.

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<table>
<thead>
<tr>
<th>United States</th>
<th>North Central Region</th>
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<tbody>
<tr>
<td></td>
<td>No. 1964</td>
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<tr>
<td>500-999 acres</td>
<td>207,520</td>
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<tr>
<td>1,000-1,999 acres</td>
<td>84,290</td>
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<tr>
<td>2,000 or more acres</td>
<td>60,081</td>
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\textsuperscript{4} It is likely that the growth of capital per firm will continue to exceed substantially the growth of capital for the agricultural industry because of farm consolidation. See Heady & Ball, "Economic Growth of the Farm Firm and Projected Changes in Farming," p. 18, Report No. 24, Center for Agricultural and Economic Development, Iowa State University (1965). From 1940 to 1966, capital per farm increased nationally from $6,158 to $64,960 while assets per farm worker during the same period rose from $3,326 to $35,958. The Balance Sheet of Agriculture, p. 17, Agriculture Information Bull. No. 314, ERS, USDA (1966).

\textsuperscript{5} By multi-member farm firm is meant a firm wherein ownership and management are provided by more than one individual.
toward nearly constant costs over a wide range of firm size.\textsuperscript{6} Some doubt exists whether in fact the long-run average total cost curve rises at all for larger farms.\textsuperscript{7} It may very well be that management is the key variable responsible for the behavior of the cost curve at high volumes. And the quality of management input on farms, particularly well-organized and financed commercial farms, is increasing at a relatively rapid rate. If the cost curve continues to decline at higher volumes, a centripetal tendency exists for farm firms to attain such size as will permit advantages of scale to be obtained. If the cost curve reveals nearly constant costs per unit or output beyond the initial low production stage of high costs, larger firms may enjoy higher incomes merely because of the larger volume of business.\textsuperscript{8} The need exists for research on the configuration of cost curves at higher volumes of production.

This paper recognizes the duality of the firm as an economic entity engaged in resource allocation and income distribution and also as a legal institution representing, embodying and participating in interfirrm and intrafirm relationships. Legally, a relatively highly developed, finite structural framework is provided for the conduct of economic activity. Although it would undoubtedly be economically desirable if the legal framework provided an organizational continuum with an opportunity for entrepreneurs to select precisely the combination of organizational attributes desired from among an infinite array, the development of organizational forms over time has produced discrete alternatives. These alternatives are the well known sole proprietorship and its principal variant wherein major blocks of inputs are obtained contractually such as under the landlord-tenant or vertical coordination relationship, the general and limited

\textsuperscript{6}\textsuperscript{Butcher} \& \textsuperscript{Whittlesey}, "Trends and Problems in Growth of Farm Size," 48 J. Farm Econ. 1513, 1516 (1966); Hunter \& Madden, "Economies of Size for Specialized Beef Feedlots in Colorado," Agricultural Economic Report No. 91, ERS, USDA (1966) (technical economies of size attained beyond 1,500 head in terms of feeding cost per head are very small).


\textsuperscript{8}\textsuperscript{See Madden, "Economies of Size in Farming," Agricultural Economic Report No. 107, ERS, USDA (1967).}
partnership, the trust, and the corporation. The economic adequacy of these traditional forms of organization is and will be increasingly open to question. No sector is more likely to dynamically test the sufficiency of the deeply rooted organizational forms during the next quarter century than farming. Enough alternatives should exist to permit attainment of relevant objectives without institutional restraint or obstruction.

As a research and policy matter, the legal framework, including that segment impinging upon the organization of the firm, should perhaps be viewed as legislatively and judicially malleable and amenable to change if properly cast in the role of a dependent variable. As elsewhere observed, "if the roots of law extend to knowledge and human experience examined by the social sciences, then legal change should ideally flow from and be directed in large part by the research results of the appropriate disciplines." By this view research designed to affect and influence the law in futuro becomes much more than a search for legal precedent. It involves, in a vital way, all disciplines that are demonstrably relevant to the social issue under study. The social scientist bears a responsibility in the molding of law to accomplish societally weighted objectives.

If social scientists were required to take an oath, it should include a firm commitment to take nothing, least of all the law, as given. With this approach, a plea that institutional restraints will likely limit the growth of firms irrationally constitutes either an indictment of the relevant disciplines or an implied criticism of the content or weighting of the societal objective function.

Societal Objectives

The performance of the legal framework giving identity to and functional basis for the firm can perhaps rationally be measured by the extent to which

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the relevant objectives are met. It would seem that, in the case of the farm firm, the set of objectives would include certain more or less well-defined national objectives plus the articulated or unarticulated objectives of the firm and of the individuals associated with the firm as owners or managers. It is especially important to recognize the role of objectives in dealing with firm structure inasmuch as a tendency has existed to use limitations on organizational form in the implementation of specific policies.\textsuperscript{11}

**National Objectives**

Although certainly not beyond the pale of argument, a substantial consensus exists that certain pervasive objectives may be distilled from contemporary economic life. These include the performance goals of economic growth, efficiency, distributive justice with concern over optimal sharing in the benefits of firm activity, and political and economic stability.\textsuperscript{12} These are not, however, the only national objectives relevant for farm firm activity. The literature abounds with a plenitude of pronouncements on the merits of the family farm, small scale land holdings that are individually owned, freedom to produce and market without restraint and the exchange system as opposed to an integrative or contract or coordinative system.\textsuperscript{13} Whether these rise to the status of national objectives or are merely deeply cherished ideals of a declining but eloquently chauvinistic segment of society remains to be seen.

\textsuperscript{11} For example, in an effort to remedy the projected consequences of foreclosure of mortgages on large quantities of land, an initiative measure was adopted in North Dakota in 1932 prohibiting corporations from engaging in farming in that state. See N. D. Cent. Code § 10-06-01 (1960). That provision was repealed in 1967 by the North Dakota legislature.

\textsuperscript{12} See, e.g., Report of the President's Commission on National Goals, Goals for Americans (1960), especially Ch. 7.

At what would appear to be a lesser stage of national commitment, distinctly undesirable connotations seem to be associated in some circles with the corporate form (as well as a tendency to equate corporations and bigness of "factory farms"), vertical integration, nonfarm capital moving into agriculture, and increase in size of farms. It may be reasonable and appropriate to ask how viable are these ideals or objectives, to what extent is the country committed to them, and what will be the likely social costs of embarking upon courses of action destined ultimately to result in the demise of one or more of them.

In the past, these often rather loosely defined goals, objectives or ideals allegedly attributed to farm firms were not seriously competitive with economic growth and efficiency. The goals were attainable at a relatively low marginal cost. However, trends are beginning to point to areas of serious divergence between national goals. Attainment of such goals as a family farm system (as presently defined by some writers) or small scale landholdings that are individually owned may be possible only at a cost in terms of over-all economic efficiency. Social scientists should be probing for such divergencies and providing knowledge and information well in advance to policy makers. It may well be that, given such a divergence, society will be willing to sacrifice a measure of economic efficiency for maintenance of an otherwise desirable structural...
system. But the evidence is sparse that a majority of people would be willing to pay that price. With the influence of agriculture in the remainder of the economy declining and with agriculture itself oriented less and less toward agrarian fundamentalism and more and more toward identification with the classic urban model, perhaps only those harking back to childhood memories will evince serious doubt as to directions taken by this branch of farm policy.

It appears likely that, for a great majority of farms, the ownership of capital and management of the firm will be provided for many years to come by individuals who are related by blood or marriage. With this view of the "family farm," there would seem to be some assurance that the family farm will continue to be an important institution through the remainder of the Twentieth Century. However, it takes no particularly high degree of perspicacity to deduce that such a family farm could and probably would be quite different from the family farm of tradition and sentiment.

If nothing else, the family farm concept deserves rigorous redefinition in terms of the important ends ostensibly to be accomplished by adherence to a family farm structure. As has been suggested, expression of the degree of family farm dominance in acreage terms may not be wholly meaningful. Similarly, the number of paid employees may not completely specify the essential characteristics of the family farm.

From a research standpoint, it would be highly desirable if the essential attributes of the family farm as a concept were identified and related to the emerging patterns of firm organization. Perhaps then a family farm could be described. Given an acceptably workable definition of the family farm and assuming a sufficiently broad base of support to assure its continued viability, it then becomes important to identify the factors that are in derogation of the family farm and those that are in fact promotive of the concept. Appropriate public policy means could then be taken to perpetuate the family farm ideal.

If no more than a myth of shibboleth, the family farm idea deserves little more than a decent interment. To the extent that the concept continues to have meaningful and priority content, it deserves a fair and impartial hearing.

**Individual and Firm Objectives**

No less important than the national objectives, the micro objective component of the over-all objective function governing the firm merits concern and becomes acutely visible as choices are made at the firm level from among alternative organizational forms available and as decisions are made and policies pursued within the framework of the organizational form. The policies a firm pursues depend heavily upon the form of its objectives. In a small, closely-held firm, of the type dominating agriculture today and likely to remain characteristic for several years, the objective function may be a question of fact, ascertainable with appropriate empirical technique.

Although traditional theory of the firm long has posited net revenue or profit maximization as the dominant if not singular goal of the firm, it has been suggested that firms are likely to pursue goals other than or different from profit maximization. It has been argued that a primary objective of the firm may be long-run security of profit or survival, maximization of sales subject to a minimum profit constraint, maximization of profit subject to a minimum sales constraint, or attainment of "satisfactory" profits. Entrepreneurial motives may also include diverse

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17/ See, e.g., Henderson & Quandt, *Microeconomic Theory - A Mathematical Approach* 43 (1958). See Shubik, "Objective Functions and Models of Corporate Optimization," 75 Q. J. Econ. 345, 347 (1961). Shubik has observed that, "the less the firm is able to influence its environment, the less needs to be known about the motivation of the management of the firm for most purposes of policy." Shubik, *supra* at 374.


personal goals (such as security, power and prestige) as well. 21/ Recent investigation has contributed to a "behavioral" theory of the firm in the way business firms make economic decisions. 22/ This view considers the firm to be an adaptive organism dealing with problems as they arise and not striving to maximize any specific objective function. In the short run, the emphasis is on moving performances to aspiration levels and, in the long run, on adjusting aspiration levels to experienced performance. 23/

Increased attention has been given in the near past to growth objectives of firms and the development of a growth theory as the dynamic counterpart to the classical static theory of the firm. 24/ Of course, growth objectives and profit objectives are not only intertwined but sometimes virtually indistinguishable. Profit is the main source of funds for growth 25/ and serves as a major inducement for

21/See Katona, Psychological Analysis of Economic Behavior (1951). An entrepreneur as a decision maker is also a member of a household which has maximization of utility as its assumed objective. If the profit maximization objectives of the firm and utility maximization goals of the individual are not in complete consonance, a modification of one or both may result.


25/For industrial corporations, an estimated 60% to 65% of all capital is internally generated by retaining earnings and accumulating depreciation allowances. See Berle, supra note 23 at 29. New-issue financing has typically contributed less than 10% of the total funds employed for expansion by established corporations. See Marris, "A Model of the 'Managerial' Enterprise," 77 Q. J. Econ. 185 (1963).
growth with growth as the sine qua non of long run profits. However, analysis of the firm from a growth standpoint may be more realistic than a static appraisal and offers highly promising research opportunities.

Since well before the publication of Berle and Means' well-known book, The Modern Corporation and Private Property, in 1932, interest has been expressed in the implications of separation of ownership and control under the corporate form and the nature and source of objectives governing the firm. The emerging theory of the "managerial" corporation has given new vitality to the idea and recognizes that the objective functions of decision makers in the firm may not always coincide with those of the owners of contributed equity capital. As farm firms become larger and involve greater separation of ownership and management, research attention will likely focus on similar problems in agriculture. If so, much can be gained from the theoretical framework now being worked out for sectors dominated by large corporations.

Sub-sets of Firm and Individual Objectives

Because of the effects of the family firm cycle and the close relationship traditionally of the firm and the household in agriculture, additional objectives in the nature of sub-systems or sub-sets are identifiable. At any point in time, farm firms may be grouped loosely in accordance with a clustering of objectives. This is neither a precise nor necessarily a complete classification, however.

A substantial group of farmers, nearing or within the third and final stage of the family firm cycle, are likely to pursue objectives within a framework of reduced planning horizons if it is assumed that the firm will not continue to function beyond their lifetimes and that the capital resources involved will be recombined with those of other firms at retirement or death. For this group, short-run profit maximization, security of

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27/ See generally Heady, Back & Peterson, Interdependence Between the Farm Business and the Farm Household with Implications on Economic Efficiency 403, Iowa State University Agricultural Experiment Station Research Bull. 398 (1953).
income and capital, retirement planning, equitable disposition of family wealth among the heirs, and prevention of erosion of family wealth in the intergenerational transfer process because of taxes and estate settlement costs are likely to be paramount. From the standpoint of over-all economic efficiency, such firms may operate in the final stages of the cycle at reduced efficiency levels comparable to the lower efficiency in the early stages of the cycle. 28/

A rapidly growing segment of farm firms, those wherein plans have been made for continuation of the firm as a functioning economic unit beyond the life cycle span of the senior (and, generally, majority) owner or owners, may pursue objectives in addition to, in lieu of or quite different from those of farmers who are willing for the life cycle of the firm to parallel the life cycle of the household. For these firms, strong emphasis is rationally placed upon arrangements to move individuals and their capital into and out of the firm in keeping with their own personal life cycle but without disrupting the firm or causing the firm cycle to parallel or even be influenced significantly by personal life cycles.

Objectives of this latter group of firms are likely to include maximizing long-run efficiency within the firm in terms of resource allocation, income distribution and extended planning horizons. The objective of perpetuating the higher efficiency levels characteristic of the mid-phase of the family farm cycle by injecting successively overlapping personal life cycles may be rewarded in sustained operation at minimum cost levels through time. The gradual divestment of ownership and control by senior members of the firm during their lives to younger members often serves to dampen modulation of the family firm cycle. The firm may be quite interested in minimizing the effects of death or departure of owners and enhancing capital availability. The senior members of the firm are frequently concerned about devolution of family wealth (much or all of which is often committed to the firm) to their heirs, including those who may be junior members of the firm and those who may have no association with the firm, as well as about preventing erosion of that wealth by costs and taxes in the intergenerational wealth-transfer process. Simplicity and economy in organization and maintenance of the organizational form may also be relevant objectives of the firm.

28/ See Heady, Back & Peterson, supra note 27.
It is explicitly recognized that many farm firms fall into neither category. In general, these are the firms operating in the early and mid-stages of the family firm cycle and that have not made a definite decision as to the future of their particular time.

Partial Analysis of Discrete Points on the Institutional Spectrum

Neither space nor time permits a detailed economic analysis and critique of the various organizational alternatives available for the accomplishment of specific firm and individual objectives. However, it is recognized that only through such analysis and critique will inadequacies of present forms be identified.

Research on incidence of use of alternative forms of organization is hampered by lack of reliable data. The Census of Agriculture does not enumerate farms by method of organization (corporation, partnership, trust, sole-proprietorship) although the resulting data would be most helpful, particularly as time series information could be built up for analysis and correlation with other data. Information published by the Internal Revenue Service indicates that fewer than 25,000 corporations classified as "agriculture, forestry and fisheries" have filed income tax returns in recent years. Limited data are available in a few states on farm corporations. Even less is known about the extent of use of the partnership or trust. Quite clearly, a pressing need exists for reliable, primary data on farm-firm organization.

In the belief that the corporation or some derivative therefrom may well be the most rapidly growing form of organization for farm firms in the next several decades, special attention is devoted to the corporation in the following paragraphs. It should be recognized that the major use


30/ In Iowa, data have been obtained in an annual search of records in the Office of the Secretary of State (where corporate articles of incorporation must be filed) with data verified by mail questionnaire. Recently, state income tax data have been made available. The Iowa data indicate that the rate of farm incorporation has increased since 1958.
of the corporate form in agriculture in recent years has been by larger family operations. Reported studies reveal that fairly general agreement exists among decision makers for incorporated farm firms as to why the corporation was selected over alternative organizational forms. The corporate form has generally been selected to facilitate accomplishing objectives of estate planning or intergeneration transfer of property, business continuation over time, avoidance of full owner liability for business obligations and income tax minimization.31

It is deceptively easy to consider current characteristics of specific organizational forms to be inherent in the form itself. In the remainder of this paper an attempt is made to concentrate primarily on the truly inherent nature of the particular organizational form. Detailed characteristics that may be either advantageous or disadvantageous and thus take on significance in the short run may have little permanence in the long term.

Static Firm Efficiency

Prior research on the firm, involving specifically the landlord-tenant relationship, has produced a set of static conditions deemed necessary to encourage operation of the firm at maximum efficiency from the combined resources of the owners.32 (1) Each owner's share of the factory of variable input must be the same as the share of product output obtained therefrom, (2) each resource owner should receive the full share of the product earned by each unit of fixed and variable resource contributed, and (3) the shares of all products must be the same for each resource owner if one party can make decisions as to level of output. Attainment of these conditions may be facilitated in firms with functional unity of ownership and management. One characteristic of the corporation or other single economic entity that has both theoretical and practical micro implications is the unity of ownership of production resources and unity of decision making in the sense of providing a mechanism for a single management voice.

Frequently, in a multi-member farm firm, the informal organizational ties among the members do not rise to the separate entity status of a recognized form of multi-member firm organization. In many cases, the various parties own different shares in the various inputs of production. Some assets may be owned solely by one member and contributed to the firm, some assets may be owned by the other members, and others may be owned in co-ownership with varying undivided interests from asset to asset. This pattern of resource ownership and control creates problems of accounting, income distribution and resource allocation.

Conventional analysis of the farm firm is based upon the implied assumption that one owner-operator makes decisions, bears the costs and receives the returns from production. If two or more individuals own production resources or their services, the sharing of costs and returns within the firm becomes a factor potentially affecting resource allocation and firm efficiency. Under perfect association of costs and returns, the resource owner receives the marginal value product of the contributed resource or resource service. To the extent there is not perfect association between input contributor and return receiver within the firm, motivations and pressures are generated for other than efficient resource allocation. The problem is basically the same whether the parties are associated together as landlord-tenant under a crop or livestock-share lease, as father and son operating under a contractual operating agreement, as an integrated firm or under some other form of relationship encompassing multiple ownership of the resources of production. Imperfections in the negotiating or bargaining process may seriously hamper attainment of this condition where the entity obtains substantial amount of inputs by contractual means.

The corporation or other economic entity, to the extent that it is the owner of production resources and also the decision maker, occupies a position similar to that of the sole proprietorship. As the contributor of variable inputs and the recipient of the entire amount of additional product, the corporation theoretically applies the variable

\[ 33/ \] Although the corporation frequently involves multiple membership at the three management levels - shareholders, board of directors and officers - the corporate control structure produces a single management voice.
input until the last unit of input equals in value the last unit of output. The sharing of costs and returns in a corporation owned by multiple shareholders is therefore automatic and attainment of the economic optimum for the firm is therefore encouraged.

The second condition for maximum firm efficiency, that each resource owner should receive the full share of the product earned by each unit of fixed and variable resource contributed, is facilitated by the corporation by virtue of its structural design. Taking, as the simplest case for illustration, the corporation issuing a single class of stock upon incorporation, the holders of stock have rights to corporate income that vary only with the number of shares held. In dividing the product among the production resources as compensation for inputs utilized in the production process, the corporation still faces the problem of compensating the labor hired, capital borrowed and property leased on the basis of market values or the marginal productivity of each resource. Once this is accomplished, however, the remainder of corporate net income from production (after taxes) is available for distribution to shareholders on the basis of a uniform amount per share of stock. Thus, the holder of stock, representing prior ownership of a specific item or items of property, receives compensation precisely equal to that of the holder of another share of stock representing prior ownership of a different item of property. The amount imputed to each share can be paid out as dividends or retained in the corporation for expansion or investment. The corporation, by being the owner of productive resources of various types, amounts and values and by being owned by individuals with identical rights to corporate income, greatly simplifies the problem of compensating resources on the basis of their marginal value productivities. Moreover, the problem of continually adjusting returns to resource owners as resource values and productivities change does not arise where resources

34/ If the resource services purchased by the corporation in the form of labor hired, capital borrowed and property rented are compensated on the basis of marginal value productivities, and if the corporation's production function is homogeneous of degree one, then the amount of product imputed directly to corporate capital assets (and indirectly to holders of corporate stock) should equal the marginal value product of such property by Euler's theorem and the total product would be exactly exhausted. See Henderson & Quandt, Microeconomic Theory - A Mathematical Approach 64-66 (1958).
are owned by the corporation. The problem of compensating resources rented, leased, hired or borrowed by the corporation remains however, and is much the same as for unincorporated firms.

A necessary condition for fulfilling the requirement that each resource owner should receive the full share of the product earned by each unit of resource contributed is that assets transferred to the corporation must be exchanged for stock and securities at fair market value or a uniform percentage of fair market value. Otherwise, a system of product sharing is established which may operate perpetually to misallocate the corporate product among shareholders.

An aspect of benefit sharing other than the perfect or imperfect nature of the scheme should be noted. The accounting system needed to maintain an orderly allocation of returns among resource owners may become quite complex if specific assets or resources of production are individually owned or held in co-ownership. For example, if a widow and children succeed to the ownership of an unincorporated firm upon death of the owner-operator (with the widow getting the customary one-third share pursuant to statute and with the remaining two-thirds interest divided among the children), operation of the firm under that division of ownership over time might result in a complicated system of benefit and cost sharing unless all transactions with respect to the firm are in complete consonance with the initial ownership pattern.

A third condition considered necessary to encourage maximum firm efficiency under multiple ownership of resources is that the shares of all products must be the same for all resource owners if one party can make decisions as to level of output or specific enterprises. This condition is frequently not met in father-son contractual agreements or landlord-tenant relationships and may not be met in integrated firms. Under the corporate form of organization, all income from the various corporate enterprises is divided among the shareholders on a predetermined, fixed basis that is uniform for all enterprises. Each shareholder receives or is entitled to receive a proportionate share of corporate net income from each enterprise.

**Dynamic Efficiency Considerations**

With the injection of time as a dimension of resource allocation and income distribution, the structural and organizational framework of the
firm takes on added importance. Basically, for maximum efficiency, each resource owner should have an opportunity to receive return on investment in fixed and variable resources made in one production period and not forthcoming until a subsequent period. In theory, the form of organization should not increase firm uncertainty or result in a shift in resource use between time periods.

In many firm relationships involving multiple-resource owners, the intrafirm associations are pursuant to contractual, time or other linkages that are frequently of indefinite or limited duration. Thus, in a life tenant - remainderman association, the linkage is the life of the life tenant (or another measuring life), either of which is the subject of substantial uncertainty, both when viewed from the standpoint of the life tenant and that of the remainderman, with respect to investments in the property over time. Likewise, in a landlord-tenant association, the contractual linkage, whether based upon a specific term or at will, is again the subject of some uncertainty for periods beyond the certain term of the lease contract. For a partnership, which technically dissolves upon death or expulsion of a partner, admission of a new partner, bankruptcy, insanity or other legal disability, or fraud or misconduct, substantial uncertainty exists as to the term of the relationship.

In a corporation, intrafirm relationships are pursuant to linkage of, arguably, a more permanent nature. Corporations in most states may be organized for a term of years or perpetually. From the standpoint of the firm, perpetual organization is advantageous inasmuch as renewal of the term of existence may disrupt the firm and result in erosion of equity capital through pay-outs to dissenters. But from the standpoint of minority shareholders, limiting the organizational form to a term provides some measure of protection in the event that withdrawal of capital from the firm becomes desirable. Except for expiration of term, a corporation can be dissolved only by operation of law or by necessary vote of the shareholders. Even if dissolution should occur, the rights of shareholders to receive their pro rata share of immature and unrecovered firm investments may be substantially greater than that provided by law for life tenants (or their heirs) or lessees.

35/ Nine states limit maximum corporate duration to terms ranging from 25 to 100 years. See 1 Model Business Corporation Act Annotated § 4(a), ¶ 2.02.
Theoretically, corporate life does not depend upon the lives of shareholders. Upon death of a shareholder, his stock and noncorporate property pass through the probate process to pay costs of estate settlement and for distribution in accordance with a will or state law of descent and distribution. The corporate assets underlying the stock are not affected by shareholder death, thus simplifying estate settlement. If corporate ownership and management succession are planned, multi-member corporation continues to function much the same after death of a shareholder as before.

By removing a portion of the consequences of owner liability, a properly organized and adequately financed corporation may limit the liability of shareholders for deficiency obligations against the firm and thus lengthen the planning horizon of decision makers. While limited liability has been a major factor enabling corporations to attract investors and assemble substantial amounts of capital, limited liability serves to protect shareholders from the full consequences of catastrophically large corporate obligations even in a small, closely-held corporation. By isolating their noncorporate assets from obligations of the farm business, the officer-director-shareholder group may be more willing to allocate resources among enterprises involving greater uncertainty than if personal as well as business assets would be subjected to satisfaction of business obligations. 36/

In two situations, however, the corporate form may affect the uncertainty and planning horizons of decision makers adversely compared with noncorporate forms. Although neither individual farmers nor farm partners can be declared bankrupt involuntarily under federal law, farm corporations may be subject to involuntary bankruptcy. 37/ Also, the privilege accorded a debtor of holding specified items of property exempt from execution to

36/ While limited tort liability (such as from employee negligence) may obtain in a corporation properly organized, adequately financed with equity capital and properly operated with due attention to corporate formalities, limited contractual liability is sacrificed for specific obligations if the shareholders are required to affix their personal signatures to corporate contractual obligations.

pay debts\(^{38}\) is generally available only to natural persons or heads of families and not to corporations. Therefore, upon conveyance of exempt property to a corporation, a debtor loses the privilege of holding the property free from creditors. Moreover, the stock received in exchange for the exempt property is not exempt from execution of creditors.

The net effect of the corporate form of organization upon the decision makers' planning horizons is unknown. Undoubtedly, the effect varies from time to time and from firm to firm. Additional research is needed to ascertain the precise effects of organizational forms upon decision making activities.

**Capital Availability and Accumulation**

With capital serving as one of the important limiting factors for growth of the firm\(^{39}\) and with capital needs of individual farm firms likely to increase still further with the expansion anticipated, the matter of capital availability will likely take on added significance for the years ahead.

1. **Equity capital.** Traditionally, each generation of farmers has furnished its own equity\(^{40}\) capital for use in the business, supplemented by debt capital obtained from external sources. Even land rented to farm firms by nonfarmers on a variable-rent basis with payment of rent in kind cannot be characterized as full risk bearing capital inasmuch as landlords

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\(^{38}\) Exemption statutes of the middle-western and western states generally favor the debtor more than those of the eastern states. Exemption statutes of heavily rural states reflect a generous policy of protecting farmers as a class from deprivation at the hands of creditors. See, e.g., Iowa Code § 627.6 (1966).


\(^{40}\) Equity capital constitutes the risk bearing fund of the firm. Equity holders have less certainty of income, greater management rights and greater opportunity to share in positive or negative firm growth than creditors as holders of debt securities.
are generally granted legal priority over the tenant's creditors in sharing in firm output.\textsuperscript{41} The landlord's payment is not necessarily a function of the firm's net profit.

Direct investment of equity capital in farm firms from sources outside the agricultural sector has not become widespread and is not comparable to direct equity investment in larger firms in other industries. This may be because of relative return on investment, relative uncertainty, size of capital-using firm or the fact that convenient and satisfactory means have not been generally available for channeling nonfarm equity capital to farm firms. It would appear reasonable to hypothesize that utilization of nonfarm equity capital would have a beneficent effect upon farm firms in that a portion of the risk and uncertainty of agriculture would be shifted to the nonfarm sector. Moreover, the absence of a fixed payment burden on this portion of firm capital should entail perhaps a lesser modification of production planning because of expectations concerning weather, price or other uncertainty.\textsuperscript{42} However, the quid pro quo would be a partial shifting of control and management rights our of agriculture. This problem has been faced most squarely by researchers in the area of vertical integration and coordination.\textsuperscript{43}

With agriculture dominated by sole proprietorships, many firms are "born" and also "die" within a generation. Over time, discontinuities in management and ownership occur in the transition from generation to generation. If family linkage in firm ownership continues from one generation to the next, a portion of the capital from a terminating farm business may be channeled to successors by testamentary succession, gift, or bargain purchase transaction. However, substantial amounts of equity capital are removed from farm firms (and may flow out of the agricultural sector) with each generation because of the relatively high rates of out-migration of farm reared people. State laws

\textsuperscript{41} See, e.g., Iowa Code § 570.1 (1966) (landlord's lien on all crops and tenant's nonexempt personal property).

\textsuperscript{42} See Heady, Economics of Agricultural Production and Resource Use 549-50 (1952).

\textsuperscript{43} See Harris & Massey, Vertical Coordination Via Contract Farming (forthcoming).
of intestate succession uniformly divide estates equally among the children after setting apart the share for the surviving spouse; and, with testate devolution, parents generally endeavor to distribute their property equitably among their children, whether on the farm or pursuing off-farm vocations. Upon completion of estate settlement, any one of more of the heirs generally may demand legal partition of the property into shares or judicial sale of the property and division of the proceeds. Thus, the result may be distribution of accumulated farm firm capital among the various heirs and liquidation of the firm or imposition of a debt obligation on the successor in order for payments to be made to nonfarm heirs without liquidation of the firm.

It is in the area of capital accumulation and retention over time that the corporation has the greatest potential advantage. With most farm corporations, the original shareholder group is limited to members of a family who were farming together as a partnership, father-son arrangement or a landlord-tenant relationship before incorporation. Assuming the non-admittance of new nonfamily equity investors, which is discussed below, a major concern is maintaining and expanding the firm's equity capital in (1) bridging the transitional ownership gap between generations, (2) lessening the impact of capital withdrawal by nonfarm heirs upon vesting of testamentary devolution rights, and (3) minimizing erosion of equity capital by estate settlement costs and taxes levied upon the estate or property passing therefrom. 44/

Although property transfers within and between generations are possible under any form of organization, certain attributes of the corporate form facilitate intergeneration and intrageneration property transfers. These attributes include the opportunity for making gifts or sales of stock with retention of working control over the firm, 45/ restricting retransfer of corporate stock by donees or vendees, divisibility of asset ownership into easily transferred shares of stock making possible the concept of farm business transfer as opposed to specific asset transfer, and possibilities for using corporate stock as an income

44/ At this point it is assumed arguendo that continuation as an intact economic entity over time is an objective of the firm.

45/ But see Rev. Rul. 67-54, I. R. B. 1967-8, p. 10 providing that retention of indirect control over transferred stock may result in inclusion of the value of the transferred stock in the estate of the transferor for federal estate tax purposes.
channeling device for minimizing family income tax liability. The choice of stock transfer alternatives (gifts and sales during life, dispositions by will, disposition at death under state law and stock redemption or purchase arrangements at death) and the time path of property distribution are generally functions of the transferor's specific objectives to be accomplished by the transfer.

Stock transfers by gift or sale during the life of a shareholder result in a partial shift in farm business ownership to the recipients of the stock, who become holders of an equity in the business. Thus, continuation of the business after the death or retirement of the principal shareholder or shareholders is promoted. Such transfers also reduce the amount of stock susceptible to passage through the probate process at death. Stock transfers to younger members of the firm during life provide security and the possibility of additional income through dividends. These factors may contribute to attraction and retention of qualified management personnel whose employment alternatives offer similar opportunities for ownership security. If stock is made available by parents to children remaining on the farm, purchases may be made by such on-farm heirs during the years of high earning capacity. Such purchases (along with gifts) may ameliorate the burden frequently falling upon those heirs of acquiring the balance of the farm business assets upon death of the parents.

To the extent that stock passes to nonfarm heirs by gift or by inheritance, two problems may arise: (1) whether such heirs would be willing to continue as shareholders for a period of time, and (2) whether, as a matter of policy, the stock should gradually be purchased by those actively associated with the firm or whether the stock should be permitted to pass to the heirs, devisees, donees or vendees of the nonfarm heirs with the stock thus likely to become publicly held after the passage of a few generations. These problems relate, of course, to the matter of feasibility and acceptability of off-farm ownership of stock in general.

From the standpoint of maintaining the equity capital of the firm intact, the disposition of a decedent's interests therein and the rights of a distributee including rights to a liquidating distribution are important. For a firm whose objective is to remain closely-held through succeeding generations, it is essential for stock ultimately to be channeled to the successors in the "inner circle" of ownership and management. If
stock passes to all the heirs or legatees of shareholders at death, firm ownership may become widely diffused in a short time. If stock passes to nonfarm heirs or legatees, the equity of the firm is preserved intact inasmuch as the holder of stock cannot obtain partition and sale as can co-owners of property generally. Thus, no diminution of equity capital occurs since there are no pay-outs to heirs or legatees, neither is there imposition of a debt obligation for the same purpose.

The involuntary nature of the equity investment by nonfarm heirs or legatees raises problems as to the stability of the investment relationship, however. Problems may arise stemming from: (1) a desire by off-farm shareholders for larger dividend declarations while on-farm shareholders prefer low dividend payments, if any, and instead may prefer to utilize corporate funds for expansion; (2) intervention in decision making by uninformed, technically unqualified off-farm shareholders; and (3) the relatively narrow market for shares in a closely-held corporation encountered by off-farm shareholders as they desire to dispose of their holdings. The latter difficulty may be compounded by restrictions on stock transfer that reduce the market substantially so that, in effect, the only permissible purchasers are the corporation or other shareholders. Moreover, with little or no history of dividend declaration, and with control vested in individuals whose objective functions may not include dividend declaration, a minority shareholder's block of stock may be additionally unattractive to investors. Off-farm shareholders in nearly all farm corporations having off-farm shareholders studied in a 1959 Iowa survey were in the first generation of off-farm residence. It is arguable that family ties to the firm and farm minority investors who are first generation heirs. It is largely conjectural whether the investment functions of second and succeeding generations off the farm will be similarly oriented. Much will likely depend upon a comparison with alternatives investment opportunities as to whether continued ownership of farm corporation stock will be acceptable to these individuals.

46/ However, participation in management, beyond the minimal management rights of minority shareholder, is likely only if the off-farm shareholders singly or in combination can muster majority or working control of the firm.

47/ Absolute restrictions on stock transfer are legally void, however.
As the form of immediate and direct compensation for equity capital contributions to the firm dividends are an important factor in attracting and retaining off-farm investment interest. Dividends occupy a position in input compensation similar to that of salaries as compensation for labor inputs or interest as compensation for debt capital inputs. One key difference, however, is that dividend payments at rates less than marginal value productivities would specify are evidently not unusual, and amounts of earnings not so declared and paid out as dividends increase stock value, thus inuring ultimately to the benefit of the shareholders.

The matter of immediate compensation in the form of dividends or mediate compensation in the form of stock value appreciation has important economic implications for off-farm ownership of stock. Shareholder compensation in the form of stock value appreciation may be realizable at a future time. Thus, compensation in such form is subject to discounting. The discount rate may be substantial inasmuch as the date of payment or realization of input compensation is generally accompanied by substantial uncertainty. In a corporation in which stock is publicly traded, shareholder compensation in the form of appreciation in stock value due to retention of corporate earnings may be realized at any time by sale of the stock. However, stock in a closely held corporation is generally not publicly traded, restraints may be placed on alienation of the stock and only minority interests with few management rights are usually made available for purchase. These factors militate against sale of stock by a shareholder seeking to realize previous compensation amounts imputed to corporate stock. Sale may be possible, but often at a price less than the fair market value of the stock as determined by the value of underlying assets. As an alternative to sale, shareholders generally must await dissolution of the corporation and liquidation of its assets before previously imputed

\(^{48/}\) One reason for low rates of dividend declarations in many corporations is that while salaries and interest are tax deductible from corporate income, dividends are not. Therefore, an incentive exists to pay out corporate earnings in tax deductible form thus skewing the income distribution schedule in favor of higher salaries for example. Only in the tax-option or Subchapter S corporations are dividends, interest and salaries treated substantially alike tax-wise.
capital compensation could be realized. It would appear that the mediacy or immediacy of receipt or equity capital compensation would be of particular importance to prospective investors in a closely-held corporation, and to off-farm heirs who receive corporate stock as all or part of their testate or intestate share of a decedent shareholder's estate or by inter vivos gift.

The attractiveness of farm corporation stock as an investment is allegedly influenced by considerations in addition to relatively low dividends, limited market for the stock, and little if any voice in management as a minority shareholder. The level of resource earnings in agriculture, compared with nonagricultural investment opportunities, is likely to affect, not only the purchase of minority interests in operating farm corporations by nonfarm investors and retention of stock by off-farm heirs, but also the important matter of whether off-farm investment groups are likely to form corporations for the purpose of engaging in farming with management and control clearly vested in the off-farm group. It is somewhat ironic that higher levels of prosperity in agriculture are likely to be accompanied by increased investment activity by nonfarmers in agriculture with the result that more management and control rights are vested in off-farm groups.

If outside equity capital were solicited for farm firms, either private placement of securities or an organizational grouping of several firms for capital acquisition purposes would be a necessity because of the relatively small size of farm firms now and for the foreseeable future. As

49/ An incentive exists to receive capital compensation in the form of appreciation in stock value rather than currently as dividends in that stock value appreciation is eligible for capital gains treatment (long term if stock is held more than six months) while dividends are treated as ordinary income.

50/ Several instances of formation of operating farm corporations by nonfarm groups have been reported in recent months. The availability of competent management inputs is likely to be a crucial factor in whether such firms succeed and ultimately increase in number. Of course, formation of incorporated farm landlords has become relatively common wherein nonfarm investors form a corporation which in turn purchases land and rents it out to tenants under a conventional lease arrangement.
a general rule of thumb, if the growth potential of the business is not such that $300,000 or more of stock can be sold, the business is not in a position to seek capital through widespread capital solicitation or from the large capital markets because the cost for small public offerings is prohibitive. 51/ The Securities and Exchange Commission has reported that more than 20 percent of public common stock issues running less than $1 million is used for expenses of issuance, compensation to underwriters and other fees. Costs for larger flotations are relatively less. If off-farm ownership of equity capital is deemed desirable, perhaps efforts should be expended in developing a suitable capital market for efficient allocation of investment capital.

2. Debt capital. As to debt capital availability, farm corporations are constrained somewhat in the short-run by nonavailability or restrictions upon loans from federal agencies. And in some cases credit extenders may be reluctant, without the personal commitment of shareholders, to continue lending at preincorporation levels if shareholder limited liability was unduly "manufactured" upon incorporation.

52/Farmers Home Administration real estate loans, operating loans and rural housing loans and grants may not be made to farm corporations 6 C. F. R. §§ 321.5(c), 331.3(c), 332.6(g) (1) (1966).
53/Federal Land Bank loans may be made to a farm corporation if more than one-half of its income is derived from farming and if a substantial portion of the capital stock is owned by individuals engaged in farming operations of the farm to be mortgaged. In addition, one or more individuals owning a substantial portion of the corporate stock must assume personal liability for the loan. 75 Stat. 750 (1961), 12 U. S. C. § 771 (1964); 6 C. R. R. § 10.3 (1966). Production Credit loans may be made to a farm corporation engaged in actual farming operations or livestock production provided 75% or more of the stock is owned by individuals actually engaged in its farming or livestock operations, or the major portion of corporate assets consists of property actually devoted to farming or livestock production and at least half the gross income is derived from these operations. 6 C. F. R. § 50.102 (1966). Holders of a majority of the shares must personally guarantee the indebtedness. 6 C. F. R. § 50.103 (1966).
On the plus side however, shareholders may be a source of debt capital and take a mortgage or pledge of corporate property in return. These are the typical manifestation of incorporation on debt capital availability.

The quantitative change in availability of debt capital by incorporation alone (assuming a given amount of equity capital) has received attention in the literature, although no objective factual data have been published upon incorporation. The effect of the corporate form itself is not great. However, it would seem that the corporation offers convenient means whereby its debtor status may be affected favorably if the corporate form is used deliberately to take advantage of the factors that impinge upon exogenous capital rationing. By providing opportunity for continuity of operation and more certain organizational posture, the corporation may appear a more stable borrower to a credit extender. If ownership and management succession is planned, the corporation offers less change of business disruption on death of a shareholder. By providing an ownership and management framework for larger scale operations, the corporation may permit greater specialization by employees, resulting in improved management in the long term. However, exogenous capital rationing may be increased by incorporation if substantial amounts of assets previously subject to satisfaction of firm obligations are not transferred to the corporation. Thus, shareholder limited liability may operate to reduce credit availability unless shareholders commit personal assets to liability for the obligation. Research is clearly needed in this area.

Employee Status for Farmers

Important consequences attach to the fact that a partner in a partnership or the proprietor in a sole proprietorship may become an employee upon incorporation of the farm business. The transformation may be accompanied by psychological adjustments as well as by shifts in both legal and economic relationships with the firm.

Employee status casts the matter of compensating labor and management inputs in bold perspective as salaries and bonuses are established, ostensibly without regard to the shareholder status of the employee. This fact may have a salutary effect upon intrafamily bargaining for shares of income of the firm wherein a tendency often exists to lump all inputs, including labor, management and capital, together in making determinations for income sharing.

Employee status automatically brings higher social security taxes, along with eligibility to participate in tax privileged fringe benefits such as group term life insurance, pension plans and profit sharing plans. With a fixed annual salary, farm employees may become eligible for higher social security benefits than a fluctuating income would produce. Retirement planning may be facilitated for employees since earnings received as dividends or interest do not reduce social security benefits.

Research Models

Considerable progress is being made in the development of techniques, models and methodology for research on the farm firm as a small, closely-held economic unit. Heidhues has developed a recursive programming model that explicitly includes savings, investment and growth. Using simulation techniques, Halter and Dean have applied a model to a situation where an attempt was made to find some improved management policies to deal with the uncertain environment in which farm firm decisions are made.

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55/ For 1967-68, self-employed farmers pay social security tax on the first $6,600 of earnings from self employment. Int. Rev. Code, §§ 1401, 1402(b). By comparison the tax is levied at a rate of 4.4% on employees' compensation up to $6,600 per year with a like amount imposed on the corporation for a total of 8.8%. Int. Rev. Code, §§ 3101, 3111. This differential is presently projected through 1987 when the difference will be a maximum of $231.00 per employee per year.


Patrick has constructed a behavioral simulation model. In research carried on at Iowa State University, this writer has developed a functional linear programming-simulation model for multi-period analysis for growth of the firm and for testing the economic efficacy of various components of the legal structure within which firms operate. Recently, interesting work on models for investigating growth of the firm has been going on in other quarters.

Simulation is a promising and exciting analytic tool and may provide the most workable approach for analyzing the firm, particularly under uncertainty. Although it has clear disadvantages, such as complexity of models, paucity of workable tests of significance and the need for a multiplicity of models because of their specificity with respect to a particular problematic situation, the flexibility and adaptability of simulation commend it for research on the firm.

The ISU-USDA model developed at Iowa State University utilizes both linear programming and simulation in tracing firm growth through time and measuring the economic effects of the legal form of firm organization. To date, the model has been used to test the corporate form; however, the model is adaptable for use in testing and comparing the sole proprietorship, general and limited partnership, trust, landlord-tenant relationship or partially or totally integrated firm. The deterministic model is recursive, involving n years of firm activity. The linear programming segment of the model first generates, for a particular year, an optimum production plan based upon ex ante price and yield expectations. The linear programming matrix, which contains several additional resource rows and activity columns to adapt the model to multi-period analysis and more finite capital accounting, then computes an ex post solution using actual prices and yields.


Relevant portions of the solution are transmitted to the simulation portion of the model as shown in block diagram form in Figure 8.1. Also, necessary accounting and inventory information is transmitted directly to the next year's linear programming matrix, thus providing an interyear production function link. The simulator, composed of almost 60 equations and containing more than 200 variables, reflects with reasonable fidelity the legal form of business organization and the legal framework for the households and estates of the firm's shareholders. The simulator produces a solution in several variables and provides input data for the next year's linear programming matrix and the next year's simulator. The process is repeated for the second year and for each of the n years under study. Various "runs" can be made for different assumptions as to the technical production function, the decision-making model, or the legal structure of the firm or the household.

Conclusion

The farm firm may well be entering an era of dramatic and far reaching structural and organizational change, perhaps the most dramatic and far reaching in its long and colorful history. Structurally, the firm has changed relatively little from the birth of the family farm concept down to the present time. But forces are already in motion to bring about significant change. The family farm will likely continue, at least for a time, if the term is redefined to encompass principally ownership and management concepts.
Farm firms of the future will be owned and managed in a great many instances by more than one individual, will be more detached from the household than currently, and will be less subject to the family cycle of its owners and managers than it traditionally has been. Substantially greater use will likely be made of the corporation and its variants and derivatives. It would appear that more equity capital will be provided to agriculture from outside the sector.

It is hypothesized that commercial farmers are prepared to accept the structural and organizational changes that appear almost inevitable. In fact, farmers may be more willing to accept the change than some nonfarmers whose contact and experience with agriculture in an earlier day has created a Procrustean mold that rejects out of hand any structural or organizational change.
RESEARCH IMPLICATIONS OF FARM FIRM
CHANGES NEEDED IN RESPONSE TO
WAGE RATES AND INCREASED DEMANDS

by Earl O. Heady* and A. Gordon Ball**

Few investors would look upon agriculture as a growth industry. Demand for its products over the last two decades has been restrained by low price and income elasticities. Resource returns have been low in terms of certain traditional measures. The labor force has fled from it, in contrast to expanding industries such as office machines, television, amusement, drugs and chemicals. It has required large-scale government programs to maintain its prices and incomes in a rather long period of rapid growth in the national economy. Other characteristics and facets of the industry are those ordinarily associated with retarded or declining growth.

