ABSTRACT

FARM CAPITAL: USE, MVPs, AND CAPITAL GAINS OR LOSSES, UNITED STATES, 1917-1964

by

C. Leroy Quance

Previous research and characteristics of the farm sector and its environment indicate that: 1) resources are attracted into farming under conditions resulting in eventual rates of return insufficient to cover acquisition costs; 2) consequently, resources earn negative rents and are contracted only at substantial capital losses; and 3) free markets would not prevent excess commitment of capital to farming, negative rents, and capital losses. The purpose of this thesis was to provide evidence supporting or refuting these tentative conclusions.

Some analyses of farm adjustment problems have contributed significantly toward understanding impacts of one or more characteristics of the farm sector and its environment, but failed to account adequately for divergencies between input acquisition costs and salvage values. This thesis combines Glenn Johnson's modification of neo-classical economic theory of the firm, which recognizes the divergence between input acquisition costs and salvage values, with a Nerlove type adjustment model, to estimate equilibrium factor shares for use as elasticities of production. The resulting elasticities, along with price and quantity components of factor shares, independent estimates of product price expectations, and estimates of actual and expected overhead costs are used to estimate 1) ex post and ex ante MVPs, both gross and net of overhead costs, 2) ex ante and ex post capital values of durables, 3) capital gains from durables, and 4) economic rents on expendables.

Estimates are compared with characteristics of the farm sector and employment of selected inputs to substantiate or refute the tentative conclusions of paragraph one above.

In drawing final conclusions about farm capital employment, MVPs, and capital gains or losses, apparent biases in the estimates were handled in an ad hoc manner. These biases resulted from 1) limited data on input acquisition costs and salvage values, 2) specification bias involving input substitutability, and 3) inadequately known discount rates. Also, some unreasonably low adjustment coefficients resulted in wide fluctuations in estimated elasticities of production and MVPs. Despite these problems, the adjustment model proved to be a promising technique for estimating production parameters by producing results generally consistent with economic theory and U. S. agricultural history.

Analyses were conducted on 28 individual capital inputs classified according to whether they were 1) durable or expendable, 2) farm produced or nonfarm produced, and 3) specialized to the farm sector or unspecialized to the farm sector. Results indicate that capital resources are attracted into farming under conditions which result in eventual rates of return less than, but sometimes greater than, sufficient to cover acquisition costs. Consequently, capital inputs earn rents and capital losses or gains. Overcommitment of capital to farm production has occurred in periods of both price supports and free markets. Farm and nonfarm produced expendables were adjusted quite rapidly toward rates of use which equated estimated ex post MVPs with acquisition costs. When imbalance and rents did occur for expendables, they were probably minor compared to the capital losses and gains imposed on fixed durables used to produce them. Relative acquisition costs and estimated MPPs indicated that, in expanding output, farmers have attempted to maximize profits or minimize losses by substituting mechanical power for horsepower and labor, feed for livestock, and fertilizer for land.

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CHAPTER I

INTRODUCTION

Farming has changed from a labor intensive industry prior to World War I to the capital intensive industry evident in the mid-1960's. Advances in technology and training of American farmers enables the United States to produce abundant food and fiber that is high in quality and low in cost, relative both to other countries and to earlier periods in U. S. history. Increases in productivity permit phenomenal increases in farm output with no substantial increases in total inputs. Using 1950 as a base, the index of total farm output increased from 81 in 1940 to 130 in 1963 while the index of total inputs remained fairly constant, ranging from a low of 96 in 1940 to a high of 103 in 1951. Output per man-hour in agriculture has more than doubled since 1950 and the number of persons supplied per farm worker increased from 8.27 in 1920 to 30.74 in 1963. Thus some productive resources produced in the agricultural sector, such as labor, have flowed into the nonfarm sector, contributing significantly to the economic development of the nation.

But accompanying the reorganization have been lagging farm income relative to nonfarm income, and governmentally owned stocks of agricultural commodities resulting from government attempts to improve farm product prices. Per capita disposable personal income of the farm population was 63.1 per cent as large as that of the nonfarm population in 1963.

In the same year, the carry-overs of wheat, cotton, corn, and dairy products were 1,195 million bushels, 11,216 million bales, 1,316 million bushels, and 12,691 million pounds respectively.[1] And on the international scene there is increasing concern over food deficit areas of the world. Per capita grain production in less developed countries is now lower than it was prior to World War II, and trends in food trade indicate underdeveloped countries are steadily losing the capacity to feed themselves.

In addition to lagging farm incomes and mounting surpluses of agricultural commodities in the United States, capital resource commitment to farm production continues despite low returns compared to returns in the nonfarm economy. If farm family and operators' labor are imputed returns comparable to industrial wage rates, residual returns on investments in agriculture are low or negative on a large proportion of farms.[2]

Government attempts to strengthen farm income are concentrated primarily in price support programs. Price support programs, combined with weak supply control measures, provide incentives to increase yields of major agricultural commodities. With an inelastic consumer demand, the resulting increases in output accumulate in government storage programs to increase downward pressure on commodity prices.

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[1]U. S. Department of Agriculture, Handbook of Agricultural Charts. Agricultural Handbook No. 275 (Washington: U. S. Government Printing Office, 1964), p. 34.

[2]G. L. Johnson, "An Evaluation of U. S. Agricultural Policies and Programs, 1956-1960." A Background Paper for the Committee for Economic Development (East Lansing: Michigan State University, 1960), p. 20.

Characteristics of the Farm Sector and Its Environment

Farm sector adjustment problems are most evident in low prices and/or surpluses of agricultural commodities. Attempts to study the farm problem usually center in commodity markets. But as Heady recently stated, ". . . the large output is a result rather than a cause."[1] Certain characteristics of the farm sector and its environment combine to commit resources to the production of farm commodities even when past experience indicates that resources so committed earn returns lower than similar resources committed to the nonfarm sector. In writing about low returns in agriculture, Hathaway says:[2]

> The roots of the problem lie in several characteristics of the agricultural industry which individually are insufficient to produce the chronic problem we now observe, but which together result in economic problems for the industry of major magnitude.

The farm sector is characterized by: 1) an inelastic demand for farm products, both with respect to price and income; 2) atomistic structure; 3) rapid technological change; 4) imperfect knowledge; 5) a family farm structure; and 6) large space and specialized input requirements. To complete the list of circumstances which have combined to cause chronic adjustment problems from 1917 to the present, several characteristics of the farm sector's adjustment and institutional environment must be added: 7) four wars; 8) a severe depression between World Wars I and II;

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[1]Earl O. Heady et al., Roots of the Farm Problem (Ames: Iowa State University Press, 1965), p. VI.

[2]Dale E. Hathaway, Government and Agriculture (New York: The Macmillan Company, 1963), p. 84. The discussion of these characteristics draws heavily from Hathaway and also from Glenn L. Johnson et al., A Study of Managerial Processes of Midwestern Farmers (Ames: Iowa State University Press, 1961), Chapter 10.

9) unstable international demand; 10) government product price support and other farm programs; and 11) variable weather.

Inelastic Demand for Farm Products

Until modern agricultural economists threw off the strait jacket of David Ricardo and Parson Malthus' dismal science, the demand for food and fiber, at least in the long run, was held to be completely elastic while supply was regarded as inelastic. According to the "Malthusian trap," there was a tendency in nature for population to outstrip all possible means of subsistence. But modern day agricultural economists, equipped with data on the performance of modern agricultural systems, generally hold that the demand for farm products, at least in developed countries, is inelastic. In the United States, the market price of farm products varies greatly with small changes in output. Brandow estimates the price elasticity of demand for all farm products with respect to all farm food prices at -.2278.[1] He obtains an income elasticity for all food of .26, indicating that a 10 per cent increase in consumer income will only increase the demand for farm products 2.6 per cent.[2] Consumers spend more for food as their incomes increase, but most of the additional expenditures go for services associated with farm products. The implications for the farm sector are the following: 1) demand for farm products does not increase appreciably with higher incomes; 2) growth in demand is largely limited to population increases; 3) modest

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[1] G. E. Brandow, Interrelations Among Demands for Farm Products and Implications for Control of Market Supply. Bulletin 680 (University Park: The Pennsylvania State University Agr. Expt. Sta., August, 1961), p. 50.

[2] Ibid., p. 17.

fluctuations in output lead to large fluctuations in the commodity price; 4) total revenue declines with increases in output; and 5) hence, if the growth in farm output exceeds the rate of population growth, there is a downward trend in commodity prices and resource earnings.[1]

Atomistic Structure of the Farm Sector

Leftwich lists homogeneity of the product, smallness of each buyer or seller relative to the market, absence of artificial restraints, and mobility as necessary conditions for pure competition.[2] The farm sector is an industry of small, widely dispersed firms producing homogeneous products. And despite the publicity given vertical integration and contract and corporation farming, the "family farm" has not been eliminated.[3] The proportion of farms small enough to operate with the land, labor and capital resources of one family has not changed much although their absolute number has decreased along with the decrease in the total number of farms.[4]

With the atomistic structure of the farm sector, constant returns to scale, as indicated by many production function studies of the farm sector, are expected. But with constant returns to scale, economic theory indicates that large scale enterprises would replace the family farm if it

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[1]See T. W. Schultz's secular analysis from Agriculture in an Unstable Economy (New York: McGraw-Hill Book Co., 1945).

[2]Richard H. Leftwich, The Price System and Resource Allocation (New York: Holt, Rinehart and Winston, 1965), pp. 22-23.

[3]Glenn L. Johnson, "The Modern Family Farm and Its Problems," Proceedings, International Economic Association, Association of Economic Sciences, 1965.

[4]Ibid.

were advantageous to farm at all.[1] It is the absence of the fourth condition for pure competition that causes the farm sector to remain an industry of small independent firms. Resources employed in the farm sector become less responsive to changes in product prices when characteristics of the farm sector and its environment combine to cause wider divergencies between input acquisition costs and salvage values.[2] Also, government restrictions on land use and prices of farm products since 1933 invalidate the requirement for the absence of artificial restraints.

Although all the requirements for pure competition are not met, the large number and geographic dispersion of farms, homogeneous nature of farm products, and freedom of entry into farming make the farm industry very atomistic. And in the absence of coercion, strong producer bargaining organizations, or government action, the farm sector is unable to adequately control aggregate output, prices, or the aggregate rate at which new technology is adopted.

Rapid Technological Change

Technical, economic, and institutional changes in the United States have not only provided more and higher paying employment opportunities for labor in the nonfarm than in the farm sector, but have provided a rate of technological development and adoption in agriculture as fast or faster than any country in the world. In general, technological changes in the farm sector result from higher prices of land and

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[1] Ibid.

[2] Ibid. Glenn Johnson points out that studies which reveal constant returns to scale in agriculture are based on comparisons between farms and hence reveal the consequences of varying inputs which are fixed for the individual farms in the studies.

labor relative to prices of capital and provide capital inputs that are technical and economic substitutes for land and labor.[1] As new land and labor saving technologies are adopted, the marginal value products of land and/or labor decrease (or fail to increase as much as they otherwise would) and the marginal value product of capital increases. New inputs partly result from and combine with reduced product price uncertainty to bring about specialization on farms and among regions, some economies of size, and larger farms with lower per unit costs.

Other characteristics of the farm sector, however, combine to cause divergencies between acquisition costs and salvage values of farm inputs. The adoption of new land and labor saving technology not only depresses the MVPs of land and labor but makes some existing capital inputs obsolete and thus decreases their MVPs. Much of the obsolete capital becomes economically fixed in the farm sector, earning negative quasi-rents relative to acquisition costs with resultant capital losses.

Imperfect Knowledge

Farmers base resource use and production decisions on expected product prices, weather, overhead costs and other variables. Imperfect knowledge causes mistakes in resource employment. Once mistakes are realized, farmers utilize the new information in cutting losses and they, their associates, and/or society bear the consequences.

Family Farm Structure

It is generally labor that is uncommitted to farm production which has greater employment opportunities in the nonfarm sector. Given

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[1] Improvements in feed or in feed conversion ability of livestock indirectly substitute for land and labor.

the family farm structure which has existed thus far, children are born into the farm labor force. There, several factors contribute toward retarding the outmigration of youth from the farm sector. Hathaway reports that because of low farm family income and other reasons, farm youth are handicapped in competing for nonfarm jobs due to less schooling; and the formal education they do receive is often of a lower quality because of less adequate teachers and facilities.[1] In many rural high schools, the only vocational training offered is agricultural, which further instills in farm youth desires for an occupation where they cannot all hope to enter and prosper.[2]

When expectations fail to materialize for labor that was committed to farming due to favorable expectations, or personal, family, and social ties to rural communities, the persons involved often have lost whatever economic ability they once had to migrate to the nonfarm sector. Although their earnings in the farm sector do not equal expected or nonfarm earnings of compatriots, high transfer costs including the acquiring of necessary skills, and social and institutional rigidities, cause net opportunity earnings in nonfarm employment to be less than earnings in the farm sector.

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[1]Hathaway, op. cit., p. 363.

[2]Ibid. For an excellent factual summary of the labor situation in the farm sector see Bob Jones, "Farm-Non-Farm Labor Flows, 1917-1962" (unpublished Ph. D. dissertation, Dept. of Ag. Econ., Michigan State University, 1964), and for estimates of future expected earnings for 25 and 45 year old males in farming as opposed to nonfarm occupations, see Venkareddy Chennareddy, "Present Values of the Expected Future Income Streams and Their Relevance to the Mobility of Farm Workers" (unpublished Ph. D. dissertation, Dept. of Ag. Econ., Michigan State University, 1965).

Large Space and Specialized Input Requirements

Farms are geographically dispersed, and individual farms cover large land areas. Thus, transportation costs are important in pricing both inputs and products.[1] Transportation and other transfer charges cause input acquisition costs to exceed salvage values. In addition, many farm inputs are specialized to an enterprise, to the farm, or to the farm sector. The greater the degree of specialization, the greater may be the divergence between acquisition costs and salvage values. A farm truck may be very versatile between enterprises within a farm organization, and with moderate transfer charges, versatile between farms and between the farm and nonfarm sector. On the other hand, an apple orchard, once planted, is usually economically fixed not only to the farm sector but to the individual farm and to a particular enterprise on the farm.

Characteristics of the Farm Sector's Environment

Wars, depressions, unstable international demand for farm commodities, and weather aggravate the formulation of expectations and resource employment adjustments in the farm sector. Farm price supports reduce price uncertainty and cause favorable product price expectations that may be short lived due to accumulated surpluses and public pressure for reduced price supports. In randomly increasing or decreasing crop yields, variable weather aggravates fluctuations in product prices and output. These weather induced fluctuations occur after most resources are committed; they may cause positive or negative rents and capital gains

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[1]Glenn L. Johnson, op. cit.

or losses and increase or decrease the pressure of farm surpluses on farm prices and resource earnings.

A Note on Agricultural Supply Response Studies

While several past attempts to analyze the "farm problem" contribute significantly toward understanding impacts of one or more of the above characteristics, past efforts fail adequately to account for resource fixity.[1] An analysis of adjustments in the farm sector should account for the impacts of all the characteristics presented above. This thesis, while recognizing past contributions on risk and uncertainty, technological advance and its adoption, and economic adjustments toward specialization and diversifications, also employs a more recently advanced modification of classical economic theory to account more adequately for economic fixity and/or variability of resources and examines resource adjustments in a historical and environmental perspective.

After reviewing the works of Galbraith and Black, T. W. Schultz, D. Gale Johnson, Willard Cochrane, and others on supply response in American agriculture, Glenn Johnson concluded:[2]

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[1]For a brief historical summary of works on agricultural supply response, see Glenn L. Johnson et al., A Study of Managerial Processes of Midwestern Farmers, Chapter 10, or see Glenn L. Johnson, "Supply Functions--Some Facts and Notions," Agricultural Adjustment Problems in a Growing Economy (Ames: Iowa State University Press, 1958), a lengthy footnote beginning on page 74. Two other important papers on agricultural supply analysis are: Glenn L. Johnson, "The State of Agricultural Supply Analysis," Journal of Farm Economics, XLII (May, 1960), pp. 435-452; and Marc Nerlove and Kenneth L. Bachman, "The Analysis of Changes in Agricultural Supply: Problems and Approaches," Journal of Farm Economics, XLII (May, 1960), pp. 531-554.

[2]Earl O. Heady et al., Agricultural Adjustment Problems in a Growing Economy (Ames: Iowa State University Press, 1958), p. 79.

> . . . work on individual commodities is more adequate than that on the aggregative response of the farm sector. Furthermore, it indicates that the main difficulty is of a conceptual nature, involving the treatment of asset fixities as they depend on shifts in the acquisition costs, salvage values, and expected marginal value productivities of assets. Thus, the problem at hand appears to be improving the conceptual treatment of fixed assets, analyzing existing data, and explaining changes in the aggregate inputs and output for the farm economy as a whole.

Johnson then proceeded to present a modification of the neo-classical model that recognizes the divergence between input acquisition costs and salvage values. It is this divergence that permits economic fixity over a wide range of earnings. If the present value of the future discounted net marginal value products of an input is less than the cost of acquiring more of the input, but greater than the salvage value of the input, it does not pay to vary use of the input; the input is fixed.[1] If the present value is greater than the acquisition cost, the input is variable upward; and if the present value is less than the salvage value, the input is variable downward.

In reviewing Johnson's paper, Willard Cochrane responded:[2]

> Not often does a man have a new idea, or do we have an opportunity to see a new idea unveiled. In the Glenn Johnson paper we have, I believe, an example of both. Johnson correctly argues that the weak spot in supply analysis has been the lack of a satisfactory theory of fixed inputs. . . . Johnson has done something about this shortcoming in supply analysis. . . . Here is a useful conceptual device for judging, or appraising, different categories of inputs, in different contexts, with regard to their variability, or lack of variability, in the production process.

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[1]For simplification, the thesis refers to marginal value product as MVP and present value of discounted future net marginal value products as capital value.

[2]Heady et al., op. cit., p. 94.

Despite favorable reactions given the Johnsonian model[1] in theory, until recently there has been no major attempt to implement it--"to analyze existing data."[2]

The RFF Project at Michigan State University

A study supported by Resources for the Future, Inc., Washington, D. C., and directed by Glenn Johnson at Michigan State University seeks to: 1) describe the national impacts of selected U. S. agricultural programs, 1917 to date on output and resource utilization in U. S. agriculture; 2) develop and state normative concepts for use in evaluating the studied programs; and 3) evaluate the studied programs in view of results obtained in 1) and 2) above.[3] The Johnsonian model is one of the tools used in this factor oriented study of United States agricultural adjustment programs and policies.