The industry has not, of course, been passive if we view its resource structure. While, in the last decade or so, output has been restrained by slow demand growth, with the exception of commercial exports and international food aid, it has had dynamic growth in the value of capital assets, in capital gains from investment, in adjusting its labor force and in transformation of its many forms of technological capital. But even if we were to consider the industry the antithesis of those commonly considered growth sectors, the agricultural firm can not be placed in the same category. The farm firm, particularly in some categories, has been even more dynamic and responsive than many growth industries, to resource and product price changes and to new technologies or knowledge. Previous papers in this series suggest that there are going to be even more rapid changes in the parameters that provide the decision variables of the farm firm. Some technologies of the agri-business sector are projected to provide chemicals and similar inputs at even lower real prices. Other technologies are expected to change the parameters of the farm firm's cost function; specifying both a larger and more specialized unit to survive under extended interfirm competition for resources. Increases in education and other investments of the human resource, plus the shifting of the age composition of farmers and

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family labor as suggested by cohort analysis, promises to reduce the supply quantity and increase the supply price of labor to the farm firm. A continuing and accentuated change in the resource structure of the farm firm is thus projected for the future. There will be fewer of them; they will be larger and more specialized; their resource structure will turn more to capital and less to labor and land, but more acres will be required to allow them the scale advantage and payoff from modern technology. The complexity of the scientific technology implies an advanced managerial function for them, or a set of managerial services furnished to them from the agribusiness sector.

One need not speculate about these possibilities—the trend is already here and is even quite well known by the man in the countryside whose quantitative analysis is "simply that which he sees about him." There is little chance that the direction of the trend will change; uncertainty exists only with respect to the rate of change and whether the trend lines will have increased slopes.

The transformation of the farm resource structure and economic organization is the key to many broad social and economic problems in agriculture. The extent and types of agricultural policies needed for the future will depend on the structure of farm firms, the extent that they continue or accentuate the substitution of capital for land and extend production capacity at rates exceeding demand growth, and their responsiveness to parameter changes and the corresponding supply elasticity in its relation to price and income stability. The size of firms, and hence the number, will determine how many people live in the countryside—and hence the population and business volume in village and town settlements of the non-metropolitan areas. Extended still further, these factors will also determine the number and sizes of towns needed in purely rural areas, the modifications that should take place in extent and form of public investments in roads, utilities, schools and even local governments. A sufficiently rapid transformation of the agricultural firm, for example, a reduction in numbers to the level of 50,000 to 100,000 as suggested by Ruttan,\(^1\) will entirely eliminate the political power of agriculture; except to the extent that the managers of the remaining firms are of a psychological nature and political orientation to initiate effective collective bargaining and market power. These transformations also will cause the worker in the urban chemical, drug or machinery factory to be substituted for the worker on the farm and in the village of the rural community; thus prolonging our attempts at solution of poverty problems in agriculture and requiring larger and more

rapid investments in vocational retraining and redirected adult education. Additionally, these changes will determine the extent to which rural institutions such as banks should organize their activities around service charges from a large number of small depositors; or around the payoff from fewer large-volume and highly commercial farm borrowers.

In short, there are few if any aspects of economic change which have such broad economic and social implications as the upcoming structure of the agricultural firm as it responds to changes in price and production coefficient parameters that are either with us or in prospect for the future. If we could count on a response in the years ahead as rapid or as great as projected by Ruttan, we would not need to hold this conference. The 50,000 to 100,000 farms would be large enough to invest in their own managerial research and aids, either individually or in small groups. Similarly, when the resource structure reduces the number of commercial farms down to this level, there will be little if any need for public investment in agricultural research and education. Farm firms with a half million to a million dollars in gross volume of sales are large enough to conduct their own applied trials and experimentation. Their results would be supplemented by or supplemental to the research conducted by the input and processing industries to sell more of their capital inputs to agriculture. Of course, public investigations might be needed for some of the more fundamental aspects of knowledge and particularly for research such as that relating to health, land use, pollution and other phenomena having little or no payoff to private industry. It also would be needed to solve the massive social and economic problems of the rural community stemming from the shift in firm resource structure necessary to allow thinning of farm numbers to this level. Obviously, the rate and extent to which the structure and organization of the farm firm brings us to any such number of farms will determine whether any public funds need to be invested in agricultural knowledge and its communication. Already, private industry invests more than the public in agriculture research, and makes substantial additional investment in the communication of this research to farmers.

Response to Changes in Factor Prices and Productivities

Projected changes in factor prices and productivities were summarized previously. In general, they favor the trends already under way in agriculture. Higher real prices for labor, brought about through greater investment in the human resources of rural areas and the resulting greater occupational mobility, minimum wage laws, an age distribution of farm operators skewed towards older persons which must give way to massive retirements and new entrants in the near future—all of these favor a continued substitution of capital for labor. The numerous
time-series and cross-section resource demand studies completed to date indicate clearly that farmers are responsive to these relative price changes for resources. Investment is made in labor substitutes as the price of capital declines relative to manpower and the quantity of labor demanded is smaller as its price increases.

**Labor Substitutions**

The use of more capital gives rise, of course, to cost or scale economies that specify larger and more specialized units if farming is to be profitable. During the past two decades these phenomena are reflected on an aggregate basis by the large decline in manpower and simultaneously a large increase in capital representing operating items, machinery and equipment. Over the period 1945-66, farm employment declined by 50 percent and non-real estate capital (constant dollars) advanced by 350 percent. At the same time, the average farm of the nation increased by 154 acres or 78 percent in size and the number of farms declined by 2.7 million or 45 percent. Aggregatively, this substitution is both real and obvious. But from a farm management research standpoint, the process is not so obvious. More needs to be known about it, both for purposes of guidance of individual farmers and for assessing the rate at which the set of social and economic problems mentioned earlier will face the rural community in the magnitude indicated. Machinery, equipment and new building designs are direct substitutes for labor. Less actual labor and more substitutes for it have, therefore, shown up aggregatively in agriculture as technologies and relative prices favored the shift. Similarly, biological forms of capital such as fertilizer, insecticides, feed additives, improved varieties and others are substitutes for labor. With higher yields per acre or animal, fewer are needed and total labor requirements of the agricultural firm are lessened. Yet, in response to the changed prices of resources, the farmer does not always or typically select a new mix of capital and labor along an isoquant and change his resource structure so easily. As the prices of fertilizer or insecticides decline relative to labor, the farmer does not simply buy more of these items, put them into use and replace some of the labor contributed by him, family members or a hired man. Neither does he typically buy a machine and release some labor from the farm. While this process does happen on farms with a moderately large input of hired labor, a farm depending on family labor or even one hired man typically lessens employment intensity of the labor supply or acquires more acres and animals to allow an effective use of the machine and labor. Following the latter route, however, some labor is replaced, as acres and animals are taken over from other operators. We know little about these indirect processes of capital-labor substitution on individual farms, although their occurrences in the aggregative time-series data are obvious. Similarly, we know little about the supply conditions of resources in the restricted market, in
contrast to a state or national market, which surrounds the individual farm for land and similar resources. Hence, we cannot describe or project the rate at which these substitutions can take place in the future. We know so little about the rural mechanisms of this capital-labor substitution and local resource supplies that we are unable to project the rate of change implied for the future firm with its broad social implications for agriculture and the rural community. Likewise, we are able to give farmers little guidance on the expansion paths or isoclines they should follow in extending the resource mix to the farm size and volumes projected to be consistent with resource prices and productivities of the future. These processes and expansion on the individual farms do not unfold in the same manner as in a set of time series regression equations to provide estimates of resource demand or its changes.

Scale Economies

A great deal of importance to individual farmers, rural communities and agri-business firms revolves around the scale economies of the firm under current and prospective technology. While the term "scale economies" is shop-worn and old much depends on the concept, or its counterpart in cost functions of the individual farm firm, in respect to who can or should farm, the source and volume of the credit or capital supply to farmers and the institutional structure of the farm. Whether there will be 50,000 or a million farms in the future rests not on time trends that can be projected from time series data but on the nature of cost or scale economies of the farm firm. Similarly, the number of merchants and the displaced labor force of agriculture, and the retraining investment involved, hinges on these coefficients. But as of now, there is only scattered evidence of these relationships. We have no adequate inventory of research, for example, indicating the existence or even the nature of short-run and long-run cost functions, in technologies related to highly mechanized and large-volume cattle feeding or dairying operations. We can find no closely related data suggesting a feasible scale of operations under environmentally controlled livestock production. Neither are there data available to indicate whether the important cost economies relating to prospective and upcoming technology rest in the farm firm or in the input-supply firm. If it is the former, one set of decision, and even political, forces will determine the direction of agricultural and the managerial research which should be conducted in its behalf. If it is the latter, control will tend to be invested in quite a different direction and the managerial resources available for generating decisions will be much more numerous and sufficient. If the major cost economies reside at the level of farms, the machines and equipment will be owned and controlled by the traditional farm manager, upgraded as he may be. On the other hand, if the relevant scale economies are in the firms that supply inputs and if the direction of development is for these input supply firms to own and furnish the machines for farm
operations on a custom basis, quite a different financing and capital of the farm firm will result. Under these circumstances, the farm operator might be a sort of sophisticated landlord or animal tender who furnished the land or animal services while the chemical or machinery firm furnished machines and operating capital.

Whether and when either of these developments comes about depends on the scale or cost economies involved in typical field and farm operations. Needless to say, our research information on scale economies is now so scant that we can not inform the farmer whether or not he should prepare to become a sophisticated landlord or animal tender while the input firm is depended upon to furnish machines, chemicals, seeds and feeds. Neither can we decide whether the seat of management will change so drastically that we should turn our services in managerial research aids in the directions of the agribusiness firm.

We have no information, at least to our knowledge, to indicate the extent to which cost or scale economies that favor larger farms unfold from price or production functions. If such scale economies are attached largely to the elasticities of the production function, it seems rather obvious that the control, management and operation of farms would continue to reside with the farm manager. The scale or cost economies could be duplicated as easily on farms as in the input supplying industry. On the other hand, if the greater economies are reflected in the price function relating to material inputs, or the cost functions of processing firms, and if mammoth scale were necessary to realize these through the capital markets, the farm operations might more nearly pass over into the hands of the input supply firms; again leaving the farmer simply as an animal tender or as a sophisticated landlord furnishing land services. If the main scale economies were associated with elasticities of the production function, farmers might band together in group farming operations as in parts of Europe. However, if economies were mainly those relating to material inputs or the cost functions of processing firms, requiring massive scale and volume, the aristocratic landlord or the animal tender might be more in prospect.

It is obvious, of course, that as relative resource prices and productivities shift to alter the marginal rates of substitution of capital for labor, with more capital and less labor used in farming, that the fixed costs of farming increase. This is true because of the large capital investment involved and the relatively rapid obsolescence of new capital forms. Hence, larger volumes are required to attain break-even points and profit margins. Modern farmers think in terms of break-even volumes and profit margins, knowing that if scale is extended far enough profits exist and grow in a larger proportion than output. They have been made aware of these concepts and operations not only because of the large investments and high overhead costs, but also because of
the large investments and high overhead costs, but also because of the
greater cash costs even for constant-per-acre-or-animal outlays for
operating items such as seeds, chemicals and insecticides.

The concepts of scale and cost functions have been widely used and
durable and continue to be important ones for employment in research
if we are to establish sensible guides for the upcoming generation of
farmers or even if we are to have dependable estimates of the number and
sizes of farms that will exist in the future. It is rather obvious that as
few as 500,000 farms could readily produce the nation's output. Once
the number of farms had been reduced to that extent they would be so
large that few would encounter difficulties in getting capital supplies
or with financing. However, the process of moving from our present
number of farms to 50,000, involving as it does the absorption of 2
million small units and consequent expansion of those that remain,
poses restraints, particularly those related to difficulties and time
lags in financing. Hence, scale studies seem relevant to better indicate
whether we are in prospect of only 50,000 farm units or the rather easily
attainable 500,000 commercial farms.

Numerous projections on "prospective" and "possible" farm numbers,
exist. If simple trends are projected, the estimated number of farms for
1980 is around 2 million. A more realistically based projection con­
sidering the distributed lags traditionally associated with change in
farm structure would put the number at 1.5 million farms in 1980, with
half of these represented by commercial units and half represented by
nominal part-time and retirement units.2/ Of course, 750,000 commercial
farms of a very reasonable and modest size, those with sales of
$10,000 and over, already could quite easily produce the nation's
food and fiber output—with only slight expansion to take over the re­
sources and output of the other farmers. But how rapidly the number falls
and whether it approaches 50,000, 100,000 or 500,000 at a near­
equilibrium of the industry, will certainly depend on the extent and
degree of cost or scale economies, and whether it will be 50,000 or
500,000 will make a great deal of economic and social difference. It
would seem that the state of the arts in economic research has both
simple and complex tools which should throw some light on the possi­
belities. Perhaps research on scale economies and cost functions,
as one of the older sets of concepts related to firms, seems too elemen­
tal to merit analysis in this dashing era of analytical techniques and
mathematical mechanisms. Yet the extent and degree of scale economies
in agriculture is more important, with respect to both the nature of the

2/ Earl O. Heady and A. Gordon Ball. "Economic Growth of the Farm
Firm and Projected Changes in Farming." CAED Report 24. Iowa
State University. 1965.
individual firm and the structure of the rural community than any other phenomenon relating to the individual farm. Needed in this realm of established concepts but less well accepted methodology, are measures of cost functions for farm firms with different complements of fixed resources (the large-scale enterprise or farm) and measures of scale returns for farms that represent multi-producing units under the same management (forgetting momentarily given management as a fixed input outside the "pure concept" of scale returns). Again whether increasing returns to scale prevail or not, and whether they unfold from the elasticities inherent in the technical production function or price functions which decline for resources or increase with outputs for large volumes, will determine whether there will be both many fewer farms and managers—or many fewer managers with more farm units held under their control and a large input of skilled laborers and supervisory personnel. The two possibilities, the former supposing scale economies through the production function and price functions and the latter through the price functions alone, have quite different implications in the labor force of agriculture and its management.

The range over which scale economies may exist and their degree, or simply the range over which the long-run cost function declines, also has optimal relationships to the institutional arrangements under which farm firms operate. If they are relatively restrained but still allow farms of sizes that give rise to problems of capital acquisition and accumulation to individual families, corporate forms of business may be best suited from the standpoint of taxes and "holding the unit together." But if the scale or cost economies extend even further and give rise to greater capital accordingly, group farming activities may provide the means competitive to the structure sometimes posed of farmers as sophisticated landlords or animal tenders while the field operations, chemical drugs and feeds are services provided by the input firm. In any case, the inter-relationships of scale and business form should be researched in order to provide guidance in decisions to farm managers, selecting among the many routes they can follow under a growing capitalization of agriculture such as corporate organizations to circumvent inheritance taxes or to accrue funds through the nonfarm capital market, integration with the input and processing industries, group farming, etc.

**Capital-Land Substitution**

While capital-labor substitution brings many problems of displacement of workers and families from farms and the rural community, capital-land substitutions bring mainly problems of producing capacity and the attending complexities of short-run supply elasticities and price and income levels. Almost every biological form of capital invented
for use and finding application in agriculture serves as a substitute for land (and indirectly as a substitute for labor in the sense that fewer acres need to be operated). Similarly, biological and other innovations that increase livestock output from given feed, or reduce feed input for a given livestock output, also serve as land substitutes. Less land is thus required to produce a given feed and animal output.

These substitutions have been mammoth over the past. Not only were we producing a 45 percent greater output in 1965 than in 1945, but we also were doing it with around 60,000,000 crop acres held out of production. The possibilities of these substitutions still exist, and perhaps their application in the future will be even more rapid than in the past. The theme in the base papers presented at this conference certainly point in this direction. Some of our own estimates emphasize these potentials. Even using the conservative assumption that trends in productivity gains of American agriculture will rise to 1980 at the 1954-64 rate, in contrast to the higher 1955-64 rate as the rates more nearly implied in the base papers of this set, we estimate that U.S. agriculture can produce the output needed by a 1980 domestic population of 243 million with per capita incomes of $3,300 (based on 1957-60 value of the dollar) with (a) 75 million acres shifted from crop production if exports are only equal to the 1965 level and (b) 50 million acres if exports grow to three times the 1965 levels.3/ These are still mammoth substitution possibilities which are realistic and too conservative against the propositions and projections offered in the base papers.

Individual technologies have high rates of substitution for land resources. Fitting even fertilizer substitution into a framework of

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continuous land-fertilizer production functions,\(^4\) we estimate that the potentials in this substitution are still extremely great. Considering fertilizer alone at the rate farmers currently use it, and basing estimates on productivities derived from experimental production functions we estimate that a ton of fertilizer substitutes for 15-25 acres of land over the Corn Belt proper.

\(^4\) In making these estimates, we started with experimental response functions of the form:
(a) \(Y = a + b_1 F_1 + b_2 F_2 - b_3 F_1^2 - b_4 F_2^2 + b_5 F_1 F_2\)

where \(Y\) is yield per acre and \(F_1\) are individual nutrients \(N_1, P_2, O_5\) and \(K_2, 0\). Next we convert them to fertilizer response functions where represents quantity of the common mixes used in the regions of the experiment. Since \(\phi\) represents the combination of \(F_1\) and \(F_2\) in the ratio of \(F_1^* F_2^*\) implies an optimal or conventional mix. For determination of the coefficients in the function \(Y = f(\phi)\) we let

(b) \(R_1 = F_1^*/\sum_{i=1}^{2} F_i^*\)
and (c) \(R_2 = F_2^*/\sum_{i=1}^{2} F_i^*\)

and since

(d) \(\phi = \sum_{i=1}^{2} F_i^*\) therefore (e) \(F_1^* = R_1 \phi\)
and

(f) \(Y = a + \phi - \phi^2\)

Now, since the function is on a per acre basis, we divide by acreage to get

(g) \(Y_a = a + \phi A^{-1} - \phi^2 A^{-2}\)

Now by multiplying by \(A\) to get land in the production function, we have

(h) \(Y_t = aA + \phi A^{-1} - \phi^2 A^{-1}\)

The equation of marginal rate of substitution from which our calculations were made is

(i) \(\frac{\partial A}{\partial \phi} = \frac{2 \phi A - a}{\phi^2 A^{-2}}\)

and we set \(\phi\) at farm level uses, the ratio \(\phi/A\), for the calculations. The estimates are from an unpublished paper: Capital-Labor Substitution at Different Locations by Fahmi Bishay and Earl O. Heady. Iowa State University. 1966.
Add other biological capital items and the rate can be equally high for the investment. New seed varieties, insecticides, growth hormones and similar items probably have even higher marginal rates of substitution relative to the investment. Herbicides may be nearly as high.

It is, of course, these operating items of capital that are having, and will have, the greatest effect in increasing the productivity of capital. They provide much of the basis for structural change as it is effected through the total supply capacity of American agriculture. These forms of capital are, and will continue, to grow in domination over the total capital used on farms. In our projects, we find that real estate capital for agriculture in total will increase by less than 10 percent in the next 15 years; although it will more than double per farm if the number of farms is halved. The growth in total real estate capital will be very modest due to farm size expansion and the consolidation of units that does away with duplicate sets of buildings that are not always fully employed on separate units. Added investment in the total stock of machinery and equipment is projected to increase by less than 25 percent for the agricultural industry. This statement refers to the value of the inventory or stock of machinery on farms. Total purchases of machinery will exceed this, as obsolete equipment is replaced by improved models. The consolidation of farms into larger units causes a dampening down of the total supply of machinery because duplicated sets of underemployed equipment are not needed on the separate farms.

For operating capital items, however, total input is projected to double in the next 15 years. Hence, the quantity per farm would be expected to quadruple, if farm numbers were halved. A mammoth substitution of biological capital for land will thus occur, and annual outlays of $50,000 per farm for operating inputs can be quite common place for conventional but large scale family farms over the next two decades, even if the number of truly commercial farms reduces only to 700,000.

In terms of capital-land substitution, the process does not take place directly on the individual farm. The operator does not buy a ton of fertilizer, a drum of insecticide and a bag of "new variety" seed and apply them while he withdraws a corresponding acreage of land (except as this process is effected through land diversion under government programs.) Rather, he buys this mix of capital inputs and applies them over the whole acreage; with the output of the entire farm increased accordingly. Yet in this process, the same or more output can be produced with less land. Hence some farmers can realize an expansion without acquiring control of additional land which would otherwise be the case. (The fact that the land isn't withdrawn results in an overly large output and low prices in the short-run.) Yet substitution
of capital for land has taken place and land at the margin could now be shifted from particular crops to other uses and substitution has taken place in a national sense. On one individual farm, the process is simply one of using more inputs. But for the farm at the margin in a different location, the problem is one of shifting its entire organization as the substitution process takes place. We should have research which interprets these processes in the broad manner in which they take place, and pinpoint the regions of major adjustments for guidance of individual farms. This indirect and round-about substitution process, which simply adds up nationally in our ability to produce more from a given national agriculture, has quite different capital implications. The farms in the "heart of the producing regions" that apply the new biological capital have to increase their investment accordingly, but they add little or no real estate investment at the time. However, the marginal or fringe area possessing the land, for which the biological capital applied at the heart of the producing regions substitutes, is faced with mammoth capital requirements as it has to acquire more acreage and shift from row crops to grass and grazing or trees.

Firm Growth

Propositions put forward in these papers, plus other projections, suggest a much larger capital investment per farm in the next 15 years. The typical commercial farm will easily be in the farm-products-sold class of $20,000 and over by then and at some point in the future, we can be sure that the lower boundary of growing and competitive commercial farms will rise to $40,000. Some of our own projections suggest that the investment per farm even when all commercial farms reach the rather modest farm product sales level of $20,000 will be $225,000 by 1980, a 27 percent increase (in constant dollars) over 1960. Many more, of course, will approach a half million dollars. While these are projections, the "speculated possible" 50-100,000 farms would entail mammoth investments per farm.

Hence, there is an important analytic problem of firm growth in agriculture. We have never had much research on this problem even for the traditional firm of the past; when it went through a definite life cycle tied in quite closely with the life cycle of the household that attached to it. Starting from a small equity, it grew in a manner related to the surplus of income generated over living expenses and its equity-restrained capital supplies. This growth process limited greatly the capital available to it. Its capital supply increased with time as the equity and credit restraint moved up with greater family income and savings. How, now will it grow to accumulate the more massive amount of capital needed? Or will this trend be represented in growth models of the individual firm, aided by new supplies of
capital provided through different institutional mechanisms such as sale of common stock in the market, or by vertical integration with the integrating agribusiness firm tapping the general capital market in sale of stock? Or will this transition not be made by an existing generation of farms that will grow to the larger scale, but by a discrete break between generations of farm firms. As owners of present farms retire, will a new group of "swinging" managers and capitalists acquire the resources and initiate an entirely new firm structure from the outset? And what will be the growth process of the latter once it is initiated?

The growth process of existing and future firms will determine if, when and by what extent farm numbers will dwindle to economically strangle the traditional rural community. It will have other implications for which we should be readying other plans to create viable rural structures and communities. Yet we know little about these processes; partly because they are difficult to study, but partly because they simply have not been studied. Sufficient time series data in the farm accounts of many states would allow application of models resting on modern growth theory. Also, many interesting normative-type analyses could be applied through dynamic and nonlinear programming models.

There has been continuous pressure during recent years for the farmer to increase his size of business. Previous papers of this conference and projections from other sources suggest that much larger farm businesses are in prospect for the future. Many of our present farmers, however, are already trapped in a situation of "forced savings" because of the competitive pressures to increase the size of their farm business. Such farmers actually lower their current living standards in order to accumulate money to invest in their business. The element of "forced savings" in agriculture together with the inflation in land values over the past decade have resulted in a situation where many farmers have acquired a relatively large net worth in their business in spite of the fact that their net farm income has been relatively low.

A recent study reported that the average per family net worth of farm people in 1962 was $51,600. While the average net worth for the non-farm family was estimated to be $11,581, and at the same time the average income for farmers was $1,430, as compared to $2,440 for non-farm families.5/

Many important problems are associated with the methods by which capital is accumulated in the agricultural industry. The high degree of dependence on their own savings has forced many farmers, particularly young farmers, to operate units well below an optimum or even satisfactory size. Since capital accumulation is an essential element in the growth of the firm, limits and obstacles to the process will have substantial effects on which farm firms survive, the firm organization and so on.

The desire to have complete ownership of the farm capital by the time of retirement has forced an unduly high rate of savings on the farmer. Should farmers be encouraged to sacrifice consumption standards during most of their lifetime in order to complete ownership of all farm capital before retirement? These and other problems relating to financing the farm and to its growth will increase in number, severity and complexity. Entirely new methods of financing the farm may be required in the future.

Research is needed to determine not only the necessary and sufficient elements of firm growth in agriculture but to explore relationships on farms between current income, consumption, investments and net worth. More needs to be known on how farmers who have accumulated sizeable net worths can best contend with estate taxes associated with the transfer of the farm once every generation. What are the prospects for farmers in the future to get their capital as Lester Kellogg suggests, by selling shares to the public and through long term loans at prime rates from established financial institutions? Is it feasible for such shares to be sold directly to the public or will such financing have to come indirectly via input suppliers or output buyers with known reputations whose shares are already exchanged on the stock market? Research is needed to determine alternative methods for avoiding the discontinuities of investment and competent management in farming associated with the life cycle.

Handling Risks and Uncertainties

Farmers have always had their relatively simple strategies for dealing with risk and uncertainties. Included are strategies that are conservative or of the maximum nature, such as selecting enterprises with low income variance, diversification to provide income stability, self-restraints on capital use and others. What types of strategies and decision mechanisms become applicable under much larger and more highly specialized farm firms? In contrast to labor technology, capital intensive technology calls much more for a high degree of specialization. When labor was the main input of farming, the farmer and his family could switch their efforts relatively easily back and forth among a
few hens, a flock of geese, a dozen milk cows, a few brood sows, a small drove of feeder cattle and a mix of corn, soybeans, small grains and hay. This flexibility melts away when the resource to be switched is capital in the form of specialized machinery and equipment. A picker-sheller can hardly be switched to milk cows or convey feed in a broiler battery.

It is for this reason that changes in resource prices that favor capital inputs over labor not only bring larger farm units but also bring greater specialization. But greater specialization also poses the possibilities and actualities of wide swings in income as yields or prices fluctuate. These phenomena may themselves squeeze specialized farming operations in the direction of vertical integration and animal tenders, in order that more of the burden of risks and uncertainties are borne by very large scale agribusiness or input-furnishing firms. There are reasons in probability to provide a mathematical justification for this trend. The large firm integrated over a large number of farms and animal tenders may have a sample large enough to reduce income variance much lower than the individual farmer. With a stronger capital position, and the ability to withhold or lessen dividends to common stockholders in scattered unfavorable years, the agribusiness thus integrated also has the possibility of more observations and a greater sample in time. It may be thus better able than an individual farm manager to operate under wide fluctuations of income of a more highly specialized agriculture.

Yet there are other strategies that are used by industrial firms and may be potentials for otherwise highly specialized farms and farm managers. Industrial firms do diversify, but not by producing a smattering of several products in the same plant. Instead, they simply buy up the assets of a specialized firm at a different location producing an entirely different product. Steel firms buy up grocery chains, electric organ manufacturers buy up firms that produce work clothes and automobile manufacturers acquire the assets of firms that produce household appliances. Are these the optimal strategies in the future for highly specialized farms? Should the owner and manager of a 50,000 feed lot in the Corn Belt buy a specialized 100,000 acre wheat farm in the Great Plains and a specialized egg unit in Maryland?

Research has never been adequate on the potentials and outcomes for farmers in meeting risks and uncertainties. The new era posed in the structure of farming for the future places new importance on problems of decisions under uncertainty and gives them renewed relevance in research. What are the outcomes in the application of existing game or decision models? What adaptations and extensions in subjective and probability models can and should be made for the new generation of farms and farm managers?
Functions and Qualities of Management

Industry has always distinguished rather sharply between the types of human resources best suited as labor, supervisory roles and management. In the traditional farm, they were the same person. Yet the upcoming structure of agriculture outlined in numerous papers in this set suggests a scale of farm operations in which the same stratification of human effort now used in industry might be applicable.

If farm numbers ever reduce to the point suggested by Lester Kellogg in his paper or to the number "tabbed" as possible by Ruttan, we will certainly have farmers who specialize in the management function leaving the actual farm operation to a highly skilled foreman or other supervisory personnel. Even if commercial farms only more modestly graduate to the present economic class of sales over $40,000 and are represented by more two-and three-man farms, we expect more of this division in functions of farm manpower. Decision procedures indicating who should become managers of farm firms and who should become the skilled workers to conduct technologically advanced operations may become highly relevant. It is possible that the two should arise from entirely different training. As has been suggested by Kellogg, perhaps managers should be trained in business schools, raised in a nonfarm environment where they are associated more with individuals who have their origin in families from the chemical, drug, computer and similar firms of the nonfarm sector. It may be more nearly the skilled worker and supervisory personnel who should go through our current complement of vocational agriculture and agricultural college training--but even the latter need further restructuring to meet the type of agriculture we are discussing here. Training even at the agricultural level needs to break more away from departments and follow interdisciplinary lines; to be based more on fundamental science and decision models, and only "topped off" by the applied agricultural courses. Training at the level of vocational agriculture in high school needs to go somewhat in the opposite direction; namely away from one man departments and "general purpose instructors," to several specialists who can surround enough deep knowledge in some discipline to surpass the knowledge of operating farmers. Of course, if Ruttan's 50,000 farms are ever attained, we won't have much room for education in specialized vocational agriculture departments and agricultural colleges. The training then will come from enrollment in business, botany, biochemistry, computer programming and similar courses.

The questions that revolve around the future nature of management resources and decision procedures are large and important. They are important for determining the magnitude and nature of agricultural education, in decisions of individuals with respect to deciding who should become a farm manager, in structuring capital investments to meet
uncertainty and for many other important issues. Research relating to managerial problems and procedures will be more important for the future than the past. But we have always had too little of it.

**Managerial Aids**

While it is less a problem of research and more nearly one of projection and enlightened guidance, some thought needs to be given to the managerial or planning methods and decision models to be used by farmers in the future. Some analysis needs to be devoted to the extent to which and conditions under which programming and related models can improve decisions and the economic performances of the firm. On the basis of these findings, specifications need to be made relative to the institutions or organizations that can best provide these aids and services.

If, as some speculate, the farmer is to become the sophisticated and highly capitalized landlord furnishing land services, or the animal tender furnishing labor services while the agribusiness firm furnishes the other inputs and services for farm operation, no problem exists. Under these circumstances the agribusiness firm will furnish the computers and models for farm decisions. These agribusiness firms will be of a scale to merit investment in the most advanced computers for applying systems analysis as some now call it (but more nearly the conventional economic models and the newer programming and related models that are the core of firm theory and profit systems). Indeed some such firms are already moving in the direction of providing these aids to individual farmers, with the services acting to complement the inputs sold the farmer.

Even if farming never reduced to the land-furnishing and animal-tending category in integration with agribusiness, but only to the level of 50,000 commercial farms, numerous of these farmers might be able to invest in limited capacity computers for applying the more modest linear programming models consistent with specialized farms. And/or they could afford to be members of a group investing in a trained analyst to provide programming routines and interpretations. With farming reduced to these numbers, certainly the major planning would be done by programming and other more sophisticated procedures. We would expect programming models to become the basis of farm planning even if farm numbers reduced, at some reasonable point in time such as 1985 or 1990, to 500,000 truly commercial farms. In this case, services of programming and decision models, as well as farm accounting, perhaps could be best furnished by firms and organizations specialized to this purpose. Whoever performs this service, the agribusiness sector, private concerns organized for this purpose or the state agricultural extension services, will find the major leadership of commercial
farming operations falls in its hands.

As part of this complex, various models of operations research need to be researched more deeply in terms of their relevance in investments and management for large-scale, specialized farms. We can imagine that the posed Corn Belt farm that uses little field machinery but many chemicals and drugs, harvests the entire corn plant and handles feed through a specialized center with advanced storage and handling equipment, produces livestock under environmentally controlled conditions, is faced with problems of antipollution in disposing of its wastes, etc., will need courses of action and investments prescribed by queuing and inventory models, simulation techniques, critical path programming, turnpike theorems and others. More research should be initiated now to better mesh and perfect models for these purposes.

**Labor Management**

Data presented here and elsewhere indicate prospects for important changes in the farm labor market. A greater proportion of the work force on commercial farms, as they transgress through economic classes, towards the structure of Class I farms with sales of over $40,000, will be hired and family labor will continue as a declining component. Investments in education and vocational training, elimination of poverty, improved employment services, retraining of established workers and other facets of the human resource will reduce the supply and increase the supply elasticity of labor to agriculture. Minimum wage laws will raise the reservation price of labor to agriculture. "Captive" migratory labor will be in smaller supply and more of the hired labor force will live away from farms--unless some rather large upgrading of living facilities and fringe benefits takes place for farm workers. Thus the farm manager must bid against competing employers for labor drawn from local sources and which lives in the towns and villages along with the labor employment in other firms and institutions of the community. This setting is quite different from that of the past and places the farmer in a different role as employer and manager of labor. The farmer is at a disadvantage where he must recruit labor from local services for seasonal tasks but cannot offer work during the rest of the year nor provide them with competitive fringe benefits.

Traditionally, the less desirable farm jobs were performed by unskilled labor with few or no alternatives. In the future, a growing number of farm workers will be able to choose better wages and working conditions of both farm and nonfarm jobs. Two-thirds of all the hired-work force lived in nonfarm places in 1965.
Most farmers have not developed the employer skills to compete effectively as recruiters and managers of labor in this type of market. Some will respond, as rightly they should when the real price of labor rises sufficiently, by substituting more machines and capacity for workers. Yet we need to investigate the conditions under which farm managers can function effectively as employers in a changing market for labor and a changing structure of the farm work force.

Conclusion

We have not attempted to inventory all of the farm firm research implied for the future. Much of it will be conventional in nature and is evident in usual decision models of old or new vintage. We have tried to select the realms of research that stand out as, through the implications of previous papers, agricultural transformation continues with the further rapid injection of new technology and operating capital into the industry. Whether the research and the corresponding communication and education is accomplished by public institutions or private institutions will certainly determine the leadership of agriculture.
OVERCOMMITMENT OF RESOURCES IN THE PRODUCTION OF FARM PRODUCTS

by Glenn L. Johnson*

Currently, there is a feeling that U.S. agriculture is at the end of a long period of surplus farm production and that all there is to worry about is expansion of farm output to feed the people being created by the population explosion. Others also feel that such drastic structural changes are taking place in the organization of agricultural production and marketing that overcommitted resources are a thing of the past.

In the following pages, I shall speculate as to whether structural changes now occurring in U.S. agriculture will prevent further overcommitment of physical and financial resources. I shall also argue that the international food gap will not reverse the long-standing tendency to overcommit resources.

In so speculating and arguing, I propose first to look briefly at the historical facts. Following this, I will look at the theoretical structures which underlie our reasoning on such subjects. Then I will look at some of the relevant structural characteristics of American agriculture and its producing firms. Following this, I will examine the structural changes which are occurring to see if they are likely to stop the overcommitment of physical and financial resources to agricultural production. Finally, I will sketch out some of the kinds of structural changes still needed to stop the overcommitment to and wastage of resources in U.S. agricultural production which will indicate some needed research in farm management, policy and marketing.

A Look at Some Historical "Facts" 1/

In looking at the history of resource use in United States agricultural production, 1917 to date, 2/ I find it advantageous to break

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1/ This section is based largely on Calvin Quance's, "Farm Capital: Use, MVPs, and Capital Gains or Losses, United States, 1917-1964," Unpublished Ph.D. Thesis, Michigan State University, 1966, and an incomplete M.S.U. thesis by Francis Van Gigch.

2/ As part of a study conducted by the author, financed by Resources for the Future and involving the work of Bob Jones, Edward Rossmiller, Arne Larson, William Lerohl, Chenareddy Venkareddy, Calvin Ouance and Francis Van Gigch with the advice and assistance, among others, of Dale Hathaway, Lester Manderscheid, David Boyne, Gladys Baker and Marion Clawson.
the period down into sub-periods: 1917 to 1929 -- from War to the Great Depression; 1930 to 1933 -- into the depths; 1933 to 1941 -- from the bottom to World War II; 1942 to 1946 -- World War II; 1947 to 1954 -- from War to Peace to War to uneasy Peace: 1955 to 1965 -- from Korea to the international food gap.

Some Historical Facts -- By Periods

The period from World War I to the Great Depression was characterized by the overcommitment of land, labor and of some forms of capital to agricultural production. The overcommitment of land was both physical -- too much was used -- and financial -- too much had been paid. This excessive commitment led to high output, low farm prices, capital losses and hardship in the rural relative to the non-farm economy. As there were no governmental programs to maintain prices above market-clearing levels, stocks did not accumulate; instead, the burden of adjustment fell on prices, incomes, wealth and hence on farmers and their families. In this period the culprit blamed was World War I which, it was correctly reasoned, had caused farmers to mistakenly "overcommit resources to agricultural production." Having found a whipping boy, few, if any, asked whether it was inherent in the system that farmers overcommit resources to the extent that the resultant output would put such adverse pressure on prices that farmers would fail to recover their expenditures on resources and fail to earn returns comparable to those obtainable in alternative industries.

Then came the 1929-33 slide to the depths of the Great Depression. This world-wide financial collapse deflated the entire economy bringing with it widespread unemployment and loss of domestic demand for farm products. As the Great Depression was international in character, an added loss of foreign demand for farm products accentuated problems for American agriculture. Thus, a new culprit had been found on which to blame the overcommitment of resources; instead of pointing an accusing finger only at World War II, we now blamed the monetary-fiscal system for the hardships experienced by American farmers as a result of producing so much that it could not be sold at prices high enough to cover investment expenditures. The linkage between the Great Depression and rural hardship was obvious. Thus, there was still no compelling need to ask whether the agricultural economy of the United States has inherent characteristics which cause it to overcommit resources to agricultural production.

The 1933 to 1941 period, the period from the depths to World War II, was characterized by governmental programs designed more to alleviate symptoms than to cure the disease of overcommitted resources. As the causes of the disease were taken to be World War I and the Great Depression, it was hard to conceive of doing anything within agriculture about causes. The prevention of wars was left to the diplomats and of
depressions to the monetary/fiscal experts while agricultural econom­ists, trained in static theory, got on with the task of supporting prices and of preventing the use of overcommitted resources -- in short, agricultural economists treated symptoms leaving the disease as they saw it to others.

Then came World War II. Farming did become more profitable and events revealed that despite governmental attempts to restrict use of overcommitted resources, more resources had been committed. Obviously, productive capacity had built up in the inter-war years despite apparently adverse economic conditions for investing in agriculture. Various studies of U.S. capacity to produce agricultural products credited technology, specialization, agricultural education, and land-grant research for the rapid expansion in agricultural production with only modest increases in the use of capital and without much expansion in the use of land and with a reduced use of labor.  

In the years 1947 to 1954 -- from World War II to the end of the Korean War -- World War II, the Steagall amendment price supports and the Korean War were blamed for overcommitments of resources to agricultural production. Production expanded rapidly and the stage was set for at least ten more years of over-production. In this period, price supports and governmental storage programs were to mean that the symptoms of overcommitted resources would be enormous governmental stocks of agricultural products rather than reduced prices and incomes and capital losses on investments in agriculture capital and land as in the 1917-30 and 1930-33 periods. Increasingly, these government programs became the culprit blamed by many of the ills of agriculture. The availability of this whipping boy, it seems, explains in part why agricultural economists, farm leaders and USDA officials did not ask themselves the fundamental question of whether inherent characteristics of American agriculture were responsible for the overcommitment of resources irregardless of World War II, the Great Depression, World War I or government programs.

3/ A few studied countercyclical measures largely under the leadership of T. W. Schultz.  


5/ The few inadequate explanations which were advanced by laymen and others were rather summarily dismissed by the better-trained theorists among agricultural economists. See John M. Brewster & Howard L. Parsons, "Can Prices Allocate Resources in American Agriculture?" Journal of Farm Economics, November 1946.
The ten to twelve year period terminating around 1965 brought U.S. agriculture to the international food gap. In this period, substantial governmental measures were taken to dispose of governmentally held stocks at home and abroad. These programs were conducted at great cost and expense to the American tax payer and were of questionable value to recipients in the developing countries. As the world demand stiffened for agricultural products, it became easier to export agricultural products and by sometime in 1965, the end of excessive governmental stocks was in sight for everything except cotton. By now, 1967, it appears that we no longer have culprits to blame. In fact some people say that a new era has come. The international food gap and the changing structure of the American agricultural economy, according to these people, now mean that we are through with overcommitting resources. Yet, a very relevant question to ask involves whether or not there are still inherent characteristics in the U.S. agricultural economy which lead to overcommitting resources.

Some Historical Facts -- By aggregated Factors of Production

Another way to look at the historical factors is to look at them from the standpoint of labor, land, and various forms of capital.

From the standpoint of labor, the record 1917 to date is one of almost continuous overcommitment of labor to agricultural production. Table 10.1, by Venkareddy, shows his estimates of the present value of agricultural laborers in five different industries: agriculture, retail services, construction, manufacturing, and laundries. Over the entire period, the value of agricultural laborers has remained rather comparable with that of laborers in laundries, while the value of laborers in construction and in manufacturing has grown steadily relative to the value of agricultural laborers. A number of agricultural economists have analyzed the supply of agricultural operators and laborers by following age groups -- cohorts -- through time. These include Clawson, T. W. Schultz, "Impact and Implications of Foreign Surplus Disposal on Underdeveloped Economies," Journal of Farm Economics, December 1960.


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<th>Year</th>
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<th>Manufacturing Present Value (in current dollars)</th>
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<td>25,617</td>
<td>35,027</td>
<td>42,118</td>
<td>23,862</td>
<td>28,194</td>
</tr>
<tr>
<td>1939</td>
<td>25,617</td>
<td>35,027</td>
<td>42,118</td>
<td>23,862</td>
<td>28,194</td>
</tr>
<tr>
<td>Year</td>
<td>Farming Present Value (in current dollars)</td>
<td>Manufacturing Present Value (in current dollars)</td>
<td>Construction Present Value (in current dollars)</td>
<td>Laundries Present Value (in current dollars)</td>
<td>Retail Trade Present Value (in current dollars)</td>
</tr>
<tr>
<td>------</td>
<td>------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>---------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>1940</td>
<td>22,575</td>
<td>44,730</td>
<td>54,415</td>
<td>28,518</td>
<td>35,035</td>
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<tr>
<td>1941</td>
<td>25,946</td>
<td>53,391</td>
<td>61,603</td>
<td>30,046</td>
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<tr>
<td>1942</td>
<td>32,049</td>
<td>65,574</td>
<td>70,689</td>
<td>32,775</td>
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</tr>
<tr>
<td>1943</td>
<td>37,625</td>
<td>72,871</td>
<td>68,058</td>
<td>35,902</td>
<td>42,261</td>
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<tr>
<td>1944</td>
<td>40,288</td>
<td>74,213</td>
<td>68,448</td>
<td>39,247</td>
<td>45,065</td>
</tr>
<tr>
<td>1945</td>
<td>41,789</td>
<td>70,505</td>
<td>71,550</td>
<td>41,217</td>
<td>47,073</td>
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<tr>
<td>1946</td>
<td>43,827</td>
<td>70,454</td>
<td>82,666</td>
<td>44,733</td>
<td>54,148</td>
</tr>
<tr>
<td>1947</td>
<td>47,559</td>
<td>83,199</td>
<td>98,431</td>
<td>48,770</td>
<td>60,535</td>
</tr>
<tr>
<td>1948</td>
<td>50,168</td>
<td>86,339</td>
<td>104,816</td>
<td>49,680</td>
<td>62,340</td>
</tr>
<tr>
<td>1949</td>
<td>48,112</td>
<td>80,595</td>
<td>96,338</td>
<td>48,428</td>
<td>61,487</td>
</tr>
<tr>
<td>1950</td>
<td>47,129</td>
<td>89,805</td>
<td>104,231</td>
<td>49,377</td>
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</tr>
<tr>
<td>1951</td>
<td>54,824</td>
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<td>1952</td>
<td>43,242</td>
<td>96,662</td>
<td>113,541</td>
<td>51,477</td>
<td>67,300</td>
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<td>1953</td>
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<td>99,288</td>
<td>119,062</td>
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<tr>
<td>1954</td>
<td>50,680</td>
<td>94,572</td>
<td>115,824</td>
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</tr>
<tr>
<td>1955</td>
<td>53,255</td>
<td>108,038</td>
<td>127,518</td>
<td>53,787</td>
<td>73,821</td>
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<tr>
<td>1956</td>
<td>55,560</td>
<td>108,491</td>
<td>134,298</td>
<td>55,237</td>
<td>74,706</td>
</tr>
<tr>
<td>1957</td>
<td>55,698</td>
<td>106,382</td>
<td>131,470</td>
<td>54,143</td>
<td>73,879</td>
</tr>
<tr>
<td>1958</td>
<td>54,756</td>
<td>100,797</td>
<td>128,844</td>
<td>54,047</td>
<td>72,617</td>
</tr>
<tr>
<td>1959</td>
<td>57,062</td>
<td>112,438</td>
<td>141,632</td>
<td>55,150</td>
<td>75,330</td>
</tr>
</tbody>
</table>
Table 10.1. (Continued)

<table>
<thead>
<tr>
<th>Year</th>
<th>Manufacturing Present Value (in current dollars)</th>
<th>Construction Present Value (in current dollars)</th>
<th>Laundries Present Value (in current dollars)</th>
<th>Retail Trade Present Value (in current dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>55,655</td>
<td>106,899</td>
<td>55,119</td>
<td>74,091</td>
</tr>
<tr>
<td>1961</td>
<td>54,164</td>
<td>105,479</td>
<td>54,183</td>
<td>72,806</td>
</tr>
<tr>
<td>1962</td>
<td>56,423</td>
<td>117,827</td>
<td>57,271</td>
<td>78,303</td>
</tr>
</tbody>
</table>

Source: See formulas for present values given in the Methodology chapter. For data on estimates of expected annual wages and unemployment rates see Appendix A and B respectively, for interest rate and expectancy of life, see Chapter III.
Bishop, Tolley, and others. Venkarreddy extended the cohort analyses to estimate how entry rates for young persons and exit rates for old persons are related to the ratios of the values of the laborers in agriculture and relevant non-farm industries for different age groups. Venkarreddy predicted about the same number of farm operators for the 1970's as Clawson, Bishop, Tolley, and others. However, the additional data used by Venkarreddy indicate that the rates of entry of younger persons and the rate of exit of older farm operators should be expected to be lower than these other analysts predicted (See Table 10.2). As a consequence, the age distribution which Venkarreddy predicts is even more skewed to the older age groups than those predicted by Clawson, Bishop, Tolley, et. al. Neither Venkarreddy's nor the earlier estimates indicate that the overcommitment of laborers to agriculture is going to cease in the decade ahead.