Over-all organization of the RFF project is illustrated in Table 1.1. The shaded portion of Table 1.1 indicates areas of interest and objectives for this sub-project concerning farm capital. Five other

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[1]I use the label "Johnsonian model" over the more common name "fixed asset theory" because the theory itself determines the economic variability or fixity of studied inputs. In extending the Johnsonian model to consumption economics, Lester Manderscheid uses the term "quasi-fixed" stressing the temporary nature of economic fixity. See Lester V. Manderscheid, "Incorporating Durable Goods Into Consumption Theory," a paper presented at a meeting of the Econometric Society in New York, December 28, 1965.

[2]Perhaps the most extensive theoretical use except by Johnson of the Johnsonian model is found in Hathaway, Government and Agriculture. See especially pages 110-130.

[3]Glenn L. Johnson, "Project Statement for the Resources for the Future Project at Michigan State University."

TABLE 1.1.--Organization and objectives of the Resources for the Future study at Michigan State University

Objectives of the RFF Project	Resource Utilization		
	Aggregation of Individual Input Oriented Studies (Glenn Johnson, Francis Van Gigch)		
	Product Price Expectations (Mil Lerohl)*		
	Land (Arne Larsen)* (Ed Rossmiller)*	Labor (Bob Jones)* (V. Chennareddy)*	Capital (Leroy Quance)
1. To describe the national impacts of selected U. S. agricultural programs, 1917 to date on output and resource utilization in U. S. agriculture. Programs to be selected will be those designed to influence:			
a. Product prices			
b. Input prices			
c. Capital facilities and service furnished by society to agriculture			
d. Output of agricultural products			
2. To develop and state normative concepts for use in evaluating the programs studied			
3. To evaluate the programs studied in view of results obtained in 1 and 2 above			

*Sub-projects completed.

sub-projects are completed; two on labor by Jones[1] and Chennareddy,[2] one on product price expectations by Lerohl,[3] one on farm land and real estate earnings by Rossmiller,[4] and one on land values by Larsen.[5] These individual input-oriented studies are partial equilibrium analyses which Johnson and Van Gigch will aggregate and interrelate. Lerohl's product price expectations study has implications for each of the input-oriented studies via expected marginal value products and decisions on resource use. Individual input oriented studies including this thesis and Lerohl's product price expectations study are limited to objective one of Figure 1.1. They provide results which permit Johnson and Van Gigch to evaluate studied policy programs under objectives two and three.

Thesis Objective

In keeping with objectives of the over-all RFF project discussed above, the specific objective of this thesis is to estimate costs and earnings of capital inputs in the U. S. farm sector to substantiate or refute the following conclusions:[6]

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[1]Bob Jones, op. cit.

[2]Venkareddy Chennareddy, op. cit.

[3]Milburn L. Lerohl, "Expected Prices for U. S. Agricultural Commodities, 1917-1962" (unpublished Ph. D. dissertation, Dept. of Ag. Econ., Michigan State University, 1965).

[4]George E. Rossmiller, "Farm Real Estate Value Patterns in the United States, 1930-1962" (unpublished Ph. D. dissertation, Dept. of Ag. Econ., Michigan State University, 1965).

[5]Arne Larsen, "Changes in Land Values in the United States, 1925-1962" (unpublished Ph. D. dissertation, Dept. of Ag. Econ., Michigan State University, 1966).

[6]Glenn Johnson reached these and other conclusions after a study of price support programs in "An Evaluation of U. S. Agricultural Policies and Programs, 1956-1960." See especially pages 108-119.

A. Resources are attracted into farming under conditions which result in eventual rates of return less than those sufficient to cover acquisition costs.

B. Consequently, resources in the farm sector earn negative rents and are contracted only at substantial capital losses.

C. A return to free markets would not prevent the development of excess commitment of capital to farming and consequent negative quasi-rents or capital losses.

Procedure

Economic theory of resource allocation in the farm sector is discussed in Chapter II. A historical summary of United States agricultural development from 1917 to 1964 is presented in Chapter III. Then, empirical techniques and sources of data for utilizing the economic theory presented in Chapter II are developed in Chapter IV. Chapters V through VII contain empirical estimates of farm capital earnings and analyses of adjustments in resource use in the farm sector from 1917 to 1964. Finally, in Chapter VIII, conclusions are drawn concerning capital earnings and adjustments in the U. S. farm sector.

CHAPTER II

ECONOMIC THEORY

Chapter I describes characteristics of the farm sector which can be regarded as possible causes of resource adjustment problems. It also touches on the literature on agricultural supply analysis and outlines the thesis. This chapter presents the theory which will be used in the thesis.

The social world is often likened to a big sticky ball of wax which becomes messier with each attempt to probe its inner working. But the analogy is more enlightening if we think of another kind of ball. If one removes the cover of a golf ball, he finds first a tangled mass of rubber strands which give the ball its dynamic nature. And if one stops here, he will surely throw up his hands in disgust, convinced there is nothing constructive to accomplish, as with the ball of wax. But with patience and endurance, the outer mass can be untangled to expose a smooth hard base that provides stability and a center of balance to the ball. Similarly with the economy, a stable center of economic relationships guide researchers to an understanding of resource allocation.

Precise technical and behavioral relations which provide the stable core of the economy are the interest of economic theory. The theorists simply cut away the mass of seemingly unrelated strands to bare the stabilizing center. But just as the golf ball is of little use to a

golfer once the rubber mass is cut away, an economic model is less useful as an analysis tool if no provisions are made to retain the dynamics.

This chapter defines the economy's stable economic core while Chapter IV provides statistical procedures which yield estimates of unknown parameters in the stable core. In this manner the dynamic and stochastic elements; that is, the rubber strands of the golf ball, are cut away to expose statically on a period by period basis the different stable cores. But over time, both studied and unstudied variables, including stochastic variables such as weather, are permitted to vary, thus placing the rubber mass back on the static core to help insure the practical usefulness of the analysis.

Economics of Resource Allocation

Given an economic sub-system consisting of N equations in N unknowns, the system is circular and can be cut at one of several points: at the consumer level, in the product markets, or in the markets for factors of production. The other N-1 sub-systems are reflected in the one sub-system chosen for examination. In this study, factor markets are the center of attention, and the average farm production function is the basic underlying relationship.

Factor Market Orientation

Input prices provide signals for allocating resources through the interactions of profit-motivated buyers and sellers in the factor market. If an input price decreases relative to the price of the product, more of the input is used. And given a relative decrease in the price of one input to another, the former is substituted for the latter, technology permitting.

But this technical limitation is a clue that prices serve as a "code" for disseminating complex economic messages concerning forces of supply and demand.

To maximize profits, use of a productive input is adjusted until its marginal value product[1] is equal to its marginal factor cost. An input's marginal value product depends upon output elasticity with respect to the input, amount of input used, output, and the product price. In turn, output is a function not only of the input under study but of all inputs that enter the production process. Thus the demand for a factor X_1 used in the production of Y is given by:

$$(2.1) \quad X_1 = f(Px_1, P_y, X_c, X_s, \eta_y^{x_1}).$$

X_1 is the quantity of the input demanded for use in the production situation $Y = f(X_1, X_c, X_s)$.

Px_1, the price of the input X_1, is determined by the simultaneous solution of the above demand function and the supply function for X_1. The supply function for the input depends upon the prices and marginal physical products of resources used to produce it. Normally, an increase in the price of X_1 causes a decrease in the quantity demanded for use in production.

P_y is the price of the product Y and is determined by a simultaneous solution of the supply and demand functions for Y. The supply of Y is a function of the prices of the inputs X_i and their marginal physical products in producing Y. Demand for Y depends on consumers' utility

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[1]While I use the term MVP for simplicity, the relevant concept for durable inputs is the present value of future marginal value products net of overhead costs (referred to in the thesis as capital values).

functions which are in turn functions of consumers' incomes, and consumed quantities of complementary and substitute products to Y. An increase in the price of Y causes an increase in the marginal value product of X_1 in producing Y and therefore an increase in the quantity of X_1 demanded for use in production.

X_c represents quantities of inputs complementary to X_1 and is determined by the simultaneous solution of a demand equation similar to (2.1) and a supply function for X_c similar to the supply of X_1 discussed above. An increase in the quantity of complementary inputs increases the marginal physical product of X_1 in producing Y and therefore increases the quantity of X_1 demanded for producing Y.

X_s represents quantities of inputs which are substitutes for X_1 in producing Y and is determined by the simultaneous solution of a demand and supply function similar to those discussed for X_1 and X_c. An increase in the use of a substitute input decreases the marginal physical product and therefore the quantity demanded of X_1 in producing Y.

$\eta_y^{x_1}$ is the elasticity of output Y with respect to the input X_1. It is the percentage change in Y given a percentage change in X_1. In this thesis, the elasticity of production is assumed constant in any given year but variable over time. Increases in elasticity of production with respect to X_1 over time increases the marginal physical product of X_1 in producing Y and, therefore, increases the quantity of X_1 demanded to produce Y. If the equilibrium quantities of Px_1, X_1, P_y and Y are determined, the elasticity of Y with respect to X_1 is the factor share $\frac{Px_1X_1}{P_yY}$ and elasticity as a separate parameter is redundant.[1]

[1]This fact is exploited in the empirical techniques chapter to derive production elasticity estimates.

In summary, given N products to produce and M inputs to use in producing N products for each farm, there are $G = 2N + MN + M + 1$ equations in a like number of unknowns for each farm. The unknowns and their equations for each farm are a profit equation, N production functions, prices of N products, quantities of each of the M inputs to use to produce each of the N products, and prices of each of the M inputs. These G equations in G unknowns encompass the supply and demand relationships for all products and factors of production for each farm. But such a system is too complex for the present capacities of research men and machines. The researcher must apply the economizing principle of maximizing useful output with limited available research resources. The thesis is a partial equilibrium analysis of resource allocation given input and product prices. Earnings of resources in aggregate farm output are studied, and because farm price support programs are commodity oriented, inputs in the production of some of the more important commodities are studied.

Dynamics in the Time Dimension

A major division of economic theory is on the basis of its static or dynamic nature. Frisch labels a system dynamical if its behavior over time is determined by functional equations in which variables at different points in time are involved in an essential way.[1] Hicks says, "I call economic statics those parts of economic theory where we do not trouble about dating; economic dynamics those parts where every quantity must be dated."[2] On the basis of these definitions, the thesis is a dynamic study.

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[1]P. A. Samuelson, "Parable and Realism in the Theory of Capital: The Surrogate Production Function," Review of Economic Studies, XXIX (June, 1962), pp. 311-317.

[2]J. R. Hicks, Value and Capital (London: Oxford University Press, 1946), p. 115.

All values of quantity, price and elasticity parameters contain a time subscript.

Alternative Assumptions Regarding Input Prices

Classical Model.--If the aggregate farm sector is viewed under the classical implicit assumptions that for all variable inputs, acquisition costs equal salvage values and for all fixed factors, acquisition costs are infinite while salvage values are zero, there is some optional allocation of resources represented by the high profit point (HPP) in Figure 2.1.

Under this classical model, perfect adjustments to the equilibrium output Y_o and to the most efficient resource use levels, x_i^o and x_j^o are possible without capital gains or losses. The direction of these adjustments depends in which of the four areas of Figure 2.1 the farm sector is located as illustrated in Table 2.1.[1]

Classical theory, in dealing with resource fixity, assumes that acquisition costs of fixed inputs, such as land, are infinite, and salvage values are zero. Theories such as Ricardo's "niggardliness of nature" land rent theory were developed to explain how these fixed inputs receive payment.[2]

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[1]The two factor diagrams used in the following pages to illustrate economic theory are merely indicative of the n-dimension input-input-output problems involved. They are drawn approximately as if the production functions were of the Cobb-Douglas form with the $\sum_{i=1}^{g} b_i < 1$ for $N > g$ where N is the total number of inputs.

[2]M. Blaug, Economic Theory in Retrospect (Homewood, Illinois: Richard D. Irwin, Inc., 1962), pp. 108-109.

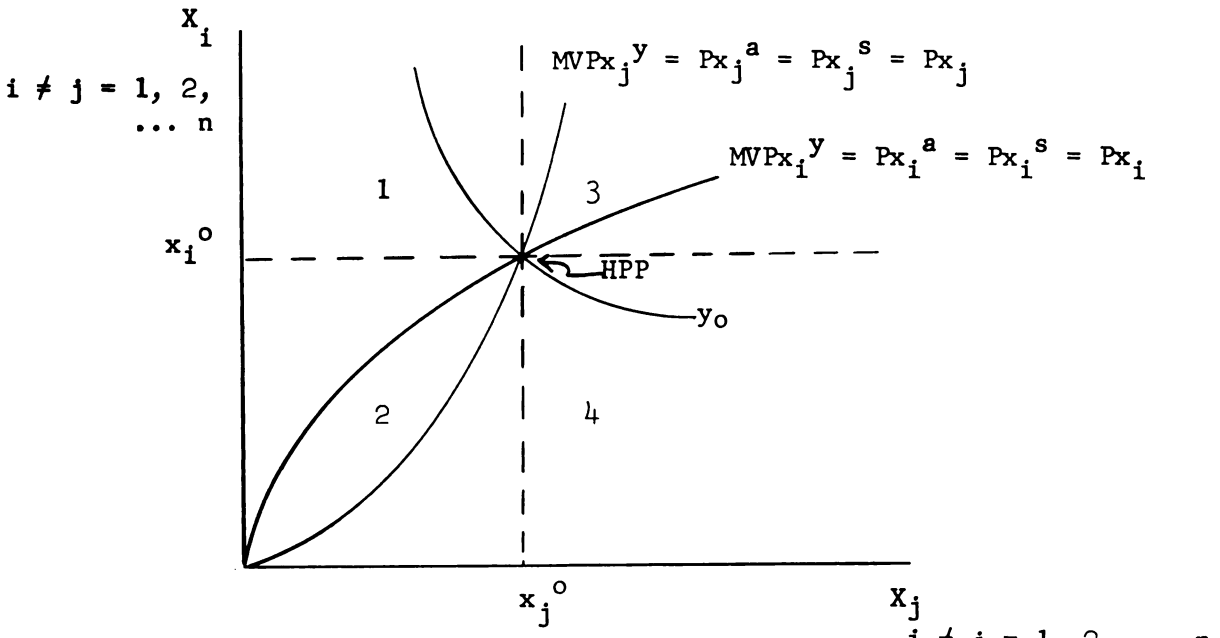

FIGURE 2.1.--The classical model

TABLE 2.1.--Resource adjustments under the classical model

Area or Point	Relation of Resource MVP to Resource Price From HPP Point of View		Resource Adjustment	
	X_i	X_j	X_i	X_j
1	$MVPx_i^y < Px_i$	$MVPx_j^y > Px_j$	Contract	Expand
2	$MVPx_i^y > Px_i$	$MVPx_j^y > Px_j$	Expand	Expand
3	$MVPx_i^y < Px_i$	$MVPx_j^y < Px_j$	Contract	Contract
4	$MVPx_i^y > Px_i$	$MVPx_j^y < Px_j$	Expand	Contract
HPP	$MVPx_i^y = Px_i$	$MVPx_j^y = Px_j$	None	None

Johnsonian Model.--An extension of neo-classical theory advanced by Glenn Johnson contains more explanatory power than the unextended neo-classical theory in light of the characteristics of the farm sector and its environment discussed in Chapter I, pages 3 to 10. Legal, transportation, storage, advertising and other transaction costs, including changes in interest rates, cause input acquisition and salvage prices to diverge not only between different time periods but within the same time period. In recognizing that normally, and especially so with durable resources, acquisition prices exceed salvage prices, Johnson defines a fixed asset as one that "is not worth varying."[1] That is, an input is economically fixed if its value in use (MVP) is less than its acquisition cost but greater than its salvage value. It follows from this definition that a resource is in economic equilibrium if:

$$Ps_i^s \leq MVPx_i \leq Px_i^a$$

---

[1]Ricardo defined fixed inputs as being "of slow consumption" while variable inputs "require frequent reproduction." Thus he emphasized the durable nature of fixed inputs. But expendable inputs may very well be fixed. A good example of an expendable input that is often fixed is roughage such as silage. A farmer will almost surely continue to feed any silage he has on hand because its off farm opportunity cost is near zero. Mill modified Ricardo's definition by distinguishing circulating capital "which fulfills the whole of its office in the production in which it is engaged by a single use," from fixed capital "which exists in a durable shape and the return to which is spread over a period of corresponding duration." This definition likewise equates fixed inputs with durables. Marshall follows Mill's definition. (See C. W. Guillebaud, ed., Marshall's Principles of Economics /London: Macmillan and Co. Ltd., 1961/, p. 75.) The classical definition most consistent with Johnson's is that of Adam Smith. His distinction between fixed and circulating capital depended on whether the goods "yield a profit without changing masters" or not. (Ibid.) If "greatest profit" or "smallest loss" is substituted for "profit" in Adam Smith's definition, it is identical with Glenn Johnson's.

The Johnsonian model is illustrated in Figure 2.2. The equilibrium HPP of the classical model expands to form area 5 in which both X_i and X_j are economically fixed and areas 2, 4, 6, and 8 come into being in which either X_i or X_j is economically fixed while the other is expanding or contracting. Areas 1, 3, 7, and 9 of the Johnsonian model represent areas 1, 2, 3, and 4 respectively of the classical model. Resource adjustments under the Johnsonian model are delineated in Table 2.2.

One characteristic of the farm sector is a tendency to overproduce, to maintain or increase investments in farm production when returns to these resources are insufficient to cover acquisition costs in the nonfarm sector. A close examination of each area of Figure 2.2 yields insight as to how such overproduction comes about.[1]

In Figure 2.2, y_o is the output consistent with profit maximization under the classical model. That is, the iso-quant y_o passes through point H where farm input MVPs are equal to input acquisition costs for all inputs. Point H produces returns to farm inputs sufficient to cover the input acquisition costs. But points other than H on y_o are disequilibrium points because input MVPs are not equated with acquisition or salvage prices. Any output above iso-quant $\ddot{y}_o$ can be viewed as overproduction and any output below $\ddot{y}_o$ can be viewed as underproduction.