For the purposes of this paper, however, we must note that Venkarreddy, as well as Clawson, Bishop, and Tolley have not taken into account significant structural changes which are occurring in the agricultural labor market. Perhaps an extension of their empirical analyses to take these into account would show a different picture. I shall address myself to this question later.

Turning to capital, we find that we must distinguish between durable and expendable forms and between forms specialized and not specialized in agricultural production. Because there are associated differences in behavior of prices over the business cycle, it is also important to distinguish between farm-produced and non-farm produced capital. Still further, it is important to distinguish among capital which (1) substitutes for labor, (2) substitutes for land, and (3) is neutral with respect to land and labor.


9/ This section is based largely on Calvin Quance, "Farm Capital: Use, MVPs, and Capital Gains or Losses, United States, 1917-1964," Unpublished Ph.D. Thesis, Michigan State University, 1967. Quance's estimates of MVPs for capital are based on the technique employed by Tyner and Tweeten, in "A Methodology for Estimating Production Parameters," Journal of Farm Economics, XLVII, No. 5, (Dec., 1965), pp. 1462-1467, except that Quance's estimates are based on the theory discussed in this paper and hence are related to acquisition prices when use of a resource is expanding and on salvage values when its use is contracting.
Table 10.2. Number of farm operators by age group in the years 1960, 1970 according to 1960 census definition, U.S.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total (thousands)</th>
<th>25</th>
<th>25-34</th>
<th>35-44</th>
<th>45-54</th>
<th>55-65</th>
<th>65+</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>3,701</td>
<td>62</td>
<td>407</td>
<td>812</td>
<td>988</td>
<td>809</td>
<td>623</td>
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<tr>
<td>1970</td>
<td>2,654</td>
<td>56</td>
<td>269</td>
<td>401</td>
<td>676</td>
<td>692</td>
<td>557</td>
</tr>
<tr>
<td></td>
<td>Bishop and Tolley (1963)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>2,616</td>
<td>30</td>
<td>222</td>
<td>415</td>
<td>688</td>
<td>701</td>
<td>556</td>
</tr>
</tbody>
</table>

Estimates for 1970 by Different Studies

Bishop and Tolley (1963)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total (thousands)</th>
<th>25</th>
<th>25-34</th>
<th>35-44</th>
<th>45-54</th>
<th>55-65</th>
<th>65+</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>2,500</td>
<td>43</td>
<td>235</td>
<td>382</td>
<td>645</td>
<td>662</td>
<td>531</td>
</tr>
<tr>
<td></td>
<td>Fox (1963)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>2,593</td>
<td>50</td>
<td>254</td>
<td>398</td>
<td>663</td>
<td>680</td>
<td>546</td>
</tr>
<tr>
<td></td>
<td>Johnston (1963)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>2,607</td>
<td>26</td>
<td>201</td>
<td>418</td>
<td>695</td>
<td>704</td>
<td>558</td>
</tr>
</tbody>
</table>

Johnston (1963)

Present Study

<table>
<thead>
<tr>
<th>Year</th>
<th>Total (thousands)</th>
<th>25</th>
<th>25-34</th>
<th>35-44</th>
<th>45-54</th>
<th>55-65</th>
<th>65+</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>2,616</td>
<td>30</td>
<td>222</td>
<td>415</td>
<td>688</td>
<td>701</td>
<td>556</td>
</tr>
</tbody>
</table>
Most of the new factors of production making up what we call "advanced technology" are not neutral with respect to labor and/or land, as a great part of our effort to improve technology has been devoted to the saving of labor and land. From 1917 to date there have been few periods in which new forms of capital which substitute for labor and for land have not been relatively profitable. Profitability as used here, includes loss minimization of use as well as profit maximization adjustments.

Farmers have been relatively quick to exploit these profit maximization and loss minimization opportunities. With respect to neutral forms of capital, farmers have tended to vary capital whenever they could maximize profits or minimize losses.

It is also important to remember that there are cycles of overcommitment and liquidation with respect to such forms of capital as beef cows, sows and gilts, and dairy animals which are quite independent of inflations and deflations but which, in total, impose capital losses on farmers.

Over the 1917-65 period, overcommitments of specialized farm or non-farm produced, durable capital have not been followed by liquidations as the salvage value of such capital outside of agriculture is virtually zero. Instead, these items have remained in production at substantial capital losses to farms.

With respect to the expendable inputs produced in the non-farm economy, rates of purchase and usage have changed as profit maximization and loss minimization opportunities have arisen. Consequently, little overcommitment and few capital losses have taken place for these items.

In the case of farm-produced expendables, the prices of these expendables have tended to go up and down in close correlation with the prices of products produced by farmers; hence, profit maximization and loss minimization rates of usage for these items have not changed much as a result of changes in farm product prices. Though, as a consequence, little overcommitment and fewer capital losses have occurred on these items, substantial overcommitment and capital losses have taken place for the durables overcommitted to their production.

It should also be noted that there have been capital losses on storable, expendable inputs produced in the farm economy.
Land, despite the theoretical difficulties involved in distinguishing between it and capital, does behave differently than many forms of capital -- for one thing, it is hard to reproduce and is highly specialized in agricultural production. For the agricultural economy as a whole, land has a very high acquisition price and a very low salvage value which means that Ricardian rent theory does explain a good part of the variation in the value of land. The characteristics of land make it easier for farmers to pay too much for it rather than over-use it physically.

The development and extensive use of fertilizer as a land substitute has had a profound influence on the land market. Undoubtedly this development has prevented land prices in general from advancing further than they have over the 1917-67 period. This influence has been selective, however, as some land has been rendered virtually worthless while other land amenable both to fertilization and mechanization has increased in value.

There has been a strong demand for land on the part of individual farmers which seems to originate in a desire to minimize losses on previous overcommitments of first labor and then large scale machinery to minimize losses on labor. Once a farmer, who has overcommitted himself to farming, acquires a set of machinery capable of handling 25 to 50 percent more land than he controls, he finds it advantageous to acquire more land often on a loss minimization basis in order to fully utilize his labor and capital equipment. The resultant competition of farmers for land bids up land prices until, eventually, gross farm incomes cannot simultaneously cover the wages of comparable labor in the non-farm economy and what was paid for both the capital and land on the farm.


See M. E. Quenemoen Thesis.
Some Historical Facts with Respect to Technology, Improvements in the Human Agent and Institutional Change

Throughout the 1917 to 1967 period, important structural changes had been occurring with respect to technology, the human agent, and institutions for controlling prices, production, uncertainty and inflation. Some of these structural changes have been blamed for the over-commitment of resources to agricultural production.

Technological advance, for instance, is viewed by some as a force which enters agricultural production at a predetermined rate with respect to time and expands productive capacity almost irregardless of decisions by governmental administrators or individual farmers. I regard this as an erroneous way of looking at the impact of advancing agricultural technology on production. Instead, I view technological advances as embodied in inputs which cost money. Typically some of these inputs are labor saving while others are land saving. If so many of these inputs are put into use that farmers lose money on them, the rate of adoption of new technologies is excessive. If we want to understand excessive rates of adoption it seems to me that we should look at the forces which cause farmers to acquire excessive quantities of these modern inputs.

The modern factors which carry the new technology are sometimes durable, sometimes expendable. Some are farm-produced; others are not. Some such as hybrid seed corn are highly specialized; others such as pick-up trucks are not.

Viewing the adoption of new technology primarily as an investment and/or expenditure problem shifts the discussion back to the section on capital use and the same conclusions apply.

Neither are improvements in the human agent mystical things. Instead, individuals invest in their own training and once they have done so possess skills which are either devoted or not devoted to


13/ At this point in time I regard the lack in T. W. Schultz's modification of Book IV of J. S. Mill's Principles of Political Economy, New York, Longmans, Green & Co., 1936, of an explanation as to why farmers overcommit themselves to the use of capital, as well as labor, as a major shortcoming of his otherwise excellent book, Agriculture in an Unstable Economy, New York, McGraw Hill Book Co., 1945.
agricultural production. If so many of these skills are used in agricultural production that returns are not comparable to what would have been used elsewhere, then these skills are overcommitted. The key question is whether or not individuals overcommit themselves.

The institutional changes in the structure of American agriculture which occurred with respect to price supports and governmental production controls from 1933 on have not been of the type which have prevented the overcommitment of physical and financial resources to agricultural production. The 1917-67 historical record is quite clear -- even when production controls have placed physical restrictions on the use of land, they have not restricted either the use of land substitutes nor the willingness of farmers to pay too much for land and acreage allotments. Excessive commitment of resources has occurred both with and without government controls. Though the record indicates that the overcommitment has been greater since the introduction of price supports and controls than before, overcommitment existed prior to their introduction.

Speculation and Uncertainty as an Explanation of High Land Prices and Overcommitment of Land and other Resources

Some people have argued that inflationary gains from land speculation more than offset the low rates of return resulting from the overcommitment of land and other factors to agricultural production. Over the long sweep of time from 1917 to date there have been about as many periods of time in which farmers have lost from deflation as periods of time in which they have gained from inflation. Even for recent years, research indicates that the stock market has been a better place in which to speculate than the land market. Thus, inflation is not an adequate explanation for the low rates of current earnings on investments in agricultural productivity for returns in farming are reduced still further relative to those in the non-farm sector when returns to speculative activity are included on both sides of the farm/non-farm equation.

Risk and uncertainty have been advanced by many as explanations of the ills of agriculture. Sorenson for potatoes, Hathaway for dry


edible beans, and the author for burley, have found that price uncertainty accounted for under-allocation (from the standpoint of average profitability) of resources. This implies above "standard" average actual returns before discounting and as such hardly explains the overcommitment, substandard returns and capital losses so prevalent 1917 to date. More will be said about this matter later after appropriate theoretical issues have been raised.

Some Historical Conclusions

The above historical summary:

1. indicates that the tendency of U.S. agriculture to overcommit resources to agricultural production was aggravated by World Wars I and II, the Korean War, the Great Depression, and government programs but

2. has also existed independently of these events as a fundamental characteristic of U.S. agriculture not explainable by

   a) advancing technology
   b) improvements in the human agent
   c) inflationary gains on rural real estate or
   d) risk and uncertainty

A Look at Theory

One hesitates to consider theoretical concepts among colleagues so well-versed in theory. Yet, it seems that we have not faced up to the theoretical issues which are becoming increasingly relevant as a result of the structural changes now taking place. In view of our historical study, we need to look at theory which contains the possibility of explaining an inherent tendency to overcommit resources.


17/ Glenn L. Johnson, Burley Tobacco Control Programs, Kentucky Agricultural Experiment Station, University of Kentucky, February, 1952.

It is customary for policy and farm business analysts to use a theoretical economic system characterized by (1) perfect knowledge and foresight, (2) resources which are fixed exogenously to the firms and, hence industries, and (3) perfect markets for factors and products in which transfer costs are zero. The third assumption is often made almost unthinkingly by tacitly assuming acquisition costs for resources to be infinite and salvage prices to be zero for fixed resources while assuming tacitly without any more thought, that the variable resources used and products produced by firms are perfectly priced in the sense that they can be bought and sold "at the barn door" at the same price.

The substantive content of our theories, however, is drastically changed if we assume, more realistically, (1) imperfect knowledge, (2) that acquisition prices for many resources (fixed or variable) may be less than infinite and salvage prices greater than zero and (3) that acquisition prices are typically greater than salvage values for most of the resources used in production.

With perfect knowledge, the introduction of more realistic assumptions with respect to acquisition prices and salvage values produces only minor changes in the theory. With imperfect knowledge, however, the differences are great and of important consequence.

I will not burden this conference with the theory and mathematics of theory by attempting to present them from this rostrum. Instead, a mathematical presentation comparing this theory with the more usual form is attached as an appendix. Also, the main characteristics of this theory have been published in a number of places.19/

The theory to be used in the remainder of this paper is based on the assumptions, among others, of (1) imperfectly informed managers capable of learning and (2) acquisition prices less than or equal to infinity but greater than or equal to salvage prices which are in turn greater than or equal to zero. Such a modification of ordinary neo-classical theory has many characteristics not present in neo-classical

theories based upon perfect knowledge and acquisition prices equal to salvage prices for variable inputs and acquisition prices equal to infinity and salvage prices equal to zero for fixed inputs. One of the characteristics of the modified theory is overcommitment of resources through time. The introduction of errors in combination and levels of resource use by imperfectly informed managers under these price conditions leads to some important conclusions concerning overcommitment of resources:

1. No mistake of overcommitting an input whose acquisition cost exceeds its salvage value is completely correctable.

2. Some mistakes of overcommitment can be partially corrected by loss-minimizing further *expansions* in resource use and output.

3. On the other side, some mistakes of undercommitment on production can be completely corrected by moving to the optimum level of resource use, while other mistakes of undercommitment can only be partially corrected by a loss minimization adjustment from a point of undercommitment to a level of output which would exceed the optimum had no mistake of undercommitment been made originally.

Conclusions 1, 2 and 3 above result in a tendency towards overproduction leading to capital losses through time with respect to acquisition prices of inputs whose acquisition prices exceed salvage value. The maximum capital losses is the difference between acquisition cost and salvage value. So long as knowledge remains imperfect through time either because farm entrepreneurs have not learned all there is to know about past changes or because new changes have occurred, this bias should be expected to be maintained.²⁰/

Some people have argued that managers would learn how much to discount expected earnings and that they would not over-produce in the long run. This would presume considerable knowledge about the distribution of technical institutional and human change. However, even if managers have such knowledge, Kellogg has demonstrated

mathematically the theoretical consequences of discounting a marginal value productivity of, say, 10% to 6% in the presence of imperfect knowledge with realistic assumptions with respect to acquisition prices and salvage values. The theoretical consequence is that entrepreneurs would (1) fail to make their discount rate and hence (2) suffer capital losses with respect to the rate of return which they had expected to get to cover their cost of bearing the uncertainty present in the system.

Characteristics of the Agricultural Economy

In general, firms of the agricultural economy have the characteristics of atomistically organized firms in any part of the economy; however, the combination of characteristics found among agricultural firms is somewhat unique. A characteristic of the agricultural firms is that larger quantities of labor are born into the agricultural household/firm complex than required to supply demand at prices which will cover acquisition costs simultaneously for all inputs.

U.S. farmers operate in an economy characterized by rapidly rising real per capita incomes and wage rates. Another characteristic of agricultural firms is that they occupy much geographic space. Large numbers of agricultural firms simply cannot be established without creating substantial transportation costs for moving inputs from non-farm sources to the farm and for moving farm products from farm to non-farm consumers. Similarly there is a substantial cost of moving farm-produced inputs from producing farms to utilizing farms. The same is true of second-hand non-farm produced inputs. This geographic characteristic of the agricultural firm introduces wide variations between acquisition and salvage prices for many inputs. For instance, in the case of silage, hay and pasture, which provide a very high proportion of the nutrients consumed by the ruminants of the U.S. agricultural economy, the differentials between acquisition and salvage prices are such that acquisition prices may exceed salvage prices by as much as 1000 percent.

Earl Kellogg has simulated the operations of an imperfectly-informed discounting entrepreneur producing on a Cobb-Douglas function of unit total elasticity with acquisition costs greater than salvage values subject to a net worth restriction.

Dale Hathaway, Government and Agriculture, the MacMillan Co., 1963, p. 84.
Another characteristic of agricultural firms is that they are operated in a rapidly changing environment by managers who are very imperfectly informed about the macro consequences of their individual actions.

Another characteristic of the environment in which agriculture operates is change -- change with respect to foreign demand, per capita incomes, war demand, technology, institutions and education. These changes, however, occur in the presence of price and income demand elasticities which means that the demand for agricultural products grows slowly relative to (1) capacity to produce (if the required investments are made) and (2) the growth in demand for non-agricultural goods and services.

This set of characteristics combines with the theory considered in the preceding section to explain "the roots of the farm problem" of overcommitting resources to production. This combination of theory and fact implies that the tendency to overcommit has been inherent in the agricultural economy of the U.S. It indicates that World Wars I and II, the Great Depression, the Korean War, and government programs have been aggravating factors but not fundamental causes.

It is now time to look at the likely impacts of current structural changes and the international food gap on this long-standing tendency of U.S. agriculture to overcommit, over-produce and to impose hardship on its entrepreneurs.

**Structural Changes Occurring in American Agriculture**

For the past half century, important structural changes in agriculture have involved (1) improvements in the human agent, (2) the creation of new technologies, and (3) changes in the institutions which control resource use.

As the educational institutions of the United States have been improved and have been adapted to serve agriculture they have tended increasingly to break the traditional bond between the farm-firm household complex and the farm child. Widespread receipt of general education has made the farm child much more flexible and capable with respect to life occupations. With the passage of time, this structural change may reduce the importance of excess labor being continually born into the farm firm/household complex. The projections of numbers of farm operators made by Clawson, Heady, Bishop and Venkareddy have not taken this structural change into account. There have also been important changes in the labor market which affect the use of both local and migrant hired labor. These changes involve minimum wage rates,
workmen's compensation, social security, medicare, housing regulations, and, increasingly, unionization. The elimination of Public Law 78 arrangements for importing Mexican Nationals has increased the real acquisition cost for migrant laborers, a development further accentuated by minimum wage rates and unionization.

Labor saving technology and the historical ponderance of operator and family labor in the agricultural labor force mean that structural changes involving migrant labor are of little overall significance except for the unmechanized, stoop-labor crops which are dependent upon such laborers. The educational changes which have occurred have probably been important.

Labor-saving technological advance has permitted capital to replace laborers so that the total supply of labor and labor substitutes in American agriculture has expanded rapidly over the years. The introduction of capital substitutes for labor has made it possible for labor to be driven out of agriculture even in periods of low, off-farm salvage values for labor as witnessed by the introduction of the corn picker into the corn belt during the depression years and the "tractoring off of the Okies" even when farm wage rates were at a very low level relative to other prices in the economy.

Similarly, the development of land substitutes has greatly increased the total supply of land and land substitutes in the U.S. agricultural economy. As a result land prices have not advanced as rapidly as they would have in the absence of the creation and use of land substitutes.

Such technological changes should not be expected either to cause or stop the overcommitment of resources to agricultural production. Instead they are changes which imperfectly informed managers have to handle. In the handling, errors are made on the part of managers. The theory looked at earlier in this paper indicates that such errors, though randomly distributed initially with respect to over and undercommitment, should be expected to lead eventually to overcommitment.

When we look to the control institutions, we find that the structural changes which have occurred with respect to governmentally-operated price supports and production controls over the past 30 some odd years have not been of the type which have prevented managers from making mistakes. To the extent they have maintained the marginal value productivity of resources, price supports have become the basis for further mistakes of farmers in capitalizing current income streams into the capital values for acreage allotments, land and durable items of capital such as breeding herds, orchards, irrigation systems and fences. This historical observation on the pricing of acreage allotments will be important later in considering the impact of the international food gap on U.S.
agriculture. Further, these programs have been set up, by and large, to maintain and protect existing farmers and investments in agriculture rather than to (1) liquidate fixed overcommitments of resources to agricultural production and (2) develop organizations for the purpose of controlling, on the basis of improved knowledge, rates of entry of farmers and investments.

In this same 30 year period, a greatly expanded program of governmental sponsored economic research and extension has not been adequate to reduce the imperfections in knowledge faced by individual farm managers to such an extent that their errors of overcommitment have been reduced substantially.

On the private side, one can ask whether institutional changes involving contract farming and vertical integration from input suppliers such as fertilizer, feed and drug manufacturers are likely to stop the overcommitment of resources. A moment's reflection will indicate that such suppliers have very little real motive to reduce the overuse of the supplies they sell. One would expect overuse to be curtailed mainly by structural changes which would make contractors and vertical integrators financially responsible for the losses associated with overuse. If we look to the buyers of farm products -- the processors, distributors, wholesalers and retailers -- we see the possibility that vertical integration, but not contracts, might reduce the overcommitment of resources. However, the general political situation is such that such agencies have to be careful about eliminating large numbers of individually operated family farms. So long as the production of the agricultural products processed and distributed by these agencies remains in the hands of other entrepreneurs there appears to be little incentive for processors and distributors to gain by setting up control mechanisms. Such mechanisms would reduce the volume of business of such firms thereby making it necessary for the controlling agencies to perform the politically unpopular act of increasing prices to consumers while reducing their own volume.

The International Food Gap and Overcommitment

We are now ready to look more analytically at the opportunities and problems likely to be created by the international food gap. Growth in demand is capable, theoretically, of offsetting the tendency toward overcommitment and over-pricing of inputs one expects in U.S. agriculture on the basis of both theory and history.

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23/ See Dale Hathaway's paper, this conference, for similar views on the private side.
The question is whether this expansion in demand is sufficient to do this in view of (1) the characteristics of U.S. agriculture listed in the next to last section and (2) the structural changes discussed in the last section.

Though the world-wide population explosion is creating a great physical need for food there are serious questions about (1) "effective demand," (2) the ability of the U.S. government to finance foreign consumption of U.S. produced food at costs of production related to advancing U.S. wage rates and (3) cheaper alternative ways of producing food abroad. 24/

Unless the expansion in effective demand is steady but almost unanticipated by farmers, the theoretical and historical examination of resource use in U.S. agriculture 1917 to date indicates that U.S. farmers should be expected to use too many resources, pay too much for land and overcommit too much operator and family labor.

With so much of the effective demand determined by U.S. political activity, with Russia overhauling her agricultural production policies and with many undeveloped countries with underutilized productive capacity overhauling their agricultural expansion in foreign effective demand for U.S. farm products. Further, as I read the farm press and observe changes in land value, the expansion in demand is far from unanticipated -- in fact, I fear that it is over-anticipated and that farmers will pay so much for land, invest so much in capital and commit so many people to farming that effective demand will not cover acquisition costs simultaneously for all inputs in the future any better than in the past. This fear is only increased by observation of this rapid current rate of increase in U.S. non-farm wage rates.

The Kinds of Structural Changes and Agricultural Economics Research Needed

When one examines the history of U.S. agriculture and the implications of the theory discussed in this paper and in view of the changing characteristics of American agriculture, it appears that needed additional structural changes involve (1) a reduction of imperfect knowledge, (2) a reduction of differences between acquisition and salvage values, and (3) development of additional control mechanism on entry of men and resources, these controls to be operated by agricultural producers.

24/ Conference on "Alternatives for balancing future world food production and needs," sponsored by Iowa State University, Center for Agricultural and Economic Adjustment, Ames, Iowa, Nov. 8, 1966; particularly the paper by T. W. Schultz, U.S. Malinvestments in Food for the World.
It is my own judgment that the public service organizations for agriculture namely, the U.S.D.A. and the Land Grant colleges and universities have not done an adequate job of reducing the imperfections in knowledge faced by individual farmers. I simply think that we can do much better research on the implications for resource use in agriculture, of technological changes, changes in the human agent, income demand elasticities, foreign demand, etc. than we have done. Currently, for instance, we are doing little that is adequate on the implications of the so-called international food gap. Better specific research is needed as to the quantities of resources which can be committed to agriculture, in the aggregate, without producing so much product that it cannot be sold except at prices which will not cover acquisition costs.

While researchers could do much better than they have done, they probably would not be able to do this job well enough to cure the long-term tendency of agriculture to overcommit resources to agricultural production. Furthermore, even if researchers were able to produce the knowledge, it is questionable whether a greatly expanded and improved extension and information distribution system would be able to get it fully distributed to and used by farmers. A reason for pessimism here involves the atomistic organization of agriculture for which knowledge of macro consequences is of little private personal importance.

If the above conclusions with respect to public reduction of imperfect knowledge are correct, then the theory indicates that steps should be taken to more nearly equate acquisition costs and salvage values for agricultural inputs. However, these differences are due, in the final analysis, largely to the geographic dispersion of farms and transportation costs. Except for expensive subsidies, differences between acquisition and salvage prices are hard to eliminate. This combines with the above conclusions about the difficulty of solving the problem through research and extension to indicate that agriculture needs to seek structural changes involving the creation of control mechanisms.

Control mechanisms are needed to regulate the rate at which resources are committed to agricultural production. Historically, the government appears to be a poor agency for doing this. It has tended to protect the resources, farmers and farm firms already committed to production and has not concentrated on stopping new overcommitments. Private nonfarm input suppliers are unlikely to perform this function well as they simply do not have incentives to control the overcommitment unless they become owners of the agricultural producing firms. Similar conclusions are reached with respect to control mechanisms which would originate on the demand side with the processors and distributors. Though, I hasten to add, that it would not necessarily be wrong for private agricultural entrepreneurs to disappear and become part of either
supplying or distributing firms and agencies, real political problems would be involved. For a long while, people in this country worried about the replacement of the family operated "Pop and Mom" grocery store by the chains. It did disappear, however, and Pop and Mom were replaced by supermarket laborers and managers. As I cannot see how the moral fiber or other aspects of American society were damaged by this transition, I cannot conclude, a priori, that American society would necessarily be damaged by a restructuring of our agricultural society to put agricultural production in the hands of input suppliers of processors and distributors. Actually, such a restructuring might mean that agricultural labor would receive returns commensurate with those received by laborers in the rest of the economy and that investments in agricultural production would earn returns comparable to those in the rest of the economy. If this came about, such a restructuring, like the abandonment of the Pop and Mom grocery store, might be a good thing. However, despite my relative lack of fear on this point, our thoughts on restructuring American agriculture should give considerable attention to the possibility of creating new control mechanisms owned and managed by agricultural producers. After researchers and extension workers have made their best efforts to produce new knowledge and to educate the public and the individual farmers, this same information could be used by organizations of producers in operating controls on (1) the entry of firms into agricultural production, (2) investments of new major pieces of capital equipment such as bulk tanks, power units etc., and (3) the commitment of youths to agriculture.

When the American economy decided to grant similar powers of control to non-farm firms by permitting them to incorporate, sufficient attention was not given to governmental arrangements for maintaining public responsibility on the part of these new institutions. Similarly, when labor was granted the right to organize and bargain collectively, rather than individually, sufficient attention was not given to the regulatory role of government. In both cases, public control of these institutions was extended and further developed subsequent to the legal changes permitting them to be established. If we change our institutional arrangements to permit a development of control structures for agricultural production, a change in the role of government will have to occur. There are reasons for believing that the legal changes providing for the creation of control institutions should simultaneously provide for government regulation of the resultant agricultural monopsonies and monopolies. This area needs much research by agricultural economists, particularly those in the field of policy.

Another comment seems appropriate. Even if expanded and more effective research and extension were provided and even if institutional arrangements to permit producers to develop control mechanisms were developed, it does not seem likely that organizations of producers
would be able to control a commodity so widely dispersed and so diverse, as, say, wheat or pork. Therefore, it seems that there is likely to continue to be a role for government to play in the field of direct price supports and direct production controls despite our rather unfortunate experiences with these institutions to date. Again, more agricultural policy research is indicated.

As a final comment, there are reasons to believe that the solution of the problem of overcommitted resources might eliminate the U.S. family farm's economic "raison d'être." Thus, if the structural changes suggested above should be adopted and prove effective, separate attention should be given to answering the question of whether or not we want to maintain family farms and if so how. As I explored this question in a paper presented at the Rome meeting of the International Economics Association, I merely refer you to that paper at this point as a guide to some relevant research which might be undertaken by farm management personnel.

APPENDIX

Theoretical Notes

At the individual firm level, we are interested in the different consequences of two alternative sets of assumptions for the inputs $X_i, \ 1 = 1, \ldots, n$.

The first set of assumptions is

\[ \begin{align*}
\text{(1)} & \quad \infty \geq P_{AX_i} = P_{SX_i} = 0 & \text{for } i = 1, \ldots, d \\
& \infty = P_{AX_i} > P_{SX_i} = 0 & \text{for } i = d + 1, \ldots, n
\end{align*} \]

$P_{AX_i}$ = acquisition price of $X_i$ and $P_{SX_i}$ = salvage value of $X_i$. We assume a one to one correspondence between prices of stocks and service flows for the $X_i$. (See paper for a discussion of consequences).

For set of assumptions (1), let $G$ stand for gain (or loss, if negative) from reorganizing a given firm.

\[ G = \sum_{j=1}^{m} P_{y_j} (Y_j - Y_j^o) - \sum_{i=1}^{n} P_{x_i} (X_i - X_i^o). \]

$Y_j$ = products, $j=1,\ldots,m$. $Y_j^o$ stands for initial output of the product $j$ while $Y_j$ stands for the reorganized output of $Y$ by the reorganized firm. Similarly, $X_i^o$ and $X_i$ stand for the initial and reorganized input of $X_i$, $i=1,\ldots,n$.

The problem of the manager of a firm is envisioned to be that of reorganizing an initial organization to maximize $G$ subject to

(a) $b_i = \sum_{j=1}^{m} X_{ij}$ for $i = d + 1, \ldots, n$

(b) $X_{ij} \geq 0$, for $i = 1, \ldots, n$

where \( X_{ij} \) is the amount of the \( i \)th input used in producing the \( j \)th product.

\[
G^* = \sum_{j=1}^{m} P_{Y_j} (Y_j - Y_j^0) - \sum_{i=1}^{d} P_{X_i} \sum_{j=1}^{m} (X_{ij}^0 - X_{ij}) - \sum_{j=1}^{m} P_{Y_j} = \text{price of } j \text{th product.}
\]

Assuming the law of diminishing returns and independence among the \( j \) production functions, \( 3 \) can be maximized by methods developed by Kuhn and Tucker. \(^{27}\) When the Lagrangian function is formed as in

\[
L \equiv G^* + \sum_{i=d+1}^{n} \lambda_i \left( X_i^0 - \sum_{j=1}^{m} X_{ij} \right)
\]

it can be maximized subject to \( 2 \)(a) and (b) above "if and only if there is a set of \( i \) (for \( i=d+1, \ldots, m \)) such that \( 4 \) is maximized with respect to the \( X_{ij} \) and minimized with respect to the \( j \)."

For each of the variable inputs \( (i=1, \ldots, d) \) used in producing a product \( j \)

\[
P_{Y_j} \frac{\partial Y_j}{\partial X_{ij}} - P_{X_i} = 0 \quad \text{(for } i=1, \ldots, d; j=1, \ldots, m \text{)}
\]

for the most profitable reorganization of the firm. For each of the "fixed inputs \( (i=d+1, \ldots, n) \)" used in producing a product \( j \)

\[
P_{Y_j} \frac{\partial Y_j}{\partial X_{ij}} - \lambda_i = 0 \quad \text{for } i=d+1, \ldots, n; j=1, \ldots, m
\]

\( \lambda_i \) can be interpreted as the "on-farm" opportunity cost of \( X_i \). Off-farm opportunity costs of \( X_i \) are assumed zero as \( P_{SX_i} = 0 \). Acquisition costs for \( X_i \) are assumed infinite. Hence, the \( X_i^0 \) for \( i=d+1, \ldots, n \) are fixed regardless of \( P_{Y_j} \) and of subsequent \( X_{ij} \) for \( i=1, \ldots, d \) and \( j=1, \ldots, m \).

The second set of assumptions is

\[
\infty \geq P_{AX_i} \geq P_{SX_i} \geq 0 \quad \text{for } i=1, \ldots, n.
\]

\( G = \sum_{j=1}^{m} P_{y_j} (Y_j - Y_{i_1}^0) - \sum_{i=1}^{n} a_i (\sum_{j=1}^{m} X_{ij} - X_{i_1}^0) \)

if \( \sum_{j=1}^{m} X_{ij} > X_{i_1}^0 \) then \( a_i = P_{AX_i} \)

if \( \sum_{j=1}^{m} X_{ij} < X_{i_1}^0 \) then \( a_i = P_{SX_i} \)

if \( \sum_{j=1}^{m} X_{ij} = X_{i_1} \) then \( P_{AX_i} > a_i > P_{SX_i} \)

Let \( W_i = \) amount of \( X_i \) purchased and \( V_i = \) amount of \( X_i \) sold. Hence

\( \sum_{j=1}^{m} X_{ij} = X_{i_1}^0 - V_i + W_i \) subject to the

restriction that \( X_{i_1}^0 - V_i \geq \sum_{i=1}^{n} \sum_{j=1}^{m} X_{ij} \)

Equation (8) can be rewritten as

\( G^* = \sum_{j=1}^{m} P_{y_j} (Y_j - Y_{i_1}^0) + \sum_{i=1}^{n} P_{SX_i} V_i - \sum_{i=1}^{n} P_{AX_i} W_i \)

where \( S_i = a_i = P_{SX_i} \) and \( A_i = a_i = P_{AX_i} \)

When placed in the Lagrangian form, (9) appears as

\( L = G^* + \sum_{i=1}^{n} \lambda_i (X_{i_1}^0 - V_i + W_i - \sum_{j=1}^{m} X_{ij}) + \sum_{i=1}^{n} \mu_i (X_{i_1}^0 - V_i) \)

which is maximized with respect to \( X_{ij}, V_i \) and \( W_i \) and minimized with respect to \( \lambda_i \) and \( \mu_i \), following Kuhn and Tucker. For each product possibly using \( X_i \), the solution involves for all \( i \) and \( j \).
(11) \[
\frac{\delta L}{\delta x_{ij}} = p_j \frac{\delta v}{\delta x_{ij}} - \lambda_i \leq 0, \quad \frac{\delta L}{\delta x_{ij}} x_{ij} = 0 \text{ and } x_{ij} \geq 0.
\]

Condition (11) indicates that the marginal value productivity of an input in producing a given product is less than or equal to opportunity cost if none of the input is used in producing that product.

The solution also involves

(12) \[
\frac{\delta L}{\delta w_i} = \lambda_i - A_i \leq 0; \quad \frac{\delta L}{\delta w_i} w_i = 0; \quad w_i \geq 0
\]

which indicates that purchase of \( x_i \) involves an opportunity cost for \( x_i \) equal to its acquisition price at the optimum.

The solution also involves

(13) \[
\frac{\delta L}{\delta v_i} = s_i - \mu_i - \lambda_i \leq 0; \quad \frac{\delta L}{\delta v_i} v_i = 0; \quad v_i \geq 0
\]

which indicates that sale of \( x_i^o \) involves an opportunity cost for \( x_i \) equal to its salvage value when less than \( x_i^o \) is sold. \( w_i \) is greater than or equal to zero when \( s_i \geq \lambda_i \) and when all of \( x_i^o \) is sold.

The solution also involves

(14) \[
\frac{\delta L}{\delta \mu_i} = x_i^o - v_i \geq 0; \quad \frac{\delta L}{\delta \mu_i} \mu_i = 0; \quad \mu_i \geq 0
\]

a condition made necessary by the fact that more of \( x_i \) cannot be sold than is on hand. \( \mu_i > 0 \) when \( x_i^o = v_i \). \( w_i = 0 \) when \( x_i^o > v_i \).

Differences and consequences of the two sets of assumptions. The first set assumed acquisition and salvage values of inputs to be either equal or infinite and zero, respectively. The second set assumed acquisition and salvage prices to be unequal.

I. Under the first set of assumptions:

A. Inputs with zero salvage and infinite acquisition prices are priced internally at opportunity costs determined by product prices, initial quantities on these inputs on hand, the nature of the production function using them, and prices (including opportunity costs) of other inputs.
B. Some of the optimizing reorganizations of farmers are reversible. These reorganizations can result from changes in (1) product prices and (2) prices of other inputs. Reorganizations are irreversible which result from changes in initial quantities of inputs on hand with infinite acquisition costs or zero salvage values, as are those resulting from technological change.

C. B, above, implies reversible supply functions of individual firms for products and reversible demand functions of individual firms for inputs.

D. If \( d = 2 \) and \( n = 3 \), the iso-value product and iso-cost map for the \( j \)th product would appear as follows:

\[
\begin{align*}
X_1 & \quad \text{LL is a line of least cost combinations.} \\
X_2 & \quad \text{HPP is the high profit point.} \\
& \quad \text{The cost functions would appear as follows:}
\end{align*}
\]

\[
\begin{align*}
$ & \quad \text{MC} \\
& \quad \text{ATC} \\
& \quad \text{AVC} \\
Y_j & \quad \text{PY}_j
\end{align*}
\]
E. If imperfect knowledge is assumed, failures to organize at the HPF can be corrected at no cost by selling any of the $X_i$ which are in excess and buying any of the $X_i$ in deficit, $i=1,\ldots,d$. Hence, no capital losses need be incurred on $X_i$ for $i=1,\ldots,d$.

F. Capital losses and gains can occur on the $X_i$ for $i=d+1,\ldots,n$, however. The capital value of any durable in this set of $X_i$ will be the present value of its expected $\lambda_i$'s and $\lambda_i$ is a function of product prices, technology (nature of the production function), $P_{X_i}$ for $i=1,\ldots,d$, changes in these determining variables can create capital gains and losses for the fixed resources.

II. Under the second set of assumptions, i.e. $\infty \geq P_{AX_i} \geq P_{SX_i} \geq 0$ for $i=1,\ldots,n$.

A. Inputs with $P_{AX_i} > P_{SX_i}$

(1) were priced internally at opportunity cost, $\lambda_i$ when $P_{AX_i} > \lambda_i > P_{SX_i}$ and are fixed

(2) are priced at $P_{AX_i}$ when $\lambda_i \geq P_{AX_i}$ and are variable

(3) are priced at $P_{SX_i}$ which might be termed an external opportunity cost when $\lambda_i \leq P_{SX_i}$ and are variable

(4) have $\lambda_i$'s (opportunity costs) determined by product prices, initial quantities of the all $X_i$'s on hand for which $P_{AX_i} > P_{SX_i}$, the nature of the production functions using them and the prices (including opportunity costs) of other inputs.

B. The optimizing reorganizations of farms which result from the changes listed in II A 4 are not reversible.

C. B, above, implies irreversible supply functions of individual firms for products and irreversible demand functions of individual firms for inputs. Irreversibility is taken to mean responses to price decreases which are not the exact opposites of responses to increases. Generally, the theoretical output responses to product price increases should be expected to exceed the contractions associated with product price declines.
Similarly, expansions in use of inputs resulting from product price increases and input price decreases should be expected to be greater than the contractions resulting by comparable product price declines and input price increases.

D. If \( n=3, \alpha \geq P_{AX} > P_{SX} > 0, \alpha \geq P_{AX} > P_{SX} > 0 \) and \( \alpha \geq P_{AX} > P_{SX} = 0 \), then the iso-value product map for the jth product will appear as follows:

The line of least cost combination when \( X_1 \) and \( X_2 \) are priced at acquisition costs need not be the same as when they are priced at salvage values. Though the first can still be dubbed an "expansion path," the second is better called a "contraction path." At this point it becomes advantageous to introduce the concept of an iso-marginal value product line. Four such lines are of interest in the \( X_1X_2 \) dimension of the production function under consideration, two for \( X_1 \) and two for \( X_2 \). In each case we are interested in all combinations of \( X_1 \) and \( X_2 \) for which \( MVP_{X_1} = P_{AX} \) and for which \( MVP_{X_2} = P_{SX} \). An \( X_1X_2 \) map of such isomarginal value products for \( Y = aX_1^{b_1}X_2^{b_2}X_3^{b_3} \) when \( \sum_{i=1}^{3} b_i = 1 \) and \( 1 > b_i > 0 \) appears as follows:
For the first set of assumptions, the iso-marginal value product lines for $P_{sx_1}$ and $P_{ax_1}$ would be identical. The same would be true for $P_{sx_2}$ and $P_{ax_2}$. Thus areas 2, 4, 5, 6 and 8 do not exist under the first set of assumptions. Area 5 is a point in that case while areas 2, 4, 6 and 8 are lines. While it is interesting to explore the values of $v_1$, $w_1$, $\lambda_1$ and $\mu_1$ for areas 2, 4, 5, 6 and 8, time can be saved and valuable simplicity can be gained by ignoring the iso-product lines which do not border area 5 and erecting perpendiculr ands extending horizontals as follows:

In addition, one iso-product line represents the HPP output for $P_{ax_1}$ and $P_{ax_2}$ has been added. This is, of course, a reproduction of Figure 4 of the main text. Let $y_{ja}$ be the output of $j$ at point $A$, $y_{jb}$ at point $B$, etc. For firms initially organized within area 1

$P_{sx_1} > \lambda_1$, $P_{ax_2} < \lambda_2$, $v_1 > 0$, $w_2 > 0$ and $G$ is max. at $B$, $y_{jb} > y_{ja}$ even for $y_j < y_{ja}$. The capitalized value of $\lambda_1$ after max. $G$ is less than at $x_1^o$, $x_2^o$ and the capitalized value of $\lambda_2$ after max. $G$ equals the stock acquisition price of $X_2$. At both $x_1^o$, $x_2^o$ and $B$ the capitalized value of $\lambda_1$ is less than the stock acquisition price of $X_1$. 
If B = A, as it would under the first set of assumptions, \( Y_{jB} = Y_{jA} \) and the capitalized value \( \lambda_1 \) and \( \lambda_2 \) would equal \( P_{AX_1} \) and \( P_{AX_2} \) for stocks, respectively.

**within area 2**

\[
P_{AX_1} > \lambda_1, \quad P_{SX_1} \quad \text{for } X_1^o \text{ along } AB, \quad \lambda_2 > P_{AX_2},
\]

\( V_1 = W_1 = 0, \quad W_2 > 0, \quad G \text{ is max. on } AB \text{ at } X_1 \text{ and } X_1^o \), and \( Y_{jX_1^o} > Y_{jA} \) even for \( Y_{jB} < Y_{jA} \). The capitalized value of \( \lambda_1 \) after max. \( G \) is less than at \( X_1^o, X_2^o \) and is less than the stock acquisition price of \( X_1 \) in both instances. The capitalized value of \( \lambda_2 \) after max. \( G \) equals the stock acquisition price of \( X_2 \). For B = A under first set of assumptions see last sentence for within area 1.

**within area 3**

\[P_{AX_1} \text{ can be made} < \lambda_1, \quad P_{X_2} \text{ can be made} < \lambda_2,\]

\( V_1 = V_2 = 0, \quad W_1 > 0, \quad W_2 > 0 \quad G \text{ is max. at } A \) and \( Y_{jX_1} = Y_{jA} \cdot Y_{jA}^o \). Capitalized values of \( \lambda_1 \) and \( \lambda_2 \) are equal to the stock acquisition prices for \( X_1 \) and \( X_2 \), respectively at \( Y_{jA} \).

For D = C = B = A nothing is changed.

**within area 4**

\[P_{SX_1} < \lambda_1, \quad P_{SX_2} < \lambda_2 < P_{AX_2} \quad \text{for } X_2^o \text{ along } BC, \]

\( V_1 > 0, \quad V_2 = W_2 = 0, \quad G \text{ is max. at } X_2 = X_2^o \) on BC and \( Y_{jA} < Y_{jX_1} X_2^o < Y_{jA}^o \). The capitalized
value of future $\lambda_2$ after max. $G < X_1^0, X_2^0 >$
$P_{S_X} < P_{A_X}$ for stock $X_2$. The capitalized
value of $\lambda_1$ after max. $G$ equals $P_{S_X} < P_{A_X}$
for stock $X_1$. For $C = B = A$ see last sentence
for within area 1.

within area 5

$P_{S_X} < \lambda < P_{A_X}$, $P_{S_X} < \lambda < P_{A_X}$, $V_1 = W_1 = 0$,
$V_2 = W_2 = 0$, $G$ is max. at $X_1^0, X_2^0$ and $Y_j = Y_j^0 >$
$Y_j A$. The capitalized values of $\lambda_1$ and $\lambda_2$ at
$X_1^0, X_2^0$ are less than $P_{A_X}$ and $P_{A_X}$ for stocks,
respectively. For $A = B = C = D$, see last
sentence for within area 1.

within area 6

$P_{A_X} > \lambda_1$, $P_{S_X} < \lambda_2 < P_{A_X}$ for $X_2$ along AD,
$W_1 > 0$, $V_2 = W_2 = 0$, $G$ is max. at $X_2 = X_2^0$
on AD and $Y_j < Y_j > Y_j^0$ even when $Y_j < Y_j A$.
The capitalized value of $\lambda_2$ after max. $G > at$
$X_1^0, X_2^0$, $P_{S_X} < P_{A_X}$ for stock $X_2$. The
capitalized value of $\lambda_1$ after max. $G$ equals
$P_{A_X}$ for stock at $X_1 X_2^0$. For $C = A$ under first
set of assumptions see last sentence for
within area 1.

within area 7

$P_{A_X} < \lambda_1$, $P_{S_X} > \lambda$, $W_1 > 0$, $V_2 > 0$, $G$ is max.

at D and $Y_j D > Y_j A$ even for $Y_j < Y_j A$. The
capitalized value of $\lambda_1$ after max. $G$ at $D$ is equal to $P_{AX_1}$ while the capitalized value of $\lambda_2 = P_{SX_2} < P_{AX_2}$ for stocks. For $D = A$ under first set of assumptions, see last sentence for within area 1.