Any point in area 3 of Figure 2.2 indicates underproduction which permits subsequent adjustments to an output yielding MVPs equal to acquisition costs. Both inputs X_i and X_j have MVPs greater than their acquisition

---

[1]"Overproduction" means a level of output greater than that output represented by the iso-quant y_o, where the MVPs of resources used in farm production are equal to their acquisition costs. At the same time, it must be recognized that any point in area 5 is a point of equilibrium output, maximum profit, or minimum losses.

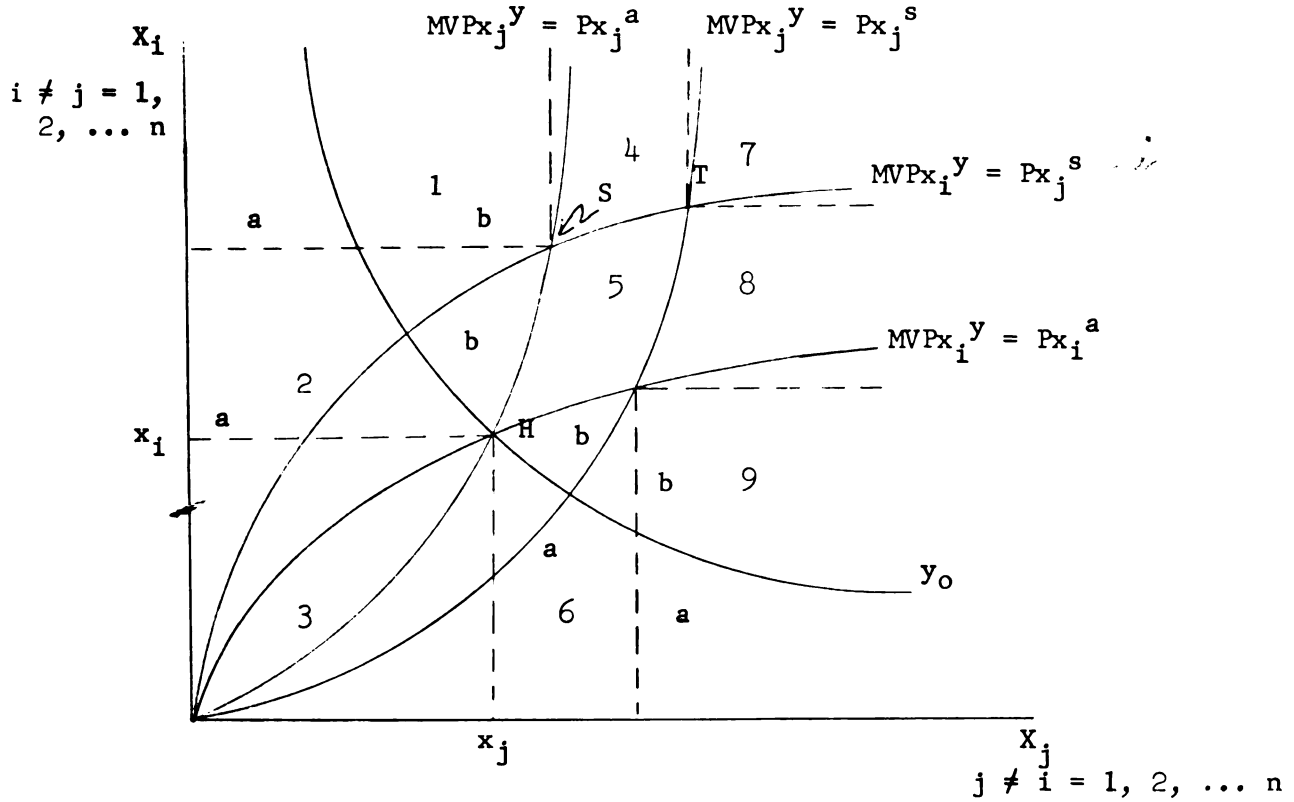

FIGURE 2.2.--The Johnsonian model

TABLE 2.2.--Resource adjustments under the Johnsonian model

Area	Relation of Resource MVP to Resource Prices from Economic Equilibrium Point of View		Resource Adjustment	
	X_i $i \neq j = 1, 2, \ldots, n$	X_j $j \neq i = 1, 2, \ldots, n$	X_i	X_j
1	$MVPx_i^y < Px_i^s$	$MVPx_j^y > Px_j^a$	Contract	Expand
2	$Px_i^s \leq MVPx_i^y \leq Px_i^a$	$MVPx_j^y > Px_j^a$	None	Expand
3	$MVPx_i^y > Px_i^a$	$MVPx_j^y > Px_j^a$	Expand	Expand
4	$MVPx_i^y < Px_i^s$	$Px_j^s \leq MVPx_j^y \leq Px_j^a$	Contract	None
5	$Px_i^s \leq MVPx_i^y \leq Px_i^a$	$Px_j^s \leq MVPx_j^y \leq Px_j^a$	None	None
6	$MVPx_i^y > Px_i^a$	$Px_j^s \leq MVPx_j^y \leq Px_j^a$	Expand	None
7	$MVPx_i^y < Px_i^s$	$MVPx_j^y < Px_j^s$	Contract	Contract
8	$Px_i^s \leq MVPx_i^y \leq Px_i^a$	$MVPx_j^y < Px_j^s$	None	Contract
9	$MVPx_i^y \quad Px_i^a$	$MVPx_j^y < Px_j^s$	Expand	Contract

costs at H. Their use can be increased until point H is reached at which the MVPs of both X_i and X_j are equal to acquisition costs. Initial organization in area 3 results in adjustments to an MVP equals acquisition cost level.

Input X_i is economically fixed in areas 2a and 2b from an equilibrium viewpoint and will not be adjusted. X_j's MVP is greater than its acquisition cost in areas 2a and 2b and the input is expanded until area 5 is reached. Then the $MVPx_j^y = Px_j^a$ and X_j is earning an MVP equal to its acquisition cost. But X_i, while earning more in production of Y than it could be salvaged for, is earning less than enough to cover its acquisition cost. Underproduction exists in area 2a but adjustments in X_j carry the farm into the overproduction of area 2b.

Areas 6a and 6b are similar to areas 2a and 2b with the roles of X_i and X_j unchanged.

Both X_i and X_j are economically fixed in area 5. Both inputs are earning more in production than they could earn in their next best alternative use. But neither input is earning enough to justify expanding its use. No adjustments occur when the farms are organized in area 5 although overproduction is present.

Input X_i is earning less than its salvage value in area 1 while X_j is earning more than its acquisition cost. X_i is contracted and X_j expanded until the upper left hand corner of area 5 is reached. Initial positions in area 1a represent underproduction which results in the overproduction of area 1b after adjustments. Organizations in area 1b initially involve overproduction that is increased or decreased depending on whether the initial production was respectively less than or greater than output at point S.

Organization in area 9 has implications similar to those discussed above for areas 1a and 1b except that the relative positions of inputs X_i and X_j are interchanged.

The value of X_i in its next best alternative is greater than the marginal value product of X_i in producing Y when farms are organized in area 4. Input X_i is contracted, i.e., salvaged at a capital loss, until area 5 is reached. Input X_j is economically fixed in area 4 and is not adjusted. Initial positions in area 4 represent overproduction and this overproduction is but partially corrected for in adjusting X_i to area 5.

Area 8 implies input adjustments and overproduction similar to area 4, except that relative positions of X_i and X_j are interchanged.

Both X_i and X_j are earning MVPs less than their salvage values when farms are organized in area 7. X_i and X_j are salvaged at a loss until the upper right hand corner of area 5 is reached and part of the overproduction evident in area 7 is corrected.

Lagged Adjustment

Though the above discussion is based on the assumptions of perfect knowledge and foresight, it will be used in the thesis in a modified form based on assumptions permitting errors on the part of managers and of consequent adjustment behavior in light of imperfect knowledge and foresight. This assumption implies that farmers adjust input use toward profit maximizing levels at a constant rate of the desired adjustment if the inputs were to reach equilibrium. That is, an input X_i is adjusted according to:

$$(2.2) \quad (F_i^t - F_i^{t-1}) = g_i (F_i^{t*} - F_i^{t-1})$$

where $F_i^t - F_i^{t-1}$ is the actual adjustment in the factor share of X_i from year t-1 to t; $(F_i^{t*} - F_i^{t-1})$ is the desired adjustment if X_i is to reach a profit maximizing equilibrium, F_i^{t*} being the equilibrium factor share of X_i in year t. The term g_i is assumed constant from year to year and represents the proportion of the desired adjustment accomplished in any year t. The estimates of the constant g, derived in Chapter IV for each input situation, are an approximation to the long run average adjustment coefficient. Due to differing degrees of imperfect knowledge over time and resulting errors of differing magnitude, it is doubtful that the true adjustment coefficient is constant from year to year. From any year t-1 to year t, the empirical techniques to be employed will not use factor shares of inputs in year t that would result from the estimated adjustment coefficients to estimate equilibrium factor shares; rather, the estimated adjustment coefficients and actual factor shares for each previous and current year will be used to estimate equilibrium factor shares for the current year. This process assumes that managers (working under conditions of imperfect knowledge and the other characteristics of the farm sector and its environment discussed in Chapter I, pages 3-10) make new mistakes each year so that they never reach the equilibrium adjustment.

There is evidence to substantiate the assumption that such an adjustment process may be a reasonable approximation of what goes on in American agriculture. Farmers do attempt to maximize profits. But due to their imperfect knowledge of change, and the excess of acquisition costs over salvage values, the adjustment is neither perfect nor instantaneous. There are also reasons for expecting the adjustment factor g_i

to vary in magnitude from one input category to another. Nonfarm produced expendables, as carriers of labor and land saving technology, for example, are adjusted more rapidly toward profit maximizing levels than are labor, farm produced durables or land. Also, it can be reasoned that the closer an input is to its equilibrium level, the less the incentive which is consistent with a constant proportional adjustment factor g_i which results in smaller absolute adjustments, the closer the input is to its equilibrium level.

Suppose the farm economy is operating in year t-1 at point A in Figure 2.3 producing Y_1 with x_1^1 quantity of X_1 and x_2^1 quantity of X_2. The desired adjustment for X_1 is to dispose of $(x_1^1 - x_1^2)$ X_1. Similarly, the desired adjustment for X_2 is to acquire $(x_2^2 - x_2^1)$ X_2. The combined desired adjustment is from point A to point B in Figure 2.3 with output increasing from y_1 to y_2. The desired adjustment in factor shares of X_1 and X_2 are $\frac{P^2 x^2}{P^2 y} - \frac{P^1 x^1}{P^1 y}$ and $\frac{P^2 x^2}{P^2 y} - \frac{P^1 x^1}{P^1 y}$ respectively.

But the actual adjustment is to some point C in Figure 2.3 where actual adjustments in X_1 and X_2 are $x_1^3 - x_1^1$ and $x_2^3 - x_2^1$ respectively. Output increases from y_1 to y_3 with resulting actual adjustments in factor shares of X_1 and X_2 $\frac{P^3 x^3}{P^3 y} - \frac{P^1 x^1}{P^1 y}$ and $\frac{P^3 x^3}{P^3 y} - \frac{P^1 x^1}{P^1 y}$.

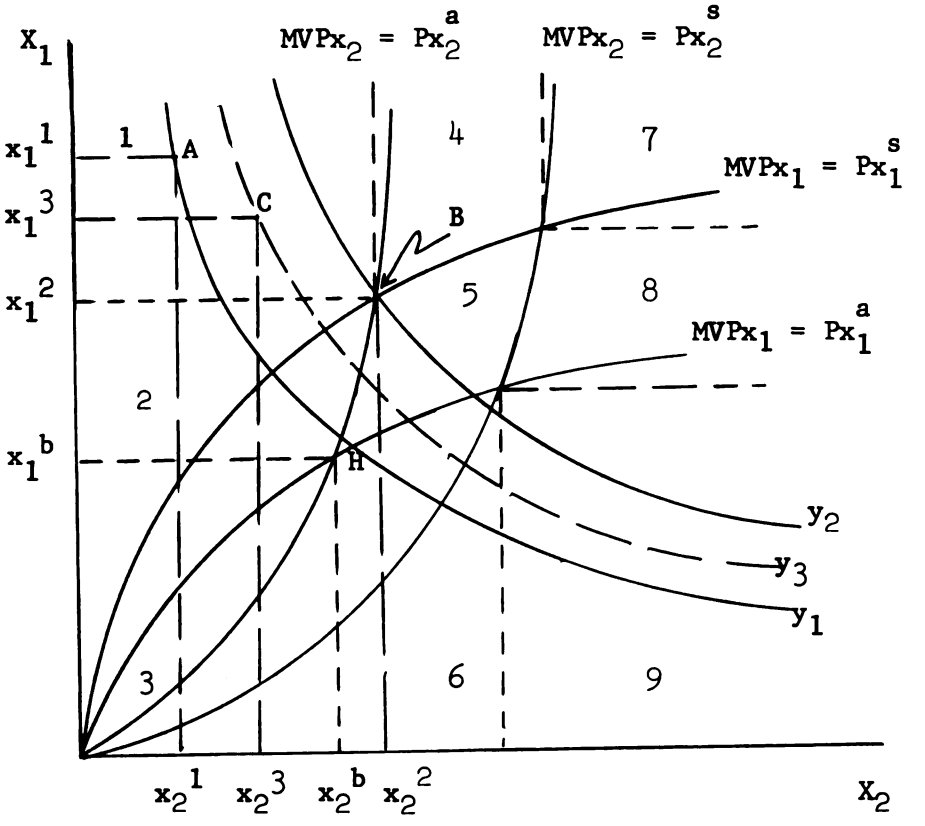

FIGURE 2.3.--The lagged Johnsonian-adjustment model

Resource Imbalance

Much literature on U. S. farm policy concerns "overcommitment" of resources to farming, and the Johnsonian model gives a basis for defining and measuring this resource imbalance. When inputs X_i and X_j are organized at the intersection of the iso-MVP curves which equate earnings with acquisition costs in Figure 2.3, they are in balance. Note that only point H satisfies this condition for both inputs simultaneously. Earnings are equated with acquisition costs for both inputs and no over- or underproduction is present. Any organization other than at point H

represents an imbalance for at least one input.[1] In areas 1, 2, and 3, X_i is underutilized, but the utilization can be corrected by profitably acquiring additional units of the input. In all other areas there is an excess use of X_i.[2] In areas 4, 5, and 6, the excess of X_i can be eliminated only slowly over time as stocks of the input are undermaintained. In areas 7, 8, and 9, the X_i excess can be partially eliminated by salvaging X_i at a capital loss, i.e., selling it at a salvage value which is below its acquisition cost. In areas 3, 6, and 9, X_j is underutilized while an excess of X_j occurs in all other areas. The consequences of underutilization or of an excess of X_j are similar to those listed above for X_i.

In addition to mistakes of under- and overcommitment discussed above, unexpected shifts in the location of area 5 occur due to changing product prices, technology, and other factors dictated by the characteristics of the farm sector and its environment discussed in Chapter I, pages 3 to 10. It is easy to see that such unexpected shifts in the location of area 5 can cause further mistakes of overcommitment to occur through time.

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[1]Even along the X_1 and X_2 expansion path, X_1 and X_2 are out of balance relative to fixed factors except at point H.

[2]By the term "excess," it is simply meant that in accordance with the definition of overproduction given in the footnote on page 24, more of the capital input is being used in the aggregate farm sector than that amount which would equate earnings with those expected at the time the resources were committed to the farm sector. This capital excess represents perfectly rational behavior of individual farmers and the farm sector.

Economic Rent

Implicit in the above statement of capital imbalance is the presence of economic rent in the case of both durable and expendable inputs and capital gains or losses in the case of durable inputs. Historically, classical economists have tended to explain rent as a return peculiar to land. But modern economists hold a more general view of economic rent. Joan Robinson, for example, defines rent as the surplus earned over and above the minimum earnings necessary to bring a factor into production.[1] This definition is consistent with, but not sufficient for the concept of rent employed in the thesis as it does not permit negative rents. And as Mrs. Robinson is aware, quasi rent is not limited to land, but rather applies to any productive asset, fixed or variable, and durable or expendable. The classical concept of rent is also not sufficient because it does not specify the method used to value assets. When asset acquisition costs are greater than salvage values and resource earnings are bounded by these prices, there can be positive, negative or no quasi rent, depending on whether salvage values, acquisition costs, or MVPs are used in pricing the fixed factors. Figure 2.4 indicates the relative positions of three possible average total cost curves computed with alternative charges, $P^a_{x_i}$, $MVP^y_{x_i}$, and $P^s_{x_i}$ for economically fixed factors.[2] Classical rent theory defined land rent as the MVP of land minus its salvage value for the economy as a whole. Since

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[1]Joan Robinson, The Economics of Imperfect Competition (London: Macmillan and Co. Ltd., 1961), p. 102.

[2]Warren Vincent, ed., Economics and Management in Agriculture (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1962), Chapter 6.

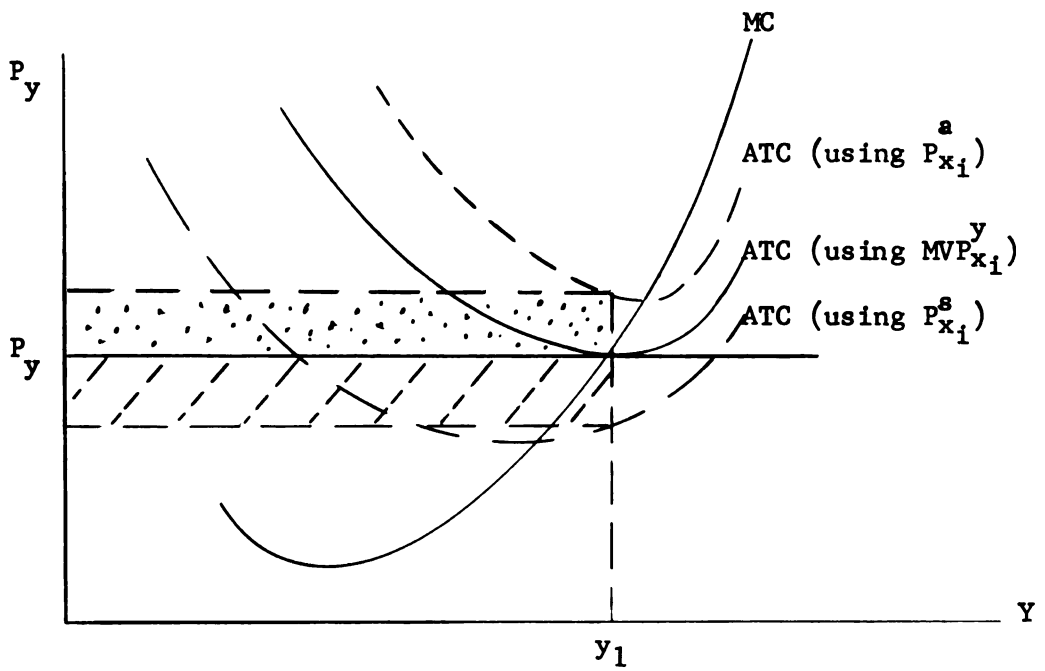

FIGURE 2.4.--Economic rent and the Johnsonian model

land had no alternative uses, its salvage value was equal to zero and land rent was equal to the MVP of land.