**within area 8**

$P_{AX_1} > \lambda_1 > P_{SX_1}$ for $X$ along $DC$, $P_{SX_2} > \lambda_2$, $V_2 > 0$, $V_1 = W_1 = 0$, $G$ is max. at $X_1 X_2$ on $DC$ and $Y_j^0 > Y_{jX_1} > Y_{jX_2} > Y_{jA}$. $P_{AX_1}$ capitalized value of $\lambda_1$ after max. $G$ at $X_1 X_2 P_{SX_1}$ for stock and the capitalized value of $\lambda_2 = P_{SX_1}$ for stock. For $C = D = A$ see last sentence for within area 1.

**within area 9**

$P_{SX_1} > \lambda_1$, $P_{SX_2} > \lambda_1$, $V_2 > 0$, $W_2 > 0$, $G$ is max. at $C$ and $Y_j A < Y_j C < Y_j^0$. After max. $G$ at $C$, $P_{SX_1} = \text{capitalized value of } \lambda_1$ and $P_{SX_2} = \text{capitalized value of } \lambda_1$ for stocks. For $C = D = A = B$, see last sentence for within area 1.

The cost functions which go with the first iso-product diagram of this section are segmented and irreversible as implied in $C$. For example, output at successive points in time for the firm under consideration for $P_y_{jt} < P_y_{jt+1} > P_y_{jt+2} > P_y_{jt+3} < P_y_{jt+4}$ where $t + i$ stands for successive production periods could be as follows:
E. The consequences of imperfect knowledge are great.

1. Under perfect knowledge, the firm would organize at A in the third diagram of II. D above. No overproduction, no capital losses, and no disappointed income expectations would follow and the differences between the two sets of assumptions would be slight.

2. Under imperfect knowledge, however, mistakes would be made and the firm would find itself in any of areas 1 to 9 of the third diagram II. D above. A check of what can happen in each of the areas (see D above) supports the statements of the main test. These theoretical events correspond closely with what has happened in agriculture. This in turn focuses interest on:

a. improving knowledge,
b. preventing mistakes in farm organization which would place farmers in areas 1, 2, 4, 5, 6, 7, 8 and 9. Mistakes in area 3 are easily and costlessly corrected.

F. Capital losses incurred in areas 1, 2, and 4 through 9 are non-Pareto better. Evaluation of circumstances leading to such losses requires, therefore, analytical procedures going beyond modern welfare economics forcing efforts such as made in Chapter 5. Under the first set of assumptions, areas 2, 4, 5, 6 and 8 would not exist and no non-Pareto better losses would occur in areas 1, 7 and 9 on \( X_1 \) and \( X_2 \) in the above example. Hence, modern welfare economics is sufficient under these the first set of assumptions for evaluation. Under both sets, capital losses can occur on \( X_3 \). In theory, \( X_3 \) is ordinarily treated as land. As both land rent and land values are implicitly regarded as unearned in theory and, hence, as subject to destruction without raising evaluative questions, economists have worried little about non-Pareto better adjustments in rents and land values, however illogical (and unjustified) that may be. This book attempts to remedy this difficulty by not distinguishing between either rental and other incomes or between capital losses and gains on land and other assets.

G. Growth in demand becomes more important for the second than for the first set of assumptions.

1. Under the first, unequal rates of growth in demand and supply have the consequences traced out by T. W. Schultz in *Agriculture in an Unstable Economy*.

2. Under the second

   a. if the growth in demand exceeds supply, many errors of organizing in areas 1, 2 and 4 through 9 (see second diagram in II. D above) are converted in errors of organizing in area 3 where correction is easy and costless. (Though growth in demand is rapid in the nonfarm industry, agriculture’s low income demand elasticity product producers appear to experience only small growth relative to the number and magnitude of their errors in organizing farms.)

   b. when growth in demand lags behind growth in output (partly as a consequence of errors of overproduction) errors of organizing in areas 1, 2 and 4 through 9 are correctable only slowly (less rapidly, perhaps, than new errors are made) and at great cost.
III. Under both sets of assumptions

A. Serious problems exist about the optimum number of units of service to extract from a given durable in a given time period. For instance, in buying tractors 500 hours of use per year might be the optimum rate of usage when buying a tractor, while some other number becomes optimum in successive time periods after it becomes fixed as a result of sequential errors made in organizing and reorganizing the business through time.

B. The aggregation problem going from firm supply and demand functions to industry supply and economy demand functions is obviously greater for the second than for the first set of assumptions. This problem has not been attacked for the second set and involves substantial difficulties for the first set. Some analysts have suggested that aggregate supply and responses would be similar under the two sets of assumptions. The following thoughts are offered:

1. In reality, macro agricultural supply responses are more responsive to increases than to decreases in prices.

2. Net prices received by sellers are not equal to gross prices paid by buyers after transaction and transportation costs are figured.

3. Causes of imperfect knowledge are repetitive and never ending.

4. (2) implies that acquisition and salvage prices never become equal in the long run. (3) implies that errors of production are repeatable in the long run.
FARM FIRMS - A DISCUSSION

by Dale O. Anderson*

The timing of this Conference is quite appropriate. Throughout the agricultural sector of the American economy, the dissatisfaction among farm groups over low product prices and rising input prices is exposed in several ways. For example, dairymen are conducting a milk withholding program in an effort to force processors to sign contracts for milk at a price level felt necessary by the dairymen, other groups are concentrating on the input side by advocating a boycott of machinery dealers, drought in much of the winter wheat producing areas is casting doubt on whether the 1967 wheat production will meet the domestic and foreign demands, and small groups are organizing to encourage farmers in the spring wheat producing areas to forego the planting of the expanded wheat allotment for 1967. These are all signs which have strong implications for future research in the producing and marketing of agricultural products and the structure which the producing units and factor and product marketing firms will take.

The three papers contained in this section do an excellent job of pointing out future direction of research in the production and marketing areas of agricultural economics. The purpose of this paper is to highlight some of the key points of the three papers in this section which are particularly important to the development of future research plans.

The paper by Neil Harl considers the organization and structure of the farm firm of the future. Harl sees this firm as being vastly different from its present form. There will be a trend toward multi-member firms, more bargaining power, and more contract buying and selling. He further asserts that the family farm concept should be redefined in terms of the goals that can be accomplished by retaining a system of family farm, particularly as it applies to the future structure of farm firms. The researcher is presented with the challenge to

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identify the essential characteristics of the family farm as a concept, and to evaluate and relate the importance of these characteristics to emerging problems of firm organization. To this end, Harl challenges the social science researcher to meet the dynamic future by including the law as a variable in analyzing the broad objectives of society. That is, the law as a variable should be one of the important model specifications as the researcher develops his program.

Much of the previous research regarding firm analysis has been a static appraisal assuming profit maximization. More recently there has been a shift toward the development of a dynamic analysis of the farm firm. This research has considered the survival and growth of the farm firm. Particular attention was directed to this area of research at the 1966 annual meeting of the American Farm Economic Association held at the University of Maryland. In addition, at least one regional research project, GP-2, has oriented its major research undertaking to an analysis of firm survival and growth.

The collection and development of the types of data necessary to successfully develop much of our research is not available. It is our obligation as researchers to make known the types of data that are needed to test hypotheses concerning various economic problems. These requests should be directed to the appropriate agency personnel as a guide to useful revision of enumeration procedures and data.

Harl feels that the corporate farm or some derivative of it will be the most rapidly growing form of farm firm organization in the next several decades. He does not mention other structures that will likely grow and develop. I think that farm partnerships, in particular, have considerable potential as the predominant farm firm structure of the future. However, I do agree that the farm firm of the future will be multi-membered. However, the farm partnership

2/ GP-2 Regional Technical Committee, "Economics of Establishment, Survival, and Growth of Dryland Farms in the Great Plains Environment".
appears to have the same necessary prerequisites for growth and development as the corporation farm possesses. It seems that the major factor favoring the corporation form of ownership is the intergeneration transfer of ownership.

Research analyzing the corporate structure in agriculture is very limited. In particular, research is needed to determine the net effect of the corporate form of organization upon the decision maker's planning horizon. This information, along with research results analyzing the effects of other farm firm organizational structures, will make it possible to make evaluations and recommendations about specific organizational structure consistent with goals and planning horizons of the decision maker of the future.

The growth and survival of a viable farm unit is dependent upon a reliable and adequate source of credit to finance the unit. Harl concludes that the corporation appears to have many elements in its favor concerning the ability to obtain credit. However, he feels that external capital rationing may be increased due to incorporation, particularly in the case of a shareholder's limited liability. Research is clearly needed to analyze the limited liability problem of shareholders in reducing credit availability, and to develop an equitable and workable policy regarding external capital rationing due to limited liability of one or more shareholders.

Harl indicates that conceptual work is needed to develop research models which will adequately analyze various forms of organizational structure of farm firms. He suggests three models which provide adequate models for analyzing different types of problems. The three are: (1) recursive programming, (2) simulation, and (3) behavioral simulation.

Earl O. Heady and Gordon Ball discuss research implications which are apparent in response to wage rate changes and increased demands. The authors indicate that there will be a distinct change in the resource structure of the farm firm brought about by technology, increased investment in the human resource through formal education and vocational training, and the present age distribution of farmers. The extent and types of agricultural policies needed for the future will depend upon the organizational structure of farm firms. In like manner, the size and number will explain rural America and the resulting "Main Street" business complex which serves it.
How many farms will there be in the United States in 1980 or 2000, or at what level of farm numbers will stability tend to exist? This question formulated in one way or another is of prime concern among agricultural leaders and all people associated with agriculture in the United States today. Some projections have predicted that farm numbers will eventually drop to 50,000. Others have indicated that farm numbers in the United States will stabilize at 1.5 to 2.0 million farms. Whatever the eventual number becomes, substantial adjustments are forthcoming in the farm and nonfarm communities of rural America. In other words, fewer farms support fewer towns, schools, and services of county government. This means further consolidation of farms, services of local businesses and services of city and county government, including secondary education.

The increased farm size and decreased farm numbers, increased investment in the human resource, greater occupational mobility and minimum wage laws will continue to force the future price of labor and other resources upward. Heady and Ball expect a continued substitution of capital for labor, and as a result feel that additional research is needed to more accurately analyze this substitution process. They cite two reasons for such a need: (1) to guide individual farmers on profitable substitutions that are profitable on their farms, and (2) to determine the rate at which social and economic problems will face rural communities.

Heady and Ball indicate that the number of farms in the United States in the future is dependent solely upon the nature of cost or scale economies of the farm firm. In short, research results are not available in the following areas:

1. Nature of short run and long run cost functions in technologies related to highly mechanized and large volume feeding or dairying operations, or environmentally controlled livestock production.

2. There are no data or research results available to indicate whether important cost economies relating to prospective and upcoming technology are more prevalent in the farm producing firm or the input supply firm.
Heady and Ball argue that area 2 above is particularly important concerning future structure of the farm firm as well as the input supply firm. They conclude that (1) if the largest cost economies are present at the farm producing level, then the present structure of farm machinery ownership will prevail, however (2) if the major cost economies are located within the input supply firm rather than the farm producing firm, the authors visualize a shift in machine ownership whereby the supply firms will furnish the machinery on a custom basis and the farmer will become a sophisticated landlord. Thus, the researcher should be challenged to determine the extent to which cost economies that favor larger farm units unfold from advantageous price position or the resulting production functions. This area of research could include: (1) a measurement of the cost functions for farms employing alternative complements of fixed resources, and (2) a measurement of cost economies for farms that represent factor input and output producing units under the same management. In addition, additional knowledge is needed to accurately assess the importance of alternative institutional arrangements of land ownership on the resulting cost economies as firms grow.

Another important element contributing to increased output from land is the capital-land substitution. In general, capital substitutes reduce the per acre requirement to produce a unit of product as opposed to the capital-labor substitution. Capital replacing land to produce the same level of output implies that land must be taken out of production. Research is therefore needed which analyzes the process of capital substitution for land and pinpoints the regions in the United States in which major adjustments in land use for individual firms must take place. The result of this research proposal carries strong implications for public policy development in this area.

Firm growth and capital accumulation would occur at a very rapid rate and in extremely large quantities if the 50,000-100,000 projection of farm numbers ever became reality. Heretofore research efforts in the area of firm growth have been extremely limited. Mention was made earlier in this paper of the firm growth emphasis at the 1966 AFEA meeting and the GP-2 regional project directed toward firm growth. Heady and Ball feel that research in this general area should be directed at an exploration of relationships on farms between current income, consumption, investments and net worth. In addition, they feel the following questions also deserve attention: (1) how farmers contend
with estate taxes, (2) what are the prospects of obtaining capital by selling shares to the public, and (3) the possibility of obtaining long term loans at prime rates.

The growing farm firm will pose problems concerning risk and uncertainty which previously did not exist. Heady and Ball suggest that strategies required of the farm firm of the future might very likely be developed from many of the strategies employed by some of the large industrial firms which are a part of our present day economy. In this regard, research must be initiated which further develops the analysis of problems regarding uncertainty. For example, the authors cite: (1) what are the outcomes resulting from existing game and other decision models, (2) further adaptation, development, and extension of subjective models, and (3) further development and application of simulation.

It is very likely that management will be the most limiting factor to the maximum size of farm firms. Harl suggests that future farm firms are likely to be multi-member units. As such there will be a separation of management and supervisors. The training and experience of these individuals will be extremely crucial to a growing viable farm unit. Research must be directed at a specific analysis of the management function in agriculture. What factors contribute to a successful manager? What management qualities are needed to successfully coordinate four or five supervisors? In this regard, Heady and Ball suggest that various operations research models must be researched more deeply to determine their relevance to investments and managerial decisions of large scale specialized farms. The North Central Region previously conducted research on a regional basis to identify the managerial function in agriculture. However, a recent revision of the research project for continued work in this area was not approved. However, individual states should continue to support this research endeavor.

Glenn Johnson considers the overcommitment of resources as applied to the production of agricultural products. Johnson first traces the history of resource commitment in the production of farm products. The historical analysis is stratified into six periods,

\[3/\] NC-59 Regional Technical Committee, "The Management Resource in Farming".
beginning with World War I and concluding with the so-called International Food Gap. During the first five periods, concluding at the end of the Korean Conflict, Johnson argues that we have turned to some "whipping boy" without asking the fundamental question of whether inherent characteristics of American agriculture were responsible for the overcommitment of resources regardless of the existence of World War I, The Great Depression, World War II, or Government commodity programs. The sixth period includes the period of time from the Korean War to the International Food Gap and takes us from large surplus stock of agricultural products to the end of excessive government stocks for everything except cotton. Johnson concludes that it appears we no longer have culprits to blame. Many contend that we have reached a new era in which we are through overcommitting resources.

A brief analysis of the inputs employed in the production process provides additional insights into the overcommitment of resources. Johnson contends that labor has been continually overcommitted to the production of agricultural products. In addition, future projections indicate that this trend will continue.

According to Johnson's analysis, there have been few periods in which new forms of capital which substitute for labor and land have not been profitable. In fact, about the only classes of capital in which overcommitment has occurred and losses have been incurred are specialized farm or nonfarm produced durable capital and storable expenditures. In general, Johnson feels that there has been very little overcommitment of capital of all other forms employed in agriculture.

Johnson argues that land is a resource having a high acquisition price and a very low salvage value. He feels that the characteristics of land make it easier to pay too much for it rather than to over-use it physically. There continues to be a strong demand for land, particularly to minimize losses from overcommitment of labor and then large machinery to minimize losses on labor.

Johnson concludes from the historical summary that (1) World War I and II, the Korean War, the Great Depression, and government programs tended to aggravate the overcommitment of resources to the agriculture sector of the U. S. economy, and (2) that this
overcommitment existed because of a fundamental characteristic of American agriculture, independent and not explainable by such variables as changing technology, improvements in human agent, inflation, or risk and uncertainty.

The second section of Johnson's paper considers some refinements and developments in theory which are necessary to a complete explanation for agriculture to possess a tendency to overcommit resources to the production of agricultural products. The theoretical developments made by Johnson are based on two explicit assumptions: (1) concerned with imperfectly informed managers capable of learning, and (2) acquisition prices less than or equal to infinity but greater than or equal to salvage prices which are in turn greater than or equal to zero. Although this modified theory leads to an overcommitment of resources through time, the following conclusions are derived: (1) no mistake of overcommitting an input whose acquisition cost exceeds its salvage value is completely correctable, (2) some mistakes of overcommitment of resources can be partially corrected by loss, and (3) some mistakes of undercommitment of production can be completely corrected by moving to the optimum level of resource use.

Johnson considers the characteristics of American agriculture and identifies those components which make it unique from other automistically organized firms. These factors include (1) an excess supply of labor, (2) U.S. farmers a part of an economy where real per capita incomes and wage rates are increasing rapidly, (3) occupy a large geographical area, (4) managers are not particularly well informed about macro consequences of individual decisions, and (5) they operate in a continually changing environment with imperfect knowledge of changes forthcoming. Thus, Johnson concludes that the combination of theory and fact implies that the tendency to overcommit resources has been inherent in the agricultural economy of the United States.

Johnson discusses some of the structural changes which are occurring in American agriculture to reduce the problem of overcommitment of resources to the production of agricultural products. These changes include (1) better trained managers, supervisors, and labor, (2) creation and innovation of new technologies, and (3) changes in public and private institutions which control resource use. In addition, the author feels that possibly vertical integration, but no contracts might help to reduce the overcommitment of resources.
Johnson goes on to suggest the kinds of structural changes which are needed in order to more completely control the overcommitment of resources in a sector of the economy which is characteristically destined to do so. The main structural change would include a reduction of imperfect knowledge. That is, more research must be directed toward the development of decision making strategies which would help to reduce the imperfect knowledge problem of resource allocation. This research would include such variables as technological changes, human resource, income elasticity, foreign demand, and the International Food Gap.

Johnson further challenges researchers in agricultural economics with the following areas which need further research. These areas include (1) the determination of the quantities of resources which can profitably be committed to agriculture without causing an overcommitment problem, (2) can the present information programs of disseminating research results and implications impress the need for necessary adjustments in resource use and be fully distributed to all farmers, (3) considerable attention must be directed toward the possibility of creating new control mechanisms owned and managed by agricultural producers.

Summary

The three stimulating papers in this section have outlined many areas of future research needs. They should provide an excellent set of guideposts from which important research projects will be formulated to provide answers to the question forthcoming in the years ahead.

There are several questions to which all the papers have alluded somewhere in their discussions. For example, it appears that research must be continued to search out more explicitly the cost economies that are present in agriculture by type of farm and method of operation. There was considerable emphasis placed on the need for research to develop models of firm growth and associated problems. Research results must be forthcoming analyzing the managerial resource in farming including, a reduction of imperfect knowledge which continually faces decision makers. More of our research should be developed with institutional factors as a variable component. This is particularly true for considerations of the corporate form of resources ownership and implications for firm growth, development, and intergeneration transfer of ownership.
IMPLICATIONS FOR CHANGES IN AGRICULTURAL PRODUCT MARKETS
FOR FARM MANAGEMENT AND MARKETING RESEARCH

by Lowell D. Hill*

The marketing system for agricultural products is large, complex, and highly dynamic. Despite continuous efforts of universities, research consultants, and market analysts, the marketing system has never quite reached a state of equilibrium with its environment. The pursuit of an equilibrium price by the forces of supply and demand is rather like the pursuit of a rabbit by a beagle. The position of the rabbit at any moment is the equilibrium position of the dog. By the time our beagle reaches the rabbit's original position, the rabbit is no longer there and the dog moves off in a new direction toward a new equilibrium position. If we were to watch only the dog, his movements would seem very erratic and unpredictable. If we gain sufficient perspective to see both the dog and the rabbit, the causality behind their actions becomes obvious and we discover the motivation that keeps them going. Our task as researchers is to study the behavior of this "rabbit" and plan strategies which will help our "economic beagle" to come closer to being in the right place at the right time. One of the problems is that the researchers are often far behind in this race. Not only have they lost sight of the rabbit, they can't even see the dog. They have on occasion devoted too many resources to the finding of an equilibrium position which even the dog has long since passed--solving problems already resolved by industry. I interpret the task of this activity to be the examination of some of the changes that are occurring and that might occur, and to suggest research areas that could provide answers to the problems of real concern to individuals, firms, industry groups, and society.

The scope and magnitude of recent changes in the product markets could be illustrated in many ways. One could look, for example, at the number of new products coming on the market. General Foods introduced over 50 new food items in a single year. Campbell Soup marketed only 44 items in 1955 but over 300 in 1965. Of the 72 new products which Borden & Co. placed on the market during a recent two-year period, 83 percent were considered successful and thus influenced the distribution of the consumer's dollar.1/ Many of these developments result in a

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different allocation of resources for producers of raw materials and a different organization of the market, as well as a different pattern of consumer expenditures.

Alternatively one could identify the changes, and implications of changes, in the concentration ratios and other structural variables of the various industries processing and marketing food. In 1937, the four largest firms accounted for 24 percent of total shipments of canned peas. By 1958, this share had increased to 53 percent of the total. The 40 largest chain stores accounted for 24.7 percent of total sales in 1948. By 1963, this share had increased to 36.1 percent of total sales.2/

A third alternative would be to examine the changes in buying practices and pricing policies of various firms in the market channels for food products. Under this heading one could examine integration in the livestock industry, or the use of private label products in food retailing, or recent anti-trust action against agricultural firms including 25 suits against the dairy industry and 12 against fruit and vegetable processors in the last 15 years. Without developing these examples in detail, I would like to start by describing change under four general headings, discuss some important examples of each category, and finally discuss the implications of these changes for researchers in farm management and marketing. The four classes of changes are:

1. Changes in buyer-seller relationships
2. Changes in consumer tastes and income
3. Changes in governmental policy
4. Changes in technology of production and processing

Changes in Buyer-Seller Relationships

During the past 100 years the development of mass distribution techniques and greater specialization have moved the final consumer farther and farther from the point of production in terms of time, form, and space. More recently, the increased size of producing units and horizontal growth of food marketing firms has made it more economical to purchase direct from producers or at least from the point of first assembly. All national, most regional, and many local chain store organizations today operate on an integrated warehousing and distribution system. Each retail store is serviced by the wholesale plant of the

parent firm. There has been a subsequent decline in the need for whole-
salers in the industry and an increase in direct purchases. With increas­
ing horizontal mergers, direct purchase is also increasing among restaurants
and cafeterias. Associated with this change in the market channel has been
an increase in specification purchases or the so-called prescription buying,
where variety, grade, size, and pack of a commodity are specified in the
purchase order prior to loading. In many instances the product is graded, 
packaged, and crated before it ever leaves the producer.

Contracting of many of the specialty crops is another approach to
specification buying in which the processor or marketing agency is able
to control the quality characteristics of the product. Tomatoes are a
good example. Many processors obtain all their raw product under pro-
ducer contracts which specify variety, size, maturity, and quality. Since
acid content is important in catsup and juice, these processors control
acidity of their product in different geographical areas through their con-
tracts by specification of the variety to be grown.

Buyer-seller relationships also include changes in the power structure
between processors, distributors, and retailers. Changes in size and
specialization of these firms have altered the marketing channel and the
relative bargaining position of processor and retailer. The milk industry
provides an excellent example of this change. In 1931, only 14 percent
of all ice cream was sold through food stores; by 1965, 54 percent was
sold through food stores. A similar change has occurred in fluid milk.
In 1930, 94 percent of the fluid milk was delivered direct from plant to
the consumer; by 1944, this had dropped to 36 percent and in 1965,
only 28 percent was home-delivered. The other 72 percent was delivered
wholesale--primarily to food stores. This change has provided food
chain stores with increased power in the market. Most national chain
stores obtain dairy products for a large number of their retail stores from
a single supplier. The threat of losing a sale of this magnitude exerts a
significant influence upon the practices and policies of the supplier.
Smaller dairies are either unable to provide sufficient volume, do not
carry a full line of dairy products, or are reluctant to commit their entire

3/ Robert E. Jacobson, Roland W. Bartlett, The Ice Cream and Frozen
Dessert Industry--Changes and Challenges, University of Illinois
Agriculture Experiment Station, No. 694, p. 19.


Farm Economics, CXCIV (July, 1951), p. 1192, Table 2.

6/ U.S. Department of Agriculture, Packaged Fluid Milk Sales in Federal
Vertical integration and contract production will be discussed in several of the other papers in this series, so I shall describe only one such change that has particular significance for product markets. This is the introduction of live cattle futures contracts in November 1964 and the live hog contracts in February of 1966. Both of these represent an innovation in marketing and pricing distinct from the traditional futures trading in products such as grain or pork bellies. Futures trading in livestock is a new concept in the sense that its function is the shifting of price risks on goods in the process of production rather than on a given inventory of storable goods. When used by producers, the live cattle futures contract is a system of forward contracting stabilizing the selling price to the producer prior to putting the cattle on feed. This futures market is not a means of allocating a given inventory over time but a means of reducing uncertainty for individual producers in the allocation of resources among various production alternatives. Unlike the traditional futures contract, a production futures contract is written for a commodity which cannot be stored. These contracts have gained acceptance and apparently will be a factor in future production and marketing. The volume of trading during the first full month of operation of the live cattle futures was 1,386 (December 1964); one year later, December volume was 14,086 and in December 1966, total volume traded was 17,082. Open interest reached a high of 665 in the first contract (April 1965 delivery) and a high of 5,173 in the April 1967 contract. Hog futures are operating on a much smaller volume and have not yet shown any strong upward trend.

No information is available on the users of these contracts—whether producers, packers, or speculators. There is some indication that producers are in the minority. This may be partly explained by the number of cattle feeders (especially smaller ones) who cannot justify the time required to learn to use the futures market successfully. This suggests a need for a program in which the futures market can be translated into a simple, guaranteed, cash price at a given point in time. A national meat packer has introduced such a contract under which the cattle or hog feeder is quoted a specific price for livestock delivered to the plant at an agreed-upon future date. The packer then hedges this sale in the option month corresponding most closely to the time of expected delivery. The palatability of the contract to producers is increased by an advance of $25 per head of cattle and $5 per head for hogs at the
time the contract is signed. The primary objective of the packer is to guarantee and stabilize his supply of slaughter stock. While the offer has been accepted by relatively few feeders at this time, interest is increasing and the goal is to have 20 percent of the total kill delivered on contract. The advantages and disadvantages of such a contract to producing and processing firms, and the ultimate effect upon the market system, is an important area of concern.

Changes in Consumer Tastes and Income

Let me define consumer tastes and income broadly enough to include the export market as well as the domestic market. For many commodities the changes in foreign demand far exceed the significance of changes in the domestic market. As the volume and value of exports have increased, the tone of foreign trade has changed. Formerly, foreign markets were the residual claimant for excess production of any commodity, grade, or quality that was found to be surplus. Present emphasis is shifting to production specifically undertaken to meet foreign requirements. Changes in quantity and quality demanded for export have been passed directly back to the producer and are influencing production decisions. One and one-fourth million bushels of an edible soybean called Kanrich were exported through Mitsui Grain Company to Japanese markets in 1966. These were purchased from producers, through local and sub-terminal elevators in central Illinois under a contract guaranteeing a 20¢ per bushel premium over the market price for soybeans. This market has developed in only the last three years to meet the increased demand and declining supply of edible beans used for production of miso in Japan.

A similar market exists for Hawkeye soybeans for producing tofu for sale in Japanese stores. A premium of 5¢ per bushel is paid for soybeans of this variety meeting quality and purity standards. Most of these beans are assembled, inspected, and cleaned on an in-transit rail rate to New Orleans or Baltimore. Barge transportation is not used since it would involve additional handling and subsequent breakage. This market is not a residual claimant for soybeans but is a demanding market which commands a resource allocation completely different from the domestic demand. More and more of the foreign markets are being based upon such requirements and are thus influencing production and marketing.

Even the increased volume of exports is a change of importance for research. Total agricultural exports which were only $2.9 billion in fiscal year 1953-54 reached $6.7 billion in fiscal 1965-66. One-fourth of the nation's harvested acreage produced for the export market in 1965-66 compared with 9 percent in 1953-54. The increase includes considerable shift in relative importance of various products. Soybean exports have increased from 57.3 million bushels to 252 million bushels
during the last 12 years, mostly to Japanese markets. Fruit and vegetable exports are increasing rapidly due in part to the feasibility of air shipments to northern Europe. Exports of meat have risen by 84 percent accompanied by an increase of 71 percent in numbers of breeding cattle since 1959.

The trend for most products has been toward development of foreign markets at competitive price levels. Much of this has been a result of private company promotion abroad. Some 45 U.S. trade and farm groups operating in 70 different countries are actively cultivating the consumers of U.S. products in other nations. In-store promotional activities are having a significant effect upon consumer attitudes in western European countries. One hundred twenty-nine firms exhibiting at trade fairs in Belgium and Germany reported over $4 million in actual and expected sales in 1965. Another factor explaining changes in volume and kinds of exports has been the rapidly rising levels of living in the land-scarce, high-income countries of western Europe and Japan. Higher per capita incomes enable these people to increase their purchases of meats, feed grains, fruits, and vegetable oils. More and More U.S. production is allocated toward satisfying the desires of foreign consumers. As the export market increases relative to the domestic, it will have even greater impact upon varieties and cultural practices of producers, and upon merchandising, packaging, transportation, processing, and pricing practices of the marketing firms.

Without taking time to develop them in detail, I would like to mention two other areas of change whose importance warrants more space than I shall devote to them. The increased leisure time of rural and urban residents has resulted in a rapid growth in the demand for recreation facilities. Current expenditures for leisure are estimated as high as $35 billion and are expected to more than triple within 15 years. The kind and quantity of this demand cannot be adequately met by the National Park System. Private lands must assume an important role in providing facilities for camping, fishing, hunting, etc. The land best suited for such uses is in the hands of farmers.

Changes in the food consumption patterns in the United States have also exerted an influence upon marketing channels and the allocation of production resources. Shifts among products as indicated by per capita food consumption are indications of changes in tastes and preferences as well as responses to changes in prices and consumer income. The effects upon various products and product forms have varied widely. Per capita consumption of frozen vegetables increased by 43 percent in the last 10 years, while fresh vegetable consumption declined by 6 percent. Per capita consumption of broilers increased by

\[7/\text{"USDA 4133 - 65," United States Department of Agriculture, December 29, 1965, pp. 1-5.}\]
by 70 percent in the last 10 years while consumption of eggs has declined by 16 percent.\textsuperscript{8}

With domestic consumption becoming less a function of "needs" and more a function of "wants," and given the impact which merchandising and promotion exerts upon consumer desires, the future changes in consumption patterns may be even greater.

Changes in Governmental Policy

I shall mention only briefly the changes in governmental policies and programs. To cover the numerous changes and their broad implications would require all three days of the conference. I also anticipate that other papers in this series will discuss some of the changes in government action and policy and their implication. I will suggest only two examples to illustrate the importance of policy to agricultural product markets.

Government policies of the United States and other countries largely determine the "rules of the game" under which agricultural products are exchanged in the domestic and foreign markets. As these rules are changed, adjustments are required of the firms in the industry. Most of these adjustments are non-Pareto better. When CCC stocks were drastically reduced in 1964 and 1965 the income for grain storage firms reached such low levels that many firms were forced out of business. Adjustments in storage rates and capacities are still in a state of flux as a result of the distortion of storage charges under the government storage program.

Many changes have occurred in trade barriers within and between countries which have altered the available markets for agricultural products. The European Common Market activities and negotiations, Public Law 480, bi-lateral trade agreements, and export subsidies on wheat are a few examples of these changes. They have had an impact upon all phases of the marketing and production of agricultural products.

Changes in Technology of Production and Marketing

The impact of technology has been a problem of economic importance throughout most of the history of economic thought. With technology increasing at an increasing rate it becomes ever more difficult to evaluate

requirements of future adjustments. It is difficult to separate technological changes from the institutional and structural counterparts required to utilize the technology. Therefore, the examples discussed under this heading could logically be called changes in market organization or put under any of several other appropriate subtitles. Professor Dahl has already referred to one of these changes which is revolutionizing the grain industry. Field shelling of corn has created a serious imbalance between the marketing resources for drying, handling, and storing grain on the one hand and the demand for services on the other. The percent of corn field shelled in Illinois rose from 6 percent in 1960 to 57 percent in 1966. The resulting changes in the marketing channel and in the services required have had diverse effects upon the returns to resources. Changes in returns to scale, locational advantage, and transportation rates, have left many elevators with excess resources receiving low or negative marginal returns while similar resources of other firms are receiving short-run economic rents. Some facilities are expanding rapidly while other elevators in the same geographical area are closing due to low returns to labor and capital. Yet the chaos in the grain trade is not entirely attributable to field shelling of corn. The trend toward increased off-farm marketings was under way before field shelling, and greater demands were already being placed upon elevator and transportation facilities. The rapid increase in grain exports would have created handling, storing, and transportation problems even if there had been no field shelling. These changes have placed tremendous pressures upon a marketing system unable to adopt new technology rapidly enough to accommodate demands of producers on the one hand and the demands of the domestic and foreign markets on the other hand.

Technological changes in processing and marketing have also had an impact upon agriculture. Freeze-drying, instant foods, and new products by the thousands are all part of the technological changes which have occurred in agriculture and agricultural industries. I would like to select only one of these changes for detailed discussion. It has already been mentioned, but I would like to carry its implication a little further. The development of spun protein fibers from soybeans has opened new vistas for edible products from grains. Although originally introduced on the market with the characteristics of meat, the form, shape, texture, and flavor of many other foods can be duplicated. With proper additives it may become pecans or walnuts, apples or oranges, beef or bacon. Adequate supplies of synthetic amino acids, vitamins, etc. are available to permit duplication of the nutritive value on nearly any food. While soybeans are deficient in the sulphur-containing amino acids, the addition of albumin and some synthetic products gives Bontrae (one of General Mills' new spun soy products) a protein efficiency ratio nearly equivalent to that of casein. Although current prices of many of these
products are relatively high, the economics of production are such that the cooked, ready-to-eat product could be delivered in quantity to manufacturers of pot pies, T.V. dinners, etc. at a cost of 35¢ to 50¢ per pound compared to cooked, boneless chicken at a cost of 85 cents to $1.05 per pound. The efficiency with which animals convert vegetable protein to meat protein is estimated at about 15 percent. The protein yield of the spun soy process is about 85 percent. Stated another way, one acre used to produce meat will provide protein requirements for one man for less than 250 days. One acre of land in soybeans will provide protein for one man for 2200 days. The limiting factor is not cost nor nutritive value but consumer acceptance.

Another technological change is the development of high lysine corn. The discovery in 1963 that a mutant gene increased the lysine content of corn, opened the door to the development of genetic strains with protein levels and a balance of amino acids tailored to particular species of livestock. Preliminary feeding trials indicate that high lysine corn is equivalent to a corn-soybean meal ration for hogs. Another mutant gene produces a different balance of amino acids more nearly meeting the requirements of poultry. In field tests at Illinois in 1966, in 17 paired comparisons the high lysine plots produced an average of 85 percent of the yield of normal corn. A few hybrids reached 90 percent of the yield of normal corn. Agronomists anticipate pilot production on farms in the early 1970's. Some seed corn companies are on a crash program to obtain stabilized strains of high-yielding, high-lysine corn to meet the anticipated demand. The impact on the corn, soybean, and livestock industries may be felt within a very few years and pressure is already building for research to help improve the adjustments. Technologically, we have barely scratched the surface of nature's secrets and have a very limited concept of their implications for the future.

Implications for Research

The examples that I have discussed include only a very small segment of the total picture of change in the market for agricultural products. However, these examples will serve to illustrate the kinds of research needed to facilitate adjustment to this changing economic environment. I shall not attempt to specify projects but only to describe some general problem areas suggested by the various kinds of changes.

Implications of Changes in Buyer-Seller Relationships

The increase in prescription buying and forward contracting by chain stores and restaurants has altered the traditional market channel and provides an opportunity for decreased marketing costs as physical movement and handling of the product is decreased. The magnitude of potential cost reductions and the effect upon over-all efficiency of marketing has little empirical substantiation. The contribution of additional market performance studies in this area would be enhanced by relating the changes in efficiency and costs to the distribution of income and the level of consumer prices. Producers need additional information on the relative costs and returns from such an organization of the market and on the implications for the location of decision making in the integrated production-marketing structure.

While retail firms have been integrating back through wholesale and processor stages of marketing, many processors have integrated forward into retail distribution. The effect upon both costs and efficiency and the research needs are similar in both cases. However, the impact upon consumer prices, the changes in income distribution, and the effect of market regulation may be quite different. In 1964, a study of 131 milk markets scattered over the United States showed gross margins varying from 5.1 cents to 14.9 cents per quart. Many of these differences were attributed to the introduction of small, low-cost, cash-and-carry dairy stores. The growth of these high-volume, low-margin stores is restricted to markets where retail prices are not regulated by state marketing orders. Where state law establishes minimum retail prices, there is no opportunity for such market innovation. Research is needed not only to determine the optimum "rules of the game" under which innovation and efficiency are encouraged, but to determine the effects upon producers and consumers of alternative organization of the market.

One of the most intriguing areas for research of recent years is the development of the futures market for live cattle and hogs. Until 1964, it was generally accepted that one criterion for a successful futures contract was that the commodity be storable. The relatively stable return to storage derived from hedging grain in the futures market helped establish order in these markets. Now a contract has been written for a non-storable commodity enabling hedging of a product not yet produced. The purpose or function of the contract for live cattle is very different from that of the contract for grain.

What will be the effect of this market innovation on the livestock industries? Research needs to begin with a serious gap in our factual information. There is no data on who uses the cattle and hog contracts, who are the longs and shorts, what is the volume of trading by producers,
processors, and speculators, or how the gains and losses from this zero sum game will be distributed. These additional data are necessary for adequate performance of the speculative function. Once some data are available, the research potential is unlimited. At the producer level: What is the effect upon optimum size of enterprise? How can the futures market be used to maximize producer returns? Does this alter the relative profitability among grades of cattle? Should the contracts cover a longer period of time to carry the price back to a basic production decision period? How will calf producers be affected? Similar questions are relevant for packers.

Looking at the market at an aggregate level, there are questions of effects upon price stability, seasonal and cyclical fluctuations in production, and the determination of daily prices. Price stability in livestock marketing may be achieved by government regulation, by vertical integration where a few firms may dominate production and sale, or by forward contracts formalized into a futures market. Policy research is needed to help agriculture evaluate these alternatives.

A starting point for such research would be a survey in cooperation with the board of trade, of the users of the live cattle futures. This would identify hedgers and speculators, the positions they have taken in the market, the size of their open interest, their profession, and the profit or losses associated with their use of the futures market. Risk models have often been discussed in the literature but have seldom been employed in empirical studies. A supply response estimate based upon risk differences when cattle production is hedged could be tested by following the cattle production records of hedgers and non-hedgers over time.

The use of the futures market as a means of contracting between packers and feeders raises additional questions. There is already some evidence that this will affect lending practices and limits. The cash advance will certainly affect the capital position of the producer. There is a need to identify the characteristics of producers using the futures markets directly, relative to the characteristics of producers selling on contract to a third party who then uses the futures market to hedge his advance purchase. How will these alternatives affect the individual producer and his production and marketing decisions? How will the rate of technological adoption be affected? What is the new equilibrium size of producing units?

Meat packers using contracts based upon the futures market for live cattle and hogs could provide the data necessary to estimate the effect of this market change upon their total supply of livestock, upon the variability of their daily slaughter, and upon the costs and returns for marketing and processing.
The development of direct buying, contract production, and vertical integration increases the difficulty in obtaining price and quantity information for the product market. A smaller volume moving in regular market channels results in less reliance upon market forces to establish prices. The usefulness of statistical records of market transactions is diminished since they may cover a small proportion of total sales. The ability to evaluate price and quantity movements is hampered by a lack of data on transactions that take place internally within a single firm. Additional research is needed to determine better ways of obtaining data for these products and of evaluating the market forces which establish prices on products moving through an integrated market channel.

**Implications of Changes in Consumer Tastes and Income**

A change in consumer tastes is another way of saying a shift in the demand curve for a given product or product group. This shift in the demand curve in the export market is the result of many factors. Most of them have been rather poorly identified and seldom quantified. A few studies have been initiated but many more are needed in the area of price and income elasticities as well as potential supply response. There has been some research by commercial firms on developing advertising and merchandising techniques oriented specifically toward foreign markets but there are many unanswered questions. There is even opportunity for some analysis of governmental policies and actions which alter the effective demand of various countries and for an analysis of the results of such actions upon the demand curve of different products.

Many spatial equilibrium models have taken export as a fixed quantity since it has been such a small proportion of the total. When volume of trading increases as it has in soybeans, for example, the solution to these models cannot be realistic unless the foreign demand is included as one of the trans-shipment points. At the micro level, the increasing demand for a specific quality and quantity for export markets--particularly where price premiums are offered--will result in a different optimum combination of enterprises. Continued research on new products may identify additional opportunities for exporting U.S. agricultural resources. Orientation of production toward specific export markets means a shift in resource allocation with implications for producers and consumers.

Shifts in the demand curves of U.S. consumers have also had an impact upon prices and quantities of many products. Conceptually, for example see, Nixar Osman, W. R. Morrison, and L. D. Bender, *Factors Affecting the Estimated Future Foreign Demand for Soybeans*, Agriculture Experiment Station, No. 712, University of Arkansas, May, 1966.
the problem is to differentiate empirically between movement along
the demand curve and a shift of the curve. Blaich\footnote{O. P. Blaich, Strength-of-Demand for 120 Market Categories of Food, 1957-61, University of California Agricultural Extension Service.} has used a
strength-of-demand concept to estimate the direction and magnitude
of the shifts in demand curves for 120 different food commodities.
This is a comparison between two points in time. There is a need
for additional refinements to identify some trends in these shifts
and also to identify the changes in price elasticity over time for
certain categories of foods. Spatial equilibrium and production
feasibility studies are in general suffering from a lack of information
on elasticities and trends in elasticities in their estimates of optimum
resource allocation and trade among regions.

The increased leisure time of society provides a booming recrea-
tion market with a very hazy set of demands. Farmers have little
experience in selling this vague service to a fickle public and most
agricultural technicians are no better prepared than the farmers to
deal with these problems. There are very serious management
deficiencies and little research available as guides. An ERS study
indicated that only 60 percent of the recreation enterprises surveyed
received any returns to management and family labor if a 5 percent
return on capital was assumed. Most farm record systems now in use
are inadequate for evaluating the returns from the recreation enterprises.
At the aggregate level, research is also needed to project the impact
of increased farm recreation upon the demand for land resources.

Implications of Changes in Governmental Policy

Export markets for our products are a function of our domestic
agriculture and trade policies, policies of importing nations, and the
policies of exporting countries competing with the U.S. It is impera-
tive that researchers in the area of foreign trade be familiar with the
past, present, and future of price support programs, tariff barriers
and nontariff barriers of all countries involved in the export and
import of any given commodity. Additional research is needed to
analyze the implications of these policies with respect to the U.S.
markets abroad. The research should be a two-way street—looking,
on one hand, at the effects of various policies upon U.S. agricultural
trade, and on the other hand at the implication of our trade for
changes in our domestic and foreign policies. Some good work has
been done on tariff barriers and there is adequate economic theory
available with which to study various tariff models. Of equal impor-
tance however is the field of nontariff barriers such as marketing
monopolies, quotas, restricted importing periods, bilateral agree-
ments, health regulations, compulsory mixing of domestic with
imported products, and special import taxes.
A good illustration of policies affecting exports may be found in the U.S. Maritime regulations. Public Law 664 requires that 50 percent of the goods sold by U.S. for export must be carried on American ships. As a result, the price of American wheat delivered to the Black Sea ports in 1963-64 was increased an estimated $3.00 per ton. We have not sold any significant volume of wheat to Russia since. This shipping policy has certainly affected the markets for our agricultural products.

Institutional or nontariff barriers of the trading nations must be considered in any evaluation of change in product markets. Although consumer demand and income levels in other countries may suggest a market for U.S. products this demand is severely restrained by institutional restrictions such as the requirement by the West German government that margarine manufacturers buy rapeseed oil equivalent to 5 percent of the total oil used. Similar mix requirements are found for tobacco in Australia (40-43% of the leaf must be domestic), New Zealand, and West Germany. In Belgium, imported wheat is restricted to 30 percent of the total wheat used in the milling industries. Health regulations have been effective in controlling European imports of live poultry and breeding stock from the United States. The effects of these and similar regulations on exports, imports, and income of trading countries can be readily hypothesized with the available economic models. However, the empirical work has been very inadequate for testing these models. Marketing and policy research must be coordinated for the goals are interdependent. Neither governmental policy nor allocation of products among markets can be taken as given in any realistic evaluation of future trade among countries.

Implications of Technological Changes

Technology and innovation are continually shifting the balance of power among firms and redistributing incomes and market shares. These wheels of change grind one firm out of existence while carrying another to new heights of power and profit. Innovation and incidence of technological change is therefore an area of considerable importance in the research efforts of land grant universities as they seek to improve adjustment in various industries.

Production, harvesting and transportation technology in the grain industry in the past ten years have resulted in a rather drastic reallocation of resources. The adjustments are still a long way from equilibrium as evidenced by the high rate of expansion of facilities and the mortality rate of firms. High priority research areas include the optimum distribution of drying and storage facilities among farms, country elevators, terminal elevators, and processors. Related to this, and perhaps drawing upon these results, are studies which will
answer the question of the optimum number, size, and location of
grain facilities. For the individual elevator firm there is a need for
information on costs, returns to scale, and market opportunities. In
many cases an integrated approach by farm management and marketing
would greatly enhance the value of the results.

In the area of transportation there is only limited information of
fixed and variable costs, alternative modes of transport, optimum
combinations of truck, rail, and water, services desired, and competi-
tive rate structure. Box cars have given way to open hopper cars,
Big John hoppers and even a Whopper Hopper. Data and research on
these changes and their costs are basic to a study of grains and most
other agricultural commodities involving transportation.

New products are difficult to research for we cannot foresee
clearly the future events, and the data are very limited on recently
introduced products. Research can be initiated on consumer accept-
ance, range of substitutability, price and income elasticity and
cross elasticity of demand for new products introduced on the market.
At the producer level there is a need for an inter-industry study of
the effects of new products such as the spun soy protein on resource
allocation, prices, volume of production, supply response, and
alternative resource use.

While U.S. consumers are adverse to diets based upon nutrient
requirements, there may be some opportunity for looking at the demand
for food in terms of nutrients, subject to certain minimum restrictions
on diet, tastes, and availability. For example, a linear programming
model is already in use at the Sara Mayo Hospital in New Orleans
which takes into account nutritional requirements, popularity of
individual items, frequency of their request, and total cost of the
diet. This model could be expanded to include intermediate pro-
ducts and competing industrial demand for agricultural production.
Basic resource requirements within the model would include land,
labor, and associated factors of production such as fertilizer, live-
stock feeds, chemicals, and equipment. Nutrients would be obtain-
able from high lysine corn, spun soy proteins, and other developing
products. Data are available for many of the coefficients of this
model although resource requirements and nutritional contribution of
some new products may require additional research. The primary
limitation is the size of such a model although recent expansion and
changes in computers and programs could handle the data. Appropriate
restrictions would include consumer preferences, demand elasticities,
and rate of new product development and acceptance. The information

\footnote{Wendell A. Clithero, "Nutrient Economics"Proceedings of the
Ninth Agricultural Industries Forum, Equipment, Feed and Chemical
Industries, Dept. of Ag. Econ., University of Illinois, 1967.}
obtained from shadow prices and opportunity costs would probably have more direct application than the resource allocation of any particular solution to the model.

One change of importance to researchers has been implicit throughout all the examples I have used. We can no longer be satisfied with restricted pieces of research pursued independent of the rest of the industry or economy. The various segments of our marketing and production systems have become so interdependent that any meaningful economic research must be done in the context of the total environment. Improved tools and techniques facilitate a systems approach and we must accept this challenge.

The research needs which I have discussed have been given no priority. Their relative importance depends in part upon the researcher's frame of reference. Rather, I have tried to indicate the magnitude and diversity of the problems that do exist--real problems, whose solutions are anxiously awaited by industry; specific problems, whose solutions can be directly applied; methodological problems, whose solutions will provide tools with which to tackle more difficult problems in the future.

In closing I would like to refer back to the analogy with which I introduced the search for equilibrium. Some economists in their zealous attempt to help the beagle, are quite willing to shoot the rabbit. This may be effective in reaching equilibrium but it will also end the chase. The fallacy of such an approach to problems of adjustment is that economic growth depends upon the chasing, not upon the catching. A dead rabbit is also a stagnant economy.
The structural and market changes which have been occurring and appear likely to occur in the credit and finance markets serving agriculture have a common thread which runs through most such modifications. This thread consists of at least two major strands. These changes are either made (1) in response to changes in the structure and organization of agriculture which confronts the credit and financial institutions as markets for the service provided by credit and financial institutions or (2) in response to shifts in the relative profitability of providing services to agriculture compared to nonfarm uses of these services. Failures to respond to changes point to the likelihood of shifts in patronage among agencies providing credit or the development of new institutions or strategies in credit acquisition.

Introduction and Current Situation

From the multiplicity of credit-related changes which have been occurring and are projected to occur, we have chosen to comment on several and to try to infer from these developments some of the areas of needed research. Before beginning this task, however, a perspective is needed on the current status and trends in providing credit for agriculture. In looking backward to establish directions of change, we will use 1950 as a convenient benchmark in most cases. Agricultural indebtedness has tripled in size since 1950 (to 1965). The share represented by farm real estate debt has risen modestly—from 45 per cent to about 51 per cent of indebtedness. Debt-asset ratios have climbed in both real estate and nonreal-estate farm debt, with real estate debt up from 7 per cent to 12 per cent of the value of real estate assets and nonreal-estate debt rising from 12 per cent to 24 per cent of the value of nonreal-estate assets.

Agricultural patronage of credit sources has shown remarkable stability among the statistically identified credit sources. Life insurance companies remain the largest separately identified source of mortgage credit with 21.0 per cent of the outstanding loans in

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1950 and 22.7 per cent in 1966. Federal land banks have increased their share of farm mortgage credit from 16.2 per cent to 20.0 per cent in 1966 while operating banks declined from 16.8 to 13.8 per cent. The share of the largest category of farm mortgage lenders, individuals and other nonreporting lenders declined slightly, from 42.5 per cent to 40.5 per cent. Loans by the Farmers Home Administration, with a limited clientele, declined slightly, from 3.5 per cent to 3.0 per cent.

Nonreporting creditors, also the largest category for nonreal-estate credit, declined as a source from 45 per cent to 41.5 per cent in 1966. The largest gains in share were made by the Production Credit Associations, with a gain from 7.5 per cent to 13.6 per cent, while Farmers Home Administration declined as a nonreal-estate source from 6.7 per cent to 3.8 per cent. Operating banks gained slightly in share, from 39.8 per cent to 40.4 per cent. Federal Intermediate Credit Banks serving agriculture through livestock loan companies and the agricultural credit corporations declined from 1.0 per cent to 0.7 per cent of nonreal-estate loans.

There is convincing evidence that change has been occurring in the kind of farm borrower served by credit agencies. Ray Doll has recently made some preliminary estimates of changes in the last decade which show that the average age of farm borrowers from banks is rising. The proportion of farm borrowers 45 years of age and over is up from 49 per cent in 1956 to about 58 per cent in 1966. The average loan per borrower is almost triple the size of a decade ago. Net worth of farm borrowers is rising too. In 1956 less than 20 per cent of the outstanding farm loans of banks were made to borrowers with $100,000 or more in net worth. In 1966 the share was over 36 per cent. Dr. Doll has also noted the shifts in purpose of bank loans made to farm borrowers. There have been significant increases in the share of bank loan funds for purchasing feeder and other livestock, modest declines in loan fund shares for use in farm real estate purchases and purchases of machinery, trucks and other equipment, with more significant relative declines in shares for other debt consolidation or payoff and land and building improvement.

1/ Percentages in this and following paragraph computed from Agricultural Credit and Related Data 1966, Agricultural Committee, American Bankers Association.

2/ From tables presented by Dr. Raymond J. Doll, Vice-President and Senior Economist, Federal Reserve Bank of Kansas City at the meeting of the Agriculture Committee, American Bankers Association, Sarasota, Florida, on February 10, 1967.
One significant shift has occurred relating to the trend of farm assets to realized net income of farms. In 1950 the average value of assets required to generate $1.00 of realized net farm income was about $7.65. By 1966, $13.13 in assets were committed for each dollar of realized net income. Essentially all this increase was in real estate assets and reflects the sharp and steady rise in farm land values. By contrast the $2.42 of non-real-estate assets needed for generating $1.00 of realized net farm income in 1950 had climbed to only $2.84 by 1966.3/

Some hints at the future directions of need for agricultural credit are found in Rex Daly's base paper. He estimates that agriculture will be using significantly larger amounts of several of the purchased input categories by 1980, although the total input mix will increase only 7 per cent from 1965 levels. Input gains range from a modest 20 per cent in power and machinery to an increase of about 90 per cent in fertilizer and lime. While we may infer at least a modest increase in the price of input, Daly provides no specifics on this point for the longer range outlook.

John Brake of Michigan State has made some rough estimates of future agricultural credit needs.4/ He projects agricultural credit needs of $100 billion in outstanding debt by 1980, compared to $87.5 billions in 1965. His estimates suggest that real estate farm debt will reach $59 billions in 1980 compared to $18.9 billion in 1965. Nonfarm real-estate debt of $41 billion is projected, compared to $18.6 billion in 1965. Average indebtedness per farm, reflecting the combination of larger farms, rising land values and increased ratios of debt to assets, is estimated by Brake at $48,000 for an asset value of about $170,000 per farm. It is apparent that if Brake's estimates were restricted to commercial farms, both debt and capitalization would be much higher. It is also likely that the larger commercial farms will have an even lower net worth per dollar of assets.


Changes in Agriculture Bearing on Responses of Credit and Finance Markets Serving Agriculture

What are the continuing changes which have been taking place in the technology, structure and organization of agriculture which bear upon the responses which credit and finance markets serving agriculture are called upon to make—and hence, which bear upon the adequacy of present institutions providing agricultural credit? Previous papers have provided a wealth of leads on such changes and the purpose here will be to briefly summarize those which pertain particularly to credit and financial needs of agriculture.

Growth in Size of Firm in Agriculture

The conclusion of continued growth in size of farm firm is reached repeatedly in previous papers. Lester Kellogg states, "The trend in the average size of U.S. farms has been continuously upward. In the years ahead, it will continue its upward course, and where it will stop nobody knows." Daly projects with a continuance of present trends, about 2-1/2 million farms by 1970 and possibly fewer than a million commercial farms by 1980. Allen, while viewing the question of a radical increase in size of Midwest feedlot operations as somewhat conjectural, appears to lean toward the affirmative, citing scale advantages in reducing price risks, more efficient feed use and prospects for effective environment control for cattle-feeding operations.

The implications of growth in size of firm for credit use range from the need for dramatically larger amounts of capital per farm, in an increasing number of cases greater than reasonable lifetime goals of capital accumulation can accommodate, to the kinds of strategies which can be employed to meet these needs. The concept of permanent or perpetual debt or leasing the land resource or devices like the land purchase contract becomes increasingly important as size of farm increases. Incorporation of farming units as a device for dealing with the problem of inheritance may also assume increasing importance in avoiding the cycle of recapitalization. Eventual gains in farm size may bring a broader consideration of the example which Kellogg cites of a corporate farm structure with significant nonfarm investment representation which utilizes farm skills of management in a large and specialized operation.

The Continuing Substitution of Capital for Labor in the Form of Power Equipment and Other Nonland Inputs

The prospective decline in the labor used in agriculture occupies major space in Schuh's base paper, while Kellogg and Allen comment, respectively, on the prospects for increase of specialized power
machinery and processed feed and fertilizer inputs in farming. Statistically, the value of assets per farm worker stand at about $36,000, more than doubling in a decade. Combined with farm size increase, the pressure for rapid adoption of new and specialized capital equipment in farming has several implications for credit needs in agriculture. First, the substitution of capital for labor has, to a predominant extent, meant the substitution of purchased inputs for nonpurchased inputs, since most inputs with increasing shares of use in agriculture in recent years are purchased off farms.

Along with the increase in mechanized equipment has come greater specialization of equipment and rising obsolescence as increasing risk hazards for purchasers as well as extenders of credit. This development has focused attention on the prospects of leasing rather than purchasing capital equipment, particularly on farms with limited capital and limited or uncertain need for annual use of the equipment.

The trends in development of specialized machine equipment also point to higher cost of individual equipment items and a growing concern for full utilization when purchase is made, leading to custom hire practices to the mutual advantages of owner and nonowner within the limits of seasonal accommodation.

The trend in power and machinery used in substitution for labor has been only modestly upward in recent years, with a gain of 2 per cent as a share (1950-65); while, collectively, feed, seed and livestock, fertilizer and lime, and other nonland inputs have increased as a share by 17 per cent during the same period. Not all the latter group of input categories is purchased, however, and machine power items have been increasing in price more rapidly than such items as feed and fertilizer.

Greater Specialization by Individual Firms in Agriculture

Several of the papers have commented upon the increased trend toward specialization by enterprise. The trend toward single enterprise operations has often been motivated by the access to lower costs per unit of production including the necessity to more efficiently use machine equipment which is more narrowly specialized. Similarly, specialization of nonmachine inputs also has contributed significantly to lower costs. Reynold Dahl points to the marked decline since the 1930's in the per cent of feed grains fed to livestock on the farms where the grain was produced. Kellogg cites an example of an enterprise (in this instance, hatcheries) which have

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not only become specialized but in the process have moved from rural to urban areas.

One consequence on increased specialization by enterprise is the increase in price risk in many instances. For large growers, this increase in price risk has led to substantially greater interest in the practice of hedging to reduce price risk.

**Aging of Farm Operators**

As part of the background for his paper, Schuh has cited the rising average age of farm operators. By 1980 the proportion of farm operators 55 years and older will have risen to over 50 per cent, compared with 39 per cent in 1960. The credit service for older borrowers of necessity must be different as well as the interest of the borrower in farm firm growth and collateral. The immediacy of problems of inheritance for such borrowers and the need to gear credit use to plans for transfer rather than firm growth are evident.

**Improvement of the Management Input in Farming**

There seems little doubt that the demands of modern farming call for continuing improvement in the level of skills of farm operators. Schuh observes in his base paper that the nature of technical change in agriculture is such that an increase in skills is necessary to farm. Dahl comments that marketing decisions have become more complex for farmers in today's environment. Kellogg emphasizes the need for quality management for successful farm operation. This need is echoed in the expanded role which tomorrow's farm operator must play. His is a larger task in acquiring enough capital for farm operation, and his is a larger task in controlling the capital assets of modern farming. In recognition of the risks and the crucial importance of quality of management in the successful use of credit, most lending agencies today rank management ability—whether it is called earning capacity, financial management ability or farm management ability—as the most important factor in lending decisions, well ahead of such old standbys as net worth, working capital and character.

**Continuing Dependence upon Government Programs for a Significant Share of Farm Net Income**

The involvement of agriculture with government programs has at least two elements of interest from the standpoint of credit. Dahl comments on one of these in his base paper when he cites the current

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shift away from price supports by loan and storage at sought-for
levels and toward market-clearing prices with a system of direct
payments. He points out that this change has brought greater price
uncertainty to grain producers with a wider market price fluctuation
which is now possible. Such price risks are also now part of the
market experience of cotton and wool among supported commodities.
A second element of concern from the viewpoint of agencies lending
to agriculture accompanies the present trend in government farm pro-
grams. This concern is the extent to which net income to agriculture
is dependent upon government payments. Preliminary estimates for
1966 indicate that government payments made up 20 per cent of the
realized net farm income. For individual states, this net income
dependency ran substantially higher—as high as about 50 per cent.\textsuperscript{8}
Clearly this degree of dependency gives lenders cause for concern
about repayment ability when a large share of repayment ability is
government generated and dependent on Congressional appropriations.

**Contractual Arrangements—Vertical Integration**

Two of the base papers have pointed to the possible development
or renewed importance of contractual arrangements—Allen in the case
of factory—mixed complete feeds on long-term contracts and Pherson
in a somewhat cryptic\ldots more long-term arrangements between
livestock producers and packers that will help eliminate supply
fluctuations and uncertainty." Daniel Padberg, commenting recently
on trends in integrated agriculture, indicates that, except for broilers,
there is only minor involvement of nonfarm firms in contractual opera-
tions in agriculture.\textsuperscript{9}

The credit relevance of contractual or integrated operations in
farming is that these represent alternative devices for moving nonfarm
capital into agriculture, tending to supplant partially at least the
usual sources of agricultural credit.

**Changes in Credit and Financial Markets and Innovations
in Meeting the Credit Needs of Agriculture**

What changes have taken place in the credit and financial markets
which serve agriculture—and what innovations and/or strategies have
been developed to serve the credit needs of a changing agriculture?

\textsuperscript{8} Computed from *Farm Income Situation*, FIS-205, February 1967,

\textsuperscript{9} D. I. Padberg, "Efficiency and Welfare Considerations in Integrated
Broadened Alternative Opportunities for Capital Lending by Credit Agencies

Sales finance companies, often product manufacturer subsidiaries, provide a convenient source of financing of producer and consumer durables and yet receive a respectable return on the loan, usually around 18 per cent. This return often exceeds the profit on the item. Often a combined sale and financing offer provides opportunity to acquire an asset cheaper than if each operation were performed separately. A farm supply dealer will usually sell an item of capital equipment cheaper if he can extend the financing. In other situations, dealers have contracts with finance companies to provide financing for their credit-worthy customers.

Commercial banks have discovered a broadened range of opportunities for credit placement outside of agriculture. Financing of consumers has become much more attractive and the institution of bank credit cards has been developing rapidly. Many larger banks have found more attractive credit placements with industry where the size of loan and term length provides more flexibility and makes more efficient use of bank credit by reducing service costs per dollar of credit extended.

Another factor which has reduced the available credit to agriculture in some areas has been the growing tendency of farm operators to utilize investment sources other than banks to absorb idle balances. Low interest rates offered by country banks on time deposits, until recently, have contributed to this tendency along with an increased awareness by farmers of other investment opportunities.

Growing Problems of Liquidity Facing Country Banks

Dr. Charles N. Shephardson of the Board of Governors of the Federal Reserve System in a recent discussion, described the country bank liquidity situation this way, "For many years, farm credit demands have been expanding much faster than have the resources of rural banks. Though this has been a comfortable situation for the banks involved, these banks have nevertheless been able to increase farm loans faster than their own deposit growth by employing a cushion of liquidity built up during the years of the Second World War. In this way, the banking system has held the decline in its share of farm financing to a fairly slow erosion." Shephardson continues, "Now, however, many banks have exhausted the wartime cushion of liquidity. The problem of obtaining funds to meet rising farm credit demands is thus reaching a critical point at more and more rural banks. In some Western States, in fact, a majority of rural banks can probably rank
this among their more urgent farm finance problems.\(^{10}\)

The liquidity problem of country banks has been enhanced by several factors, notable among which is the simple fact of expansion of credit use about three to four times as rapidly as gross and net income to agriculture, since the increases in productivity brought by more intensive use of capital have increased output and depressed farm prices. Also involved is the native conservatism of some country banks. Governor Shephardson points to the fact that in many banks in rural areas loan-deposit ratios in the 30 to 40 per cent range are found in communities which also have other banks with high ratios.

The legal lending limit constitutes a principal restriction faced by the smaller agricultural banks in serving large commercial farmers. Although the limits continue to increase, approximately 27 per cent of all banks in 1966 had limits under $50,000 per individual as compared to 43 per cent in 1962. The most striking changes occurred in the Corn Belt and Plains where in 1962 nearly one half of the banks could not make loans in excess of $50,000. By mid-1966 the number had decreased to 25 per cent and 35 per cent respectively.\(^{11}\)

**The Broadened Base for Risk Transfer Through Hedging Operations**

For a significant share of the basic crops, the prospect of hedging to protect for price risk has been an available service for a long time. Further, for several of these same communities, the need to hedge to protect a lender or the borrower was small, due to the significant protection offered by price support guarantees. With the shift to market clearing supports and direct payments, as Dahl has pointed out, the element of risk—price risk—is enhanced. Hence the use of futures markets in the staple crops for which the technique of price support has changed is increasing. The more recent advent of futures trade in live cattle and hogs has served to further reduce price risk on production loans to feeders in an area where government price protection has been largely absent. Everette Harris of the Chicago Merchantile Exchange indicates that a significant share of the live cattle futures contract trades are made by cattlemen.\(^{12}\)

\(^{10}\) Charles N. Shephardson, "Banking and Farm Finance: The Present Challenge." Speech delivered at the 22nd Annual Virginia Bankers Farm Credit Conference, Natural Bridge Virginia, March 8, 1967.


Credit agencies making livestock loans have expressed an increased interest and a growing number insist upon hedged contracts by borrowers to protect their livestock loans.

**Development of the Line of Credit Concept by Production Credit Associations**

Production Credit Associations by their very nature are primarily responsive to the needs of farmers. Prompt service is needed by most farmers and the PCA's have responded by making loans immediately available. Same-day service is available to members who have an established record. This practice of extending a line of credit has placed the PCA's in a more competitive position, service-wise, with the commercial bank.

**Addition of Specialists in Agriculture to Staffs of Country Banks**

The need for knowledgeable personnel to deal with the agricultural-lending operations of rural banks is being increasingly recognized as agriculture becomes more commercial and more complex. In 1965, an estimated 49 per cent of the agricultural banks had an agricultural specialist. There is also an increasing trend toward devoting the full time of a specialist to agricultural-lending operations in rural banks. This greater attention to agricultural loans has been paralleled by the growth of such separate features as special forms for agricultural lending; and a few rural banks have installed computer customer services oriented to agricultural needs, with others now considering adding such services.

**Modifications in Operating Bank Techniques to Meet the Needs of Agriculture**

The primary changes which have been made in operating banks to meet agriculture's changing needs include at least three developments with varying rates of adoption. These include the use of correspondent banks for overlines, branch banking and the establishing of agricultural credit corporations.

The use of correspondent banks to share overlines arises from necessity for rural banks to service agricultural loans which exceed the loan limits prescribed by the National Banking Act (10 per cent of net unimpaired capital and surplus, with a limit extended to 25 per cent if the loan is secured by livestock) or limits prescribed by state banking statutes. The use by rural banks of larger city banks to take the overline in agricultural loans has been growing significantly. A decade ago there were about 800 banks with $80 million in farm loans on which another 400 banks had participated by taking $43 million in overlines. Last year the number of rural
banks using correspondents had grown to 2,500, with $574 million in agricultural loans on which 1,100 banks were participating to the extent of $300 million. In spite of this impressive rate of growth, the extent of use of correspondent banks for loans is quite small—less than 3 per cent of farm loans extended by banks.

Branch banking which permits the use of the loan limits of the parent institution (a city bank) in rural branches has been advocated and widely used in those areas where branch banking is legal—notably in the western part of the United States. Rapid growth of branch banking in those parts of the country where permitted indicates the potential of this means of accommodating the larger sized agricultural loans.

In a limited number of instances, rural banks, faced with a shortage of loanable funds, have established agricultural credit corporations. Such corporations provide a means for the parent bank to discount its agricultural paper with the Federal Intermediate Credit Corporation in a similar method to that used by the Production Credit Associations. There has been a reluctance by rural banks to use this method extensively and the number of agricultural credit corporations remains small.

Strategies or Devices Adopted by Farm Firms in Meeting Credit Needs of a Changing Agriculture

Several strategies have been developed by farm operators to meet the problems in credit and capital acquisition faced by modern agriculture. Their adoption has not been widespread as yet. As the pressures of rising capital requirements for modern agriculture continue to grow, at least three of these will receive greater attention. These are incorporation, the leasing of capital and the concept of perpetual or permanent debt.

Incorporation of the farming business has not been employed significantly thus far. Some studies suggest that the use of the corporate form of organization for farms has not provided any significant improvements in capital access. Others, such as Hesser and Castle, see the increase of incorporation as a form of farm organization but mainly for the reason of tax and estate management.

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As farm size grows, the ease of transfer of the going farm concern from generation to generation—as well as ease of entry—will weigh larger in favor of incorporation. Still other observers see promise in the device of incorporation as a means of solving problems in the growth of farm size. Examples such as Kellogg cites in his paper may be the forerunner of a broadened use of incorporation. Prime barriers still lie in the establishment of the image for corporate farms which has been so successful in attracting investor capital in nonfarm business where risks are at least equally great.

The acceptance of the idea of permanent farm debt appears to become broader as farm size increases and inheritance tends to be the major route to debt-free ownership on a growing number of larger farms. Hesser and Castle regard the problems and interest-rate change risks for the creditor to make the notion of pay-down to say half the value of the farm with interest maintenance after that point for a loan length of 30–40 years unattractive to lenders. They suggest, rather, incorporation with the sale of preferred stock in lieu of a loan with partial pay-down. The effect, they point out, is similar to permanent debt but would allow for change in real interest rates.

The leasing of capital has already begun to find abroad use to meet growing capital shortages in agriculture. During the formative phases of the leasing market for farm capital, there will be a period of experimentation and discovery of equitable rates and discovery of areas and items of major leasing adaptability. The use of leased capital will continue to be a choice, just as it has been in nonfarm capital such as automobiles, and will be responsive to particular kinds of needs and shortages of liquid capital rather than supplanting farm capital ownership.

Research Implications of Changes in Input Markets for Credit and Finance

Suggestions for needed research in the area of credit and finance are not in genuine scarcity. In fact, the iterative character of such suggestions in the literature tends only to confirm common diagnoses of problems faced in this area. George Tolley and others discussing the topic at the symposium on "Capital and Credit Problems in a


16/ Hesser and Castle, op. cit., p. 184.
Changing Agriculture" advanced a number of useful ideas for research.\textsuperscript{17/}

More recently several other writers have advanced research ideas in the area of this paper. A partial list would include Leon Hesser, Edward Schuh, M. E. Wirth, C. B. Baker, J. M. Holcomb, Emery Castle, John Brake and Lester Kellogg. The contributory role of ideas garnered from these writings is gratefully acknowledged.\textsuperscript{18/}

From the standpoint of efficiency, credit should play a neutral role in the entrepreneur's production decisions. Plans for adjustments should be based upon the expected returns over costs for a particular activity. Returns to the equity capital should be comparable to what is paid for borrowed capital. Ideally, whether or not to borrow the capital should be a matter of indifference. Actually, many decisions hinge on whether or not credit is to be used. Often, farmers are prevented from making and carrying out plans because capital is rationed by the lending agency or by the farmer himself.

Both lenders and borrowers ration the use of capital because of uncertainty. Uncertainty arises from a variety of reasons but all have psychological foundations which we as economists are ill-equipped to handle. The values and attitudes toward credit need a more thorough examination with the view of determining how they are changed and in what direction will the changes likely occur. Estimates of credit needs made on the basis of productivity, considering the element of risk, can vary widely. The crucial question is how the need for credit is to be estimated. Can research develop objective lending criteria which are really more reliable than those commonly used by lenders?


Capital and ways of acquiring its use become immediately the central problem in such questions as the optimum-size farm unit in any given area. Although the economic-sized unit will change over time as technology and other factors change, research should provide us with some idea of what is an optimum-sized unit for various types of farming. An estimate can then be made of the capital needed to reorganize an undersized unit into a more reasonable economic and competitive unit.

Research in agricultural price analysis leaves much to be desired as results are largely historical and not projective. Indeed, our level of confidence in price projections tends to be significantly lower than the assurance with which physical output or utilization is estimated. Prices affect costs of inputs as well as the value of output, and the difference of the two affect the repayment schedule of loans. Do we really know what forces and what effect they (input and product prices) have on farm real estate values over time? Obviously, agricultural productivity is only a minor force in determining land values in many cases. General economic activity can only be an insignificant factor also in many areas. Is land valuation a subjective appraisal which is largely psychological in nature? Can the farm management people tell us more precisely how the use of more machinery and less labor with accompanying substitution and scale effects change the cost of output? To what extent should the repayment schedule on loans formally take into account the varying firm profit expectation over time?

The problem of acquisition or control of resources in sufficient quantity and quality becomes increasingly important as agriculture becomes more highly commercialized. A major problem still exists in our society as to how a farm may be transferred to succeeding generations without going through the cycle of improvement and depletion. Partnerships, corporations, perpetual debt and perhaps others have been suggested to cope partially with this problem, but the real question is have we exhausted the possibilities which might make it easier to obtain and/or transfer the resources as needed in order to compete effectively?

The managerial ability of a farmer constitutes probably the single, most important determinant in acquiring and controlling capital resources. The criteria used by lenders in evaluating the financial ability of a farmer are vague and inadequate. Most lenders will agree that poor financial management is by far the main cause of delinquency in repayment. With less than adequate criteria for determining the ability of a farmer to manage his resources, some lenders continue to look first at equity and collateral to secure the loan although the importance of management ability is recognized.
As yet, there has been no general breakthrough which will help lenders select those farmers who can repay their obligations as planned.

Most of the past research has dealt with the financial practices followed by lenders but very little has been concerned with how lenders may operate more efficiently and in providing new and more innovative services to farmers. The commercial banks have been very aggressive on the consumer level but many farm lending agencies have followed many of the same general procedures for decades. The fact that individuals and miscellaneous lenders hold nearly twice the amount of farm mortgage loans held by the next most important organized lending agency (insurance companies) indicates that the formal agencies for whatever reasons are not fully meeting farm mortgage credit needs. The amount of merchant credit extended also indicates that perhaps the short-term and intermediate credit available from the conventional lenders does not fill agriculture's requirements completely.

Much can be said about the adequacy and inadequacy of the various theories needed in examining the current and future credit problems. Much of the micro- and macroeconomic theory is useful in approaching credit problems, but considerable advances have been made in our sister disciplines—psychology, philosophy, mathematics and the hybrid, operations analysis—which may contribute toward the improvement and applicability of our concepts. More significant advances in managerial theory would lead to a better understanding of loan applications and improve the ability of the farmer to utilize a larger capital base.

The rapid changes which are taking place in the organization and adoption of technology suggest that we should search for an adequate theory of technological evolution which will help to indicate an optimal organization with appropriate technology which can be expected over the next several decades. This would help in making predictions regarding the financial needs of farmers and in providing for an adequate supply of capital. Closely related to this suggestion is the need for a more applicable theory of institutional and cultural change which would permit the credit market to operate more efficiently within the known constraints.

An improvement in the rate of capital accumulation is a generally accepted goal. How much do we know about how farmers accumulate capital over their life span? What can we say about the savings and investment function of farmers under varying conditions? Further, what do we know about the time preference system of farmers in production and consumption activities under varying degrees of asset control? In spite of a fairly appropriate set of models currently available, how much data and information have our production economists
given us regarding time production possibilities of farms under varying situations? Not unrelated to this need for knowledge of how capital is accumulated is the need to know more about the value systems of farmers and how their attitudes toward capital and credit are developed. To what extent and by what methods value systems and attitudes should be influenced is a debatable problem, but nevertheless extremely important, in achieving social and economic goals.

As the managerial level of farmers improves, the capital needed will also increase; but can we speak intelligently about the capital requirements and the necessary ability to utilize it efficiently, particularly as the farmer emerges more from the noncommercial to the commercial sector of agriculture? The appropriate role of the public lending agencies could well be one of providing joint technical assistance and credit to emerging commercial farmers who due to lack of experience and knowledge of the commercial farm business appear as high risk borrowers. Some avenue of "escape" should be provided for the individual from the noncommercial sector who has the potential to enter the commercial farming business to prevent him from being "locked in" by the culture and the economy in which he resides.
The conference found time for questions from the audience. Here a participant listens to an answer to one of his questions.

Besides formal discussion periods, participants had a chance to discuss the papers and viewpoints informally.
Presenting a paper on the farm labor market was Bob Jones of Purdue University. On the left is Peter Helmberger, chairman of the session. Awaiting his turn to comment on several of the papers is A. Allan Schmid.

After listening to Bob Jones and Allan Schmid, the audience responded with comments and questions. As chairman, Peter Helmberger directed the question-answer period.
If in the next 15 years the farm population were to decrease by the same absolute amount as in the past 15 years, there would be no farm population by about 1980. A similar statement can be made about changes in the number of man-hours required in farm production. These have been astounding changes and are indicative of the rapid changes in American agriculture which have occurred since about 1950.

Within the general framework of this activity, the objective of this paper is to focus on the input markets for labor and labor substitutes. The assignment here is to discuss the implications of changes in those markets for research in farm management and marketing.

The paper is organized into four main parts. The first part discusses the extent of capital-labor substitution in agricultural production and presents a classification of production based on the present status of mechanization and types of labor required. The second part of the paper considers some of the research implications of economic changes and relationships. The third part emphasizes research implications of recent legislative developments. The last part contains some concluding comments about our traditional backward-looking approach.

The Extent of Capital-Labor Substitution

A common policy prescription for increasing per capita farm income has been to encourage farm-employed labor to seek alternative nonfarm employment. Persistent low relative income has been one of the symptoms back of this proposed remedy. Also, studies of the agricultural adjustment process have indicated a need for continued downward adjustment in labor use in agriculture. And projections of farm employment based on productivity trends have indicated that continued reduction in farm employment is likely. Although these relationships appear consistent at the aggregate level, they have not been consistent with farmers' pleas of a labor shortage and government policy which permitted importation of foreign labor until January 1965.

*Assistant Professor, Purdue University. Helpful comments on an earlier draft of this paper were received from Paul Farris and Arlo Minden.
It is helpful in gaining perspective on the farm labor markets to divide farm crop production into two broad classes. Grain production and, more recently, cotton production represent a type of farm production with rather distinct labor requirement characteristics. Fruits, vegetables, and specialty crops represent a separate class of products with different labor requirements. Distinctions between the two groups is developed in the following section. This classification will be maintained throughout the remainder of the paper.

After listening to papers that have been presented, I believe this distinction is important. We have been discussing aggregate problems and I believe we tend to think of U.S. agriculture with a Midwest perspective. But there are some important regional differences and some important differences in capital-labor substitution situations based on type of production or kind of product.

Consider now the first class of products represented by grain production. In this class technology is now available which permits most, if not all, functions to be done by machine. Future capital-labor substitution possibilities consist of substituting larger machines for smaller ones or for substituting chemical or biological forms of inputs for mechanical forms of capital. Questions arise about the rate of discard of smaller machines and the rate at which it is economically feasible to adopt the newer labor-saving methods. The adjustment process involves recombination of farms into larger production units, with release of labor one consequence. With the exception of cotton farms, production units have typically been organized around the labor available from the farm family with hired labor of only minor importance.

Continuing with this generalization, it has been the food grains, feed grains and cotton which have been in over-supply and thus "too much" labor has been devoted to production of those commodities. Tobacco production, also in over-supply, is a labor-intensive crop and presumably at present does not have the same capital-labor substitution possibilities exhibited by grain and cotton production.

The second type of production includes fruits, vegetables, nuts and other specialty crops. A principal difference in labor requirements between this kind of production and grain production consists of the level of mechanization available and the amount of labor required per unit of production. Planting and cultivating are largely mechanized, but the extent of additional mechanization varies among crops, and is much further developed in some lines of production than others. Harvesting methods vary from use of a high proportion of hand labor to use of highly sophisticated machines. At present levels of technology, capital-labor substitution consists of substituting machine methods for hand
methods rather than larger, more efficient machines being substituted for smaller machines. For some job operations mechanization possibilities are limited because machines have not yet been invented or their performance is unsatisfactory because of plant characteristics which make them unsuitable for mechanization. Further mechanization depends upon development of suitable machines and development of varieties which are adapted to machine operations.

Typically, production of fruits, vegetables and specialty crops has been organized into economic units which require more labor during peak seasons than is available from the farm operator family. Thus, seasonal hired labor is required during peak seasons.

Over-production of fruits, vegetables and specialty crops has been less a problem than for grains and cotton. Labor has been more a "shortage" problem than a "surplus" problem.

When this classification scheme is extended to livestock production, it appears that most, if not all, livestock production comes under the same heading as grain production. Technology in the form of materials-handling equipment and housing is available or is becoming available which permits substitution of capital for labor. The extent to which substitution has occurred has depended upon fixety of resources in production, relative costs of capital and labor, and size of production units.

Studies of farm labor markets have been highly aggregate-type studies which have considered national or regional markets for labor. Classification by type of farm labor, i.e., family and hired labor, on a national or regional basis has comprised the extent of disaggregation attempted in econometric studies of labor. These studies have provided useful estimates of the parameters of the demand and supply functions for agricultural labor. However, a lower level of aggregation is required to analyze the relationships implied in the classification presented above.

Sources of Supply of Labor

The farm family has been the traditional source of supply for the bulk of labor requirements on most grain and livestock farms. On these farms both the operator and hired labor supply have come largely from the farm community and farm families. Relative wage rates, individual preferences for kinds of work, and employment opportunities in the farm and nonfarm sectors have been the relevant factors determining the number of persons seeking employment in the farm sector. It is clear that the level of aggregate demand and the level of unemployment in the nonfarm sector are important factors determining
the rate of out-migration from agriculture and hence are factors determining the quantity of labor supplied to agriculture.

In general, farms which produce specialty crops have relied less on family labor and more on hired labor than have grain and livestock farms. Historically, claims have been made that domestic labor supplies have been inadequate to meet the demands of specialty crop production. Manpower policies instigated during World War II are evidence of this purported shortage. Until 1965, legislation (P.L. 78) permitted recruitment and importation of foreign nationals where need could be demonstrated. Refusal to extend P.L. 78 beyond 1964 does not represent a decrease in the claimed shortage, but a decline in the power of agricultural interests to secure the legislation which it favors.

Although farm wage rates have been low relative to nonfarm wages, it is not clear that higher wages would bring forth the "desired" supplies. Also, it is not clear that workers, on the average, have been paid less than the value of their marginal product, given that skill levels are low and that functions to be performed are relatively simple. Because of the low status attached to this type work by our society, the value placed on leisure, availability of welfare payments and nonfarm employment opportunities, labor seeking this type of employment represents a residual supply. Thus it remains employed in agriculture only so long as nothing "better" is available.

It can be argued that labor engaged in grain and livestock production as contrasted to labor engaged in specialty crop production represents non-competing groups. Surplus operator labor in grain production is not likely to be seeking employment as hired labor in specialty crop production. Earnings may be comparable (although at low levels), but the low status attached to hired labor, particularly of the type done by migrant labor, precludes movement of operators to fill available hired worker positions except under severe economic pressures.

The labor surplus-shortage situation in U.S. agriculture can be summed up as follows. Low relative incomes indicate an excess supply of labor in agriculture. Disaggregation suggests a large proportion of the surplus labor is in grain, cotton and livestock production. Technology imbedded in various forms of capital is available which would permit continued release of labor from farm production. The rate of release of labor is dependent upon the ability of operators to modernize agriculture through acquisition of capital. The adjustment process requires recombination of farms into larger units, and temporary shortages of labor develop in this sector as operators are
slow to acquire labor-saving technology and are slow to respond to rising wage rates.

The labor situation has different aspects in specialty crop production. Machine technology is available only to a limited (but growing) extent, and thus opportunities for substituting capital for labor are limited. I do not wish to minimize the present extent of mechanization available or efforts being made to develop machines. But many functions which require hand labor have been difficult to mechanize. Relatively simple tasks remain to be done which require only limited skills. These tasks have undesirable work characteristics and jobs are taken only by workers who are unable to find employment elsewhere. High levels of economic activity which enable workers to find nonfarm employment result in hired-labor supply schedules shifting upward and to the right with the wage rate tending to equal or exceed the marginal value product of the labor in agriculture.

Research Implications of Economic Changes

Given the classification scheme presented here and the structural changes developed in the base papers, what research areas are implied? The following list is not intended to be all-inclusive; the intention is to present major areas where additional work would appear to be fruitful.

Projected Labor Requirements
Assuming Various Capital Situations

A combination of factors which includes the long-time trend of farm wage rates rising relative to the cost of substitute inputs, labor "surplus" in some areas of production and "shortages" in others indicates a need for additional research attention to labor questions per se. This need will become greater as additional slack is removed from the agricultural labor force. Furthermore, the slack is likely to become less over the next decade, if one assumes economic growth rates comparable to those attained in the 1960's which have permitted unprecedented removal of labor from agriculture.

Research should be undertaken which would project future demand for agricultural labor under various conceivable capital situations and economic organizations of agriculture. The approach should be sufficiently disaggregated that numbers of workers could be estimated together with the skills required for the various capital situations.

Analysis of the kind being suggested here would provide information for policy decisions when recruitment of workers into agriculture is required. Also, it is not clear that present agricultural training
provides the type and amount of training for workers using modern equipment and methods. A projection of skill needs would provide information useful in setting up training programs for persons presently in the agricultural labor force and whose best opportunities probably remain in the agricultural labor force because of age or other reasons.

Cohort analysis indicates an age structure of farm operators heavily weighted with the age groups past 50 years. Due to their relative immobility, it is important to know what upgrading of skill requirements will be required of them. It is conceivable that capital suppliers could provide part of the needed training if they had better information about what skills are required.

**Capital-Labor Substitution**

The substitution of capital services for labor has been a major factor in the release of labor from farm employment. As labor costs continue to rise, opportunities for substituting additional capital for labor will be sought. For example, technology is currently available which permits one man to double or triple pork production without increasing the labor input, but it is not in use on many farms. These facilities require relatively large sums of money, are highly specialized and have expected life of 10 to 20 years. Because of the tendency of farmers to over-invest in fixed facilities, it is important to have good estimates of capital-labor substitution rates. However, economic analysis of alternative building and equipment systems is hindered by lack of good technical information on the capital-labor substitution process.

Farm management manuals prepared for use in teaching farm planning and organization of farms contain labor coefficients for the various enterprises. However, these are usually average coefficients for a given size of enterprise and often are not accompanied by sufficient detail about what specific capital is included. Limitations of these data are probably a reflection of the lack of research data on capital-labor substitution relationships at a sufficiently disaggregated level. What is needed is analysis of systems of production with sufficient information available to identify size of operation and other relevant facts. In order to secure these data for analysis, it may be necessary to engage in interdepartmental cooperation between economists and the physical scientists in laying out experiments emenable to economic analysis.

Since farm operators are interested in new equipment as it comes on the market, they are interested in economic evaluation before it is available from traditional sources. Capital suppliers have become
increasingly involved in research and development, but they are more concerned with design, marketability, and consumer acceptance than in analysis which permits comparison with other systems. Also, objective analysis without vested interest is a consideration.

New approaches which permit more rapid evaluation of new labor-saving technology need to be tried. One approach would be for university researchers to work directly with firms supplying equipment. An example would be for an interdepartmental university group to serve as consultants to a firm in the building and equipment supply industry for feeding experiments set up to evaluate controlled-environment feeding of cattle. Problems would arise with respect to release of experimental results, "apparent" university endorsement, and objectivity of the analysis, but they do not appear to be insurmountable problems.

Location of Production

One response to rising labor costs which an industry can make is to move to a new location where labor costs are lower. A movement of production may involve gains in employment opportunities for one region at the expense of losses in other regions. Other reasons for a region to gain or lose in competitive position consist of new production or business organization techniques which facilitate production in a new location, e.g., movement of broiler production to the South.

Assuming that underemployed agricultural labor is spatially relatively immobile, what opportunities exist for shifts in location of production to reduce underemployment and for making more efficient use of labor resources? What role has regional differences in labor costs had in shifting locations of production and in the development of geographic specialization?

Other locational questions arise over the possibility of shifts in location of production to areas outside the U.S., where labor costs are lower. For example, what is the likelihood of labor-intensive vegetable production shifting to Mexico, where workers are willing to engage in hand labor? This shift is quite likely as the movement is already underway,1 but what is known of its extent? What are the impacts for the U.S. and Mexico of such international specialization?

Use of Available Supplies of Labor

Agricultural production has become increasingly specialized by geographic region and on farms within regions. This development has been contrary to the trend of horizontal integration in nonfarm business organizations. This specialization has led to loss of some of the traditional complementary relations between enterprises. Questions of how to organize to make efficient use of available labor arise. One alternative is to make greater use of seasonal labor. What are the possibilities, particularly on Midwest crop farms, of making greater use of part-time help during peak work periods? Would this take hourly wage rates two or three times greater than present farm wage rates? If so, is this a lower-cost and more-efficient alternative than use of full-time labor which is kept employed in only a modestly efficient livestock operation for the remainder of the year?

Regular part-time labor may be a real possibility near industrial areas where workers have farm backgrounds, have had experience with machinery, and may want to earn additional income. How could an organization be set up to utilize this source of supply of labor to farms? What form would it take? Might this be a cooperative venture organized by employers rather than as an employment agency? How would industrial unions react to organized, planned multiple-job holding?

An alternative solution to the "tight" labor situation is to purchase labor along with other commercially supplied inputs. New forms of fertilizer have reduced the amount of labor required in their application. Also, bulk spreading of fertilizer by the farm supplier results in less on-farm labor required. Custom application of pesticides, insecticides, off-farm processing of feeds, and commercial seed production all represent purchase of labor services with the product and all permit greater output with a fixed on-farm supply of labor. These inputs represent the trend toward use on farms of a larger proportion of purchased inputs. It follows that crop and livestock production is becoming less a primary production process and more a transformation process using purchased inputs and thus is moving closer to industrial-type production.