When acquisition costs of fixed factors are used to compute average fixed cost, negative rents represented by the "dotted" area of Figure 2.4 result. If salvage values are used to compute average fixed cost, positive rents indicated by the "dashed" area of Figure 2.4 result. And if the $MVP^y_{x_i}$ are used to compute average fixed cost, no rents occur. Thus it is clear that in discussing rent, the method of pricing fixed factors must be indicated. In this study, acquisition costs are used to price inputs in determining rents, where rent is defined as the MVP of the marginal unit minus acquisition costs. Using the MVP of the marginal unit to compute rent is consistent with production relationships displaying constant

returns to scale where the MVP of the marginal unit is equal to the MVP of all previous units and hence to average value product.

Capital Gains and Losses

Capital gains and losses have two general sources: inflations or deflations and changes within the farm sector. Also, it is important to distinguish between capital gains and losses in real terms and those in book or monetary values. According to Boyne, the net gain in real wealth of the owners of farm real estate amounted to $29 billion from 1940 to 1960, whereas book capital gains over the same period amounted to about $90 billion.[1] Interest in this thesis is focused on extending the concept of economic rent discussed above for expendable inputs to a measure of annual average capital gains or losses accruing to durable inputs over their expected life.

Capital gains and losses estimated by Johnson,[2] Hathaway,[3] and Grove[4] are changes in current dollar values of farm capital. Such capital gains and loss estimates are made by adjusting current dollar values of a particular resource for quantity changes. The residual, or change in current dollar value due to price changes, is referred to as a capital gain or loss. Boyne's real wealth gains and losses are capital gains and

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[1]David H. Boyne, Changes in the Real Wealth Position of Farm Operators, 1940-1960. Tech. Bulletin 294 (East Lansing: Michigan State University Agr. Expt. Sta., 1964).

[2]Glenn L. Johnson, "An Evaluation of U. S. Agricultural Policies and Programs, 1956-1960," pp. 11-49.

[3]Dale E. Hathaway, "Agriculture and the Business Cycle," Policy for Commercial Agriculture. Joint Economic Committee, 85th Congress, 1st Session, 1957, pp. 51-76.

[4]Ernest Grove, "Farm Capital Gains--A Supplement to Farm Income," Agricultural Economics Research, XII, No. 2 (April, 1960).

losses adjusted for changes in resource prices necessary to maintain investment purchasing power.[1] By contrast, the capital gains and losses in this thesis are estimates of real wealth changes due to changes in resource earning power. They measure changes in technical productivity and in real changes in product prices over the life of durable inputs. The excess of a durable input's capital value over its acquisition cost multiplied by the number of units of the durable input divided by its expected life in years is the measure of capital gains or losses employed in this thesis. This technique of estimating capital gains is unique and naive compared to estimates by Boyne, Johnson, Hathaway and Grove, but it yields estimates of capital gains consistent with the economic theory and estimates of MVPs and capital values of capital inputs used in this thesis. By contrast, conventional estimates of capital gains and changes in real wealth are based on year to year revaluations of durables and involve a considerable amount of farmers' expectations about future earnings, and whatever else causes asset prices to change.

Aggregation

In estimating marginal value products, this thesis utilizes aggregate measures of inputs and outputs in the farm sector. The resulting MVPs and capital values can be viewed as averages for the farm sector. Though this procedure avoids embarrassing questions about whether the concept of an aggregate production function is employed, other important questions of aggregation remain.[2]

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[1] Boyne, op. cit., p. 6.

[2] In addition to these theoretical considerations, some practical aspects of aggregation are discussed beginning on page 91.

In order for the average MVPs and capital values to have meaning, it must be assumed that individual farm managers behave in a reasonably similar way. It seems reasonable to assume that all farmers are profit maximizers. If farm managers do seek to maximize profits, then the average MVPs and capital values have meaning in this respect. But Edwards concluded that farmers' production decisions are a function of their initial positions and because initial positions vary widely, so do farmers' decisions concerning input employment.[1] Given similar prices, some managers contract a given input, some expand its employment, while still others hold it constant, though all are attempting to maximize profits or minimize losses. Thus important problems of aggregating inputs across farms which vary with respect to age and composition of durable factors, presence or absence of fixed inputs, geographic locations, net worth, institutional obligations and services, etc., question the validity of the aggregations carried out in this thesis.

Ackley points out the positive aspect of average relationships for analysis tools in the "canceling out" of the variance in many unstudied variables explaining individual behavior.[2] Production decisions of farm managers depend not only on the studied variables discussed under economics of resource allocation above, but also on many other things assumed constant. These variables include age of operator, family size, equipment age, whether inputs are owned or rented, the incidence of

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[1]Clark Edwards, "Resource Fixity, Credit Availability and Agricultural Organization" (unpublished Ph. D. dissertation, Dept. of Ag. Econ., Michigan State University, 1958), p. 77.

[2]Gardner Ackley, Macro-economic Theory (New York: The Macmillan Co., 1961), p. 22.

sickness, and so on. To study individual farm production, these variables are very important. But for explaining aggregate behavior, the influences of many of these variables cancel. The age structure of the total farm population changes very slowly, as does the percentage of owned as opposed to rented farms. Births, deaths and sickness alter production decisions of many individual farmers, but the incidence of these in the average may be predictable and stable, or change slowly over time.

One way the thesis attempts to minimize the problem of aggregating across different situations is to adjust estimating procedures for the nonhomogeneities which create the aggregation problems. Where it has not been possible to adjust the estimates, conclusions are qualified accordingly.

CHAPTER III

AGRICULTURAL DEVELOPMENT IN RETROSPECT: 1917-1964

The farm sector and its environment have been characterized by: 1) an inelastic product demand, 2) atomistic structure, 3) rapid technological change, 4) imperfect knowledge, 5) four wars from 1917 to 1964, 6) a severe depression between World Wars I and II, 7) unstable international demand, 8) a family farm structure which results in children being born into the farm labor force, 9) large space and specialized input requirements which widen differences between acquisition costs and salvage values, particularly of durables, thereby making such durables more subject to economic fixity, 10) government farm price support and other farm programs, and 11) variable weather. This combination of characteristics was said in Chapter I to sometimes cause resources to be committed to the farm sector in such quantities that they earn less than their acquisition cost.

Specific objectives of the thesis in studying these "roots" of the farm problem are also stated in Chapter I and encompass the estimation of capital earnings and an analysis of capital use in the farm sector from 1917 to 1964. Chapter II presents a theoretical basis for studying resource adjustment and earnings. And Chapters IV through VII contain empirical analyses of capital use and earnings in the farm sector. The importance of the characteristics of the farm sector and its environment

are manifested in their impact on resource use and earnings which is investigated in the following chapters. Because the relationships of these characteristics through time cause imperfect knowledge, mistakes in committing resources to farm production, economic fixity of inputs, and the resulting under- or overproduction and capital gains or losses, resource adjustment in the farm sector is examined from a historical perspective in this chapter.

Many volumes are available on agricultural development in the United States and only a cursory chronological treatment is possible in these pages.[1] The chronology is developed around seven periods from 1917 to 1964: World War I from 1917-20; post World War I farm depression, 1921-29; general depression, 1930-33; recovery, 1934-41; World War II, 1942-46; post World War II boom, Korean conflict and adjustment, 1947-54; and general growth and expansion, 1955-64. Within each time period, discussion encompasses the usual market determinants of resource use relative to aggregate farm inputs illustrated in Figures 3.1, 3.2 and

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[1]See, for example, U. S. Department of Agriculture, Farmers in a Changing World--The 1940 Yearbook of Agriculture (Washington: U. S. Government Printing Office, 1940), for an over-all view of agricultural history in the United States; Gladys L. Baker et al., Century of Service (Washington: U. S. Government Printing Office, 1963), for an accounting of the role of the USDA in agricultural development; and H. C. Taylor and Anne D. Taylor, The Story of Agricultural Economics in the United States, 1840-1932 (Ames: Iowa State College Press, 1952), for the economics profession's contribution. Murray R. Benedict's Farm Policies of the United States, 1790-1950 (New York: Twentieth Century Fund, 1953) is an excellent description of farm policy up to the post World War II era. And for an over-all view of agriculture and farm policy since World War II, see Dale E. Hathaway, Government and Agriculture (New York: The Macmillan Co., 1963).

3.3;[1] five and ten year average expected product prices compared with actual five and ten year average product prices in Figures 3.4 and 3.5; estimated influence of weather on farm output illustrated in Figure 3.6 for aggregate farm output and averaged over specified periods for aggregate farm output, corn and wheat in Table 3.1;[2] capital gains and losses and real wealth changes in Table 3.2; surplus farm commodities illustrated in Figures 3.7 and 3.8; adoption of new technology; marketing; international trade; and government farm price support policies.

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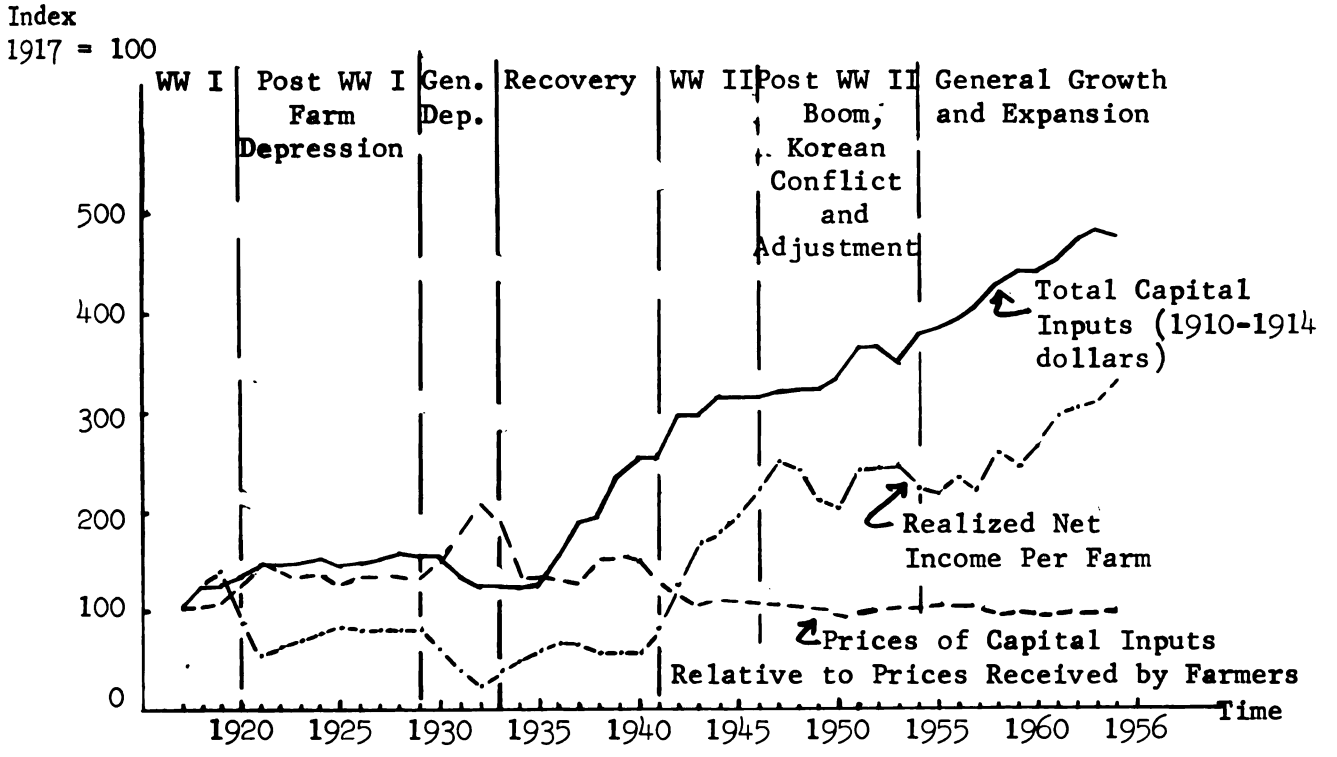
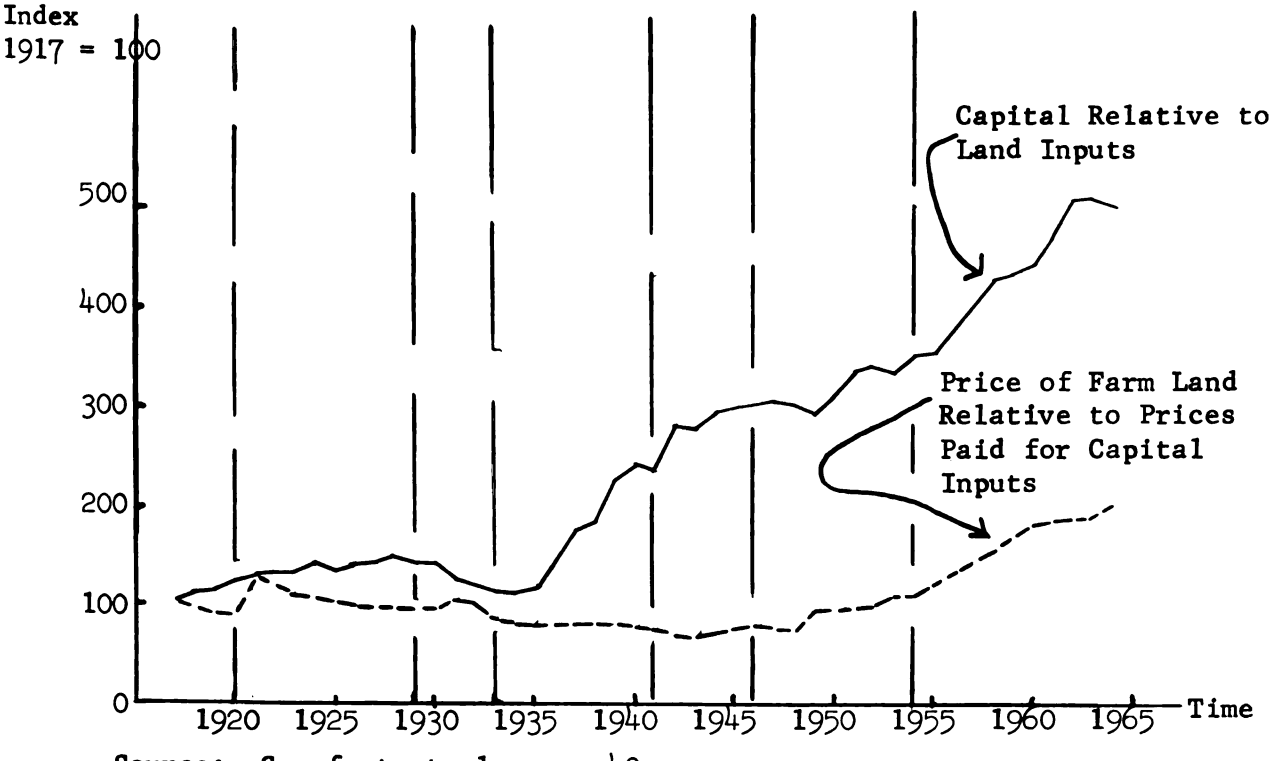
[1]Estimates of capital inputs were aggregated by the author from data in the Farm Income Situation, FIS 199, ERS, USDA, July, 1965. The total includes: 1) farm depreciation and other capital consumption expenditures in Table 15H, page 63, with the exception that those changes for farm operators' dwellings and automobiles were excluded; 2) current farm expenditures on fertilizer, lime, and operation and repair of capital items in Tables 14H, page 62 and 17H, page 65, with the exception that repairs and operation of farm operators' dwellings are excluded; 3) government payments for conservation practices found in Table 22H, page 70 (the government payments were doubled to account for matching expenditures by farmers); 4) expenses for purchasing livestock found in Table 14H, page 62; and 5) expenditures for feed and seed found in Table 14H, page 62. Realized net income per farm is from FIS 199, Table 9H, page 57. Prices of capital inputs are the index of prices paid by farmers for all commodities bought for use in production, Agricultural Statistics, 1965, Table 684 and 1957, Table 681. Prices received by farmers are from Agricultural Statistics, 1965, Table 683 and 1957, Table 680. Land inputs are from Statistical Bulletin No. 233, revised July, 1965, "Changes in Farm Production and Efficiency: A Summary Report, 1965," USDA, ERS, Washington, D. C. Land prices are from Agricultural Finance Review, December supplement, 1964, Table 35, page 63. Data on the labor input are from SB 233, revised, 1965, Table 17, page 31. The farm wage rate is from Agricultural Statistics, 1965, Table 649 and 1957, Table 681.

[2]James Stallings, "Weather Indexes," Journal of Farm Economics, XLII (1960), pp. 180-86; and updated by William E. Kost, "Weather Indexes: 1950-1963," Quarterly Bulletin of Mich. Agri. Exp. Sta., XLVI, No. 1 (August, 1964), pp. 38-42.