Growing use of purchased inputs leads to questions about optimum combinations of purchased and nonpurchased inputs. Which services should be performed on the farm? For example, where is the optimum location of grain-drying facilities? On farms? Or in commercial elevators? What are the economics of grain-drying facilities? Also, how does access or lack of access to these facilities affect the prices received by producers for grain?
Personnel managers in industrial firms have recognized the importance of selection, training and supervision of workers in increasing the productivity of labor. Traditional attitudes of most farm operators toward hired labor and the relatively small labor force on most farms have not contributed to good personnel management on farms which hire labor. What kind of personnel management training programs should be provided to farm operators? Who should train the workers for tomorrow? How should they be recruited? What kind of training should they receive? Surely the day of hiring the first person that comes down the road is about over in agriculture.

Aging of Farm Operators

The changing age structure of farm operators is the major change in demographic characteristics of the farm labor force. The increasing average age of farm operators is a reflection of the fact that the reduction in numbers of farm operators has been accomplished through reduced entry rates and relatively low exit rates with aging farmers remaining in agriculture. The net entry and exit rates as determined by cohort analysis do not reveal the extent of movement in and out of the agricultural labor force. Perkins and Hathaway found that gross exit rates of persons in the agricultural work force were relatively high. But because they were not able to maintain permanent employment in the nonfarm sector, they shifted back to farm employment; hence, net annual off-farm migration rates were relatively small.

Kanel found that younger farmers tended to make greater adjustments in size of farm and in volume of products sold than did older farmers. Despite this competition, older workers have chosen to remain in agriculture voluntarily or because of lack of alternative opportunities. Thus, both off-farm alternatives and on-farm opportunities have been more limited for older workers than for younger workers.

On the other hand, older workers do not make particularly good candidates for retraining because of the relatively short period of time for recovering training costs. Since their limited contribution may be greatest in agriculture, it is important that they have access to resources and that they be provided with technical and managerial


training. What are their needs and how can they be met?

Legislative Developments and Research Opportunities

A conspicuous aspect of federal labor legislation has been its exceptions for agricultural labor. Social Security coverage was not extended to agricultural labor until 1950. And then only a small segment of the labor force was provided with coverage. Social Security coverage for self-employed farm operators was not available until passage of enabling legislation in 1956. Minimum wage legislation exempted farm labor until February 1, 1967. Manpower programs initiated during World War II evolved into legislation providing for the importation of foreign nationals for farm work in the U.S. This enabling legislation was extended periodically until January 1, 1965, when the program was allowed to expire despite much protest from agricultural interests.

Expiration of P.L. 78 appears to be the turning point for exceptions for agricultural labor. Since that time agricultural labor appears to be gradually entering the mainstream of labor legislation.

Unionization

It is not clear how rapidly or to what extent agricultural labor will become unionized. But recent successes at organization suggest that it will be only a matter of time before unionized agricultural labor becomes a viable force in agriculture. As farms become larger, unionization will become more feasible. However, it is important to maintain perspective on the size of the future labor force on farms. Daly estimates there will be fewer than one million commercial farms by 1980. He also estimates they will be using around three and one-half million workers by that date.\(^4\) This would indicate an average of only three and one-half to four workers per farm, including operator labor. Thus, the average labor force on farms will not be large by industrial standards. However, because of wide variation between farms in organization and size, there is likely to be wide variation in the number of workers per farm.

Schuh has argued that the growth of unionization and the impact which it has on wage levels, employment practices and working conditions will depend upon the form which it takes. If it is assumed that unionization is accomplished, what services will the unions

perform for their members and for the employers? Will they facilitate hiring practices and be useful in assuring a source of supply of labor through a hiring hall?

Will employers be able to bargain effectively with the union on an individual basis, or will a producer bargaining organization be required? If the monopoly union emerges, it would appear that a form of producer organization or board would be required for conducting negotiations on a counterveiling-power basis. How will this transfer of power to a bargaining association affect firm decision-making? How will the public interest be represented in these negotiations? What lessons in dealing with organized labor can be learned from industry experience?

The federal government has looked with favor on efforts at unionization of agricultural labor. Probably activities of unions will come under increased scrutiny as they grow in power, particularly if the flow of food supplies is seriously threatened.

**The Traditional Approach--The Backward Look**

As an appendage to this paper, I wish to briefly consider our traditional approach and the possibility of its being biased by our values and attitudes toward farm organization. I suspect we are biased even though we make a strong plea for objectivity. I suspect a large proportion of us are "displaced" farmers and have been influenced by the traditional values. If this is true, have we as agricultural economists been so closely tied to the values held by the agricultural establishment that we have failed to consider relevant economic organizations for agriculture? Although Kellogg has not been the first to raise this issue, he has again called it to our attention. We are all familiar to some extent with all the arguments put forth in justification of the family farm. How relevant are these arguments today? Are they really just rationalizations of what has been?

Suppose, for the sake of discussion, we consider input suppliers as they drive toward dealing more directly with farm operating units as becoming more oligopolistic in character and conduct. Further, suppose product markets do become more oligopsonistic in character. Then presume that between these two groups there exists only 100,000 to 150,000 farms producing the bulk of farm commodities and that agricultural labor does become unionized with monopoly characteristics and has power in dealing with employers. Given this situation, what kind of commodity or producer organizations will be required to deal with input suppliers and purchasers of products? Or will the farms become merely an extension of the marketing agencies?
These speculations may pertain to conditions so far in error or so many years in advance that they are not worthy of our consideration here. Yet, our adherence to traditional value positions may be keeping us from examining some of the relevant issues of the day.
I should like to begin with a theme used by J. K. Galbraith in his Reith BBC lectures last year. He notes that when Henry Ford created his first automobile it was manufactured from parts that were readily available in stock or could be machined in general purpose shops. The steel, gears, wheels, etc. were those which were widely available and in general use. The machine tools needed were those available in many shops making bicycles and various other items. If these materials and tools were not used for one thing they could be used for another. When the idea for a new combination of these came to the creative mind of old Henry, the market could respond readily. Let's contrast this with the latest model, the Mustang. The development and design period stretched over many years. It contains materials specially made for it alone. For example, its planning involves making sure that metals of certain characteristics are available when a certain key part is to be made. No longer can a creative genius call up the local materials warehouse or bicycle shop and hope to find the appropriate components. Materials manufacturers no longer just toss out their product to see if anyone wants it nor do consumer goods manufacturers expect to find what they need in such materials heaps.

What has all this to do with agriculture and the subject at hand? Lester Kellogg tells us that it takes John Deere 5 to 7 years to develop, test and put into production a major new machine. If they do not correctly estimate the needs and demands years in advance they are in big trouble. Or conversely since they are a large supplier and other suppliers can make the same error, agriculture will just have to put up with the available machines and wait for the manufacturers to retool. I wonder if the cost of mistakes here are as significant as any errors that farm firms might make in resource combinations or even in buying one too many machines that Glenn Johnson talks about.

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The new technological processes demand a degree of predictability and coordination which differ from the good old days. Some of the speakers have well pointed this out. George Allen notes that more fertilizer manufacturers are moving to company owned retail outlets. He also speaks of the broiler industry needing more rigorous control over nutritional balance in feeds and that this may require large scale mixing plants. The case of tomato canners who must balance acid content of their products illustrates that the simple product markets of the past are going the way of the dodo bird. Lowell Hill has another example of a meat packer offering contracts for future delivery at a specific price and time to achieve an orderly supply. A processor can't sit there with an expensive single purpose plant and hope that his publication of a periodic price list or making bids at an auction will call forth the correct products at the right time. The richness and detail of the communication needed seems to overtax generalized market transactions. The expansion of administrative transactions to link different stages of production within the corporation and new devices for linking separately owned firms have made planners of us all and the only possible reversal is a denial of the technological process itself.

The speakers have done a good job in pointing out the impact of technological developments on profitable input and enterprise combinations, location of production, market concentration, and the like. I would like to extend this to consider how technology affects the market as an institution. Depending on the system of market rules and property rights, changes in technology produce effects which have feedbacks on the technological process itself. Let me try to explain. The beauty of the atomistic competitive market is that one man with a cost saving innovation can force others to follow. The innovator has great power to propagate change without considering what costs it might be creating for his fellows. This feature is sometimes forgotten in the much more praised characteristic that no one producer can affect price. Yet, one of the important economic growth features of competitive markets in the past is this ability of a few innovators to move others. When technological change was more modest this created few problems that couldn't be solved by the normal outmigration of the death rate. The few hardship cases could be treated by local charity. Now, when change is nonmarginal and the asset values and savings of large groups are wiped out in the process, the distribution of these losses can have an important impact on the process of technological creation and adoption and thus the future performance of the economy. Here, the old insistence in economic theory dogma of separating income distribution and resource allocation analysis falls flat. Let me illustrate further with some examples from Lowell Hill. He points to the dramatic increase in field shelling of corn. So a few small business men with truck mounted shellers
lose their shirts. So a few shellers are bombed, who cares? This changes things like enterprise locations and costs and returns but there is little impact in terms of future technological adoption or creation.

But, I wonder if the next generation of equipment will go so quietly. Hill mentions the big hopper cars being developed for transport of grain. I can't help but wonder if the "Whopper Hopper" will go as gracefully as will the truck mounted shellers. I wonder if their owners won't do something to protect the asset values of these costly and increasingly specialized pieces of equipment and plant. And, I wonder if this something might not be the slowing of the process of technological adoption itself. My research hypothesis is this: Unless we develop positive policies through our market rules and organization to systematically plan for and share the costs of these big technological changes we invite the application of much creative effort to the slowing down of innovation. We need to search for institutional alternatives here. The experience of Sweden might be useful. They give much aid to displaced workers so that they do not fear change. This aid includes retraining and housing help in their new location. Our own agricultural price support programs have surely put a firm base under the adjustment process and make it more palatable. It provides capital for further investment and the move out. Yet, it does not distinguish sufficiently between the needs of those staying and those leaving and does not provide enough tailor made help and incentive. But, the answers, if indeed there is a problem here, need not lie in direct governmental activity. The conglomerate firm has interesting implications. They may be better able to roll with the punches of technological change in one of their product lines since it has other enterprises to carry it over the adjustment period and pick up the overhead. An example is the diversification of the tobacco industry. Of course, the conglomerate firm is troublesome for its ability to use this same power to enter a product line by undercutting competitor's prices because of their flexibility in allocating costs.

To summarize a bit at this point, I see various rigidities being built into our whole economy as each individual group tries to protect themselves from change. Agriculture has done less of this than some other industries to the benefit of the country and hardship of many farmers. But, agriculture may be trying to catch up. Agricultural economists could perform a valuable service and provide a good example for the rest of the economy if they could solve this

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basic problem of a society with rapid technological change.

Before turning to some of the specific markets I would like to make one more general point on technological impact on market institutions. New innovations are the source of the great gains and profits in our economy. The power to allocate these gains will be the battleground for much future debate. Hill talks about the development of manufactured spun vegetable protein which can duplicate the texture of a wide range of products including meat. For another example, just allow your mind to contemplate the havoc that the development of a synthetic coffee flavor will have on Brazilian agriculture. I don't know enough about these to know whether anything on the horizon could have this kind of impact in American agriculture. But whether it is tomorrow or the next, I have a feeling that the past revolution in agricultural technology focused on farm practices (hybrids, fertilizers, pesticides, etc.) will be paled to second order by the changes to take place on the manufactured food side. The subsequent adjustments while they can't again affect such large numbers of people may be equally dramatic and costly.

But, let's leave the question of compensation and adjustment aid aside and ask a question about allocation of the net gravy. To dramatize my concern let me use another non-agricultural example. There is now a new communications satellite system which was developed in large part by public funds and immersed in the whole social enterprise of education and research where allocation of costs to individual developments is often impossible. Comsat, a private-public corporation, was capitalized in 1962 for $200 million to use the new technology primarily for international communication. By 1965, the technology had advanced so much that the firm was over-capitalized for its original mission. Now it appears that it is practical to use it for domestic TV transmission at half the present cost. Who is going to get this new windfall?

A.T. & T. says it would, through its corporate wisdom and according to sound business practices (whatever they are), spread the gain over its entire telephone rate base and make all phones a bit cheaper. The Ford Foundation suggests that the gains from domestic TV transmission sales be used to finance educational TV production instead of depending on tax revenues.

This is an example of the great power that private and public groups have at their disposal as a result of our success in creating new knowledge. I don't know if there is anything as dramatic as Comsat in the agricultural industries, but I would guess that there may be numerous opportunities to allocate various costs and productivity gains among various product lines. To conclude here, I would suggest that the power to decide which prices to lower may be worth investigation along with the more traditional market power to raise prices.

May I summarize what I think I have said so far:

1. The problems of investment coordination and timing are more important with the new technologies. This is nothing new, but the process continues. We will need to search for new marketing institutions that can carry the richness and detail of communication that will be needed to avoid inefficient linkage of production processes and missed opportunities for new gains. The days when we could toss products on the market to see if anyone wanted them and adjust production in the next period accordingly are fleeting away.

2. If we fail to coordinate agricultural investments and plan for and share the costs of adjustments created by new technologies we may be inviting a costly reaction which will slow future technological advance. We need to know the macroeconomics of tossing out a new machine or food product. These past bombs, so disastrous to some farmers and so great for consumers up till now, may have a feedback which will slow future innovation, particularly on the industrial side of agriculture. To share in the costs of adjustment may be a good investment in future productivity gains.

3. Finally, the new technologies create gains to be distributed by the chosen ones. This could have a tremendous impact on the content of our growing G.N.P. Can research lay out some of the broad alternatives and choices here?

Now, I would like to address a few points organized by the topics of the 4 papers I am to discuss.

Product Markets

The lack of attention to consumer problems in the papers and the whole conference is notable. It's great to have efficient production and distribution, but . . . . I know that research on consumer difficulties with various package sizes and labels will not generate the political approval of a new study of feeding rations or farm supply inventory procedures. Still, every time I try to get the last ounce
out of a narrow-necked catsup bottle, I wonder if I am swearing alone. The fact that the price of catsup has been kept down or even lowered a few pennies doesn't impress. When are the home economists going to publish the results of their product tests? How can people decide how to allocate research resources for greater efficiency in production when they can't get good information on the products themselves? Enough sermonizing.

I applaud Hill's mention of some of the non-food and fiber outputs of rural land. How about developing a good management record book for farm recreation enterprises and some cost and return studies? Rural land produces water, landscape views, and air purification as well as food. How about some good production economics studies of these?

**Labor**

As various authors have pointed out we are likely to see labor laws developed in industry increasingly applied to agriculture. I do not have wide experience in agricultural labor but perhaps I can indicate the kind of problem that concerns me by another example. D. Gale Johnson tells the story of his secretary who likes to eat her lunch in the office while she handles her own correspondence and types for outside hire. While she is there, an occasional telephone call comes in which she is perfectly willing to take. This was fine in the good old days. Now under the fair labor practices law, answering the phone during noon break will have to be compensated as over-time and there is no way for the secretary to agree otherwise. The result is that Dean Johnson may be forced to prohibit her to stay in the office and use the typewriter at noon. The employer and employee and the whole society are the losers. Yet, the law probably has a good purpose to protect employees from being taken advantage of.

I suspect that agriculture with its demands for flexibility, timeliness, and multi-skilled work patterns may not fit some of the rules that made sense in industry. Bob Jones mentions the potential for part-time workers in agriculture but this may be restricted by the paper work and labor rules not appropriate for their employment. Are we going to be creative enough to figure out ways to protect workers rights and still retain flexibility? Here is another chance for agricultural economists to make a contribution to a problem that plagues the whole economy.

Jones also points out the prospect for unionization of agricultural workers. Food is one place where work stoppages could be very costly for the whole society. Again, I wonder if we can be creative enough to somehow separate the wage bargain from the work process.
In a less interdependent economy one group could withhold its labor to gain higher returns and the rest of us could ignore it. Not so now. We need ways to keep production going while people argue over their relative shares.

Land

The classical doctrine of diminishing returns to land has been defeated in the United States. Acres of cropland cropped in agriculture have decreased while output has increased. The major substitutes for space are well known and elaborated in the conference papers. While fertilizer, better seeds, and pesticides make it possible to get more out of the same space it is also true that there have been considerable investments which are closely associated with land as space—namely, drainage, conservation practices, flood protection, and irrigation. However, these latter items have not received much attention.

Perhaps this is due in part to the persuasive work of T. W. Schultz which makes a great deal of the declining relative supply price of land during 1910-14 and 1956. He concludes from this that land improvements are low return investments.

It just happens, of course, that the symmetry of this conclusion is disturbed a bit by the fact that fertilizer has also declined in relative price. This latter, however, is viewed as a great boon and the research, innovations and investments in fertilizer production that kept prices down are applauded and along with things like hybrids are given most of the credit for keeping land prices down. All of this leaves me uncomfortable. At a common sense level I just wonder if Griliches' discovery of a 700% return to hybrid corn research would have been so great if the Dust Bowl conditions of the 30's and soil erosion had been allowed to continue. The space used in agriculture today is not the same as that used in 1900 and the difference is not alone that of fertilizer and hybrids incorporated in it.

Whatever an adequate historical analysis might show, we may well have done the job and further land development investments may have low marginal returns. If this is correct we might take the

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4/ Dale Dahl's paper was not available when this was written.
SCS and ACP budgets and use them to help move and retrain farmers no longer needed in agriculture. All recent Presidents whether Republican or Democrat have recommended cuts in the ACP budget. What does our research have to contribute to this decision?

Whether tied to land or not it seems to me that production and marketing researchers have not given enough attention to publicly provided agricultural inputs. We know relatively little about the return to rural electrification, education, health, roads, mails, and extension activities. The production people seem too concerned with private firms and marketing people with the market as such. Schultz has, of course, taken his stand on the side of education. He questions "allocation of more resources to government for housing, urban development, river basin development, land and water conservation, hospital and other health facilities, highways, parks, and other recreational facilities." He asks "where is the evidence to create even a plausible case that the enlargement of the role of the public sector in these directions will increase the rate of economic growth substantially?" And again, he asks "Will these particular public measures, other things remaining the same, increase substantially the rate of economic growth?" His answer was, "There is no evidence at hand, to my knowledge, that would make an affirmative answer plausible." Of course, lack of evidence to the affirmative does not prove the negative. The hard fact is that we know very little about the returns to public investments in agriculture.

I suspect this gap in our knowledge is especially important when public investments might be used as key leverage points in farm adjustments. When we are trying to get a new enterprise started and a production region pointed in a new direction, the problem of coordination and timing of investments may be critical.

Perhaps I can illustrate my point with a proposal often suggested as the answer for the economic doldrums of northern Michigan. The animal husbandry people think the beef cow-calf herd is the salvation of the area. Farm management research indicates that it has promise as a supplementary enterprise combined with off-farm work. Full time enterprises also have some promise but are limited by the problem of putting together large acreages. Public agencies are doing little to facilitate this land market problem. Also, this type of budgeting study takes the existing costs and returns mostly as given. There

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are often external economies which mean that the first producers have high costs, but if scale can be built up, costs can be lowered. When the FHA makes credit available on a cafeteria basis for various enterprises and at the same rate to everyone regardless of purpose, it is difficult to overcome the initial high cost stage of production. The FHA takes great pride in keeping its loss record low. Yet, it might make sense as part of a planned adjustment to make some risky loans initially for a new enterprise whose expansion could really change future costs, rather than scatter a few safe loans which will never have great expansion potential and leave cost and return levels as before. Now, the credit program need not operate in a vacuum. The loan may be safer if tied to pasture improvement aided by ACP and SCS and training programs and marketing cooperatives organized by the Extension Service. Here again these agencies are providing assistance on a cafeteria basis. Cost sharing for conservation practices are scattered and the cost share rates not structured to concentrate on key enterprises.

We need to give much more attention to the macro-economics of agricultural adjustments and the coordination of public programs. It is interesting to make a side observation on an ideological issue that this presents. I have made the point earlier that market coorination may not be sufficient. There is no guarantee that assigning the responsibility to public agencies will do the job as is evidenced by the agricultural programs. There has to be some positive way for the agencies representing the various inputs to relate to each other.

The way the public agencies keep records is of no help. We know how many miles of terraces were constructed, farm plans drawn, loans made and defaulted. But, no place do we relate these programs to a development objective appropriate for an area and consistent with the national context.

Land Substitutes and Demand in an Urban Economy

Great emphasis has been placed by people in this conference on the productivity impact of things like pesticides. Little has been asked about the net benefits. Pesticides create losses for some natural resource users, but not enough attention has been given to the macro-economic impact.\(^9\)

Agriculture is being immersed in the urban economy. The noise of the irrigation motor at a cottage lined lake or the smell of a live­stock feeding yard or a mushroom operation in a built up area are troublesome indeed. Land space has served as an insulator for these and while it is probably not limiting on Kansas wheat or Iowa corn farms, land is scarce in certain specialty crop areas and where close­in transport is important. I include this lest we think the land space problem is completely a thing of the past.

**The Land Market**

I want to examine some additional issues related to the land market itself. The structure and organization of this market is not a popular subject for marketing research. I wonder why? Perhaps it is because it has none of the obvious market faults and tendencies toward concentration. Yet, it is a peculiar sort of market. There are a very limited number of sales per unit of time. It is a local market flavored with personal contact and influenced perhaps more by the particular characteristics of the owner. Yet, we use the data from these few marginal sales to indicate average labor returns in farm management studies and compare these with non­farm incomes and draw policy conclusions.

An important puzzle in the land market now is why buyers insist on bidding most of the gains from support prices into land values. One expects that net income will be capitalized into the fixed factor controlling access to that income and if this did not occur we would certainly need to ask why. Yet, why do buyers over do it. Why do they *over*­capitalize. Apparently there are still a lot of people with even poorer alternatives. This is an area which needs more research and is rich with policy implications.

Along this line, I wonder how long we will retain our historical legal unconcern about the characteristics of the owners of farm land. In some of the Scandinavian countries you must be a bona­fide practicing farmer and small acreages cannot be sold except to people who can combine them into larger units. Our problems are not as severe in this respect of consolidation but still questions are use­fully raised. Recently the Justice Department raised a question about the acquisition of the American Broadcasting Company by I.T.T. In part this is concerned with the usual market power questions, but part of it is the fact that I.T.T. is partly owned by foreign govern­ments. The question of income distribution in agriculture is attracting more attention and the question of who gets the agricultural income will probably generate more interest in the future. We are lately see­ing various non­farm corporations buying or expressing an interest in farm land. Some are agriculturally based and some are not. Is this
just an expression of entrepreneurial curiosity or is this a trend based on something they see and we do not?

**Capital**

Redman and Rudd note that credit service for older borrowers must be different from the young. They argue that the older farmers need to gear credit to plans for transfer rather than firm growth. If this is true it creates real costs to society. Maybe this is one of the advantages to large outside corporations. Could avoidance of the slowdown in growth between generations be an important efficiency factor? It seems hard to imagine that industrial firms can find the kind of investment returns in agriculture that they have been used to. Yet, maybe we have not been looking at a long enough time period where maintenance of growth might be an important source of profit that we don't see in our shorter run studies. Redman and Rudd also note that large banks prefer to loan in large chunks thereby reducing service costs per dollar of credit extended. Do some of these things add up to significant advantages of large scale investment by outside corporations in farms? I must leave this as a question and turn to a quite different capital and credit consideration.

Our subject is the input markets for agriculture. I wonder if it would be fair game to raise a question about the markets for inputs into firms which in turn provide inputs for farms or for inputs into food processing firms. With reference to farms, Redman and Rudd speak of the lender's problem of selecting those farmers who can repay their obligation. This is a classical banking problem at all levels but I wonder if its complexion changes a bit when applied to non-farm firm loans. I am impressed by Adolf Berle's emphasis on the role played by retained earnings in the whole economy especially for risk ventures. The data are hard to come by, but his analysis indicates that of the gross capital formation from 1919 to 1947 about 34 percent came from business savings. He further cites Department of Commerce figures that from 1947 to 1957, three-fifths of all capital funds used by corporate business had been derived from internal sources. An additional one-fifth came from long-term markets (mostly debt issues) and the remainder from short term debt (including bank debt). The point is that industry is less reliant on outside financing than once was the case. Redman and Rudd state that from the standpoint of efficiency, credit should play a neutral role in the entrepreneur's decisions. This may be true with reference to a given

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goal, but the source of funds has important implications for the firm's policies and use of market power. More and more the successful "borrowers" select themselves. What are the implications of this for performance in the agricultural input industries?

New Marketing Institutions

I have the uneasy feeling that we have become locked in on certain institutions and that we are desperately in need of some new ones. For example, I wonder if we have ridden the price support, input subsidies, acreage restriction and maybe even group bargaining into the ground. Let me illustrate first with an example I stole from Jim Shaffer. He observes the tendency toward overproduction in the Michigan tart cherry industry and notes that total production varies considerably. This is caused in part by the fact that there are marginal lands planted to cherries which only bear when weather is favorable and the normal crop areas also are having bumper yields. In simpler days we could just say that if people located in the wrong place it was their tough luck and others should let them alone. But in this case the over-planting on marginal lands is not merely disastrous for the marginal producers but for the normal producers as well through no particular fault of their own. Shaffer suggests a type of land use zoning as a possible solution. This is widely accepted in the Northern Lake States to prevent isolated agricultural location in forested areas where they would create the need for costly public services. Why not for cherries?

A more homely illustration of the need for institutional innovation is the case of weeds. I have vivid recollection as a child of cutting thistles out of our pasture accompanied by a hopeless pit in my stomach as I looked over the fence and saw our neighbor's weeds going unhindered to seed. I wonder if we have studied opportunities to reduce individual farm costs through group action. Nebraska now has a weed district law, but it doesn't work. Why?

Off in another direction, I wonder if farmers ought to place less reliance on price supports and payments and try for a 27-1/2 percent depletion allowance like the oil business. Supposedly the oil provision is to encourage investment and exploration. Just as good a rationale could be developed for agriculture in the face of rapid technological change that I discussed earlier. Agriculture needs to get its returns some way that do not show up as a Treasury expenditure. However, one of the problems with tax provisions is that they are not generally designed to be selective. Take, for example, investment tax credits for agriculture. Instead of broad tax incentives we should consider stimulus to certain key investments identified
by research appropriate for enterprise reorientation and growth of agriculture by areas.

To conclude, I don't know how one does research where the wanted output is a new institution. Most of these have come in the past through practical men and a process of trial and error. The speed of change in technical knowledge throws men into new social relationships where the luxury of long term incremental experimentation may be costly indeed. If social scientists can not provide a good share of workable new ideas for future marketing rules we will fall further and further behind our world's potential.
CHANGE AND COMMUNITY ADJUSTMENT: THE METAMORPHOSIS OF RURAL AMERICA

by Karl A. Fox*

The first part of this paper is organized around a number of maps and figures which will help us to visualize the changes which have taken place in the structure of rural society in the United States during the past 50 to 60 years. The second part of the paper will relate these changes in rural society more directly to the purposes of this conference.

The maps and figures are organized into three clusters. The first cluster shows the small geographical scale on which rural communities, rural labor markets and retail trade areas were organized about 1911-13 in a horse and buggy society.

The second cluster portrays the nature of the transformation of rural society under the impact of the passenger automobile. The effects include a tremendous expansion in the sizes of labor market and retail trade areas; the emergence of a hierarchy of central places or trade centers as the automobile gave relatively free rein to economies of size in store, schools and other establishments; and the de facto organization of the residents of these trade centers, together with the surrounding farm population, into relatively large functional economic areas or low density cities, each representing a synthesis of rural and urban society in an area as large as several typical counties.

The third cluster of maps presents a view of the United States economy as a set of functional economic areas (FEA's) which both absorbs and extends the present system of Standard Metropolitan Statistical Areas (SMSA's) and supersedes the traditional dichotomy between urban and rural society.

The Social Anatomy of an Agricultural Community, 1911-1913

In 1915, C. J. Galpin, a University of Wisconsin sociologist, published an Agricultural Experiment Station bulletin which immediately

*Professor and Head, Department of Economics, Iowa State University.
became a classic. Galpin made his field survey during 1911-1913. His study covered a single 16-township county (Walworth) in southern Wisconsin. Figures 16.1, 16.2, and 16.3 are reproduced from Galpin's 1915 bulletin.

Rural society as of 1915 was organized on a very small geographic scale. Figure 16.1 indicates that there were about 100 school districts in Walworth County, each covering on the average an area of five or six square miles. These school districts were no doubt organized when an eighth grade education was the norm and it was believed that the subjects essential to farm boys and girls could be taught in one-room school houses.

Figure 16.2 shows that Walworth County was served by 12 trade centers, towns ranging from about 500 to 2,500 in population. The average trade area covered about 50 square miles. The farm population of each trade area was about as large as the population of the trade center. Galpin also commented that the farm people patronized the same stores and obtained the same range of services from the trade center as did the residents of the center itself.

Galpin also delineated 11 banking zones, 7 local newspaper zones, 12 village milk zones, 12 village church zones, 9 high school zones and 4 village library zones. In general, these various types of areas tended to reinforce one another. Galpin summarized his findings with respect to "the actual but unofficial community" in the following words:

"Eight of the twelve civic centers of Walworth County are incorporated; four as cities and four as villages. Officially, that is, legally, the incorporated centers are treated as communities, each by and for itself. The foregoing analysis of the use of the leading institutions of each center by the farm population discloses the fact, however, that these institutions are agencies of social service over a comparatively determinable and fixed area of land surrounding each center; that this social service is precisely the same in character as is rendered to those people--whether artisans, employees, or professional persons--who happen to live within the corporate limits of the city or village; moreover, the plain inference is that the inhabitants of the center are more vitally concerned in reality with the development and upkeep of their particular farm land basis than with any other equal area of land in the state.

Figure 16.1. A map of the school districts of Walworth County. The small zigzag areas on this map show the scale of the prevailing type of organized rural social life in Wisconsin. The village and city centers, however, suggest a changing scale commensurate with the coming economic rural order. Source: C.J. Galpin, op. cit.
Figure 16.2. Trade Communities. Twelve villages and small cities situated in the county serve as trade centers for the farm homes precisely as for the village and city homes and all the homes trading at the same center form a trade community. Township lines six miles apart indicate the distance. Source: C.J. Galpin, op. cit.
"It is difficult, if not impossible, to avoid the conclusion that the trade zone about one of these rather complete agricultural civic centers forms the boundary of an actual, if not legal, community, within which the apparent entanglement of human life is resolved into a fairly unitary system of interrelatedness. The fundamental community is a composite of many expanding and contracting feature communities possessing the characteristic pulsating instability of all real life."

Galpin then proceeded to summarize the essence of his findings by means of Figure 16.3 which he called "a conventionalized community form":

"It is possible to conventionalize the form and relationship of these 12 agricultural communities in the following way. Suppose the civic centers to be equal in size and population, equally complete institutionally, and equally distant from each other; suppose all farm homes to be connected with the centers by equally good roads at all seasons of the year, and also equally direct. Then apparently each community would be a circle, with the agricultural city as its center, having a radius somewhat longer than half the distance between any two centers. In order to include all the farm territory within some circle, and to have the least possible common area, we must impose the further condition that the centers be arranged so that only six centers are equally distant from any one center, as shown in Figure 16.3."\(^2\)

Galpin used the phrases "agricultural community," "fundamental community," and "urban community" interchangeably to describe what he saw.

Figure 16.4 (by Karl Fox) is in keeping with the small scale of the communities Galpin found. However, it incorporates a constraint upon the form of such a community which is imposed by a rectangular grid of section roads. Such road grids cover much of the Midwest. (This was not strictly true of Walworth County, but we wish to illustrate a fairly widespread phenomenon.)

Consider the square centered on East Troy. Given a complete grid of east-west and north-south section roads, each corner of the square is five miles by road from the trade center. However, if we wish to reach certain points on the northeast boundary of the square we must travel one mile east and four miles north, two miles east and three miles north, three miles east and two miles north, or four miles east and one mile north. In each case, we must travel five miles by road (the order of operations is immaterial) to reach the

\(^2\)Galpin, op. cit., pp. 16-19.
Figure 16.3. The theoretical form of an agricultural community. If all the conditions relating to farm homes and neighboring trade centers were conceived to be equal, then apparently the agricultural community would be in the form of a circle whose outer edge it would share more or less with neighboring communities. Source: C.J. Galpin, op. cit.
Figure 16.4. Schematic map of county studied by C.J. Galpin (1915), assuming a rectangular road grid and travel (pedestrian or horse and wagon) at 5 miles per hour.
boundary of the square. If we assume that people in 1915 could travel on foot or by horse and wagon at an average speed of five miles an hour, the boundary of the East Troy trade area is essentially a circle with a radius of 60 minutes. Under our assumptions, the rectangular road grid transforms this 60-minute circle into a square measuring five miles from center to corner—and also from the center to any point on the sides of the square.

The Impact of the Automobile

Figure 16.5 visualizes some of the changes wrought or facilitated by the passenger automobile. In 1915, the horse and wagon was still the dominant mode of local transportation; the village grocery store and the one-room school were dominant or at least typical institutions of the rural community.

Rural roads improved only gradually, and their quality at any given time imposed a limit on practicable automobile speeds. As of 1930, the automobile was already the dominant mode of transportation; grocery stores were beginning to accommodate themselves to a motorized clientele; and most rural parents were encouraging their children to attend high school.

By 1966, most residents of rural areas in the Midwest owned automobiles which could cruise at 70 miles an hour on good roads. They did much of their food shopping at supermarkets and they were encouraging their children to take some education or training beyond high school.

Figure 16.6 like Figure 16.4 assumes a rectangular road grid. However, reflecting improved roads and fast automobiles, the squares measure 50 miles from the central city to each corner. If we wish to reach the midpoint of the northeast side of a square, we must travel 25 miles east and 25 miles north (in any order we like). We assume that motorists can drive 50 miles in 60 minutes. Therefore, each square represents the projection of a 60-minute circle upon a rectangular road grid which transforms it into a square of the size shown.

The linear dimensions of the squares in Figure 16.6 are ten times as large as those in Figure 16.4; the areas of the squares in Figure 16.6 are 5,000 square miles, as against 50 square miles for those in Figure 16.4.

Walworth County, with an area of 576 square miles, contained 12 trade areas. As of 1967, Iowa, with an area of 56,000 square miles, contains about 12 of the expanded trade areas.
Figure 16.5. The automobile and rural social change, 1915-1966.
Figure 16.6. 50-mile commuting distances from the central business districts of all FEA (Including SMSA) central cities in or near Iowa.
Iowa has 99 counties. Each trade area shown in Figure 16.6 is equal in size to 8 or 10 counties. However, as the county boundaries in most cases run east-west and north-south, the boundaries of the 50-mile squares in Figure 6 are oriented at a 45 degree angle to the county lines. Perhaps we should not make too much of this "rotation of rural society," as variations in topography, road quality, and natural barriers (such as rivers with a limited number of bridges) tend to disrupt the perfect symmetry implied by the 50-mile squares. More important is the change in regional scale, which means that a trade area of the kind shown in Figure 16.6 includes a number of whole counties and parts of several more. Even if we approximate these trade areas in terms of clusters of whole counties, the individual counties are too small to cope with problems of area-wide significance.

To some extent, we have assumed what we have not yet proved—namely, that areas of the size shown in Figure 16.6 are the modern counterparts of Galpin's "fundamental communities" of 1911-13. We shall adduce additional evidence shortly concerning the character of the present day functional economic areas of Figure 16.6.

Figure 16.7 suggests the effects of the passenger automobile on intervillage competition.

We assume ten retail trade areas, each surrounding a village and each with a fixed boundary, the group as a whole forming a compact cluster covering a contiguous geographical area. We assume that the number of consumers resident in each of the trade areas remains constant, as do their incomes.

The spatial-equilibrium model underlying Figure 16.7 determines the number of units of (say) groceries purchased by the residents of each of the ten areas, the equilibrium price in each area, the number of units "exported" from or "imported" into each of the areas, given a stipulated 10 by 10 matrix of customer travel costs (per unit of groceries purchased) between all possible pairs of areas. The matrices of per unit travel costs between areas are not reproduced, but for the highest level of such costs, $T_6$, the range is from $0.84$ to $3.60$. When travel costs are reduced by 16 2/3 percent to level $T_5$, the range is from $0.70$ to $3.00$ per unit. Finally, when travel costs are reduced to one-sixth of their original ($T_6$) level, that is, to level $T_1$, the range becomes only $0.14$ to $0.60$ per unit.

When customer travel costs are at the high ($T_6$) level, only Village 2 makes sales to residents of other trade areas. Grocers in Villages 1 and 7 compete directly with the grocer in Village 2 and hence indirectly with each other. The residents of areas 3, 4, 5, 6, 8, 9 and 10 shop only in their respective villages; the
Figure 16.7. Spatial equilibrium among ten production-and-consumption locations: Inter-location trading arrangements at three levels of transportation costs.

(A) \( T_6 \) (Initial Level; High Transportation Cost)

\[
\begin{array}{ccc}
.9 & .3 & 1 \\
(2) & $1.32 & (2.28) \\
.10 & .4 & .6 \\
.8 & & \\
\end{array}
\]

(B) \( T_5 \) (Transportation Cost Reduced 16 \( \frac{2}{3} \) Percent Below \( T_6 \))

\[
\begin{array}{ccc}
10 & $1.50 & (0.16) \\
(4) & $2.05 & (0.07) \\
& & .8 \\
\end{array}
\]

(C) \( T_1 \) (Transportation Cost Reduced 83 \( \frac{1}{3} \) Percent Below \( T_6 \))

\[
\begin{array}{ccc}
10 & $0.30 & (0.34) \\
(4) & $0.41 & (1.93) \\
(2) & $0.14 & (2.00) \\
(3) & $0.31 & (2.87) \\
& & .8 \\
\end{array}
\]

\( a \) Dollar figure by each arrow is transportation cost per unit (say, a standard "market basket" of groceries); figure in parentheses is number of units bought at location from which arrow leads by residents of the location at point of arrow.
grocer in each village has a true monopoly within a "reasonable" price range delimited by the cost of customer travel to the nearest alternative village.

A reduction of one-sixth in travel costs brings the grocer in Village 5 into direct competition with the grocer in Village 2 and indirect competition with those in Villages 1 and 7. Also, the grocer in Village 10 finds himself in direct competition with those in Villages 4 and 9, and the grocers in Villages 4 and 9 are in indirect competition with each other. Grocers in Villages 3, 6 and 8 retain their positions of (limited) monopoly in their respective trade areas.

A reduction of five-sixths in the cost of customer travel brings the grocers in all 10 villages into competition with one another, directly or indirectly. The grocer in Village 2 draws some patrons from areas 1, 5, 6 and 7, but some residents of his own trade area shop in Village 4. The grocer in Village 4 also draws some customers from areas 8 and 10. Grocers in Villages 9 and 3 are in direct competition with those in Villages 10 and 1.

The assumed reductions in travel costs may be interpreted as reductions in time required for customer travel; thus, if \( T_6 \) reflects customer travel at five miles per hour, \( T_1 \) reflects customer travel at 30 miles an hour.

Figure 16.7, then, suggests the revolutionary impact of the passenger automobile in breaking down former village monopolies of all kinds. The first storekeeper who shifts from a village grocery operation to a modern supermarket will drastically change the interarea trading pattern and the opportunities left for other village grocers. But we will not labor this example further.

The speed of the passenger automobile has permitted larger establishments to emerge in the larger towns. These larger establishments include larger numbers of employees and involve hierarchies of several stages. The higher level positions in these job hierarchies usually require more education and/or drive and/or ability than the top jobs in the small establishments found in villages and small towns. Figure 16.8 gives schematic representation to this fact.

A good deal of so-called "migration" across county lines may occur within the same trade area, as additional education, training or experience qualifies young people in the more rural counties for better paying jobs which necessarily involve working in larger towns or cities than any found in their previous counties of residence. For example, the 1960 Census of Population indicated that 80 percent of the residents of Fort Dodge and Mason City (central cities of two of
Figure 16.8. Job hierarchies in towns of different sizes.
the trade areas in Figure 16.6) had been born in Iowa. A large percentage of these had very likely been born and raised within 50 miles or so of these two cities.

Figure 16.9 is reproduced from a study by Borchert and Adams.\(^3\) Borchert and Adams classified the hundreds of small towns and cities in the Upper Midwest (Minnesota and several states and parts of states to the north and west of Minnesota) into several categories or hierarchical steps on the basis of the retailing and wholesaling functions they performed. For example, a minimum convenience center would contain a gasoline service station, a grocery, a drugstore, a hardware store, a bank, an eating place and any two of four other specified kinds of retail stores. These requirements might be met by the small town of 1,000 people.

The Borchert and Adams categories seem to fit the Iowa situation rather well, and probably apply roughly to most nonmetropolitan areas in the United States. Small towns such as those Galpin studied in Walworth County would in most cases be convenience centers today. County seat towns of 2,500 to 5,000 people would typically serve as partial shopping centers, while towns of 5,000 to 25,000 population would serve as complete shopping centers.

In Iowa, the central cities of the trade areas shown in Figure 16.6 range from 30,000 to more than 100,000 in population.\(^4\) Borchert and Adams would characterize these cities according to their wholesaling functions, although I am not convinced that wholesaling is their most important attribute. With one exception, the centers of trade areas in Figure 16.6 would meet the Borchert and Adams criteria for either secondary or primary wholesale-retail centers.

Figure 16.10 shows the distribution of town population sizes in one of the trade areas of Figure 16.6—the area centered on Webster County just north and west of the center of the state. Fort Dodge (population 30,000 in 1960) is the economic, social and administrative center of the area shown. It contains the largest and most complex private and public establishments in the area, including a department store and a community college. Several towns in Figure 16.10 would qualify as complete or partial retail shopping centers. Some of the smaller towns shown are convenience centers according to the

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\(^4\) Excluding Spencer—if the area centered on Clay County in northwest Iowa is classified as an FEA.
Figure 16.9. Trade center types defined by business functions. Graphic summary of characteristics of six levels in the Trade Center hierarchy. Type of center is indicated at base of each bar. Types of business are listed in right-hand column. Businesses which were required and optional in defining each type of Trade Center are indicated by markings on each bar. Width of bar is proportional to dollar volume as indicated for Partial Shopping Centers and above. Source: Borchert and Adams, op. cit.
Figure 16.10. Distribution of town population sizes in the Fort Dodge area.

*Areas of squares are proportional to 1960 town populations. Only towns with retail sales of $2.5 million or more for year ending June 30, 1964 are shown.
Borchert and Adams criteria. In addition, the area within the square includes 50 or 60 smaller towns, each with retail sales of less than 2.5 million dollars in the year ending June 30, 1964. Few of these towns would qualify as full convenience centers; most of them would be in the minimum convenience center category or lower in terms of services available.

Figure 16.11 is the map of a midwestern city of about 50,000 people in the late 1950's. The central business district contains the department store or stores such as are found in Fort Dodge. The black oblongs are supermarket locations; these identify shopping facilities comparable to the complete and partial shopping centers found in towns of 5,000 to 12,000 population in the Fort Dodge area. Not shown in Figure 16.11 are the neighborhood stores, service stations and other small establishments analogous to those found in the convenience and minimum convenience centers in the Fort Dodge area.

If we measure distances in terms of minutes, including time spent waiting for traffic lights and looking for parking places in the congested city, it appears that the area in Figure 16.10 may be regarded as a projective transformation of a central business district, medium and large-sized shopping centers, and neighborhood stores such as those found in Center City. The economic base of Center City consists primarily of 10,000 or more factory workers whose homes and work places occupy only three or four square miles of land. The economic base of the Fort Dodge area consists primarily of 10,000 or more farmers and farm workers occupying nearly 5,000 square miles of farm land. The range of consumer-oriented services found in the Fort Dodge area is quite similar to that found in Center City.

Unpublished data from the 1960 Census showing the townships of residents and counties of employment for a sample of the employed labor force support the view that areas such as that around Fort Dodge are relatively self-contained commuting and labor market areas in the short run. Very few people living within the boundary of the square in Figure 16.10 work outside that boundary. Conversely, relatively few persons living outside the boundary commute toward Fort Dodge. The labor market and trade area aspects of Figure 16.10 (and Figure 16.6) tend to reinforce each other in defining a modern "fundamental community" comparable to those Galpin identified in 1911-13.

Figure 16.12 indicates that the populations of Iowa counties containing the central cities of trade areas in nearly all cases grew more rapidly from 1950 to 1960 than did the outlying counties. Some apparent exceptions can be readily explained. From 1900 to 1960, population growth in the 12 Iowa cities (with their suburbs) which
Figure 16.11.

Map of Center City

- Industry
- Residential
- Business
- Supermarkets

*Some of the 50-mile commuting perimeters are included to stress the redistribution of population occurring within functional economic areas.
are centers of functional economic areas amounted to about 540,000, slightly larger than the total population increase for the state. Many of the rural counties showed absolute decreases in population, and most towns which had populations of 1,500 or more at the turn of the century showed considerable population growth. The process underlying Figure 16.12 might be called "creeping urbanization," the population of each area has been gradually moving inward toward the central city, and the population density gradient from the perimeter toward the center of each square has become steeper.

**The Spatial Organization of United States Society, 1967**

Most economists are familiar with the system of Standard Metropolitan Statistical Areas (SMSA's) which figure prominently in the U.S. Census Bureau's publications of economic and demographic data. There are about 213 SMSA's in the United States. Each SMSA consists of a county or a cluster of contiguous counties at the center of which is a city or urbanized area with a population of at least 50,000. As of 1960, Iowa contained seven SMSA's, each consisting (within Iowa) of a single county; two of these SMSA's also included one or two counties in adjoining states. The central city of each SMSA in Figure 16.13 is also the central city of a functional economic area with its labor market and trade area aspects. Nearly all of the 213 SMSA's in the United States also serve as the centers of labor market and trade areas which are more extensive than the SMSA's as such.

Figure 16.14 shows similar 50-mile squares or 60-minute commuting perimeters around several Iowa cities of less than 50,000 population. Obviously, the 50,000 minimum population for an SMSA central city represents an arbitrary truncation of the frequency distribution of city sizes. The central cities of four of the Iowa functional economic areas shown in Figure 16.14 had populations of 30,000 to 35,000 in 1960. It is worth noting that the total population of each of these four areas is approximately 150,000, or three times as large as the minimum population for an SMSA!

The dashed outline around Clay County in northwestern Iowa may be regarded as containing a potential rather than an actual functional economic area. The central city of this area is Spencer, a town of about 10,000 people, but with large retail sales for its size; its population and retail sales are expanding quite rapidly.

Figure 16.15 is identical with Figure 16.6; it is obtained by superimposing Figure 16.14 upon Figure 16.13. About 80 percent of the area and 90 percent of the population of Iowa are within these 50-mile squares. The completion of new interstate highways (and
Figure 16.13. 50-mile commuting distances from the central business districts of Iowa SMSA central cities.

*Central cities of 50,000 people or more in 1960. Each shaded county or pair of shaded contiguous counties are SMSA's.
Figure 16.14. 50-mile commuting distances from the central business districts of Iowa FEA central cities with less than 50,000 population.
Figure 16.15. 50-mile commuting distances from the central business districts of all PEA (including SMSA) central cities in or near Iowa.

*Central cities selected on the basis of range of economic activities performed and relationship to surrounding area.
other improved highways) is having the effect of packing adjacent functional economic areas more tightly together and filling or reducing some of the gaps in Figure 16.15 (if we choose a one-hour commuting radius, rather than 50 highway miles, as our most basic concept). It would evidently be possible to partition Iowa into about 12 areas which would include the entire territory of the state. If desired for political or statistical reasons, these areas could consist of clusters of whole counties.

Areas such as that centered on Taylor County in southwest Iowa could be allocated between adjacent functional areas on the basis of major shopping criteria. Taylor County is nearly 100 miles from either Des Moines or Omaha, so daily commuting is not a good alternative. Between 1950 and 1960, the number of males aged 25 to 34 in Taylor County decreased 41 percent, indicating that a great many young men had migrated from the area.

Figure 16.16 suggests that an exhaustive set of functional economic areas could be delineated for the entire United States. East of the Missouri River, the vast majority of the population lives within 50 miles of towns of 25,000 or larger. In the Mountain states, it appears that towns with populations of 10,000 to 15,000 provide essentially the same range of goods and services as is found in towns of 30,000 to 50,000 population in the Midwest. In sparsely-populated areas, highway speeds are faster than in the congested areas; also, the residents may be willing to spend longer times on their individual shopping and recreational trips. (Whether they will tolerate longer daily commuting time is another question.) It appears that a number of functional economic areas in the Mountain states would include less than 40,000 or 50,000 people within reasonable commuting times of their central cities.

It is evident that a functional economic area of FEA system could absorb the existing SMSA system without difficulty. East of the Missouri River, most FEA's would include total populations of 150,000 or more. If the residents of such an area recognized their community of interest, they should be able to support school systems and medical services of as high quality as a city of 150,000 people. Such an area should contain a substantial and diversified pool of professional and lay talent and present a wide range of problems and challenges for potential leaders.

It is not clear that an area with a population of only 40,000 can provide as full a range of services and leadership as can the more populous areas east of the Missouri River. Conceivably, several contiguous areas in the Mountain states might need to cooperate in providing a sufficient population and tax base for high quality
Figure 16.16. Population distribution: 1960
educational, professional and cultural services.

We have shown how the passenger automobile, operating for more than half a century, has transformed the rural community of Galpin’s time into an expanded community of perhaps 100 times the area. The automobile has permitted the realization of economies of size and specialization in many kinds of private and public establishments and has encouraged a new synthesis of rural and urban society.

It appears that the United States can be viewed as a set of 400 or so relatively self-contained labor market or commuting areas. It seems likely that the automobile will continue to be the dominant mode of personal transportation during the next decade or two. Improvements in this mode of transportation will tend to pack the existing functional economic areas more closely together, but are not likely to change the basic "granular" structure of the United States economy.

These areas provide a logical basis for regionalizing the national data system and for formulating and implementing economic and social policies relating to employment, education, retraining and other people-oriented objectives. These areas could also be used as basic units for estimating the effectiveness of government programs in a more tangible way than that of working directly with national aggregates.

**Implications of the Present Structure of the United States Economy for Farm Management and Marketing Research**

The picture of the United States economy and society we have drawn has certain implications for the consumer end of the food marketing system and also for adjustments in the ratios of labor to capital in agriculture within each labor market area.

**Nature of the Consumer Market for Farm Food Products**

Each functional economic area appears to be a relatively self-contained labor market, shopping and consumer service area. Each one has its export base activities, including agriculture and/or manufacturing in most cases. The residentiary sectors of different functional economic areas are characterized more by similarities than by differences. National chains of department stores, hotels, motels and other establishments recognize these similarities and also reinforce them.
Hence, we may view the United States as a set of 400 or so "macrohouseholds," each with a consumer demand matrix and a consumer-income constraint analogous to George Brandow’s national model of the demand for food.\(^5\)

In the nonmetropolitan functional economic areas (as in Figure 16.10), it may be helpful to classify goods and services into those which are available only in the central city; those which are available in the central city and also in complete shopping centers of perhaps 5,000 to 25,000 people; and those which are also available in towns of less than 5,000 population. (Borchert and Adams described several hierarchical levels of trade centers; however, it may be that no more than three levels of retail trade centers are economical in the sense of justifying new construction at the present time.)

If the trade centers in an FEA are classified into (say) three hierarchical levels, equilibrium for each household in the area involves maximizing the utility of goods and services that can be purchased and brought home within the family’s income constraint. An optimal solution to this problem involves spatial equilibrium considerations in addition to the family budget constraint.

The same model can evidently be extended into metropolitan areas so far as consumer purchases are concerned. The article on Shopping Centers in the 1965 edition of the Encyclopaedia Britannica speaks of three kinds of shopping centers or plazas in metropolitan areas. The largest of these is the so-called "regional shopping center" serving as many as 500,000 people, the chief tenant of the center being a suburban branch of a large downtown department store. The next smaller kind is the "district center" and serves from 60,000 to 120,000 people; the chief tenant of such a center is usually a department store (though smaller and less distinctive than the dominant type found in a regional center). The smallest kind of shopping center recognized in the article is the "neighborhood center" which serves from 15,000 to 30,000 people; the chief tenant is usually a food supermarket.

Around smaller cities, the labor market and shopping areas tend to be coextensive. In the largest cities, the connection between retail trade areas and commuting areas is loosened by the existence of alternative modes of transport. But, the consideration of this problem within metropolitan areas is not germane to the purposes of

this conference.

In nonmetropolitan areas, the central cities of FEA's are the concentration points for wholesaling and warehousing activities. For example, the warehouses in Fort Dodge, Iowa, a city of 30,000, are much too large for Fort Dodge as such. Their size is determined and justified by the total population of the trade area, which is approximately 150,000.

In considering the prospects for economies of scale, it appears that the opportunities available to food wholesalers, dairies and bakeries might well be visualized in terms of discrete numbers of functional economic areas, perhaps including in that definition the "regional shopping center" trade areas in the larger cities.

**Nature of Resource Adjustments Within FEA's Regarded as Labor Market Areas**

We have indicated that each functional economic area is a relatively self-contained labor market in the short run. We might conceptualize the process of agricultural adjustment as an iterative logical procedure along the following lines: (1) Starting with the existing labor force and stock of capital in an FEA, we might re-allocate these resources within the area: (a) to equalize the marginal value products of labor of any given quality among sectors and (b) to equalize the marginal value products of capital among sectors, agricultural and nonagricultural. We may subdivide both agriculture and nonagriculture into as many sectors as may be required to recognize significant differences in production functions or processes.

If this initial reallocation were done on the assumption that the FEA is a "point economy," we might next let in real space and allow for the possibility that the marginal value product of labor of a given quality performed at a distance of 50 miles from the central city might be smaller than the marginal value product of that labor applied in the central city itself. In other words, within the FEA we would expect to find wage and opportunity cost surfaces for each distinctive kind of labor. These surfaces would have their highest points at the central city and would slope downward with increasing distance from the central city.

The next logical step would be to compare the marginal value products of labor of given qualities among FEA's and also the marginal value products of similar kinds of capital. Then, using spatial equilibrium concepts, we might calculate a pattern for equalizing marginal value products among areas which would minimize the social and economic costs of migration and capital relocation among FEA's.
Next, we might consider an optimal pattern of organization in each FEA under 1967 technology and make retraining of the local labor force an alternative to migration. Once again we would equate marginal value products across sectors within each FEA and (globally) among FEA's.

It must be stressed that an FEA is a labor market area, urban and rural, agricultural and nonagricultural. If the United States should adopt an active labor market policy like that of Sweden, it would be logical to try to maintain full employment in each FEA. Any worker who could not be employed in a "good" job in the FEA at a given time would be paid while engaged in additional training or retraining. Wages for agricultural workers under such a policy would have to be fully competitive with wages in other sectors of the area's economy at all times.

If the federal and state governments cooperated to maintain essentially full employment (including persons engaged in sponsored training programs) in each FEA, one result would be a steady economic pressure to reallocate persons with managerial talent as between farming and other activities.

In the nonagricultural sectors, there is a strong income gradient favoring moves up the managerial hierarchies of both consumer-oriented and export-oriented enterprises. With continuous full employment in an FEA, it appears that agriculture would also tend to move toward sizes of operating units in which managerial, bookkeeping, technical and "blue collar" functions would be performed by distinct individuals. If different functions received very different salaries or wages, a man who could perform the highest salaried function should ordinarily spend full time on it. Producers' and/or marketing coops could (and in some cases do) accomplish some of this specialization; so do integrators in the broiler industry.

One other possibility should be considered as we look ahead. We hear much talk about air pollution, water pollution and traffic congestion in our major metropolitan areas. We also hear arguments in favor of the establishment of "new towns" as an alternative to continuing expansion and increasing congestion in our largest cities.

If it became federal policy to encourage the growth of trade area centers which now have 20,000 to 50,000 people until they reached 75,000 or 100,000 people, there would be construction booms in many rural areas. This policy might also be viewed as a major instrument for stimulating the development of lagging regions, by using "growth centers" as the leading sectors in regional economic development.
Several of the smaller European countries appear to have achieved unemployment rates of less than 2 percent or even (in some cases) less than 1 percent. If the United States should strive for similar standards area by area, agriculture would be under constant pressure to pay fully competitive wages to hired workers and to provide fully competitive incomes for farm operators and for farm boys who were considering careers in agriculture.

My view of the present and future framework within which marketing and farm management research must operate may be summarized as follows:

In the United States the traditional dichotomy between urban and rural has largely disappeared. The image of the traditional dichotomy lingers in the minds of many people, rural and urban alike, and contributes to much confusion concerning appropriate solutions for the economic and educational problems of "rural" people. The greatest problem of rural society in the United States is the belief that a rural society still exists and can be manipulated successfully apart from the society as a whole.

For better or for worse, the city as an economic and cultural entity has surrounded the country. Farmers and agricultural economists must now deal with an essentially urban market for labor, for capital and, increasingly, even for land.
ON ORIENTING FARM COMMODITY RESEARCH TO STRUCTURAL AND MARKET CHANGE

by George D. Irwin*

Commodity orientation has fallen from style in farm policy discussion. We now talk of a people orientation.1/ So what is the place of a discussion on commodities, and what is the relevance of commodity research? I intend to use this question as a vehicle for proposing a general theme. I will then expand on the theme in selected areas where changes have particular impact on research priorities.

Rationale of Commodity Orientation

I propose that studies related to farm commodities remain vital, even though the general policy focus is in terms of people. We have merely added a dimension to policy2/ which may actually increase the significance of commodity problems and permit a clearer look at them. It may be useful to review six reasons why this is true:

1. Since people orientation has freed commodity price from a general agricultural welfare function, price is likely to become a more important corner post of the welfare of commercial farmers.

2. Commodity analyses and policies have an additional special significance for rural welfare arising from the aging of the farm population and its immobility. The effect is two way. The aging phenomenon, and people policies related to retirement and consequent recombination of freed resources, impose an important dimension in supply response work. And on the other hand, results in the commodity market help determine the extent to which aging creates a continuing welfare problem in the commercial agriculture industry.


3. Commodity is related to general welfare programs through the cost of food and its availability.

4. Structure and functioning of commodity markets have important overall policy implications in terms of long run income distribution between consumers and owners of factors of production.

5. Commodity price is still the primary means of getting consumer preferences reflected back to raw materials. Increasing loss of identity through processing will continue to offer more difficult imputation problems and may reinforce pressure for more specification buying. This could serve to increase the number of commodities and to increase clarity of the price signals, besides its less clearly positive structural implications for efficiency in the food marketing chain.

6. Commodity is, some observers suggest, the focus about which farmers may organize in the future to concentrate their influence, and thus, is likely to continue as an important policy concern.

A General Theme

Many of the pressures for change in recent years have come from the farm input markets. Thus the general theme I wish to convey is that we cannot any longer take input and other product prices as given in commodity research related to farm policy. Nor is it possible to automatically assume structure as given. That is the import of the changes discussed in the background papers. It is the message of Ruttan, as he described the five sets of market relationships through which interactions between farm and nonfarm economies are restructuring agriculture. It is also a major lesson dramatized by the regional adjustment studies which swept the country during the past decade. For lack of homage to this new dictum, we often found the terrain rocky in trying to relate individual economic units to aggregates in our regional supply studies. This partial failure was to some extent understandable, for until recently, the product market was the primary link to the nonfarm economy. We built models without interdependence on the input side, and were surprised when the models traced through to yield the general theme I have asserted. This serendipitous result, which was reinforced by other separate analyses arriving at the same conclusion, is perhaps the most significant outcome of the regional studies. It brought home to a great many researchers the need to widen their horizons in response to the changing real world. At the same time, it spoke well that the general economic models were able to trace through to an unanticipated result.

Ruttan. op. cit.
Research Orientations

What can we learn from this which will help us in future research? Is the only lesson that we may expect our future efforts to falter on the rocks of erroneous assumption? Perhaps. Certainly the danger is real, but I find it significant and hopeful that many of us are now aware of the changed research environment we must encompass to be relevant to policy needs.

It is my feeling that most commodity research has policy implications, but that it is certainly appropriate and feasible to look at priorities. Juers, from the viewpoint of a policy adviser, noted that making research useful for decisions implies an understanding of at least three features of the policy process:

1. The analysis must be timely. Preferably, this means the research must be completed before the issue becomes "hot" in the political arena. This, in the public eye, correlates with objectivity.

2. Results need to be presented in a decision making framework. We must provide a general research understanding. Then comes the all-important, often neglected step. Someone must spend the time to interpret it in terms of current issues. Specialization has hit in this area, too, and we tend to be either researcher or policy analyst. We as researchers are often prone to assume that a research report on the general results will be enough, and that anyone can frame it for decision making. This step, whether you call it adaptive research, extension, or policy analysis, has become more difficult as our research models become more complex, powerful, and difficult to comprehend. My point is that we need to reconsider the question of who is to put results into the decision framework. Perhaps the researcher has a contributory role, and probably he stands to gain from this experience a new sense of relevance in his future efforts.

3. Political and administrative considerations, as well as economic, enter the policy analysis. And the weight given economics depends on the economic analysis available.

From this standpoint, I find it useful to think of farm commodity-related research in this rapidly changing economy in a dichotomous framework. On one hand, we need to study and describe the leading edge of developments in order to get inductive insights into the

\footnote{Juers, Linley E. Adequacy of Current Research and Education as Viewed by a Farm Program Analyst. J. Farm Econ., Dec. 1962.}

\footnote{The parallel between research and extension in farm management on one hand, and policy research and analysis on the other is significant.}
relevant external and internal forces, and the direction they are taking us. These areas are not very amenable to our supply-demand models, but they furnish invaluable fuel for propelling their development into useful channels. On the other hand, for reasons I shall expand upon later, we also need studies encompassing the whole of a commodity—or the aggregate and its components. Where is it going as a result of these forces, and where are its lagging components in terms of income and welfare? These are the areas where formal research models can best be adapted. Looked at in another way, the dichotomy contrasts the basic difference in emphasis between short run possibilities with existing structure and equilibrium models, on one hand, and the longer run, necessarily less formal procedures designed to isolate potential sources of breakdown in our analyses which assume fixed parameters. One approach streetlights an entire scene, the other spotlights its moving border.

At the Leading Edge

Where are the moving borders, the issues we need to work on in commodities? I will concentrate on five conventionally defined areas which seem particularly relevant. For them, specific detailed attention seems warranted. The areas also provide an important component of variability which must be accounted for in the aggregate analyses I will get into later.

Demand Forces

Some analysts would contend that the major unstable elements have been on the supply side in recent years. Demand forces are destined to take a less passive role.

The most prominent reflection is in the expanding world market, which already has shown both spectacular increase and great year to year variability. For example, recent work on feed grains indicates an export market for about 1/5 of the production by 1972, against less than 1/7 in 1964. Instability was demonstrated by the dramatic jump in 1965-66, and the equally significant fallback in the 1966-67 figures due to better world production conditions. Our grain stocks in reserve insulated the United States market from much of this impact. The next time, our stocks might not be so adequate.

The point is that these markets furnish important components of, and important instabilities to United States production requirements. Several nations have high income elasticities of demand for commercial exports of feed grains derived from their domestic demand for meat. But projection has some different twists from that done for the United States where population and per capita income (and in a few cases changing tastes) are the significant demand shifters. The world market portion of United States commercial demand also depends on the situation of competitive suppliers and on such policy aspects as national balance of payments. Of course, the noncommercial exports of food aid are a direct resultant of United States foreign policy. The fact that these forces are less than completely economic in their outcome does not lessen the importance they carry in future United States commodity demand. As self interest, we need to place a high priority on exploring and understanding them as far as possible.

A second demand force is found in what amounts to a proliferation of commodities in the United States market, which make the relationship to a broadly classified raw commodity increasingly tenuous. A result is the tendency toward specification buying by processors. Another is in contracting and integration. One aspect of this proliferation is a consequence of sub-specification of consumer tastes. Langemeier and Thompson recently completed a study which showed United States consumers now differentiate between fed and nonfed beef. A similar development, though originating on the technology side, is the coming breakdown of corn into several commodities. We already have sweet corn. High lysine (protein) corn promises great improvement in human, swine, and poultry nutrition, and has potential impacts on the oilseed proteins which are poorly understood. We may expect certain industries to develop high-starch corns to meet their needs. And improved grain hybrids, bred for short stalks, are increasingly unsuited to high silage yields. The point I make is that our domestic demand studies cannot be satisfied with traditional commodity categorization if they are to meet these changing needs. Another aspect of proliferation arises in better recognition of the divergence between raw product and consumer product. One dairy representative recently noted that the loss of butterfat sales in the

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switch to low fat milk by consumers was just about offset by the increase through sour cream. A meatpacker noted that the so-called meat-type hog provides larger hams and loins, which are discounted because those sizes have been associated with lower priced sow pork, and because they are too large for the average consumer. New products are obviously called for if the desired gain in hogs prices from the meat-type animal are to become fact. Each of these examples points to increasing distance between initial and final product, and for the need to recognize and identify these products in studies of demand. A further aspect of proliferation arises in the large proportion of housewives in the labor market. They require convenience foods in more processed forms.

A thread winding through the discussion of proliferation leads to a third demand force - the increasing difficulty of relating farm level to consumer demand. We need to look at these imputation problems in terms of the market structure and power possessed by buyer and seller at the various levels. The simple notion of a marketing margin is likely to become less and less satisfying as a summarization of the set of relationships between the raw product producer and the retailer. Tracing these impacts in a form useful for decision making will frequently require us to make shorter term demand analyses, and to recognize interrelations with supply.

Supply

Some important "leading edge" implications for supply emphasis grow out of two developments: (1) the shift of agriculture from being heavily land and labor based to being capital based, and (2) the average aging of the labor force, with the prospect that this will continue to be with us for several decades.

The switch to capital based production imposes some vital changes in the nature of product supply curves and of production response. They are reflected particularly in reversibility, vulnerability, and uncertainty. Capital basing, as has been pointed out, involves higher cash costs as a percentage of gross income, and thus increases vulnerability. A smaller percentage of the resources are the traditional residual


11/ Haynie. op. cit.

12/ J. Havlicek, L. H. Myers and Anthony Prato at Purdue have demonstrated the importance of including supply variables in quarterly demand estimation for beef and pork.
claimants, family labor and capital, which can take deferred compensation as a reaction to unfavorable situations. This cushion is withering. Capital has been imbedded generally in larger enterprise size and increased specialization. Once the investment decision has been made, it is largely irreversible and organizational adjustments are less flexible. Because of the relative ease of entry into agriculture, the biological time lags between decisions and production and the high capital requirements, we have an almost classic opportunity for investment cycles resembling those of industry, and particularly in livestock breeding. Thus, as Kottke\(^{13}\) has pointed out, we need to examine firm supply functions with respect to identifying where they are reversible. Specialization also raises questions about efficacy of allocation models, which we will explore later. The increased dependence on purchased inputs emphasizes the need to make supply and demand analyses for these inputs in order to consider these variables in estimating commodity supply.

A parallel influence is the aging of the labor force described by Schuh in his paper. Aging generally means reduction in the number of alternatives to farming. It therefore may reduce supply flexibility and raise questions of income adequacy, particularly since adequacy of business size appears to be inversely related to age. In most research we have not considered age or stage in the family life cycle as classification variables for supply analysis.\(^{14}\) We need some work to test the hypothesized relationship between age and response.

**Regional Advantage and Location**

An easily overlooked effect of the capital revolution is that it reduces the extent to which regional advantage is land based. Shifting location of consumption centers and the recent drastic alterations in transportation rate structures come to play a more dominant role. These effects, combined with the specialization and large enterprise trend in beef feeding, have been well demonstrated by the growth of western feedlots. I think we need some work to determine the causes of this rapid location shift of recent years. I might hypothesize that the growth rate curve would flatten out in western locations as the fed beef supply catches up with population in that area. All this is apart from the question of increasing size of feedlot, although we also need to know whether there is some causal interrelation between size and location. It would be useful to test the hypothesis that


\(^{14}\) An exception was Ph.D. work done at Michigan State by Orlan Buller on fruit farms.
regional differences in size are due solely to slower adjustment to
economies of size in older feeding areas, due to unrecovered invest­
ments in smaller-scale fixed assets.

Another series of questions in location arise in the commodities
where per capita demand curves are shifting right and being amplified
by a growing population. We see this particularly for beef. Rumors
are that the western range is nearing its capacity as a source of feed
for the beef cow herd, one of the enterprises that has remained
strongly land based. Is this true? If so, is the mid-South the region
of next advantage? How would an expansion in this area affect the
location of feedlots? Comparative costs of shipping grain, feeder
animals, fat animals, and meat are changing, and are bringing into
question our traditional answers to these important questions.

Comparative Structures and Pricing

Heflebower\textsuperscript{15} has pointed out that the fruits of technical
progress tend to be distributed as wages and profits under oligopoly,
but as lower consumer prices in a competitive situation. In commodity
areas with different kinds of structure among buyers and sellers,
questions of bargaining power arise.

Pressures are felt for coordination through contracting or inte­
gration. The pricing mechanism is put to a severe test as an allo­
cator and distributor. It has been suggested that the pricing mechanism
works most efficiently when fixed costs are low (marginal costs are
allocable), a rapidly disappearing situation in both farming and the
processing industries. The rising fixities are embodied in special­
ization in large enterprises. The switch to capital-based agriculture,
plus the specialization foster what we have come to recognize as
the cost-price squeeze. The traditional answer economists have
given to farmers is volume. Today, we find many who are saying
"no - the answer is bargaining." This strikes me as an extremely
significant change in the psychological environment of agriculture.

It opens for us as researchers a number of new research doors.
We have questions of equity in contracting arising from unequal market
power, and of direction of enterprise control which may lead to further
vertical integration.

\textsuperscript{15} Heflebower, R. B. Market Power: Its Sources, Distribution, and
Consequences in Farmers in a Market Economy. Iowa State Univ.
Press. 1964.
Information serves as a key to success of a pricing mechanism, along with power. An increasingly significant mechanism for focusing information is the futures market.\(^\text{16}\) The possibility for hedging in fat and feeder livestock suggests the possibility that the commercial farm may become a producing operation, with the risk bearing portion of the entrepreneurial duties shifted to investors. In addition to needing to study this as an alternative to direct forms of contracting and vertical coordination, we need a great deal of analysis on the information focusing success of the futures market. From the viewpoint of farming, we also need to study it in the context of its functioning in the farm operation. From society's point of view, exchange through a competitive futures market may be an attractive alternative to bilateral bargaining arrangements as a pricing mechanism for specification buying.

Instability of Farm Prices

Almost all of the forces discussed so far lead one to conclude that we may expect greater problems with instability of farm prices. World markets are growing and are annually unstable. The durable equipment associated with specialized enterprises and ease of entry suggest the possibility of widening inventory and price cycles. The uneven advance of technology promotes uncertainty, uneven adjustment in supply, and periodic readjustments. The effect of these instabilities on incomes is accentuated by the extreme stability in prices of purchased inputs. Three decades ago such a price-cost situation led to efforts to stabilize commodity prices. In recent years, supports have lowered in order to get in equilibrium with world markets, and some have implied that they should be eliminated. Yet it seems reasonable to argue that today's high capital agriculture is less able to withstand variability. I am suggesting that we have a potential need for some stabilizing policy recognizing the world market, and that information in this area may be a fruitful goal for some commodity research work. Stabilizing at an equilibrium price level, rather than at a level designed to provide income transfers to agriculture, amounts to a form of forward pricing and absolutely requires keen commodity analysis work.

On the Aggregate Picture

In addition to studying the leading edge to identify the long range developments, we also have obvious needs for knowing about the mass, the aggregate, and its components. In this area, the general theme I

stated at the beginning has its greatest impact. Integrative analyses are called for, involving product demand, input supply, the transportation system, and the production processes. They need at times to be disaggregated regionally, by type of farm, and by age of operator for welfare and other distributional analyses.

The integrated and disaggregated approach has been developing methodologically for some time. One example, combining the successful features of much earlier work, has been the ERS-Farm Production Economics Division national model. It recurses between a demand model and a group of area production models, with the recursing built in a cobweb way on the fact that production decisions are made well in advance of harvesting output. The model has potential for adding a transportation network and more regional demand relations, at the expense of computational size. So far, only limited attention has been given input supply relations. It seems to me that a good conceptual framework for handling the growing complexity of these integrative models may be the Leontif type of model, but expanded in the farm production row and column. Alternatively, we could think of adding a less detailed "activity" to present models to handle the related input and product relationships. The integrative model focuses on a growing need to understand appropriate time lags in responses.

In the area of supply analysis, the structure and market changes have at least two important implications for our models. In commercial farming, the various forces leading to specialization have progressively reduced the enterprise choices. Increasingly, we have a clearly dominant profit situation for a particular enterprise. Decisions are more clear cut. The capital revolution, on the other hand, means an increased possibility of variation in level of inputs on any one enterprise. Thus the implications for our research models are: (1) a need for more attention to multiperiod-investment decision models, and for less of the traditional static enterprise choice models. This puts our analysis more nearly in a firm growth context, where we need to take a close look at the appropriateness of models assuming the growth path follows a sequence of static equilibria. (2) A need to expand the allocative models by making more activities available in the direction of variation of input levels. We may, for example, need to allow several fertilization levels to choose among in studying a corn farmers' response to a new feed grain program.

17/ Dale Hathaway noted this point over 5 years ago in terms of helping farmers. The point is equally applicable to more aggregative analyses. Hathaway, D. E. The Implications of Changes in the Economy for Work in Agricultural Economics. J. Farm Econ., Dec. 1962.
We need to look a long way ahead, and this is particularly difficult in a rapidly changing environment. Results from extrapolating our econometric models based on time series break down after a shorter time in this kind of situation, but I feel they will remain extremely valuable for verifying the changes that take place. They are indispensable for short range policy work, and provide some help in the difficult problem of providing a standard for checking our more anticipatory normative models.

Concluding Comment

In summary, reports of the imminent death of farm commodity research are, to use the well known phrase, very much exaggerated. Reports that we may expect a significant mutation, on the other hand, are accurate. The commodity creature, which was formerly isolated from all except product markets, is fast being exposed to the entire economic environment. Adaptive processes must be forthcoming, and the underlying stresses may be expected to alter its personality and behavior. Some priority research problems lie in developing research models to analyze policy alternatives and their effects over time; but we must avoid the pitfall of getting so involved with the models that we fail to provide the leading edge explorations which nourish these models and also have significance on their own. Both kinds of problems thirst for data, and imply a high priority to isolating the kinds of data needed and to collecting it. Of particular significance in each priority category, it seems to me, are (1) renewed attention to differential aspects of the demand situation by income level, country, and product differentiation, (2) examination of the combined effects of age distribution and capital-inflexible, high cash cost specialization on supply response and on the recombination of land units over time, and finally (3) exploration of the structure of input markets, both to provide supply and demand data for research models and to assess the questions of market power, exchange equity, the external forces for changing structure of farm firms which do not fit our usual formal models.
As I understand my mission, it is to stimulate discussion concerning what relation recent developments and research findings in marketing have to say to those concerned with research and other related activities in agricultural policy. This is a wise exercise for our profession. The policy research and extension efforts have been one of the stronger phases of our professional efforts in the past. However, if the identified policy problems of the past are merely projected into the future, our work will be refining the answers of the wrong set of questions.

As I understand the past, our policy research efforts for several years right after the World War II floundered as we attempted to identify the pertinent policy problems. Then after many seminars and discussions, agreement pretty well jelled that "the" farm problem was best described as one of inadequate farm incomes. After this decision was made, alternative solutions were proposed and explored such as curtailing production, increasing demand, and reducing marketing costs. Consensus gradually was reached that the route of curtailing production was most fruitful and research efforts focused in on how to best accomplish that job. I, for one, believe that this research was generally meaningful and valuable. It not only generated needed data and relationships but it also produced proposals and plans. The extension service helped the body politic in making its action decisions. Action was taken. This combined effort and activity certainly was one of the profession's "finest hours" (I say one because I believe the decade of the thirties would also qualify) for it turned its energies toward what social scientists are supposed to be concerned with--the aiding of men to manipulate their business and economic resources toward desired ends. It was involved in the role of invention of new concepts and rules rather than in the static role of scolds.

The major point that I wish to make in this discussion is that the formulization of "the" farm problem as one of inadequate farm incomes will not adequately define the policy problem areas of needed action of the future. First, I do not believe that issues relating to the farm can any longer safely be segmented out from the business context of

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the total system in which the farm operates. I suggest that the pertinent arena is food and fiber policy for the nation — not narrowly defined farm policy. Secondly, I do not believe the "levels of incomes of farmers" any longer adequately describes the concerns and problems of this food and fiber industry either from the viewpoint of the members of the industry, including farmers, or from the viewpoint of society as a whole. Several developments occurring within the marketing segments of our total food and fiber industry are contributing to these emerging issues. It is to these I will now turn.

The Collapse of the Neutrality Assumption

I think it can be safely said that in much of our farm production oriented research it has been assumed that the marketing system was essentially a neutral ingredient. Farm level demand was derived from consumer demands with the costs of the marketing process intervening. The source of change in demand was largely attributable to changes in the numbers and incomes of consumers. (Preferences of consumers were considered — but the source of these preference changes were either largely ignored, assigned to such stable factors as religion or race, or tied into income.) These demand changes were then dutifully transmitted by the marketing system to the farm level.

Several conclusions are now emerging from research point to the proposition that the marketing segments is far from a neutral transmitter of consumer demands. These might be summarized as follows:

1. Numerous studies are concluding that consumer income effects on expenditures for food are largely for more marketing services and processing. The residual income elasticity of demand at the farm level may be very low. And, furthermore, whatever effect incomes have on aggregative farm level demand probably comes largely from a change from low-resource-using to higher-resource-using products in the desired raw product mix.

2. The marketing system is not neutral or ineffective in its efforts to shift consumer level demands for the product mix. The development of new processed products, merchandising techniques and advertising expenditures can and do shift consumer expenditure patterns among product lines at least within the total food budget. Research results in this important area are confusing and muddy, but they certainly are not conforming the hypothesis of no effect. There has been a low-margin merchandising of broilers. Probably more students of the problem than not, conclude that such policies have tended to enhance the demand for the rapidly expanding broiler production. Milk is another product for which there has developed a
rather universal approach for low margin merchandising on the part of major retail establishments. There has been a rather sudden interest of the potato industry in new product technology. There is evidence that this development has influenced the demand for potatoes. There has developed a similar interest in the turkey industry concerning processed turkey products. It is not at all clear whether this development which is increasing year around turkey use will simply reduce expenditures for other meats - or increase the total meat area expenditure. Such examples could be greatly expanded.

3. A related point to the preceding is that such marketing activities may be highly selective in their product orientation. Such activities may be either consumer demand increasing, marketing cost increasing (or decreasing) or both. In addition, the incidence of cost or benefit from such development may be shared in various ways among consumers, marketing agencies and farmers. This fact is at least a partial source of the recent unrest among both consumers and farmers. The feeling of these particular groups is that they have been required to bear the burden of changes in the marketing area over which they exercise no control.

The Problem of the Appropriate Unit of Focus

Much of policy analysis has treated the farmer and farm production as an aggregated whole. The aggregate demand and supply of farm products has been the vehicle of analysis and the impact on aggregate farm income the goal.

There is rapid tendency toward enterprise specialization in the farm firm and some tendency toward more regional specialization of production patterns. And at least within the assembly level of marketing there is growing enterprise specialization. We have already noted that marketing activity and costs changes may vary widely among product groups. Integration activities have not taken place between marketing and agriculture in general but have developed very unevenly among specialized marketing agencies and a particular farm enterprise. These developments all point to the enterprise or product as the appropriate unit of policy concern and research analysis.

There are other developments which confuse the issue, however. The production units of processing seem to be increasingly specialized. For example, separate hog, cattle, broiler, and turkey slaughtering facilities are tending to replace the multiple purpose slaughtering facilities. In the critical issue of managerial control of business units, however, the issue is not so clear. The development of the conglomerate manufacturing unit of many product lines, both combining products
within the food complex and also combining food and nonfood products seems to be on the increase. The retail unit itself has trended away from product line specialization toward complex aggregation of many product families. Specific product line orientation of management has given way to viewing all the products as something to be manipulated as part of the whole. Pricing the product mix is common terminology.

Where does this lead us as we seek the appropriate units of problem identification and analysis? It seems clear a general agricultural production focus is less appropriate at the initial production level. If we increasingly have specialized producers of pork, cattle, and chickens, the possibility that an effective broiler advertising campaign may be largely at the expense of pork is of little concern to the cattle group. Integration activities in turkeys is of only passing interest to specialists in dairying. On the other hand, the retailer pricing his mix to maximize his retailing returns couldn't care less that his use of near-loss operations on one product and loaded margins on another may have very special implications to one group of producers compared to another. Defining policy problems, proposing alternative solutions and analyzing impacts must increasingly take these divergent developments into consideration if such work is to be effective and helpful in guiding decisions and actions.

The Decline of the Validity of the Community of Interest Assumption

Both of the above developments, the growing inappropriateness of the assumption of neutrality of the marketing system and the increasing difficulty of identifying the appropriate unit of focus, are very closely related to another assumption that has been carefully cultivated over time - even though many of the cultivators may have done so with tongue-in-cheek. This is the idea that the farm community and the marketing community are interdependent and have one big community of interest. Interdependent they certainly are, but this does not make them one big happy family in which actions benefiting or hurting one member automatically have similar results on other members.

This is only another way of stating that different segments of the food industry are developing differing capabilities of exercising market power. One trend almost all marketing research agrees upon is that firms are increasing in absolute size. Whether this development is leading toward increasing concentration of power in all relevant markets is a question not so clearly answered. Certainly there is developing market concentration in selected areas of the food industry.
What kind of market behavior results from these trends is not at all clear. Our research has been over-occupied with measuring concentration ratios. There is a considerable shortage, however, in work that assesses and evaluates what these varying levels of concentration mean to market performance and the nature of competitive behavior. The need is critical for devising realistic and acceptable criteria for answering the question of how effective is the existing level of competition. Unfortunately we often appear as if we were divided into two opposing camps: one group holding firm to the model of perfect competition and decrying any departure from the model as bad; the other group holding firm to the view that existing competition is keen and vigorous and that any obviously unacceptable behavior or performance is temporary and will be automatically corrected in the long run. Neither of these extremes is very useful as a philosophic base for policy analysis. But the middle ground lacks definition and content.

The Deterioration of the Exchange System

It is concerning the exchange system and the mechanics of price discovery that the findings of much current market research are probably saying the most to researchers in policy. Three specific developments here can be mentioned:

1. There is a proliferation of price discovery points at the raw product levels and the reduction of such points at the processor-wholesaler-retailer levels.

Part of our conventional wisdom as agriculturalists stems from the time, now many years ago, when products moved from the farms into the hands of processor, wholesale and retail buyers located in large urban centers and organized around various kinds of market facilities and "market streets". Here prices were discovered under conditions assumed to approximate the model of perfect competition. There were weaknesses, to be sure - especially in the areas of communication and product identification. But these could be largely overcome by governmental policy which fostered the free assembly and dissemination of market information and promoted the increased use of uniform standards and grades. Prices were discovered by individual buyers and sellers exercising their classic propensity to haggle in the market place. The one thing which is clear is that these organized terminal markets are no longer a major vehicle for the exchange process. Buyers have moved out into the production area to acquire their needs through direct negotiations with individual farmers either at their farms or at many local buying points. At the other end of the marketing system with the increasing size and manufacturing activity of processors and the increasing size of retail organizations, the
exchange process is increasingly taking place through individual isolated agreements between two interested parties. Though the actual physical use of the old system has declined, evidence points to the fact that the use of the pricing results of the vestigial activity has not.

Whenever title exchange takes place, decision must be made as to the value of the particular product at that particular time and place. Increasingly the food system is using a system of formula relationships tied to specific quotations of the old terminal system to arrive proposed exchange price levels. This is occurring at the very time that the validity of such price levels in increasingly under question.

2. The number of open pricing point levels in the marketing channel is being reduced. No matter how one evaluates the situation the conclusion is unescapable that integration through either ownership or contract both between initial producers and other parts of the marketing system and between the other levels of the marketing system is increasing. The drive or desire to establish more effective control over the market channel exists strongly in important marketing decision centers.

Some have argued that integration is simply a new arrangement of the traditional open-market exchange system. Others have suggested that integration and contractual arrangements constitutes a replacement of this system. Regardless of conceptualization, the results of this development is a shrinking of the amount of open and uncommitted trading which takes place. Though for a different reason, the results of this are similar to the decentralization process discussed earlier. Less products are available for any type of centralized trading. Here, also, many groups and firms making contractual arrangements and struggling for some base to tie to, are using formula relationships tied to the price result of the marketing process that it is tearing down.

3. There is a decreasing use of uniform product standardization and an increasing use of service and differentiation in the product package in the pricing system at all levels of the food industry. More and more processing and service is being added to the raw product of the farm as it passes through the marketing channels. This increases the importance of technology in the marketing process. It permits the increased manipulation of the design and differentiation of the final consumer product. Added to this is the impact of multi-unit retailing and self-service merchandising. With this are greater expenditures to influence consumer acceptance and loyalty to a store or group of stores and/or a particular product or product line. As the Food Commission concluded: the food industry is becoming more and more
"sales oriented"; increasing emphasis is on manipulated consumers and less on simply producing a good product for less. In the farm production operation itself technology and knowledge have increased the possible control over the variation in the farm product production.

All of these changes add up to an increased concern over the variation of the product throughout the system. At the farm end this has resulted in increased integration referred to previously and an increase in so-called specification buying. Such buying is really extra standardization being enforced over very narrow ranges of a product line. Traditional "uniform" grades and standards of products and their packaging are often used as a basis upon which extra requirements are added by both the buyer and seller. Such relatively minor technical differences in products are of great importance to the effective operation of highly mechanized and standardized marketing firms. To this then are added an increasing bundle of services and intangible factors which are used to additionally direct and control the flow of products through the system. This may take the extreme form of complete contractual arrangements specifying production, product and packaging activities or the less complete forms of the furnishing of advice, technology and materials to the participants. Prices generated upon goods using broad and widely used standards are often not considered to be adequate signals for organizing the flow of goods.

All of these add up to the proposition that traditional efforts to increase the use of uniform standardization and to generate improved market intelligence may no longer be an adequate approach. We may be the period of transition to a basically different system of organizing and controlling the production and flow of food and fiber products.

The Policy Implications

If the above adequately describes the developments in the marketing system, then there are many implications to research and activities in policy. I believe that in many ways, as professionals concerned with agriculture policy, we have lost touch with what farmers and others consider their problems in the real world. The unrest is there, but the action agencies in the field are not hammering on our office doors for our advice, counsel and research.

We should again turn our talents to that area where we should have some unique talents - in helping to sort out and identify the relevant problems of the food and fiber industry and then devising and evaluating alternative solutions. I say problems because I believe that policy issues of tomorrow will not simplify themselves into a single category such as that of inadequate incomes. I say food and fiber industry because isolating out farms and farmers will not be realistic.
I would suggest that society in the years ahead will be in the process of devising new rules under which the production and marketing of food and fiber will function. In the past when this has occurred it has taken the form of many individual pieces of legislation put together to establish new institutions and develop the ground rules for different acceptable behavior. The Sherman Act and the following legislation over the years helped shape the form of competition. Laws were passed creating the cooperative, the Federal Land Bank, the market order system.

Should we restrict the freedom of firms to differentiate products and influence consumers? Should we regulate the freedom of a retailer to manipulate prices as he pleases? Should there be some boundaries placed on integration activity? Are the present statutes adequate in defining the dimensions of a cooperative; the rights and behavior of bargaining groups? Should Farm Boards, or pricing-by-committee, or the organized bargaining table be instigated as an alternative to the deteriorating pricing system? Society will answer such questions as these with or without our help. I believe it would find more effective long-run solutions if the talent of our profession participated.
IMPROVING AGGREGATION VALIDITY

by John E. Lee, Jr.*

In recent years, increasing concern has been expressed in the literature of our profession over the problems of aggregation in models of agricultural demand and supply (1, 3, 4, 5, 7, 8, 12). Most frequently the concern has been with the validity of aggregated supply estimates when micro supply situations are simulated in linear programming models.

The aggregation problem stems from the fact that while most economic activity originates with individual firms and households, economists, with increasing frequency, want to say something about the behavior, in the aggregate, of all or a group of such units. One obvious approach is to build up to the aggregate, firm by firm. This is not feasible in an atomistic economy such as agriculture. A second approach is to ignore the individual units by working with observed or postulated relationships among economic aggregates. A third alternative, especially for an atomistic or purely competitive economy, is to approach the aggregate through "representative" units or through the analysis of subaggregates.

The latter approach has been particularly popular in agricultural supply research. The so-called Regional Adjustment Studies (NC-54, S-42, etc.) have used linear programming models of representative farms to derive regional estimates of supply schedules for the major commodities. The basic units of analysis for a model of national agricultural production developed by the Economic Research Service are representative resource situation subaggregates. Linear programming models of these units are used to estimate aggregate supply response to economic stimuli. These are but two examples of the micro-oriented approach to estimation of aggregate behavior—an approach that has almost become conventional in farm management and production economics research.

* Agricultural Economics, Production Adjustments Branch, Economic Research Service. This version of the paper has benefited greatly from the suggestions of Lee M. Day. The author also appreciates the comments of Fred Abel, Glen T. Barton, and W. Neill Schaller. The views expressed are the author's and do not necessarily reflect the views of the U.S. Department of Agriculture.

1 Numbers in parentheses refer to Literature Cited at end of paper.
The concern for the validity of aggregate estimates of supply derived from the approach typified in these models is justified. There are at least three sources of invalidity in that approach:

1. The failure to be consistent with respect to time in the formulation and specification of supply models;

2. The failure to recognize that constraints on economic activity at higher levels of aggregation may be different than at micro levels; and

3. The failure to systematically group farms and construct units of analysis so as to recognize the interfarm variation in forces that shape economic behavior.

These failures are interrelated; thus, the distinctions between them are somewhat arbitrary. But the breakdown provides some "handles" on the aggregation problem and an organization framework for the discussion which follows. I will work from conceptual and theoretical benchmarks, but the emphasis in this paper will be on practical guidelines for improving aggregation validity in models of agricultural supply.

It seems appropriate to begin with a look at the aspect of the aggregation problem which has been discussed most frequently. The problem is that of exact aggregation; or simply, the problem of grouping farms so that analyses of aggregate behavior will be free from bias or error attributable to the grouping process itself.