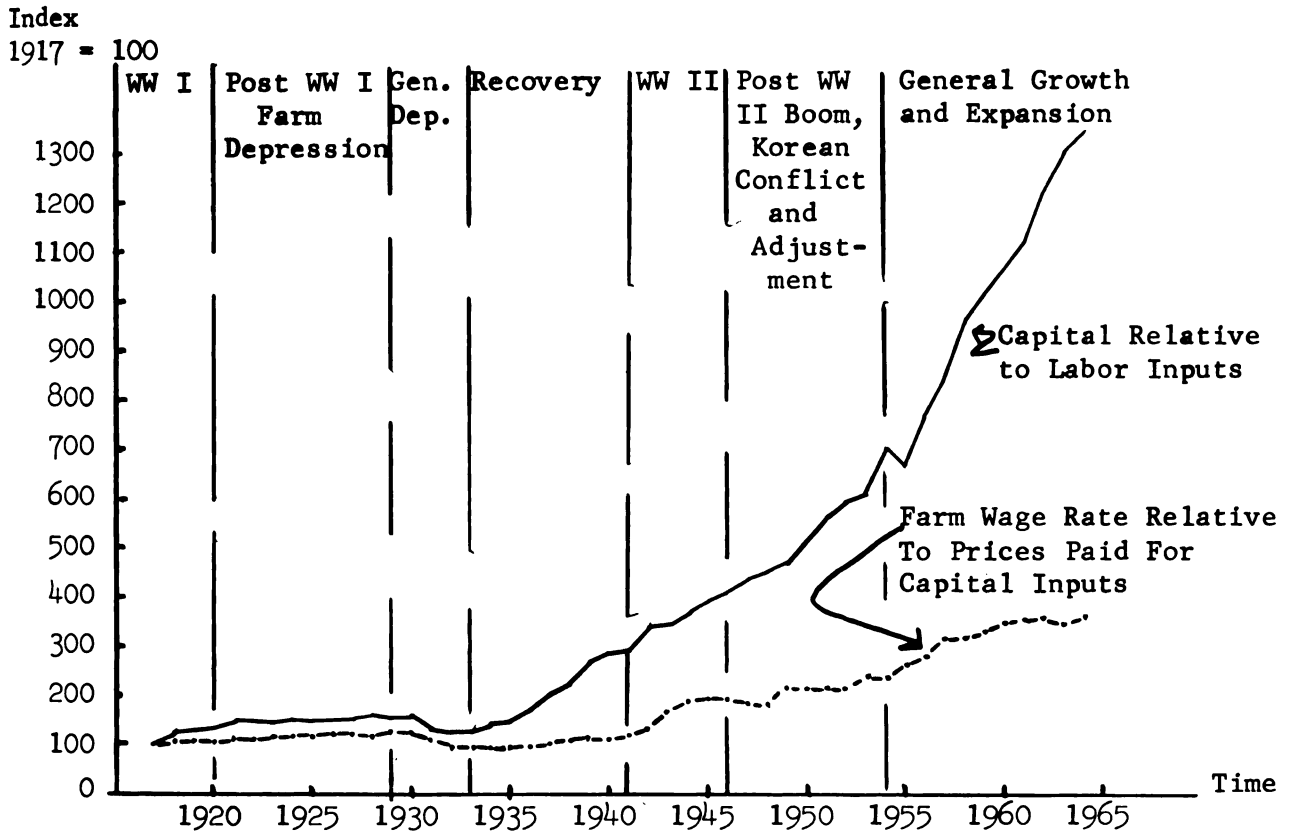
Source: See footnote 1, page 40.

FIGURE 3.1.--Indices of total capital inputs, prices of capital inputs relative to prices received by farmers, and realized net income per farm, United States, 1917-1964



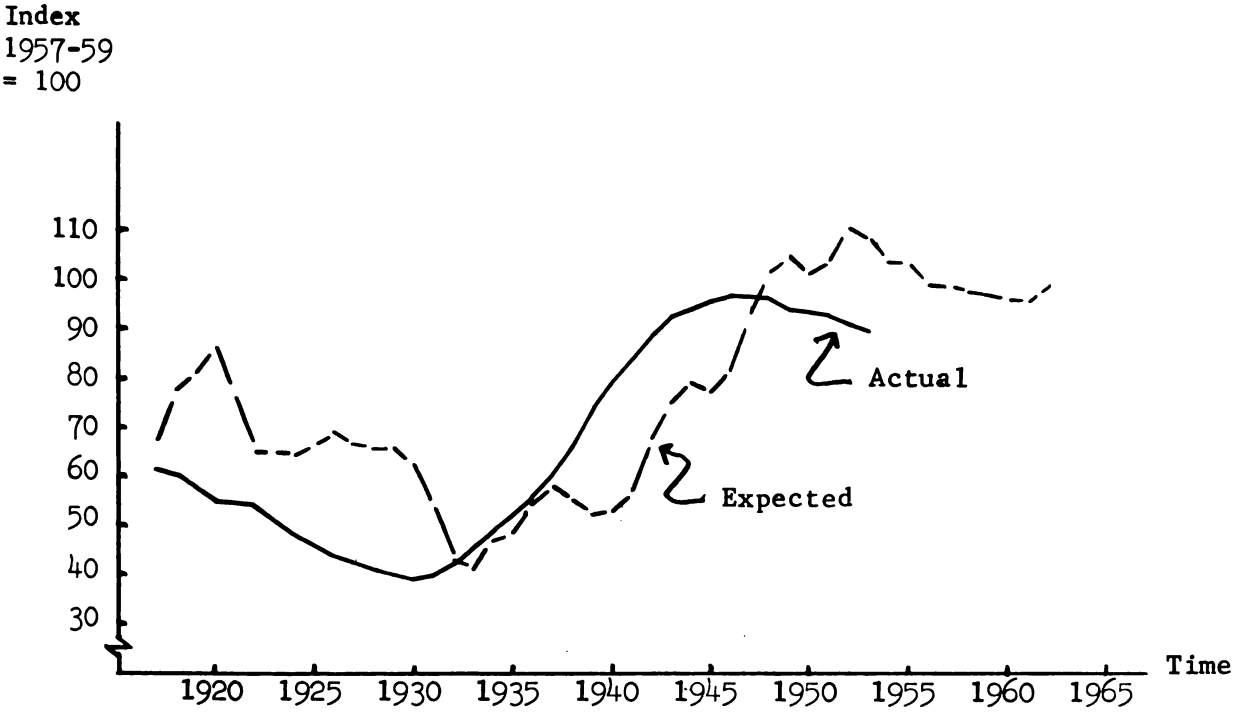
Source: See footnote 1, page 40.

FIGURE 3.2.--Indices of price of farm land relative to prices paid for capital inputs and capital relative to land input, United States, 1917-1964



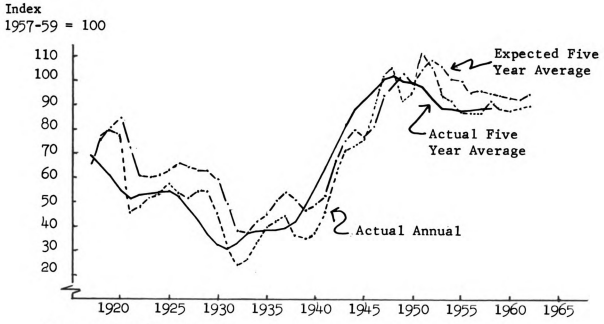
Source: See footnote 1, page 40.

FIGURE 3.3.--Indices of farm wage rate relative to prices paid for capital inputs and capital inputs relative to labor input; United States, 1917-1964



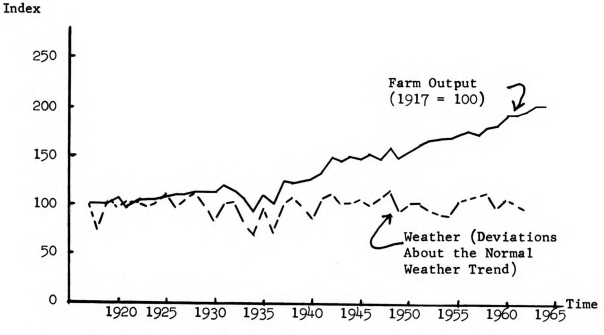
Source: Lerohl, op. cit.

FIGURE 3.4.--Indices of ten year average actual and expected prices received by farmers for the current and next nine years, United States, 1917-1962



Source: Lerohl, op. cit.

FIGURE 3.5.--Indices of five year average actual and expected prices received by farmers for the current and succeeding four years, and actual annual prices received by farmers, United States, 1917-1962



Source: See footnote 2, page 40.

FITURE 3.6.--Indices of farm output and weather, United States, 1917-1964

TABLE 3.1.--Average weather influence on gross farm, corn, and wheat output during specified periods, United States, 1917-1962

Time Period	Average Stallings Index of Weather Influence on Yields		
	Corn	Wheat	Gross Farm
World War I 1917-1920	107	90	94
Post World War I Farm Depression 1921-1929	103	101	104
General Depression 1930-1933	91	108	92
Recovery 1934-1941	94	84	92
World War II 1942-1946	103	111	104
Post World War II Boom, Korean Conflict and Adjustment 1947-1954	98	98	98
General Growth and Expansion 1955-1964	110	90	102

TABLE 3.2.--Changes in current value of livestock and machinery, 1917-1959; and changes in farmers' real wealth of livestock and machinery due to price changes, United States, 1940-1959

Year	General Situation	Net Changes in Current Value of Capital Assets[1]		Changes in Real Wealth Measured in Constant 1910-1914 Dollars[2]	
		Livestock	Machinery	Livestock	Machinery and Motor Vehicles
		Billion dollars			
1917	World War I	1.29	.59	-	-
1918		.48	.84	-	-
1919		-.28	-.23	-	-
1920		-1.90	-.37	-	-
1921	Post World War I Farm Depression	-1.29	-1.15	-	-
1922		.27	-.28	-	-
1923		-.18	.67	-	-
1924		.19	-.05	-	-
1925		.54	.14	-	-
1926		.22	.00	-	-
1927		.49	-.10	-	-
1928		.55	.14	-	-
1929		-.16	.08	-	-
1930	General Depression	-1.71	-.42	-	-
1931		-1.42	-.18	-	-
1932		-.66	-.31	-	-
1933		.12	.07	-	-
1934	Recovery	.60	.39	-	-
1935		1.72	.16	-	-
1936		-.03	.16	-	-
1937		.05	.18	-	-
1938		-.03	-.14	-	-
1939		-.19	-.39	-	-
1940		.14	.27	.05	.14
1941		1.46	.63	.90	-.07
1942	World War II	2.08	.34	.68	.38
1943		-.36	-.46	-.77	.21
1944		-.10	.74	-.46	.39
1945		1.02	-2.08	.37	-.84
1946		2.64	.95	.87	-.56
1947	Post World War II Boom, Korean Conflict and Adjustment	1.95	2.58	-.07	-.03
1948		1.39	1.04	.24	.16
1949		-1.99	-.02	-.43	.22
1950		4.23	-.53	1.52	.09
1951		1.38	1.30	.05	-.06
1952		-5.13	-1.34	-1.94	.01
1953		-2.70	.10	-1.02	.07
1954		-.66	-.41	-.20	.02
1955	General Growth and Expansion	-.73	.69	-.19	.11
1956		.63	.80	.17	.29
1957		3.16	.04	1.04	-.05
1958		4.30	1.47	1.08	.14
1959		-2.60	.58	-.91	.14

1/Glenn L. Johnson, "The Labor Utilization Problem in European and American Agriculture," American Economics Journal, XIV (June, 1960), Table II, p. 82.

2/Boyne, op. cit., Table 11, p. 39.

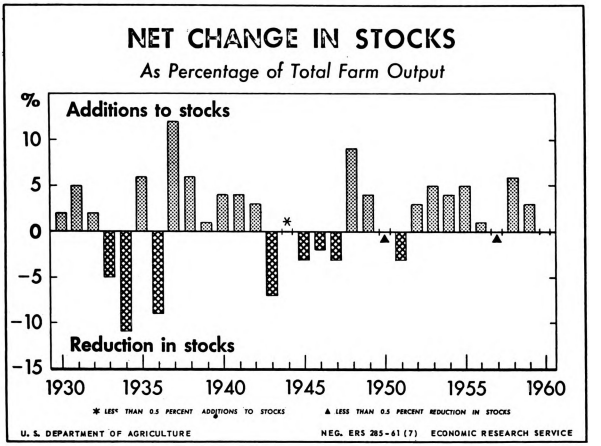


FIGURE 3.7.

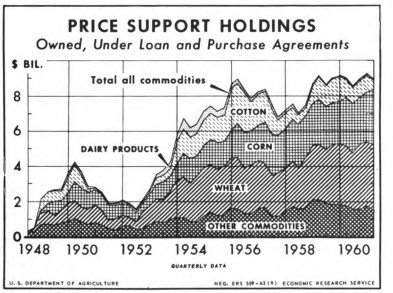


FIGURE 3.8

World War I, 1917-1920

During the World War I period, the farm sector began changing from extensification to intensification of production.[1] Prior to World War I, farm production was increased through tapping virgin lands and bringing more people into farming. But virgin lands were exhausted and nonfarm demands for labor exceeded the farm demand in the war effort.

Wartime Demand Attracts Capital Into the Farm Sector

The only way the farm sector could meet the challenge of high farm prices during World War I was to replace horse and human power with mechanical power. Tractors began appearing on farms about 1917, the use of horses and mules declined, and land formerly used to feed horses and mules was freed to produce food and fiber for human consumption.

The Exodus of Farm Labor Began

The mechanical power which replaced horsepower was also a profitable substitute for increasingly expensive labor. A combination of greater nonfarm opportunities and decreased demand for labor on farms began an exodus of people from the farm sector that was only momentarily checked by the great depression and continues today.

High Farm Prices Were Mistaken for Long Run Expectations

High prices for farm commodities resulted from wartime demands and credit extended to our allies. In addition, shipping lanes to such farm commodity exporting countries as Australia were cut off. With

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[1]Ralph A. Loomis and Glen T. Barton, "Productivity of Agriculture, United States, 1870-1958," USDA Technical Bulletin 1238 (April, 1961), p. 6.

seaways from the United States protected from Germany, this country was the major outside source of food and fiber for western Europe. By 1918, hog prices were $16.60 per hundredweight, corn was $1.52 per bushel and wheat was $2.05 per bushel. And as Figures 3.4 and 3.5 illustrate, farmers erroneously based long run expectations on inflated farm prices and overinvested in productive capacity. Both five and ten year average expected product prices were increasing throughout World War I as were actual annual product prices. However, realized five and ten year average product prices were decreasing. The index of total capital inputs increased from 100 in 1917 to 125 in 1920 despite rising prices of farm capital relative to prices received by farmers and land prices. The index of farm output increased from 100 in 1917 to 107 in 1920 despite adverse weather which according to the Stallings index caused average yields 6 per cent below normal from 1917 to 1920, and a decrease in realized net income per farm from $2,260 in 1917 to $1,362 in 1920, measured in 1957-59 dollars. In 1919 and 1920, farmers were beginning to realize their mistakes of overproduction, and stocks of both livestock and machinery were devalued according to Table 3.2. The current value of livestock decreased .28 and 1.9 billion dollars in 1919 and 1920 respectively due to price changes, while the current value of machinery stocks decreased .23 and .37 billion dollars during 1919 and 1920 respectively due to price changes.

Post World War I Farm Depression, 1921-1929

The factors discussed above describe the environment in which the farm sector operated in World War I. They combined with structural

characteristics of the farm sector, discussed earlier, to cause chronic adjustment problems following World War I.

High Wartime Demands Vanish

Farm prices fell sharply at the close of World War I causing a large decrease in realized net income per farm. Augmenting the decreases in demand from trade channels opening to normal peacetime operations was a growing trend toward nationalism in world politics. The United States was a creditor nation with our allies owing debts which had been extended to finance the war effort. But the war also fostered feelings of nationalism and protectionism both here and abroad. Instead of moving toward freer trade as one might expect a creditor nation to do, the United States increased tariffs and imposed import quotas. In 1922, legislation provided the highest tariffs in United States history. France and Great Britain counteracted by imposing their own tariffs.

Prices Not Supported

Most action regarding farm policy centered around the "farm bloc," a bipartisan group of congressmen from farm states who banded together about 1921 to evolve public policies to aid the farm sector. The "farm bloc" acted in concert with or at the behest of major farm organizations, especially the American Farm Bureau.[1] Congress, however, was not yet ready for direct intervention in the market; therefore, rather than to support prices, government policy was channeled through service facilities of the USDA such as the market news service and

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[1]Hathaway, Government and Agriculture, p. 187.

standardization work in the inspection of fruits and vegetables by the Bureau of Agricultural Economics, and the Purnell Act of 1925 (which provided funds for marketing research).

Inputs and Output Remain High

The stock of durables accumulated during World War I kept the index of total capital inputs high during the 1921-1929 period, and the index of farm output actually increased from 93 in 1921 to 112 in 1929. The latter was partly due to favorable weather which, on the average, caused yields 4 per cent above normal according to Table 3.1. Relative prices and use of land, labor and capital remained fairly constant from 1921 to 1929, as illustrated in Figures 3.2 and 3.3.

Farm Prices Carried the Brunt of the Adjustment Problem

With the supply of farm products maintained throughout the post World War I period in the face of a depressed and inelastic demand, the index of farm prices decreased from 211 in 1920 to 124 in 1921. With no government or private storage program, surpluses did not build up; available supplies either cleared the market, spoiled in the field, or were destroyed. Prices received for hogs decreased to 7 cents per pound in 1923, the price of corn fell to 52 cents per bushel in 1921 (one-third its World War I peak), and wheat sold for 93 cents per bushel in 1922. Although the over-all index of prices received by farmers increased slowly in the mid- and late 1920's, farm prices never came close to the high World War I levels which attracted durable resources into the farm sector. Figures 3.4 and 3.5 indicate that while farmers were adjusting their long run expectations downward, the extended period of low prices

was more than they could visualize, and realized 5 and 10 year average prices remained less than those expected. This could account for the slight increase in total capital inputs for the 1921-1929 period indicated in Figure 3.1.

Table 3.2 indicates that capital losses occurred for livestock in three of the nine years from 1921 to 1929 and in four of the nine years for machinery. These capital losses are based mainly on farmers' own devaluation of durables on an annual basis and involve considerable expectations on the part of farmers. Figures 3.4 and 3.5 indicate that product price expectations held by farmers during the 1921 to 1929 period were never realized. Therefore, it is likely that actual capital losses, based on what farmers paid for durables and what the durables actually earned over their productive life in periods of depressed product prices, were much more numerous and severe than indicated by Table 3.2.

Development of Improved Technology Continued But Its Adoption Lagged

The fruits of the technological revolution whose harvest began during the favorable farm price conditions of World War I continued to ripen during the post World War I period of continued prosperity in the nonfarm sector. The following list represents advances in the development of mechanical farm technology during the 1921-1929 period.[1]

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[1]The source of this data is the Farm Equipment Institute as presented in the February, 1952 issue of Popular Mechanics and tabulated in William A. Cromarty, "The Demand for Farm Machinery and Tractors," Technical Bulletin 275 (East Lansing: Michigan State University Agri. Expt. Sta., November, 1959).

Tool-bar idea for mounting tillage tools on tractors
Combination tool-carrier for heavy implements
Mounted-type tractor implements introduced
Electric ventilating system for dairy barns
Cultivating or tricycle-type tractor
Two-row, tractor-drawn rolling stalk cutter
Cotton stripper built commercially for the high plains
Jet-type pump introduced
One-way or wheatland disk plows popularized
Two-row, power-take-off cornpicker, and one-row mounted picker developed
Land-leveler for irrigation farming
Crankcase oil filters
Two-row mounted cornpicker
Attachments for placing fertilizer in bands

But with depressed farm prices, the earnings of capital inputs and the relative prices of capital, labor and land inputs did not bring about the rapid rate of adoption of these innovations that prosperous farm conditions would have encouraged. Figures 3.1, 3.2 and 3.3 substantiate this lack of adoption of improved technology.

General Depression, 1930-1933

Depressed product prices and low input earnings prevailed in the farm sector long before the general economy collapsed in late 1929. But the general depression caused the bottom to fall from the farm economy.

Monetary Collapse Worsened the Farm Situation

With the stock market crash of 1929 gross national product of the United States fell from 103.1 billion dollars in 1929 to 55.6 billion dollars in 1933,[1] and the index of prices received by farmers decreased from 148 in 1929 to 63 in 1932. Realized net income per farm decreased from $1,783 in 1929 to $778 in 1932.

[1]Economic Statistics Bureau of Washington, D. C., Handbook of Basic Economic Statistics, XX, No. 1 (January 15, 1966), p. 224.

World War I Build Up of Durables Partially Depleted

While the decrease in farm prices following World War I caused some durables to be fixed in farm production during the post World War I farm depression, there was negative net investment in farm capital in 12 of the 14 years from 1921 to 1933.[1] By the end of 1933, the farm economy had exhausted most of its excessive capacity. The index of mechanical power and machinery (1917 = 100) decreased from 143 in 1930 to 114 in 1933, and the total number of cattle and calves had decreased continually from the World War I peak of 73,040 thousand head in 1918 to 57,322 thousand head in 1928. Table 3.2 indicates that farmers received severe capital losses on livestock and machinery in each year from 1930 to 1932 due to falling prices of these assets.

Although new technology such as portable sprinkler irrigation, power lifts for farm tractors, diesel powered farm tractors, pickup balers and low-pressured rubber tires for farm tractors were developed, conditions were not favorable for their adoption. Prices of capital inputs increased sharply relative to prices received by farmers, and mass unemployment caused farm wages to decrease absolutely and relative to prices paid for capital inputs. The index of farm labor actually increased in 1931 in a reversal of the exodus of farm labor.

Growing Awareness of the Importance of Foreign Markets

The Smoot-Hawley Tariff Act of 1930 established new record tariffs, and 22 English Commonwealth nations established tariffs in retaliation. Tariffs were an attempt to export unemployment, but there

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[1]ERS, USDA, Farm Income Situation, FIS 199 (July, 1965), Table 18H.

was a growing awareness that freer world trade was necessary to utilize the farm sector's productive capacity. Producers of wheat, cotton, tobacco, pork and lard, depending heavily on sales abroad, attributed part of their troubles to the virtual disappearance of United States farm exports.[1] The Trade Agreements Act of 1934 was designed to implement a freer international trade policy.[2]

Farm Policy Turns to Price Supports

The first major government attempt to modify farm prices and marketings was the Federal Farm Board set up in 1929. Although Figure 3.7 indicates additions to stocks of farm output in 1930 through 1932, the Farm Board's efforts to stabilize prices by making commodity loans in the face of a complete collapse of consumer demand in the general depression were fruitless. The Board was abandoned after its $500 million capital fund was exhausted with farm prices still at rock bottom.[3]

While the Federal Farm Board's activities were centered around free market prices, the Agricultural Adjustment Act of 1933 introduced the parity price concept. The act's objective was to establish and

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[1]Lawrence W. Witt, "Trade and Agricultural Policy," Annals of The American Academy (September, 1960), p. 2. Much of the material presented in this chapter on international trade is summarized from Professor Witt's lectures on international trade as compiled in notes by Howard Bodenhamer (East Lansing: Michigan State University, 1962).

[2]Raymond J. Penn, "World Trade: What are the Issues?" No. 3. Reciprocal Trade Agreements. Farm Foundation, National Committee on Agricultural Policy, Agricultural Policy Institute, North Carolina State College and the Center for Agricultural and Economic Adjustment, Iowa State University, p. 1.

[3]Dale E. Hathaway, Problems of Progress in the Agricultural Economy (Chicago: Scott, Foresman and Co., 1964), p. 38.

maintain such balance between the production and consumption of agricultural commodities, and such marketing conditions therefore, as would re-establish prices to farmers at a level that would give agricultural commodities a purchasing power with respect to articles that farmers buy, equivalent to the purchasing power of agricultural commodities in the base period.[1] For all agricultural commodities except tobacco, the base period specified was August, 1909 to July, 1914. For tobacco the base period was designated as August, 1919 to July, 1929.

Activities to bring production and marketings of farm commodities in line with demand undertaken in administering the Agricultural Adjustment Act of 1933 were discontinued after the constitutionality of the act was successfully challenged by the refusal of the Hoosac Mills Corporation to pay certain processing taxes on cotton.

Weather Was an Aggravating Factor

While adverse weather existed on the average during the general depression with the Stallings index for aggregate farm production measuring 8 per cent below normal yields, wheat, with a very inelastic demand and low prices, showed an 8 per cent increase in yields due to weather in the 1930-1933 period.

Recovery, 1934-1941

During World War I, farmers made investments which led in many cases to post war farm business failures. Low prices, aggravated by protectionists' trade policies, following World War I, caused serious

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[1]Murray R. Benedict, Farm Policies of the United States, 1790-1950 (New York: Twentieth Century Fund, 1953), p. 350.

adjustment problems and overproduction that were worked out in the free market with little direct government interference. The result was an extended period of negative rents, capital losses, low realized net income per farm and negative net investment in farm capital according to some measures. By 1934 farmers had either gone broke or weathered the worst of the depression. But the stimulus for investing in productive capacity provided by price support programs in the period 1938 to 1941 brought about a reappearance of the symptoms of chronic adjustment problems in the farm sector.

Prices Supported

An alternative to the Agricultural Adjustment Act was found under the Soil Conservation and Domestic Allotment Act of 1936. This act paid farmers to divert acreage from "soil-depleting" to "soil conserving" crops. Thus income transfers to farmers were continued until more effective and constitutionally acceptable control programs were devised.[1]

The Agricultural Adjustment Act of 1938 left the main features of the Soil Conservation and Domestic Allotment Act unchanged but emphasized price support loans and commodity purchases and authorized marketing quotas to regulate flows of farm commodities to market. The 1938 act's provision for nonrecourse loans is the primary authority for government support of farm prices.

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[1]Lyle P. Schertz and Elmer W. Learn, Administrative Controls on Quantities Marketed in the Feed-Livestock Economy. Technical Bulletin 241 (Minneapolis: University of Minnesota Agr. Expt. Sta., December, 1962), p. 9.

Build Up in Durables Resumed

Price support legislation provided farmers with expectations of favorable long run earnings just as did World War I. Figure 3.5 illustrates that farmers' expectations of five year average product prices were increasing and exceeded realized five year average prices from 1934 to 1938. Farmers responded quickly to these unrealized expectations by increasing investments in farm capital. The index of mechanical power and machinery (1917 = 100) increased from 114 in 1934 to 157 in 1941 with rapid increases in the number of tractors, motor trucks, grain combines, corn pickers, and many other nonfarm produced durables on farms. After reaching the bottom of a trough in 1938, the cattle cycle began a strong upswing. This build up in durables was accompanied by similar increases in the use of complementary expendables, especially nonfarm produced fuel, fertilizer and electricity. Table 3.2 indicates that farmers received capital losses on livestock in three of the eight years from 1934 to 1941 and capital losses on machinery in two of the eight years. In the other years, farmers received capital gains.

The primary incentive for increasing capital inputs was to increase output in response to false product price expectations that were induced by price supports, but considerable capital inputs were required to replace the exodus of farm labor which was finding more favorable employment opportunities in the nonfarm sector. On a 1917 = 100 basis, the index of farm labor decreased from 89 in 1935 to 84 in 1941.

Surpluses Accumulate

With the exception of 1936, surpluses accumulated at support price levels in every year from 1935 to 1941 as illustrated in Figure 3.7. While freer trade policies provided some relief, the terms of trade were turning against agriculture despite price supports. Whereas farm products accounted for 45 per cent of total U. S. exports from 1910 to 1919, by 1930-1939 they accounted for only 32 per cent. With the farm wage rate increasing relative to the prices paid for capital inputs, and adequate credit facilities available, capital inputs increased both absolutely and relative to land and labor. And the declining price of capital relative to prices received by farmers encouraged the adoption of the backlog of output increasing technology.

Symptoms of Chronic Adjustment Problems Reappearing

The placing of price supports on farm commodities provided expectations of favorable long run earnings similar to those provided by World War I. Farmers responded by investing in durable capital inputs that would maintain a high productive capacity up to 10 years into the future. Output increased and prices sagged. Government storage programs bolstered prices, and surpluses began accumulating in 1937.

While price supports were supposed to be part of the solution to low resource earnings and income in the farm sector, they were originally designed to take up the short run slack in supply and demand of farm products. But under rigid price supports and no effective supply restriction on the atomistic farm sector, price supports were transformed into favorable long run expectations. Also, with the elastic supply of farm products for increases in quantity supplied, surpluses accumulated in government

storage facilities. Surpluses lead to capital losses for farmers when public pressure leads to lower farm prices and/or to burdens of farm subsidies and surplus disposal costs on taxpayers. The index of prices received by farmers decreased from 109 in 1935 to 95 in 1939 and surpluses increased in every year from 1937 to 1941. If it had not been for the outbreak of World War II, the pressure of chronic adjustment problems in the farm sector would have demanded another outlet.

World War II, 1942-1946

World War II provided an outlet for surplus farm products which had been mounting since 1937 and for increased farm output. But wartime legislation fixing rigid price supports again provided false expectations of long run favorable earnings for farm resources.

High Wartime Demand and Farm Prices

Demands for farm produce by the United States and our allies caused sharp increases in farm commodity prices. Realized net income per farm showed the largest increase of any period of similar length from 1917 to 1964. Capital input prices declined relative to prices received by farmers, farm wage rates, and land prices. Use of capital inputs rose sharply, both absolutely and relative to land and labor inputs. Although the index of farm output increased from 133 in 1941 to 153 in 1946 (1917 = 100), the war requirements for food and fiber were great, and Figure 3.7 indicates that there were net reductions in stocks of farm commodities in every year from 1943 to 1947 despite the shifting of government farm adjustment machinery from production controls to encouraging increased production.

Farmers Fearful of Repeating World War I Mistakes

Considerable long run productive capacity had been built up during the recovery period of the late 1930's. Farmers were fearful of committing durables to farm production at high wartime acquisition costs and then receiving capital losses after hostilities ceased. Figures 3.4 and 3.5 show that both five and ten year average expected farm product prices were less than actual five and ten year average farm product prices throughout World War II. The index of production inputs increased only from 97 in 1941 to a World War II high of 101 in 1943 and 1944 (1957-59 = 100). And while the index of mechanical power and machinery (1917 = 100) increased from 157 in 1941 to 207 in 1946, much of this increase in farm capital was required to offset a decrease in farm labor. The index of farm labor decreased from 84 in 1941 to 76 in 1946 (1917 = 100). But inasmuch as the build up in productive capacity during World War II followed a substantial build up in the pre-World War II recovery period, and with the prevailing wartime legislation such as the Steagall amendment which promised high price supports until 1948, the productive capacity on U. S. farms at the end of the war was sufficient to cause chronic adjustment problems. In addition, as Table 3.1 indicates, above average weather contributed to increased farm output.

Estimates of changes in farmers' real wealth position due to changes in prices are available beginning in 1940. These real wealth changes for livestock and machinery are presented in Table 3.2. Generally these changes in farmers' real wealth positions indicate that the net capital gains on farm assets are not as great in "real values."

These data also indicate that in several years, farmers have experienced decreases in real wealth as well as decreases in "current value" of assets.

Post World War II Boom, Korean Conflict and Adjustment, 1947-1954

Farmers' expectations of a post World War II depression did not materialize. Continued price supports and World War II savings encouraged a build up of durable capital. Farm output increased far beyond quantities demanded at price support levels and surpluses accumulated. The Korean War, however, temporarily relieved the chronic adjustment problem in the farm sector.

Post World War II Depression Did Not Materialize

With both the cold war and U. S. efforts to feed and reconstruct western Europe immediately following World War II, farm prices continued to increase in 1947 and 1948. The Agricultural Act of 1948 called for flexible price supports, but subsequent amendments prevented the flexibility from becoming effective and prices for most farm commodities were supported at 90 per cent of parity.

Rigid Price Supports and World War II Savings Encourage Build Up of Durables and Specialization

With prices received by farmers at a record high following World War II and indications of continued rigid price supports, farmers used wartime savings and easily accessible credit to continue the substitution of nonfarm produced inputs for labor which was finding higher paying

opportunities in the nonfarm sector.[1] Hydraulic-lift equipment on tractors, self-propelled combines, automatic self-tying pickup balers and much improved fertilizer and machinery for applying fertilizer were some of the labor and land reducing innovations being adopted due to land and labor prices which increased absolutely and relative to prices paid for capital inputs as indicated by Figures 3.1 through 3.3.

Not only were farmers becoming more specialized by buying more nonfarm produced inputs but also by less diversification on farms, and among regions. The increasing complexity of farm technology, changing structure of agricultural markets, and economies of size encouraged moves toward larger farms with fewer enterprises per farm.

Output and Surpluses Increased

With marketing quotas defined as the actual or normal production on allotted acreage,[2] the substitution of fertilizer, insecticides and other output increasing capital inputs for restricted land was encouraged. With no effective production controls and rigid price supports, the index of farm output increased from 147 in 1947 to 169 in 1954 (1917 = 100); surpluses of dairy products, cotton, corn, wheat and other products mounted as illustrated in Figure 3.8.

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[1]For estimates of nonfarm opportunity costs for farm labor, see Chennareddy, op. cit.

[2]Wayne D. Rasmussen and Gladys L. Baker, "A Short History of Price Support and Adjustment Legislation and Programs for Agriculture, 1933-65," Agricultural Economics Research, XVIII, No. 3 (July, 1966). Reprinted in ERS 303, USDA, July, 1966.

The Korean War Prevented Chronic Adjustment Problems

Prices of nonfarm inputs increased appreciably during and after World War II, and continued high farm prices were required if durables purchased in this period were to earn sufficient returns over their productive life to cover the high acquisition costs. Figures 3.4 and 3.5 show that both five and ten year average expected prices of farm products began exceeding realized five and ten year average farm product prices in 1948. As surpluses accumulated in government storage programs (Figure 3.8), public pressure caused farm prices and acreage allotments to decrease. This reduced the earnings of durables specialized in the production of supported commodities below their acquisition costs and provided capital losses to owners of the economically fixed durables. Table 3.2 indicates that farmers received capital losses on livestock and machinery in four of the eight years from 1947 to 1954 and that these were "real wealth" losses in several years.

The outbreak of the Korean War in June of 1950 again required a shift from discouraging production to securing sufficient food and fiber to meet any eventuality in the war effort. Figure 3.8 shows a large decrease in price support holdings by the Commodity Credit Corporation in 1951 and 1952, and the index of prices received by farmers increased from 250 in 1949 to 302 in 1951.

General Growth and Expansion, 1955-1964

The period 1955 to 1964 was characterized by the following: marked increases in land and labor prices relative to prices of capital inputs, increases in capital input prices relative to prices received for

farm commodities, continued decreases in the number of farms, a continued increase in total capital inputs, increases in farm output and surplus stocks, and freedom from any major economic disturbances.

Capital is Substituted for Land and Labor Under False Expectations

The public cost of maintaining price supports and disposing of farm surpluses increased from .06 billion dollars in 1946 to 3.3 billion dollars in 1957.[1] Figure 3.8 indicates that farm surpluses, especially of wheat and corn, increased rapidly despite cuts in acreage allotments and price support levels. For example, wheat price supports decreased from 90 per cent of parity in 1954 to 75 per cent of parity by 1958 while the national acreage allotment for wheat decreased from 62 million acres in 1954 to 55 million acres in 1958.[2] But larger tractors and implements, fertilizer, irrigation, improved seed varieties, and other forms of farm and nonfarm produced capital were profitable substitutes for the restricted land at supported price levels which farmers mistakenly interpreted as long run price expectations. Land harvested for crops decreased from 340 million acres in 1955 to 294 in 1964 while the use of principle plant nutrients increased from 4,507 tons in 1955 to 8,093 thousand tons in 1964.

At the same time, the nonfarm wage rate was increasing relative to the farm wage rate and to farm income. Hired, operator, and family labor were moving out of the farm sector, and the total number of man

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[1]Glenn L. Johnson, "An Evaluation of U. S. Agricultural Policies and Programs, 1956-1960," p. 17.

[2]USDA, ARS, Farm Production: Trends, Prospects, and Programs. Agricultural Information Bulletin 239 (Washington: U. S. Government Printing Press, May, 1961), pp. 94-95.

hours used for farm work decreased from 12,808 million hours in 1955 to 8,411 million hours in 1964.

As emphasized earlier, the pressure of increased farm output and mounting surpluses caused farm prices to decrease. The index of prices received for farm products decreased from 302 in 1951 to 236 in 1964, and Figures 3.4 and 3.5 indicate that neither five nor ten year average expected farm product prices were realized.