**Grouping Microunits for Aggregation Validity**

**Recent Conceptual Developments**

Richard H. Day (3) has shown that conditions sufficient for exact aggregation are proportional variations of resources and behavioral "bounds," proportional variation of net return expectations among all farms in the aggregate, and finally, common technical coefficients which appear in the constraints on the farm's decisions. Tom Miller (7), searching for less restrictive conditions for exact aggregation, has shown conceptually that the responses of different farms to a given set of relative product prices will be proportional if the farms have homogeneous activity vectors and if the same activities appear in the linear programming solution vector for each farm. In other words, farms that have the same enterprises in the optimum enterprise mix can be grouped without bias or error. While Miller's conditions are less restrictive than Day's (groupings of farms under Day's conditions
would be subsets of groupings under Miller's conditions), they are of limited practical value because they are defined as requirements of the solutions to the individual farm problems, rather than as observable characteristics of the farms themselves.

In another recent paper, Sheehy and McAlexander (13) hypothesized that if farms could be sorted into groups having the same absolute restriction (limiting resource) on output, benchmark farms based on the averaging of resource levels within each group would give unbiased aggregate results. They proceeded to apply these grouping criteria only to single-product firms and not to the more general multiple-product, multiple-resource case where variations in relative prices must be recognized.

Thus, several writers have advanced sufficient conditions for exact aggregation. However, these have been rather restrictive conditions or have applied only to special cases. None of these efforts answered Lee Day's (1) call for research to determine the necessary conditions for exact aggregation and to determine the magnitude and direction of error at various prices associated with different levels of variance in the proportionality of resources. We turn to that task now.

The Necessary Conditions for Exact Aggregation

In an extension of Miller's analysis, this writer (6) showed how the "qualitatively homogeneous solution vector" conditions could be translated into observable characteristics of the farms themselves. This was done by solving the dual to Miller's primal problem. In so doing it was revealed that the shadow prices (marginal value products) of the resources were the same for all farms which Miller showed could be grouped without aggregation error. Further, these shadow prices were constant over the range of resource ratios represented by the aggregated farms. The task remaining was the practical one of determining the exact ranges of resource ratios over which the marginal value product was constant.

In the article to which I just referred, simple graphics were used to demonstrate that, in effect, the activity vectors in a linear programming situation represent marginal value product "borders." All farms with combinations of resources bounded by the same marginal value product "borders" or activity vectors have the same shadow prices in the dual, have the same activities in the primal solution vector, and can be aggregated without error. The number of cells or bounded areas represents the maximum number of groups of farms needed for exact aggregation.
Working with the dual counterpart to Miller's theorem rather than with the primal was a matter of convenience rather than necessity. All farms whose resource coordinates lie between the same two feasible activity vectors will maximize revenue with some combination of those same vectors, thus meeting the "qualitatively homogeneous solution vector" conditions of Miller's primal theorem.

From this exercise it was apparent that the key to determination of the resource ratios relevant to error-free grouping of farms is the relationship between the ratios in which resources are required by alternative activities and the ratios in which resources are available to farms. This observation has been used to develop an exact aggregation algorithm for multiple-product farms in a completely general price situation.

The difficulty with multiple-product farms is that the resources available to a given commodity (activity) are subject to change as prices (and thus the relative profitability of the activities) change. The answer to that difficulty, of course, is to recognize all possible orderings of the relative profitability of activities (that is, to recognize all the possible orders in which activities could come into the linear programming solution). This can be done in the following way. First, all the relevant combinations of two resources are determined. For example, if one or more activities use all three of resources A, B, and C, the relevant combinations of two resources would be AB, BC, and AC. Then the critical ratios of each of these combinations of two resources are determined from the technical coefficients of the activity vectors. In other words, the boundaries to the critical ranges of each resource ratio are the ratios in which the various activities use these resources. Then farms are grouped according to the critical resource ratio range in which each combination of two resources falls. Sequential sorting on the basis of all possible relevant combinations of two resources (assuming that prices of all outputs could vary from zero to infinity) produces a number of groups of farms free of aggregation error.

Since the same conditions must be met for each relevant resource ratio by the farms in each group, the order of the sequential sorting process will not affect the composition of the final groups of farms. Because for each farm in each group the output of each commodity will be limited by the same restraint at any given price, the shadow prices for the resources of each firm are identical and the conditions for zero errors are met.

In fact, this "critical resource ratios" grouping algorithm provides the minimum sufficient conditions (and therefore the necessary conditions)
for exact aggregation in a completely general model. If any farm in any one of the groups derived meets anything less than these conditions (that is, if any of its resource ratios fall outside the critical ranges which delineate that group) there will be aggregation error at some combination of prices.

The exact aggregation process can be made general with respect to technology and time as well as to prices. This can be done by expressing technological capacity as restraints, and variations in operating technology (crop and livestock practices) as alternative activities. In the case of multi-period models, all known technologies which are possible alternatives over the whole sequence of time periods can be included as vectors in the original grouping procedure.

The Concept of Error "Trade-off"

It should be obvious that in a problem of any size, the number of aggregation-error-free groups delineated by the critical-resource-ratios method just outlined will be very large. The natural question then is, "What effects on costs and quality of information would result from combining some of the exact aggregation groups?"

Previously, this question of a "trade-off" between analytical costs and aggregation error has been thought of in terms of representing a heterogenous population with a single representative farm and then proceeding to increase the number of representative farms one by one, noting while doing so the marginal rate of substitution between increased costs and reduced aggregation errors. However, now that a procedure is available for exact aggregation of firms, it seems logical to move in the opposite direction, that is, to gradually reduce the number of aggregates to be programmed by successive combining of the basic groups which are free of aggregation error.

As a part of research recently completed, this approach was developed in three stages. First, a measure of aggregation error in multiple-product, price-general models was developed. That measure was based on the value of the productive capacity of resources misallocated as a result of combining the original error-free groups of farms. Then an algorithm was developed for successively combining the two groups which minimized the maximum marginal aggregation error. The final stage or result was the plotting of a schedule of accumulated maximum aggregation error for successively smaller numbers of groups of farms (from the original number of error-free groups to one). Conceptually, a cost schedule could be superimposed on the accumulated error schedule to develop a decision framework for an acceptable "balance" between the amount of aggregation error one is willing to live with and the costs one is willing to incur to further reduce error.
The point I want to make with this discussion is that the necessary conditions for exact aggregation are known. These conditions imply burdensome numbers of groups of farms. Offsetting this, proposals are being offered for efficient "trade-offs" between numbers of groups of farms for analysis and the potential aggregation error.

Recent Empirical Developments

Very few empirical analyses have explicitly addressed the problem of aggregation error. Two articles (4, 13) in a recent issue of the Journal of Farm Economics reported applications of Sheehy's and McAlexander's "homogeneous restriction method" for grouping farms. In both cases, use of this method resulted in less aggregation error than the more conventional grouping methods. However, the sample populations in both cases were farms on which dairying was the single dominant activity. Tom Miller has worked with samples of multiple-product farms at Iowa State, searching for practical guidelines for reducing aggregation error. The results of that work have not yet been published.

To evaluate the "critical resource ratios" method for exact aggregation and the associated error "trade-off" concept which were discussed in the previous section of this paper, a sample of 100 farms in southwest Georgia was selected. These were multiple-product farms; most of them produced some combination of cotton, peanuts, wheat, corn, oats, soybeans, beef cattle, and hogs. Survey data for each of the farms were used to construct separate linear programming models. The model for each farm was solved and the solutions to all farm models were added to derive the "true" aggregate supply schedule for each commodity.

In the models, the actual variations in activity coefficients for each commodity, as revealed by the survey data, were retained to provide maximum realism. In addition, there were as many as 18 potentially limiting resource restraints. For the population of 100 farms, exact aggregation required 100 groups. Each group obviously contained a single farm.

These results were not at all surprising. Exact aggregation is a demanding requirement. For the population of farms included in the experiment and considering the restraints included in the models, it is possible that a slightly larger sample would have produced some groups with more than one farm per group. That is, at a certain size of sample the ratio of number of error-free groups to farms in the sample would have dropped below one to one, and beyond that the ratio would have fallen at an increasing rate as the size of sample increased.
The error "trade-off" concept was tested with a subsample of 21 farms, for which exact aggregation required 21 groups. A completely general price situation was assumed. The 21 groups were sequentially reaggregated; first to 20 groups; then to 19 groups; and so on until finally all farms were back together in a single group. Each step consisted of combining two groups of farms so that the potential aggregation error was minimized. The resulting "trade-off" curve is shown in Figure 20.1. That curve shows the relationship between the number of groups of farms and the maximum relative aggregation error from misallocating the productive capacity of the resources involved.

The magnitude of the possible error depicted in Figure 20.1 is at first distressing. But it must be remembered that the situation in which all prices can vary from zero to infinity is an extreme case. Usually we are concerned with the magnitude of error for more modest price variations.

The same farm models were resolved with the prices of all commodities except cotton held constant at 1962 prices. The price of cotton was varied from $0.16 per pound of lint (including a return for cotton seed) to $0.40 a pound. The resulting error for alternative numbers of groups of farms is shown in Table 20.1. Data from Table 20.1 were used to construct the "maximum actual error" and the "average actual error" curves in Figure 20.1.

The models for the groups of farms shown in Table 20.1 were solved with all the activities of the original farms included. For the three-group and one-group models, "modal" activities were estimated and the models rerun. The results are compared in the first four columns of Table 20.2. The use of modal activities reduced the aggregation error considerably. In fact, constructing modal activities for the single aggregate farm reduced error more than breaking the aggregate into three groups, each of which retained the original activities.

For comparison of the minimum-error-grouping procedure with more conventional procedures, the same farms were grouped according to size. The size categories were those used for the same region for the S-42 Regional Adjustment Study: Under 150 acres of open land; 150 through 249 acres of open land; and 250 acres and more open land. The results are shown in the two right-hand columns of Table 20.2.

The absolute results of this simple experiment must be used judiciously and may not hold for other regions or farming situations. Certainly the complexity of the aggregation problem and the magnitudes of error involved in the "trade-off" process will be smaller in regions where the production of one major commodity, such as wheat in parts of the Great Plains, dominates alternatives over a wide range of prices.
Figure 19.1. The relationship between number of groups of farms and aggregation error, 21-farm sample, southwest Georgia.
Table 19.1. Aggregation error as a percentage of "true" aggregate value of production for specified numbers of groups of farms and at selected prices of cotton

<table>
<thead>
<tr>
<th>Cotton price ($/lb.)</th>
<th>Error for alternative number of groups of farms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
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<tr>
<td>0.16</td>
<td>11</td>
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<tr>
<td>0.20</td>
<td>11</td>
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<td>0.22</td>
<td>11</td>
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<tr>
<td>0.24</td>
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<td>11</td>
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<td>0.32</td>
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<tr>
<td>0.36</td>
<td>5</td>
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<tr>
<td>0.38</td>
<td>11</td>
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<tr>
<td>0.40</td>
<td>10</td>
</tr>
<tr>
<td>Weighted average error</td>
<td>10</td>
</tr>
</tbody>
</table>
Table 19.2. Aggregation error as a percentage of "true" aggregate value of production for specified groups of farms and at selected prices of cotton

<table>
<thead>
<tr>
<th>Cotton price ($/lb.)</th>
<th>One group, inclusive activities</th>
<th>One group, modal activities</th>
<th>Three groups, inclusive activities</th>
<th>Three groups, modal activities</th>
<th>Three sizes, inclusive activities</th>
<th>Three sizes, modal activities</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Percent</td>
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<tr>
<td>0.16</td>
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<td>36</td>
<td>41</td>
<td>16</td>
<td>64</td>
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<tr>
<td>0.20</td>
<td>56</td>
<td>36</td>
<td>41</td>
<td>16</td>
<td>65</td>
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<td>0.22</td>
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<tr>
<td>0.28</td>
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<tr>
<td>Weighted average error</td>
<td>54</td>
<td>37</td>
<td>41</td>
<td>17</td>
<td>62</td>
<td>23</td>
</tr>
</tbody>
</table>
However, these empirical experiments do serve to illustrate concepts which in turn may provide practical guidelines for improving aggregation validity.

Implications for Constructing the Basic Units of Analysis

Despite the theoretical developments reported in this paper, it is a practical reality that, for the time being, programming models of regional and national agricultural production as well as models of resource use and interregional competition must contain a relatively small number of basic analytical units (each representing a group of farms). That being the case, the greatest returns in terms of reduced aggregation error may come from doing a better job of constructing these units of analysis.

Weighted Average Activities

The empirical experiment with the sample of Georgia farms demonstrated that the use of "modal" activities resulted in less error than including all the activities of each farm in models of groups of farms. Theoretically, at least, error from variations in coefficients for a given activity can be totally eliminated by using coefficients that are weighted averages of the coefficients for that activity for all farms in a group. Using weighted averages is necessary because different farms furnish different proportions of the total potentially limiting resources and the influence of the technical coefficients of each farm is proportional to that farm's share of the total output.

Weighted average activities may be obtained by weighting the reciprocal of the technical coefficient of each farm (for a given activity) by the proportion of the potentially limiting resource contributed to the aggregate by that farm and then obtaining the reciprocal of the result. In other words, the output of given commodities for individual farms of a group of \( j \) farms could be expressed as

\[
Q_{ij} = a_{ij} X_1 + b_{ij} X_2 + c_{ij} X_3
\]

where \( i \) represents the commodity or activity \((1...M)\), \( j \) is the farm \((1...n)\), and \( a, b, \) and \( c \) are the technical coefficients for resources \( X_1, X_2, \) and \( X_3 \), respectively. The total output of each commodity for the group of farms could be expressed as

\[
Q_i^T = A_i X_1 + B_i X_2 + C_i X_3
\]
where \( A_i = \sum_{j=1}^{n} \left( \frac{1}{a_{ij}} \right)^{-1} \), and where \( \Theta \) is the proportion of \( X_1 \) contributed by the \( j \)th farm. The weighted average coefficients in equation (2) would constitute the activity vectors in models of farm aggregates.

Perhaps a small sample of the farms represented by a model would be sufficient to establish both the variations in coefficients for a given activity and the weights for each of those variants. The only difference in the data required to estimate weighted average coefficients and that required to estimate "modal" coefficients is that the former requires resource quantities data for each farm.

**Improved Restraints**

Even when good aggregate restraint data are available, we get error in models of production because of the variation in the relative scarcity of specific restraints from one farm to the next. It is common, for example, in some regions that some farms must hire additional labor while others have idle labor. In most cases the idle labor on one farm is not available to farms with labor shortages. In addition, some restraints (and their coefficients) are somewhat elastic and the restraint quantities are hard to define. In critical periods, farmers may work harder, faster, and more hours per day. In a crisis, other family members, not normally a part of the farm labor force, may pitch in and help. Machine capacity may be expanded by using machinery more hours a day.

Two suggestions may be appropriate for improving estimates of restraints for models of farm aggregates. Both should help reduce aggregation error. The first is the use of the "inclusive" method for estimating restraints. For example, in short-run supply models, it is not uncommon to use census of agriculture estimates of total land available in a region. Sometimes this estimate is adjusted by subtracting out land used by enterprises and types of farms not included in the model. But this process is often not taken far enough. It may be better to start by estimating the land used by activities specifically included as model alternatives. From that benchmark, estimates could be made of (1) additional quantities of land that could be available to the included activities, and (2) the economic conditions which might make those quantities available.

The second suggestion is a variation of the inclusive approach and may be particularly useful for shorter-run predictive models. It may be called the engineering method of estimating restraints. Weighted average coefficients for, say, labor in period \( t-1 \) could be multiplied
by actual activity levels in period t-1. The product is a first approxima-
tion of the labor restraint in period t. This estimate could be ad-
justed if there are reasons and data for doing so. Then the model
could be run to see what pressure points develop with respect to labor.
These points could then be examined and the reasonableness of the
restraints further evaluated. This approach helps to reduce the problem
of attributing positive productive capacity in the aggregate to resources
which on individual farms may in fact be in surplus. Again, the use-
fulness of this suggestion depends on the research objectives.

Formulating Models to Improve Aggregation Validity

Recent attempts to evaluate some of the regional studies of
agricultural production and adjustments prompt me to say something
about the relation of assumptions about time, resource mobility,
and research objectives to the validity and usefulness of the results
of supply models.

Model Realism and Aggregation Error

The original assignment to write this paper called for emphasis
on realism in aggregation. But the realism of the aggregation pro-
blem is a function of the realism of our models, which are themselves
abstractions to the extent that they do not perfectly simulate the real
world. I have not been able to understand the surprise and dismay of
researchers who, when they conduct optimizing analyses with highly
unrestrained models, built on assumptions of advanced technology,
and weight these results to aggregate levels, get supply-price relation-
ships highly unlike those they observe in the real world. It would be
grossly inaccurate to attribute all the differences between the model
results and the real world to aggregation error. If we want results to
compare with the real world we have to build models of the real world--
including all the relationships, uncertainties, and subjective and
objective goals and restraints of the real world.

The nature of the aggregation problem varies with the "realism" of
our economic models. In highly abstract models in which all resources
are assumed variable, knowledge is assumed perfect, and all farmers
are assumed to have perfectly adjusted to a common "best" technology,
the problem of aggregation bias or error from grouping farms with unlike
resource ratios, technical coefficients or expectations does not exist.
If, however, any of the real world's asset fixity and imperfect know-
ledge are permitted, the possibility of aggregation error in the results
of a given model must be recognized. In general, the intra-model
aggregation problem becomes more complicated as the realism of the
models increase; that is, as we move from static to dynamic assumptions
and from more "normative" to more "predictive" assumptions.
Potential aggregation error may be suppressed in more predictive models where so-called "behavioral" or "flexibility" restraints are included. These restraints, which generally take the form of upper and lower bounds on the solution levels of specified enterprises, indirectly account for the many forces that cause lags in adjustment or temper profit-maximizing behavior in the real world. Thus, this particular method of adding realism to supply models may reduce aggregation error as a by-product.

Assumptions about Time

Too often the validity of the supply schedules generated by models is impaired by inconsistent assumptions about time. This may be called an aggregation-over-time problem. For example, in one major study: (1) The time period used for yields was assumed to be of sufficient length for the full effect of improved practices on crop yields to materialize; (2) the time period used for restraints was assumed to be long enough for intermediate-term capital investments in buildings, farm machinery, equipment, livestock, and pasture improvements to be considered as variable costs (yet operator labor and management were considered fixed); (3) farm numbers were those projected for 1975; and (4) the price and cost projections represented "... the level of prices that may be expected to prevail over an extended period of years under assumptions of relatively high employment, a trend toward peace, continued population and economic growth, and a stable general price level." One wonders whether the time periods of (1), (2), (3), and (4) were consistent. Failure to ensure that all the assumptions about time are consistent could result in mongrel supply schedules that have meaning for no time period.

As researchers, we have some license to play around with any assumptions we like. It may be useful to know the nature of "equilibrium" under alternative assumptions even though we imply ceteris paribus assumptions about the rest of the world and ignore the number of iterations of our model needed to reach equilibrium. But we get into trouble if we try to ascribe realism to our model results when we have failed to translate economic time into calendar time. Imagine trying to explain to a policymaker how he should interpret the "long-run" supply schedules I described a moment ago. Some economists tend to hold the policymaker's lack of appreciation of long-run research in contempt. But economists who have had occasion to work closely

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2/ For an excellent discussion of the meaning and estimation of "proxy" restraints, see Schaller (9). For examples of their use, see (2) and (11).

3/ See pp. 8-10, (14).
with policy problems share the policymaker's disappointment at the failure of supply models to provide results to which he can attach specific dates under real world conditions.

I do not mean to imply that "long-run" research is not useful. But we should be as rigorous and consistent in our long-run models as we have to be in short-run predictive models.

Assumptions about Resource Mobility

There is an inter-model as well as an intra-model dimension to the aggregation problem. This is the question of the validity of deriving aggregate supply schedules by horizontal summation of representative farm supply schedules. Sharples, Miller, and Day (12) have recognized this problem in their evaluation of the NC-54 study. But the process of horizontal summation of supply schedules, per se, is valid. The invalidity lies in the failure to account for the aggregate limitations on availability of resources that are assumed to be variable or unlimited at the representative farm level. This failure has been particularly serious in the Regional Adjustment Studies because of the longer-run assumptions about the variability of resources. It is less serious in the shorter-run predictive models wherein most resources are fixed.

Individual farms or representative farms may buy land, but the aggregate supply of land is fixed. Labor or capital may be assumed unlimited for representative farms, but the aggregate quantities of the resources are certainly limited. When these aggregate limitations are not included as constraints on model results it is no wonder that the representative farm supply schedules and thus the summed schedules are biased upwards.

One possibility for reducing the distortion of supply estimates resulting from assumption of unlimited resources for representative farms is to include the matrices for a number of such farms as diagonal blocks within a regional matrix. Thus, some resources could be unlimited for individual representative farms but fixed for the aggregate of all such farms. The final solutions for each representative farm or resource situation subaggregate would reflect the competition for the fixed amount of resources available at the regional level. The validity of the supply schedules so derived would depend on the extent to which resources were mobile among regions represented by separate matrices. For example, the supply of land may be fixed for a region but labor and capital may flow among regions.

For year-to-year predictive models the failure to consider the aggregate effects of the decisions of individual producers on input and output prices may not be particularly serious. For many agricultural
enterprises, the nature of production is such that resources are committed to production in a planning period and the aggregate consequences of individual behavior are not relevant until the next planning period. This lagged response to the interaction of aggregate supply and demand means that individual regions and representative situations can be analyzed independently of others within a given production period without the kind of simultaneity considerations which would be necessary in the analysis of an oligopolistic industry. However, the aggregate price implications must be considered in models of multi-period enterprises such as livestock or in longer-run models in which the passage of time is implicit.

Some Additional Aspects of the Aggregation Problem

Aggregation Validity and the Representative Farm Concept

The "representative farm" is a useful tool for budgeting and farm management purposes. But the conventional representative farm may not be the appropriate unit of analysis for aggregate supply studies. There is a tendency to construct such units on the basis of "look alike" criteria such as acres of land, size of labor force, or current enterprise combinations. These criteria may not be those which minimize aggregation error in estimates of aggregate supply.

The representative farm concept as it has evolved has chained researchers to thinking in terms of "typical" identifiable entities which are instantly recognizable (small farms, part-time farms, peanut-cotton farms, etc.). The purposes of aggregate supply analysis may be best served if the researcher is not constrained by the idea that he has to be able to typify the characteristics of the farms in a group within the context of a single "representative" farm. It may well be that when farms are grouped in a way which minimizes aggregation error, the farms in a given group may not "look alike" in the standard sense. For example, when the Georgia farms in the sample described earlier were grouped according to criteria which minimized aggregation error, the intra-group variance in size (acres of land) was greater than the differences in the mean sizes of the groups.

It may be useful to think in terms of treating whole groups of farms as single decision-making entities (while ensuring that the decision "rules" are appropriate for the individual farms involved). This is the aggregate representative resource situation approach. There is no apparent need for researchers who take this approach to "scale down" the aggregate to the average or representative farm to see how that micro unit looks.
If it is really necessary to interpret the results of aggregate supply analysis for identifiable situations, it may be necessary to group farms into those situations first. Each group could then be subdivided for the explicit purpose of minimizing aggregation error.

The Need for "Open-Structured" Data \(^4\)

In practice, the approach to aggregation may be dictated more by the nature of the data available than by the beauty of the relevant theory. To deal with the aggregation problem, more "open-structured" as opposed to "pre-structured" data are needed. Much of the survey and census data available are already processed and "canned" before the user gets them. Perhaps for general descriptive uses this form of presentation must be retained. But aggregates and averages for counties, states, and other units cover up the micro variations that are the very source of the aggregation problem. With today's modern data processing facilities it is becoming more feasible to preserve, on tapes, cards, and discs original sample data for micro units. With proper programs this data could be retrieved in unstructured form or restructured to meet the needs of users. The same data that would permit grouping of farms to minimize aggregation error would also be the best data for estimating the parameters of the analytical models of those groups.

Until such data are available, builders of models of aggregate supply can use sample surveys designed for their own needs or try to utilize data from surveys conducted for other purposes. There are always likely to be data gaps from the latter approach and these may be critical.

A Look to the Future

The changes in the structure of agricultural production and marketing which have been discussed in these papers will affect the problem of aggregation validity. On the marketing side there is likely to be less price uncertainty as more commodities are produced under contracts or on a custom basis for large buyers. This reduces the variation in net return expectations. The same marketing forces will call for increased specification of product qualities, grades, sizes, and dates of delivery. Contractors may even specify certain types of pesticides, levels of fertilization and harvesting methods. The result will be greater uniformity of products and ways of producing them.

\(^4\) See (10) for a more elaborate discussion of data needs for aggregate supply models.
There will still be variations in weather and soil qualities, but even these may be more subject to control through cloud seeding, irrigation, and more scientific feeding of nutrients to the soil.

Changes in both marketing and production will continue to provide incentives for further specialization. This may tend to reduce the number of enterprises on individual farms and increase the specialization of machinery, labor, and the overall bundle of resources. There will thus be increased validity in grouping farms on the basis of their specialization because of the increased fixity of specialized resources and because farms within these groups will have increasingly similar resource ratios and technical coefficients.

Even management may become more homogeneous. As Professor Leontief once remarked to a Harvard class: "Every year more managers think like economists say the economic man should think because every year more managers have been trained by economists to think like the economic man."

It is likely that some of the emerging structural changes will complicate the aggregation problem. But on the whole, the kinds of changes I have described will simplify the aggregation problem and improve aggregation validity. This, in turn, will increase both the accuracy and the relevance of the more predictive models of economic behavior.
LITERATURE CITED


EFFECT OF CHANGES IN MARKET STRUCTURE ON OWNERSHIP PATTERNS OF WEALTH AND ON THE DISTRIBUTION OF INCOMES, RIGHTS AND PRIVILEGES

by Thomas T. Stout

There was once a Professor of Economics in our College of Commerce at Ohio State University who's examination questions caused me to sit and meditate during the first hour of a two-hour examination period. I did this in order to be more assured that during the remaining hour I could write in response to what I thought were the central issues of his questions. The title of this paper which defines my responsibilities here reminds me of one of the good professor's examination questions, and I assure you it has caused me to meditate, and to worry, while other things persistently encroached upon what otherwise would have been time spent in preparation for my presence before you now.

But I have been consoled by three thoughts: (1) My preparatory chore does not prove really to be a matter of exploratory research to substantiate my comments; presumably I may take as given the essential reliability of evidence presented by the Bureau of the Census, the Department of Agriculture, and the previous papers. (2) Second, when I tried to refuse to participate in this program on grounds that other duties would prevent diligent preparation, Gordon Ball assured me that "something speculative" was desired. So I felt less obliged to present 90 percent proof and 10 percent conclusions, which seems to be the standard proportion for presentations to an audience of this kind. (3) Finally, it occurred to me that, since I would be the last man on the program, then perhaps with a little luck there would be no one left to hear my comments anyway.

Those who have preceded me on this program have said what needs to be said to provide opportunity for me to conclude with some of the things I think it all means. Moreover, some of what it all means has already been said with clarity, with eloquence, and with scholarly precision and insight by others on this program, and on other occasions by persons like Bonnen, Hathaway, Paarlberg, and Breinmyer. And by

*Professor of Economics, The Ohio State University. The author is indebted to M. F. McDonald, L. L. Jones, and M. H. Hawkins, Department of Agricultural Economics and Rural Sociology, The Ohio State University, for assistance in the preparation of this paper.
inference, it has been said by people like Francis Parkman, Bernard DeVoto, Irving Stone, David Lavender, Bruce Catton and Mari Sandoz, and by others still, who include Hamlin Garland, O. E. Rolvaag, Willa Cather, Edith Wharton, Conrad Richter and Harvey Allen -- and Remington -- and Russell -- and Harvey Dunn.

You recognize of course that I am confessing to a certain bias which causes me to respond rather willingly and perhaps enthusiastically to artist-historians, journalist-historians, and contemporary agricultural economists who are intrigued with main themes and central tendencies. I am less concerned on subjects that we have attended to in these sessions, with whatever the quantitative proportions of their distributions may be proved to be by those who are devoted to their measurement. Perhaps this is so because what I have to say doesn't require confidence limits beyond about the 75 percent level and my judgment tells me that my remarks could achieve those limits.

For much of the post-war period, most of us believed that nothing really very spectacular was occurring in agriculture, or at least that whatever startling rates of change we did encounter either would not amount to much or could not be maintained. We were too close to the information. Even information has diminishing marginal utility, and when you sit at the communications crossroads the next little tidbit doesn't excite you too much and gets easily discounted. But the tidbits have been piling up, and while the standard classroom word to cadaver-eyed scholars has been "little opportunity in agriculture", something akin to Tablets from Sinai has been accumulating at the crossroads. I believe that one of the reasons we have gathered here this week is to try, with some trepidation, to discover what the Tablets say. About all we have been able to make out on our own is an exciting word here or an ominous word there -- like OPPORTUNITY and DANGER. Like explorers in an ancient tomb, we find the surroundings somehow threatening, we are curious, even anxious for the next discovery, but a little frightened by what we may find.

In the past, nearly every published prognostication about change in agriculture has proven to have been grossly conservative. For example, in June, 1955, at a time when there were 5.2 million farms in the United States, Fortune Magazine published a major article which assessed the agriculture of 1980. The article speculated that by that date, 25 years later, there would be only 4.2 million farms in the country. But by the time 10 of those 25 years had elapsed, the number of farms already was reduced to 3.2 million. Of course a change in census definition occurred in the interim, but it is true nevertheless that the article forecast an 18 percent reduction in farms on the basis of the old definition. What occurred, based on the
current definition, was a 33 percent reduction in 10 years, with the expected 18 percent reduction occurring in the first five of those twenty-five years.

What else happened during the past ten-year census period? As I recite a few of the developments, recall the reasons why they happened, if you will; your memory-span need by only about three days long. And consider whether it is perhaps legitimate to project the rate of change another ten years, even though the trends of the past five years have moderated the ten-year influence.

The value of all farm products sold has increased 43 percent. The value of products sold per farm has risen 118 percent. The value of land and buildings per farm is up 186 percent; value per acre has climbed 74 percent. Cash grain farms have decreased 25 percent, dairy farms are down 33 percent, poultry farms down 47 percent, and cotton farms down 69 percent. Average farm size has increased 45 percent, and the only farms that increased in number were those of 500 acres or more -- up ten percent. Farms of lesser size decreased between six percent (260-499 acres) and 44 percent (under 100 acres). Farms selling $40,000 or more in products increased 39 percent in the past five years, and those realizing sales of $20-39,999 rose 23 percent. All others decreased drastically.

Generally, these trends have been more moderate for the Central Corn Belt states of Indiana, Illinois and Iowa, with two striking exceptions. Whereas the national increase in farms with sales of $40,000 or more was up 39 percent, this three-state area increased 59 percent. While national averages registered a ten percent increase in farms over 500 acres, these Corn Belt states experienced a 51 percent increase.

Where does this really put modern agriculture today? Well, for one thing, it could be argued that already we have more severe concentration ratios in agriculture today than in most industries with which we enjoy playing concentration-ratio games. Yes, the top four food retailing firms had 20 percent of the retail grocery sales in 1964, and those sales occurred in only 3.6 percent of total retail grocery stores. But also in 1964, the top 3.4 percent of U.S. farms ($60,000 or more in sales) realized what appears to be about 29 percent of total sales. The four largest meat packers did not do as well in 1964, nor did the four largest firms in fluid milk, prepared animal feeds, or bread and related products. Perhaps you feel compelled to remind me that our concerns for concentration stem principally from central decision-making and control, which is conducive to structural power, and that such centralization is absent in agriculture. I think my position would be that technology and pure competition already
have produced the willing maiden of agricultural concentration, and needing only an introduction to a series of skillfull suitors she could be quite a prostitute. Moreover, I would submit that in the past ten years the suitors have noted her succulence and have started to call.

I believe we are on the threshold of revolutionary change in agriculture. I mean revolutionary in the literal sense that revolutions leave earlier forms unrecognizable and cause persistence in customary patterns of thought and action to be untenable. I think we are entering upon a period of fundamental re-appraisal for agriculture, a period in which difficult and unprecedented questions will be asked about the proper economic and social role of agriculture, and a period in which changing attitudes, values and social requirements will require the development of radically altered programs to properly realign a mutated agriculture in a mutated social setting.

Another ten years like the last would bring us by 1975 to this: Farm sales will be a 50 billion dollar industry. The average farm will generate $25,000 to $35,000 in sales annually, and this from a farm quite large by present standards. We will have 2.1 million farms, and perhaps as few as one million really commercial farms. Average per acre value of land and buildings will approximate $250, but in the central Corn Belt it will more closely approach $550. Average farm real estate investment in the U.S. will be about $130,000 per farm, but in the central Corn Belt it should be more like $280,000. We could be left with something like 300,000 cash grain farms and as few as 50,000 cotton farms, with possibly no more than 50,000 farms that each produce more than $40,000 in annual sales. To facilitate the rate of change these figures suggest would require nearly 450 farm title transfers every business day of every year during the entire 10-year period.

By 1975 the growth of "large farms" will permit farms of 500 acres or more to account for nearly 20 percent of all farms. But the startling thing is that such farms will be only average in size; projecting present census trends leads to an average size of 510 acres by 1975.

What kind of a distribution in farm size are we moving toward when only 15 to 20 percent of the farms are larger than average and 80 to 85 percent are smaller than average? What kind of investment in agriculture are we contemplating for large farms when average investment in land and buildings will approach $130,000 and average Corn Belt investors will need between a quarter and a third of a million dollars? What kind of investors do we have in mind for that end of the distribution that lies above the average; what kind of entrepreneurial talent?
Really, we already know, don't we? They little resemble the noble son of the soil when they retain Arthur D. Little to tell them they may anticipate an 18 percent after-tax return on equity capital. Or when they employ Battelle Memorial Research Institute to recommend that they begin now in investing $35 million dollars in integrated livestock production in 26 states. Or when Humbel Oil acquires 6,000 acres of citrus land in Florida; or when Campbells completely integrates production for Bounty canned foods and Swanson frozen foods; or when Kearn County Land Company controls J. I. Case; or when Norris Grain expands integration and ownership in Great Plains grain and livestock production. Why should not substantial corporations with investable funds, forced by anti-trust laws toward conglomerate merger, consider investments in an area where opportunities assume growth-industry proportions? (The recent Supreme Court decision on the Proctor and Gamble-Clorox merger could have tremendous implications for future growth patterns in agriculture.)

The conventional wisdom of astute observers in the post-war period has been consistently to pontificate that opportunity for corporate endeavor in agriculture was minimal - this for a variety of "well-founded" reasons, but principal among them was low return on investment. This just is not true, and the fiction certainly is not a restraint to alert management with investable funds at its disposal. Low average return figures in agriculture are misleading for at least two reasons: (1) Such extreme variation surrounds the average that the average reflects no meaningful central tendency, and (2) equity positions appear ridiculously high (83.2 percent of assets in the 1967 Balance Sheet of Agriculture) to the potential entrant who seriously intends to maximize return on equity capital. Those of you here from the Great Plains are familiar with the 40 percent equity perpetual loan arrangements under which business is conducted on aggressive farms and ranches in your states. Yet even this by no means develops the full opportunities that are feasible for maximizing returns to equity.

This kind of activity in the top end of the spectrum is not a final result, but only a next step in a continuing process of acquisition, combination and concentration that agriculture has been undergoing at an accelerating rate ever since social actions were taken to facilitate it, beginning in the last century. I think it can be argued convincingly that solicitous social attitudes toward agriculture have facilitated this development handsomely.

Consider the conventional equilibrium models against which we measure and judge economic performance. Out of our concern for equity arises the social model for perfection in economic equity which we call perfect competition. Of course we do not expect it to exist,
but we find it a handy navigational device, and against it we compare all forms of economic activity that do exist, and we label them all imperfect competition. Imperfect competition ranges from benign, harmless forms which equate with pure competition, onward to most malignant forms considered monopolies, which either are drummed out of the corps or reduced to docile public utilities through legal techniques for economic emasculation.

Still, one must be careful about these social judgments, for we have discovered that perfect equity and great wealth and productivity are incompatible. Perfect equity would prohibit pure profit, yet the search for pure profit is the essential lure that draws capital and management on to great accomplishments.

So in our need for compromise, we restrict our judgment to carefully defined categories of right and wrong concerning how pure profit may be acquired. Certainly, pure profit is realized only by achieving non-tangency between average revenue and total cost curves, and, true, our measures of competitive imperfection hinge upon how much control the firm or industry appears to exercise over one or both of these curves. But how may this be done?

One technique of pure profit acquisition that is particularly distressing is the exploitation of inferior skill, knowledge or power in the market place. We judge this to occur when purely competitive industries are confronted in the market by more powerful counterparts which prove to be oligopsonistic in their purchases. When the oligopsonist exercises superior skill, knowledge or power to artificially depress his cost curve, he is depressing the revenue curve of the supplier.

"This must not be permitted to happen to agriculture!!" Let us stabilize the price or average revenue curve with buttresses from the social model of perfect competition. We can increase product homogeneity with a proper system of grades and standards. We can improve the level and distribution of knowledge among all parties by a functional system of market news and marketing information. We can increase factor mobility by socially subsidized education and financing. We also can facilitate freedom of entry and exit with proper financing, and with Homestead Act rationales and re-training programs. Oh, there seems to be no end to the devices that can be employed, and we may point with pride to our accomplishment when in classrooms we recite the instances wherein agriculture displays the characteristics of pure competition. It is now much safer for farmers to sell their hogs to local markets than it is for them to sell their automobiles to used car dealers.
But what has this done to agriculture, or more specifically to the entrepreneur in agriculture, who responds to the lure of pure profit just as readily as does any entrepreneur anywhere? While we have afforded him protection by stabilizing his average revenue curve in a competitive market we also have, by fixing the price line to both individual buyers and sellers, denied him opportunity to achieve price-cost non-tangency by trying his skill with the price line. No doubt it is true that farmers have lacked the skill and power to do much but lose ground had they been permitted to try, but is it not interesting to note how they no longer cry out vigorously for protection, but for the opportunity to try? While free-for-all withholdings may still not have much more likelihood of success than before, astute groups are attempting more surgical approaches with specialty crops; and licensing ideas and similar plans receive the serious attention of sophisticated planners.

But what is important to the argument here and now is that the opportunity for pure profit to farmers has, over the past half-century been carefully identified by a series of public programs to be a matter of mastering cost curves.

And the best-prepared farmers have taken the most obvious route; that is by acquisition of land to achieve economies of scale.

Not only does continuing inflation assist in following this route, but it is simpler, easier, than working longer and harder, reading industriously to build a stockpile of technological understanding, or thinking hard enough to become the county's leading innovator. Certainly all these desirable entrepreneurial attributes have developed too, but my position is that economies of scale have provided the most obvious route to cost-cutting, and the public programs of the past half-century have helped to point the way.

We have tended generally to regard agricultural people as a group of information-receivers needing only the Gospel of What-and-How to lead them to better lives. Perhaps this has been true, and certainly the evangelical programs that have arisen to help farm people receive the message have been workable, generous and charitable. But I do not believe we ever concerned ourselves too much with the implications of there being outright information-hungers sprinkled among the information-receivers and interested by-standers. No matter whom the information is intended to assist, it is the information-hunters who get it most and use it best. For example, a two percent sample of the mailing list for our monthly extension publication, Economic Information for Ohio Agriculture, discloses that the percentage of farmers who receive it has declined to 40 percent. The other 60 percent is made up of bankers, brokers, investment counselors,
farm equipment dealers, fertilizer companies, manufacturers and processors, county PCA's and SCS offices, and here and there a teacher.

We have set a pack of hounds in motion with our information, and now they go baying down the hot trails in the damp, still night. Some are away in the lead while others cry over lost trails far behind; trails they never found, and never will. Certainly, the system of public information for agriculture can take as much credit for creating misery among the losers as it can for blessings dispensed among the winners. Now with gathering momentum, and joined by hounds from other kennels, the leaders rush down a trail that leads to more concentration, more potentially undesirable characteristics of imperfect competition, and in far more uncomfortable proportions than is true of most industries today.

All that is needed to bring us to the point of re-appraising our mutated agriculture is effective product differentiation, effective restrictions to entry, and some central decision-making authority. Agriculture will have arrived, but its identity will have been lost. Capital requirements, technology, and management demand already are posing substantial barriers to entry. The advent of direct marketing, corporate ownership, integration, contracting, and the brand names of the integrators can provide the central decision-making authority and the product differentiation. It can also erase the familiar identity of agriculture and replace it with the image of a Weyerhauser tree farm.

I do not wish to register with you simply a concern for the mere presence, per se, of corporations in agriculture. What is worth exploring is the implications to the total system of the injection of massive amounts of investable funds and superior management skills into the upper end of the agricultural production spectrum. It is only incidental, though not innocent of portent, that astute corporations happen to possess large quantities of both of these inputs. What is not incidental, and certainly not innocent, is the nature of problems that potentially emerge in terms of the holy-trinity, if you will, of structure, performance and conduct. The problems emerge into a technological society that has other problems also to consider and is more than ever capable itself of central decision-making. It is also a society that has other demanding uses for land, and has a growing tendency to become impatient with a misperforming and militant sector that holds little policy-making authority but controls too much of a basic factor of production to be trusted with it. I think it would be interesting to present for your consideration sometime an argument which might be entitled: "The Circumstantial Evidence Supporting the Feasibility of Socializing Agricultural Land." It is not a possibility that I like to contemplate, but it is one we had
better explore, if for no other reason than that we would wish to devise a better possibility, in order that public control does not pick up the marbles by default.

However justified they may feel their attitude to be, I believe farmers take a very inexpedient tack when they voice militant demands concerning their rights and privileges. However much we may sympathize with their complaints, nor no matter how much their outcries reflect a broader-based unrest and turmoil, what they are asking is dangerous it seems to me. No economic sector has inherent rights; only those that society chooses to give. What they are asking when they plead, for example, for permissive legislation to bargain, license or withhold, is for public recognition that the social model of perfect competition is unwanted and should no longer be employed in their behalf. They ask that legislation make public the record of official denouncement of the model that has been the basis for public attitudes toward agriculture over the past century. One cannot ask this without expecting a certain consistency of action to go with the requested new public attitude. One cannot ask that monopolistic competition, with oligopoly opportunity, be the order of the day without also expecting confrontations with regulatory forces heretofore largely held at bay. One cannot expect continued disproportionate receipt of facilitating programs once one has been granted the opportunities of a structural form capable of taking care of itself.

These considerations provide room for interesting conjecture about the future role of certain facilitating services close to our hearts. Namely, what is the role of the agricultural college, the agricultural experiment station, the agricultural extension service, the Department of Agriculture—if the agriculture it serves wishes to be known as a big boy; independent, capable, self-reliant? It is not satisfactory to say that the same old demands for information will remain. That may be. But the same old excuse for providing it will not remain. It is probably not unreasonable to speculate that perhaps the modal group of agricultural economists who expect to complete careers as agricultural economists in domestic public service has already been trained.

I do not believe this is true, however, of rural sociologists, whose presence in our departments over the years often has done little more for agricultural economists than to constitute occasional assurance that, in the pecking-order of the professional hierarchy, agricultural economists could be worse off. Everett Rogers once referred to agricultural economists and rural sociologists "as close bedfellows without much academic intercourse." I suspect that, not only has the modal occurrence of rural sociologists yet to appear, but that in the future some academic intercourse must occur if we expect our research
offspring to provide meaningful solutions to many of the real problems we are about to encounter with the agricultural economy and its changing social setting.

I would re-emphasize in closing that the changing structure of agriculture and the implications to resource requirements, interregional and international competition, market performance, and investment opportunities or the lack thereof, are not separately identifiable or even the central problems we are about to confront. I believe that in the coming decade we will be participating in social self-examination and appraisal of the multiple bases on which, over the years, we have judged the equity of apportionment of wealth, income, rights and privileges. We are finding many of our precedents less than completely satisfactory. We are entering upon a period when we may regard none of them above scrutiny and re-evaluation. I confess that this frightens me: I am already a programmed social animal somewhat like the Londoner who preferred not to read the New York Times because it got him "all mixed up."

What are the implications for marketing and management research? They arise in the recognition that marketing and management research have tended to make their most substantial contributions in times of stable social attitudes about economic performance; times when policy alternatives were identified and defined with reasonable certainty that these were in fact the relevant alternatives. I expect the research of the coming decade, whether microscopic or magnificent in scope, to predominate in work with strong sociological and policy overtones.

I would encourage agricultural economists to recognize how, more and more, we have reduced our discipline to schools of technicians adept at assessing the performance of this bearing or that drive shaft in quite a spectacular piece of machinery, but often to the detriment of their ability to assess the performance of the total machine. As we enter upon a no-man's land of no rules and new rules in observing the interrelationship of society and economy, let us remember that economics is a discipline in perspective -- one of the very few disciplines in perspective that exists.

When Winston Churchill assumed his duties as Prime Minister during World War II, he had occasion to say: "I have not become the King's first minister in order to preside over the liquidation of the British Empire." Some observers of the passing scene have remarked, however, that that is precisely what Sir Winston did nevertheless, and that perhaps the surgery of subsequent years might restore a view of realism and relevance to the leadership of the Empire. Perhaps we have performed a similar function these past three days. Perhaps we have been presiding over the liquidation of cherished traditions and useless illusions about a changing empire. For the sake of our effectiveness in confronting the problems of the future, let us hope so.