International Trade and Public Law 480 Reduce Pressure of Surpluses

After World War II, 21 major trading countries adopted a General Agreement on Tariffs and Trade (GATT). Now the 39 participating countries account for over 80 per cent of world trade. Trade concessions include reductions in tariffs and commitments not to increase tariffs, and the participating countries agree to the most favored-nation principle.[1]

Another important trade development was the Agricultural Trade Development and Assistance Act, better known as Public Law 480. This act, approved in July of 1954, served as the basic authority for the sale of surplus farm commodities for foreign currency and has proved to be of major importance in disposing of farm products abroad.[2]

In supporting domestic prices of major farm commodities above world prices, the United States encourages imports and discourages exports. This necessitates import quotas and tariffs to limit imports. Then export subsidies are utilized to lower export prices. These

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[1]Penn, op. cit.

[2]Rasmussen and Baker, op. cit., p. 76.

policies tend to insulate domestic agriculture from the world market. Domestic surpluses accumulating under price support policies are partially disposed of through sales for soft currencies under PL 480, gifts to food deficit countries through church and other private agencies, and domestic demand expansion programs, all at considerable expense to the taxpayer.

These trade developments did not affect prices received by farmers as directly as they would have prior to the use of direct price supports. But inasmuch as they proved useful in the cold war against communism and reduced burdensome surpluses, they reduced public pressure for lower farm prices or increased production restrictions.

Government Policy Assumes Many Forms

While public effort to increase farm income through direct intervention in the marketplace usually receives the most attention, government policies affect all aspects of resource use in the farm sector. Minimum wage legislation increases the opportunity costs of qualified farm labor in the nonfarm economy and increases the farm wage rate. Public supported research at land-grant colleges and institutions provides subsidized research in all aspects of farm life. The federal and state supported agricultural extension service disseminates information to the farm level and provides managerial assistance at little or no cost to individual farmers. Public supported education from kindergarten through post Ph. D. programs provides 1) opportunities for rural youth to successfully migrate from the farm sector which is over supplied with labor to nonfarm industries and professions; 2) future farmers with a degree of technical and managerial competence unsurpassed in the world,

past or present; and 3) a source of nonfarm human skills that provides superior research, education, marketing, production, and professional services to the farm sector. Public investments in roads, waterways, markets, dams, etc., provide complements to the natural resources of the farm sector at little expense to the individual farmer. These indirect public actions affecting the farm sector were important in all periods from 1917 to 1964.

One form of direct public action in the farm sector considerably different from price support and surplus storage programs was the Soil Bank. Established by the Agricultural Act of 1956, the Soil Bank was a large scale effort to reduce farm surpluses by taking farmland out of production. The program involved an acreage reserve and a conservation reserve. The objective of the acreage reserve was to reduce the amount of land planted to allotment crops--wheat, cotton, corn, tobacco, peanuts, and rice. Farmers reducing land planted to these crops below their allotments received payments for the diversion of such acreage to soil conserving uses. In 1957, 21.4 million acres were placed in the acreage reserve.[1] In addition, farmers could designate certain cropland for the conservation reserve and receive payments for putting it to conservation use. In July of 1960, 28.6 million acres were under contract in the conservation reserve. This aspect of the Soil Bank met with considerable opposition when some rural communities were disrupted by many farmers placing their entire farms in the conservation reserve.[2] It is the withdrawing of whole farms from production which has the

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[1] Ibid., p. 77.

[2] Ibid.

greatest output reducing impact, inasmuch as this typically takes complementary labor and capital inputs out of production, too.[1] When only a small portion of a farm is placed in the conservation reserve, it is the most unproductive land; and the labor and capital formerly used on the restricted land are used to farm the remaining productive land more intensely.

Gradually Decreasing Farm Prices and Increased Specialization Induced Asset Fixity

With increased farm surpluses despite new trade outlets, farm prices tended to decrease over the decade from 1955 to 1964. At the same time, the trend toward specialization in the farm sector has required investment in expensive durables such as large self-propelled grain combines, caged layer houses, milking parlors, feed storage and handling equipment in feed lots, and so forth. As farm enterprises moved toward specialization, the machinery and buildings involved became more specialized with fewer employment opportunities in alternative enterprises. These specialized durables were purchased on expectations of high long run (10 years of more) product prices. When the increased output caused by these capital inputs accumulated in government storage programs or depressed the market, product prices fell, lowering the earnings of durables such that their capital values were less than their high acquisition costs. With few alternative employment opportunities, the specialized durables remained in production, further increasing output and downward pressure on product prices.

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[1]See Hathaway, Government and Agriculture, pp. 302-310.

Specialization is a Double Edged Sword

One important impact of the technological revolution is that farmers now purchase a much larger per cent of inputs off the farm. Purchased inputs increased from 24 per cent of total inputs in 1917 to 57 per cent in 1964. While prices of nonfarm produced inputs are fairly stable over time, prices received by farmers fluctuate over inelastic demands for farm products. This in turn makes expendable capital inputs on farms susceptible to positive and negative rents and durable inputs susceptible to capital gains and losses.

Intra sectorial specialization represents the exercising of comparative advantage and increased efficiency. While the farmer's profit per unit is cut, he is able to produce a much larger quantity of the product for which he has a comparative advantage in producing. The nonfarm sector has exercised its comparative advantage in producing transportation, processing, advertising and retailing services. Improvements in these services have succeeded in increasing consumers' expenditures as well as in cutting the farmer's profit margin. In many cases, the additions to farm income from greater consumer expenditures add more to farm income than the reductions due to increased marketing and overhead costs.

Specialization according to comparative advantage has also taken place within the farm sector between farms and among regions. Often specialization of this kind leads to increased output with no changes in inputs or technology, where technology is defined as the discovery of a new input.

International Food Gap and the Viet Nam War Prevent Intolerable Surpluses

Again the farm sector's ability to expand output in response to favorable product prices threatened to exert critical pressure on government attempts to support farm prices. With record investments in livestock, buildings and farm machinery as well as inflated land prices, lower farm prices could have resulted in severe capital losses and a repeat of the post World War I farm depression. At any rate, in 1963 the per capita disposable personal income of the farm population was 63.1 per cent as large as that of the nonfarm population. And in the same year, the carry-overs of wheat, cotton, corn and dairy products were 1,195 million bushels, 11,216 million bales, 1,316 million bushels, and 12,691 million pounds respectively.[1]

The escalating Viet Nam war and concern over the international food gap make farm surpluses a valuable weapon, however, in both the hot and cold wars against communism. The United States military build up in Southeast Asia seems to indicate a determined effort to win a military victory against the Viet Cong and its communist allies in South Viet Nam. And there is constant danger that the conflict could spread to other parts of an already food deficit Southeast Asia. There is increasing concern over all food deficit areas of the world. Per capita grain production in less developed countries is now lower than it was prior to World War II, and trends in food trade indicate that underdeveloped countries are steadily losing the capacity to feed themselves.

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[1]U. S. Department of Agriculture, Handbook of Agricultural Charts. Agricultural Handbook No. 275 (Washington: U. S. Government Printing Office, 1964), p. 34.

Chronological Summary of Adjustment in the Farm Sector

The following is a chronological summary of the chronic adjustment problem in the farm sector, its symptoms, characteristics of the farm sector's environment which contribute to its development, and how the adjustment was alleviated.

Period	General Characteristics
World War I 1917-1920	Spurred by wartime demands of both the U. S. and our allies whose shipping lanes to such farm commodity exporting countries as Australia were cut off, resource commitment and output in the farm sector increased markedly in response to high farm prices. With no virgin lands left to open, land prices and farm indebtedness greatly increased. Farmers mistook the high wartime earnings of farm resources for long run expectations, invested heavily in durable capital, and the seeds for financial disaster were sown.
Post World War I Farm Depression 1921-1929	When the seaways were again open to Australia and other agricultural exporting countries, the world could no longer absorb our agricultural output. Farm prices were not supported by government programs, surpluses did not accumulate, and the fall of farm prices caused the large stocks of durables built up during World War I to be economically fixed in farming. A growing spirit of nationalism after World War I and the resulting trade restrictions severely limited the foreign markets for

Period	General Characteristics
	farm products, while above average weather enhanced yields and price depressing output. With no effective public action to take the burdensome production off the market, the atomistic firms in the farm sector reaped a disastrous harvest of financial losses.
General Depression 1930-1933	Monetary affairs of the economy caused a general collapse; despite meager attempts by the Farm Board to support farm prices, they continued to decline. Adverse weather worsened the farm problem and farmers began to realize what trade restrictions were doing to their foreign markets. Much of the excess stock of durables accumulated during World War I, however, was being used up by the end of 1933, and most farmers had either gone broke or weathered the depression.
Recovery 1934-1941	The "New Deal" era ushered in price supports for farm commodities during a period of general economic recovery, and adequate farm credit became generally available through public action. With long run expected farm prices tending to exceed realized long run prices, farmers again began to over-invest in durables. While the 1917-1921 build up of durables was caused by wartime demand and worked itself out in free markets with serious losses to farmers, the build up in durable capital in the late 1930's was caused by price support inspired

Period	General Characteristics
	expectations of favorable long run product prices. When prices sagged, the federal government's surplus accumulation and eventually World War II prevented a repeat of the post World War I farm depression.
World War II 1942-1946	Farmers responded to favorable product prices in meeting war needs for food and fiber. But they were fearful of over-investing after experiencing the post World War I depression. Long run farm product price expectations fell short of realized long run prices. Excessive stocks of durable capital did not build up during World War II due both to low product price expectations relative to actual prices and to production restrictions on nonfarm produced durables.
Post World War II Boom, Korean Conflict, and Adjustment 1947-1954	Post World War II prosperity, efforts to rebuild and feed western Europe, and the Korean conflict staved off an expected depression. The Steagall amendment had extended rigid wartime price supports with no adequate supply control. This caused expectations of continued high prices, and with wartime savings and credit, the farm sector invested heavily in productive capacity, especially nonfarm produced durables. Only the Korean conflict prevented growing surpluses from becoming intolerable and a farm depression. A trend toward freer world trade and PL 480 added support to the world market for farm products and reduced the pressure of surpluses on farm prices.

Period	General Characteristics
General Growth and Expansion 1955-1964	Continued price supports without adequate production controls and continued investment in new productive capacity and mounting surpluses occurred. But employment opportunities in the nonfarm sector for farm youth, a decline in the number of traditional family farms, and continued government and private efforts to aid underdeveloped countries lessened the burden of low earnings in the farm sector. Another military conflict, Viet Nam, combined with a growing international food gap make farm surpluses a valuable weapon in the hot and cold war rather than a burden. Nevertheless, symptoms are present for surplus induced pressure on farm prices as well as capital losses for owners of durable farm inputs in the event a reasonable solution to the Viet Nam war is found and the world food situation improves.

CHAPTER IV

ESTIMATION TECHNIQUES

In order to study adjustments in farm capital in Chapters V through VII, statistical techniques are required for estimating elasticities of production, marginal value products (MVPs), and capital values of inputs which are: 1) consistent with the economic theory of Chapter II and 2) permit dynamic variables to change over time in accordance with the historical perspective of Chapter III. The basic technique is a Nerlove type adjustment model which enables the derivation of production elasticities on an annual basis.[1]

Estimating Production Elasticities

Underlying firm production functions are assumed of the form:

$$(4.1) \quad Y = b_o X_1^{b_1} X_2^{b_2} \cdots X_n^{b_n} ;$$

where the b_i, $i = 1, 2, \ldots, n$, are elasticities of production Y with respect to inputs X_i and are constant over the production function. Such

[1]Marc Nerlove, Distributed Lags and Demand Analysis for Agricultural and Other Commodities. AMS, USDA, Agricultural Handbook No. 141, June, 1958. Fred H. Tyner and Luther G. Tweeten used adjustment models in estimating agricultural production parameters in "A Methodology for Estimating Production Parameters," Journal of Farm Economics, XLVII, No. 5 (December, 1965), pp. 1462-1467.

a Cobb-Douglas production function is usually estimated directly in log form using ordinary least squares regression analysis. But frequently, due to time series clustering around the expansion path, inputs are highly correlated and yield estimates of individual b_i that while unbiased, are unreliable. In other words, their probability of being the right estimates is reduced. Also, high correlations between included variables and excluded variables, while not increasing standard errors of included variables' coefficients, does bias estimates of the included variables' coefficients. And, when included variables are correlated with the error term, estimated coefficients are biased. Thus it would be beneficial to use estimating techniques which avoid these problems.

The Adjustment-Factor Share Technique

An alternative method of estimating elasticities of production is to employ a Nerlove type adjustment model on factor shares of inputs. This technique avoids correlation problems encountered in the direct least squares approach and lends itself to implementing the Johnsonian model.

Input use is at an equilibrium level if its marginal value product (MVP) is bound by its acquisition cost and salvage value.[1] Assuming

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[1]While I use the term MVP for simplicity, the relevant concept for durable inputs is the present value of future net marginal value products (capital value). In order to prevent the analytical technique from yielding elasticities with respect to the total stock of durables rather than that part used up in the current production period, a linear depreciation schedule is assumed, and the factor shares of durables are obtained by dividing the stock of durables by the expected life in years. The resulting MVPs of the flow of services from durables are capitalized into present values.

$Y = f(X_1, X_2, \ldots X_n)$, the equilibrium condition for each input X_i is:[1]

$$(4.2) \quad P_i^s \leq MVP_i \leq P_i^a ,$$

dividing through by P_y

$$(4.3) \quad P_i^s/P_y \leq MPP_i \leq P_i^a/P_y ,$$

or equivalently

$$(4.4) \quad P_i^s/P_y \leq \frac{\delta y}{\delta X_i} \leq P_i^a/P_y .$$

The elasticity of output Y, with respect to inputs X_i, i = 1, 2, ... n, is given by:

$$(4.5) \quad \eta_i = \frac{\delta y}{\delta X_i} \cdot \frac{X_i}{y} , \quad i = 1, 2, \ldots n .$$

If input use is expending, i.e., $MVP_i > P_i^a$, equilibrium will be reached when $MVP_i^y = P_i^a$, or $\frac{\delta Y}{\delta X_i} = P_i^a/P_y$. Thus, in an equilibrium resulting from an expansion adjustment, P_i^a/P_y is substituted for $\delta y/\delta X_i$ in (4.5) and the elasticity becomes:

$$(4.6) \quad \eta_i = \frac{P_i^a}{P_y} \cdot \frac{X_i}{Y} ;$$

which by definition is the factor share F_i of X_i in producing Y.

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[1] In the analysis which follows, only i subscripts are used to indicate factor relationships. That is, X_is are reserved to indicate quantities. Also all prices and quantities are for a current year t. Time superscripts are added when necessary to distinguish current from lagged values.

Similarly, if an input reaches equilibrium from a contracting adjustment, the elasticity of production is

$$(4.7)\quad \eta_i = \frac{P_i^s}{P_y} \cdot \frac{X_i}{Y} \quad .$$

Thus, the thesis uses estimated equilibrium factor shares as production elasticities, acquisition costs to value expanding inputs, and salvage values to value contracting inputs.[1]

The adjustment function:

$$(4.8)\quad F_i^t - F_i^{t-1} = g_i(F_i^{t*} - F_i^{t-1})$$

is used where g_i is the proportion of the desired adjustment $(F_i^{t*} - F_i^{t-1})$ accomplished in year t by the actual adjustment $(F_i^t - F_i^{t-1})$. Further assume the equilibrium factor share F_i^{t*} is some function:

$$(4.9)\quad F_i^{t*} = \alpha_o + \alpha_I I^{t-1} + \alpha_i P_i^{t-1} + \alpha_k P_k^{t-1} \quad ;$$

where

F_i^{t*} is the equilibrium factor share of input X_i in year t;

I^{t-1} is realized net income per farm in year t-1;

P_i^{t-1} is the price of input X_i relative to prices received by farmers for the product Y in year t-1; and

P_k^{t-1} is the price of an important substitute input relative to the price of the input X_i in year t-1.

Now the right hand side of (4.9) is substituted into (4.8) for F_i^{t*} and the result solved for F_i^t yielding:

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[1]When inputs are stable or contracting at less than or equal to depreciation rates, acquisition costs and salvage values are averaged for computing factor shares. Also, all overhead costs associated with keeping one unit of the input in production for one year are included in the price of the input for purposes of computing factor shares.

$$(4.10)\quad F_i^t = g_i\alpha_o + g_i\alpha_I I^{t-1} + g_i\alpha_i P_i^{t-1} + g_i\alpha_k P_k^{t-1} + (1 - g_i)F_i^{t-1} .$$

To permit a curvalinear relationship, equation (4.10) is fit in logarithm form. This requires an adjustment equation (4.8) of the form

$$(4.11)\quad \frac{F_i^t}{F_i^{t-1}} = \left(\frac{F_i^{t*}}{F_i^{t-1}} \right)^{g_i} .$$

In fitting time series data for each studied input to equation (4.10) in logarithm form, estimates of adjustment coefficients g_i are obtained by subtracting the estimate of the coefficient $(1 - g_i)$ of the lagged factor share F_i^{t-1} from one. Then plugging the estimated adjustment coefficients into equation (4.11), converting to logarithms, and solving for F_i^{t*} yields estimated logarithms of annual elasticities of output Y with respect to studied inputs X_is:

$$(4.12)\quad \text{Log } \hat{\eta}_i^t = b_i^t = \text{Log } \hat{F}_i^{t*} = \frac{1}{\hat{g}_i} \text{ Log } F_i^t - \frac{1 - \hat{g}_i}{\hat{g}_i} \text{ Log } F_i^{t-1} .$$

Anti-logarithms of the right hand side of (4.12) are the thesis estimates of the elasticity of production with respect to inputs X_i. Estimates of equation (4.10) in logarithm form for studied inputs, standard errors of estimated coefficients, $\bar{R}^2$s and estimated adjustment coefficients are presented in Appendix Table A.2. Sources of time series data on independent variables in equation (4.10) for studied inputs are in Appendix Table A.1. Appendix Table A.4 contains estimated salvage values.

Estimated annual production elasticities are in Appendix Tables B.1 to B.28 for studied capital inputs.

Actual Marginal Value Products and Ex Post Capital Values

Analysis of resource flows in the farm sector requires estimates of the value of inputs in production, that is, the present value of discounted future net marginal value products.[1] Given estimates of average production elasticities for farms, actual MVPs and ex post capital values are estimated using empirical techniques presented below. Estimates of actual MVPs and ex post capital values are to be found in Appendix Tables B.1 to B.28.

Marginal Value Products

From the underlying production function (4.1), input marginal value products are given by:

$$(4.13) \quad MVP_i = \frac{b_i YP_y}{X_i} \quad ;$$

where b_i is the elasticity of output Y with respect to X_i, YP_y the value of output, and X_i the quantity of input X_i.

Net Marginal Value Products

In obtaining capital values of inputs, it is necessary to subtract overhead costs from gross MVPs before they are capitalized. Using

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[1]Present values of discounted future net marginal value products are referred to in the thesis as capital values. These estimates are ex post capital values and, as such, they vary from capital values which actually existed at a point in time. The difference is that capital values which actually existed were by necessity based upon expectations while thesis estimates of capital values are based upon annual MVPs which actually materialized.

estimates of overhead costs C_i, net MVPs are obtained by:[1]

$$(4.14) \quad NMVP_i = MVP_i - C_i \ .$$

Ex Post Capital Values

Ex post capital values refer to the discounted lifetime earnings of an input. Being ex post values, these capital values are unknown to farm managers when production decisions are made. They are useful only in retrospect to estimate the consequences of over- or undercommitment of resources to the farm sector. Ex post capital values are estimated by discounting actual net marginal value products over the life of the input to ex post capital values:

$$(4.15) \quad CV_i^{t_o} = \sum_{t = t_o}^{t_o + n-1} \frac{NMVP^t \ \frac{CPI^{t_o}}{CPI^t}}{(1 + r^t)^{t-t_o+1}} \ ;$$

where $CV_i^{t_o}$ is the estimated actual value in year t_o dollars of one unit of X_i over its n year life in producing product Y discounted to year t_o. Multiplying each annual net marginal value product by the ratio of year t_o's consumer price index to year year t's consumer price index is required to obtain capital values in terms of year t_o dollars--price weights comparable to the year t_o price of the input X_i.

The Production Credit Association average cost of loans is used for a discount rate. This implies the Production Credit Association

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[1]No attempt is made to determine that portion of an input's MVP which is actually the product of other studied or unstudied inputs which is attributed to this particular input due to correlation among independent variables determining input factor shares and adjustment coefficients.

average cost of loans is equal to the opportunity cost of farm capital or a rate of return comparable to returns of similar resources in the non-farm sector. If an input's ex post capital value is equated with its acquisition cost, the marginal efficiency of capital for the investment is equated with the opportunity cost. If the ex post capital value of an input is less than its acquisition cost but greater than its salvage value, the investment actually earns less than enough to cover its acquisition cost over its lifetime, but remains in production until depreciated out of existence so long as its ex ante capital value does not fall below its salvage value.

Expected Marginal Value Products and Ex Ante Capital Values

Because farm managers base production decisions on comparisons between acquisition costs of inputs and their expected MVPs and ex ante capital values, estimates of expected or ex ante capital values are useful in determining the causes of over- or undercommitment of capital inputs to the farm sector.

In obtaining estimates of ex ante capital values, farmers are assumed to expect production elasticities are constant over the life of inputs. Also, input stocks are assumed constant over the expected life of inputs at their present year t_0 levels. It then follows that expected output remains constant and all that remains is to employ expectations of future product prices and overhead costs. Estimates of expected earnings are in Appendix Tables B.1 through B.28.

Expected Marginal Value Products

Actual gross MVPs are deflated by prices received by farmers and then multiplied by product price expectations to obtain expected gross marginal value product estimates:[1]

$$(4.16) \quad EMVP_i^t = MVP_i \frac{EP_n^t}{P^t} \quad ;$$

where P^t is the index of prices received by farmers for the commodity in year t and EP_n^t is Lerohl's expected product price for year t and the next n-1 years. This yields the average expected MVP for year t and the next n-1 years where n is the average life of the input.

Expected Net Marginal Value Products

Average expected overhead expenses for the next n years are estimated according to:

$$(4.17) \quad \hat{EC}_{i_n}^t = a_o + a_1 C_i^{t-1} + a_2 C_i^{t-2} \quad ;$$

where $\hat{EC}_{i_n}^t$ is the average expected overhead cost for input X_i for the years t to t + n - 1; n being the expected life of the input in years. C_i^{t-1} and C_i^{t-2} are estimates of actual overhead costs and a_o, a_1 and a_2 are estimated coefficients. Values of a_o, a_1 and a_2 for specific inputs are in Appendix Table A.3.

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[1]Lerohl's 1, 5, and 10 year product price expectation series are used depending on whether the input has a 1, 5, or 10 year average life respectively. For 1963 and 1964 product price expectations, Lerohl's mechanical price expectation models were used to obtain price expectation estimates. See Lerohl, op. cit.

Subtracting these overhead expenses from gross MVPs yields average expected net marginal value products for the n-year period.

$$(4.18) \quad ENMVP_{i_n} = EMVP_{i_n} - EC_{i_n} \ .$$

Ex Ante Capital Values

In obtaining ex ante capital values (ECV) of expected future net marginal value products, expected net MVPs derived by equation (4.18) are discounted according to:

$$(4.19) \quad ECV_{i_n}^{t_o} = \sum_{t = t_o}^{t_o+n-1} \frac{ENMVP_{i_n}^{t_o}}{(1 + r^{t_o})^{t-t_o+1}}$$

Economic Rent and Capital Gains or Losses

Economic rent and capital gains or losses are defined with respect to the relationship between the marginal factor flow and acquisition costs. For expendable inputs the difference between marginal value products and acquisition costs multiplied by the quantity yields estimates of economic rent. If MVPs are greater than acquisition costs, positive rents ensue and it would have been profitable to expand use of the input. When MVPs are less than salvage prices, inputs earned negative rents that would have been eliminated by contracting the input. Economic rents are estimated by:

$$(4.20) \quad ER_i = (MVP_i - P_i^a)X_i \ .$$

Durable inputs with ex post capital values greater than acquisition costs represent capital gains, and stocks of these inputs could have been profitably increased. When ex post capital values are less than

acquisition costs but greater than salvage values, owners of such durables sustained unavoidable capital losses. Durables with ex post capital values less than salvage values could have been salvaged to minimize capital losses.

The capital gain or loss for a durable input is the excess or deficiency of the durable's ex post capital value over its acquisition cost. To estimate the capital gains or losses to purchasers of a durable of a specific type in a specific year, the capital gain or loss per unit of the durable in a specific year should be multiplied by the total quantity acquired in that year. Then, in accordance with the assumption of linear depreciation over n years, $\frac{100}{n}$ per cent of the stock of durables can be assured to be replaced each year. Thus, if the capital gain or loss per unit of a durable is first multiplied by the total number of that type of durable on farms and then divided by the expected life of the durable, a rough estimate is obtained of the capital gains and losses eventually incurred, ex post, on the quantity of the durable acquired in that year. The actual formula used for the computation follows:

$$(4.21) \quad CG_i = (CV_i - P_i^a) \frac{X_i}{n} \quad .$$

Estimates of economic rents for expendable inputs and capital gains or losses for durable inputs are in Appendix Tables B.1 through B.28.

Data

A large quantity and variety of secondary data on capital inputs, output, and prices in the farm sector provided by the USDA is utilized in

the study. USDA publications used for specific data sources are listed in Appendix A. Problems associated with using available data are discussed below.

Capital Input Series

The real problem in measuring capital inputs is that physical capital assumes meaning within a given set of prices, and for a given technological and institutional framework. In the progressive United States economy, this meaning undergoes constant change. This point was amply illustrated by Alvin S. Tostlebe in his 1957 ground breaking study of durable capital in the U. S. farm sector.[1] The series developed by Tostlebe provide the basis for many of the current series on capital inputs in the farm sector.

Perhaps Zvi Griliches has written the largest number of articles criticizing capital input data. Griliches chastises the USDA for using commodity definitions in vague general terms as "most commonly bought by farmers." He estimates, for example, that "quality change" accounts for between one-third and two-thirds of the actual change in list prices of some automobiles in the periods 1937-50 and 1950-59.[2]

The thesis avoids the index problem so critical in measuring capital inputs in deflated expenditure series by measuring inputs where possible in numbers on farms. This makes the quality problem more explicit. In estimating machine numbers, for example, all machines,

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[1]Alvin S. Tostlebe, Capital in Agriculture: Its Formation and Financing Since 1870 (Princeton: National Bureau of Economic Research, Princeton University Press, 1957).

[2]Zvi Griliches, "Measuring Inputs in Agriculture: A Critical Survey," Journal of Farm Economics, XLII (December, 1960), p. 1411.

large or small, new or old, those used 1,000 hours and those not used at all, count as one. Some have attempted to measure such farm machinery as tractors in horsepower units, but progress in this direction is slow.

While Griliches endorses the declining balance method of depreciating capital inputs used by the USDA, he believes the rates of depreciation (trucks 21 per cent, tractors 18.5 per cent, and other farm machinery and equipment 14 per cent) are too high. Rather than using rates derived from used machinery prices, as Griliches suggests, the USDA decided on rates by the arbitrary criterion that the resulting rate depreciates the item to 5 per cent of its original value by the time its "useful" life is up.[1] Griliches believes that the USDA underestimates stocks of tractors by about 75 per cent, and other classes of machines are underestimated by varying smaller percentages.

The changing quality of capital inputs is not as critical as might be expected. Each year is, in effect, a separate study with production elasticities estimated on an annual basis. Inasmuch as the underlying Cobb-Douglas production function involves constant elasticities of production over all combinations of inputs, the annual differences in elasticities serve to shift the production function due to changing input quality. Although not the purpose of this study, a considerable contribution could be made to the measurement of technological advance by a careful analysis of the year to year changes in estimated production parameters.

Because each year of the analysis is essentially a separate study, with a particular input of one year of different quality from the same

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[1] Ibid., p. 1421.

input in name of another year, nominal input prices which reflect quality changes are used.

Flow vs. Stock Concepts.--Expendable inputs embody a stock of services that is completely used up in one period of the production process. Thus, whether we use stock or flow concepts in the case of expendables makes no difference--they are identical. But durables embody stocks of services that are used up or flow into the production process over more than one period of production. Durables, then, are measured either according to the annual flow of services derived from the stock, or the stock itself. There exists considerable controversy as to which concept--stock or flow--is the right one for estimating production functions. Sune Carlson argues that only flows of services should be included.[1] However, Smith argues:[2]

> The direct objects of adjustment or action parameters of the firm are (1) the current inputs to current production, and (2) the physical stocks of the various kinds of capital goods employed. The distinguishing characteristic of capital goods is simply that their presence, in the form of physical stocks, is required in order for production to take place.

Still another view is that provided by Nerlove in his treatment of both stocks and flows of durable factor services as variables in the production function.[3] In any given study, one input may be measured as a stock and another as a flow. What is important is to avoid measuring

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[1]Sune Carlson, A Study in the Pure Theory of Production (London: P. S. King and Sons, Ltd., 1939).

[2]Vernon L. Smith, "The Theory of Investment and Production," Quarterly Journal of Economics, LXXIII (February, 1959), pp. 65-66.

[3]Marc Nerlove, Time-Series Analysis of the Supply of Agricultural Products (Chicago: Workshop, Estimating and Interpreting Farm Supply Functions, January 20-22, 1960), pp. 33-38.

a stock and treating it as a flow or vice versa, unless measures are taken to convert one to the other.

By assuming a linear depreciation schedule, the thesis converts durable input stocks to flows of services in estimating production elasticities and derives capital values of annual flows of service from the durables over their expected life.[1]

Economic considerations important to a study of farm capital other than durability include degree of specialization and source of supply. All these factors are relevant to a classification of capital inputs initiated by Glenn Johnson and modified in the study. Table 4.1 contains the classification and the particular inputs studied in the production of aggregate farm output and specific commodity aggregates.

The durable vs. expendable classification is important for reasons already discussed. Farm produced as opposed to nonfarm produced source of supply is important due to the variability in supply prices. Prices of farm produced inputs are highly correlated with farm product prices and fluctuate much more than prices of nonfarm produced inputs. This in turn, ceteris paribus, makes 1) use of farm produced expendable inputs more variable than nonfarm produced expendables, and 2) farm produced durables less susceptible to prolonged capital gains or losses.

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[1]One important problem not investigated directly in the thesis is that while the stock of durable inputs may be economically fixed, the farm manager can change the rate of use of the input. The thesis assumes that inputs are used at a linear rate over their life span. This problem has only recently become apparent as a result of emphasis on asset fixity. Earlier analysts including J. M. Keynes and A. W. Lewis have considered "user cost" in relation to salvage values, but did not include a full analysis of the roles of both acquisition costs and salvage values. See J. M. Keynes, The General Theory of Employment, Interest and Capital (London: Macmillan and Co., 1942), pp. 23, 53, and the appendix starting on p. 66, and A. W. Lewis, Overhead Costs--Some Essays in Economic Analysis (London: George Allen and Unwin, 1949), p. 10.

TABLE 4.1.--Classification of studied capital inputs[1]

Production Situation	Input Classification							
	Durables				Expendables			
	Farm Produced		Nonfarm Produced		Farm Produced		Nonfarm Produced	
	Specialized	Unspecialized	Specialized	Unspecialized	Specialized	Unspecialized	Specialized	Unspecialized
	Studied Inputs							
Aggregate Farm	Horses and Mules		Tractors Grain Combines Pickup Balers Field Forage Harvesters Buildings and Land Improvements	Motor Trucks			Fertilizer	Gasoline Electricity
Beef		Brood Cows			Hay	Corn Heifers Steers		
Milk		Milk Cows			Hay	Corn Dairy Heifers		
Pork		Sows				Corn Feeder Pigs		
Poultry						Corn Chickens		
Wheat		Tractors Grain Combines						
Corn		Tractors Corn Pickers						

[1]In addition to these capital inputs, labor in each of the production situations listed above is analyzed in order to provide estimates of the marginal rates of substitution between studied capital inputs and labor.

The specialized vs. unspecialized categories in Table 4.1 refer to the farm sector; and, of course, some inputs are specialized in the production of a particular commodity. The more specialized an input, the less responsive its use is to economic change and the greater the likelihood of the durable inputs sustaining capital gains or losses.

Aggregation.--Input classifications outlined above would provide categories of inputs, which behave similarly with respect to MVPs, acquisition costs and salvage values, within which inputs could be aggregated. But because data is available on many individual inputs within these categories, and because farm price support programs are commodity oriented, individual inputs are studied separately. However, serious aggregation problems remain. In Chapter II, pages 35 to 37, it was pointed out that aggregating across individual firms and across inputs of different characteristics within the firm invalidated an aggregate production function for the farm sector. Thus, it is desirable to view thesis results as averages for the farm sector.

In aggregating across inputs of different ages, opportunity for analyzing such phenomena as the cattle numbers cycle are lost. However, by using average expected MVPs of beef and dairy cows, the thesis may estimate expected capital values of cows of different ages and compare these with acquisition costs and salvage values over the cattle cycle. Similar calculations are made for nonfarm produced durables.

In the thesis, known or suspected biases from aggregating across firms of different size, equity and managerial levels are handled on an ad hoc basis in interpreting thesis results.

Sources and/or estimating techniques of data series for the studied inputs listed in Table 4.1 are contained in Appendix Table A.1. Actual input series are presented in Appendix Tables B.1 through B.28.

Product Prices and Output

Time series of product prices and output are readily available in Agriculture Prices publications and Agricultural Statistics. Sources of price and output series used in the study and their variable identification codes are contained in Appendix A.

Input Prices

The acquisition costs used in the thesis are found in Appendix Tables B.1 through B.28 and salvage values in Appendix Table B.4. Sources of data and/or method of estimation are also contained in Appendix Table A.1. Because traditional research in agricultural economics is oriented around neo-classical economic theory of the firm, data on resource prices are not specific as to whether available price data represent acquisition or salvage prices. And with most price data representing farm values, it is often unclear as to whether they are acquisition, salvage or use values. These difficulties with input price data are also handled on an ad hoc basis in interpreting results.

The general estimating procedure for durable input prices follows these general guidelines: 1) The year 1955 is used as a base because a survey of farmers' expenditures in 1955 provides considerable cost information not available for other years. 2) 1955 base period prices of durables specialized to farming are multiplied by the relevant prices paid index converted to a 1955 = 100 base. The resulting series are used for the acquisition costs of durables specialized to farming. Zero

salvage values of durables specialized to farming are assumed. 3) Studied durables not specialized to farming include motor trucks, beef cows, and milk cows. Acquisition costs of these unspecialized durables and salvage values of motor trucks are computed similarly to acquisition costs of specialized durables. Salvage values of beef and milk cows are obtained by estimating their slaughter values based on average weights and prices of slaughter cows reported in livestock statistics. 4) Overhead expenses for maintaining durables in production are an important part of durable input costs. These overhead costs are estimated using data reported from the 1955 survey of farmers' expenditures, costs and returns of commercial farm series and relevant indices of prices paid by farmers.

Analyzing Thesis Results

Estimation techniques presented above are used to estimate economic variables useful in analyzing capital resource adjustment in the farm sector. Chapters V through VII use estimated MVPs and capital values to compare with input acquisition costs and salvage values in analyzing capital adjustment in the United States farm sector from 1917 to 1964. Analyses are developed in light of economic, technical, meteorological and political developments summarized in Chapter III. The limitations of static economics, available data and aggregation problems permit only general explanations of capital adjustment, while individual numbers remain questionable.

CHAPTER V

FARM PRODUCED DURABLE CAPITAL

Horses and mules, beef cows, and milk cows are the farm produced durables studied in the thesis. Horses and mules decreased in number continually from 1917 to 1964. Beef cow numbers contracted during the 1921-1929 period but have increased in number in every sub-period since then. Milk cow numbers increased during the farm and general depression years 1921 to 1933, then contracted in succeeding periods up to 1964 except for an increase during World War II.

Prices of farm produced durables are correlated very closely with prices received by farmers while prices paid for nonfarm produced durables are fairly independent of prices received. Average life expectancies for livestock are less than for many nonfarm produced durables, and when the expected future income stream of a beef or dairy cow falls short of the animal's value as a slaughter animal, the farmer can sell it in the nonfarm sector. Farmers typically salvage cows as slaughter animals rather than to let them expend their full lives in production. These considerations combine to make farm produced durable livestock less subject to economic fixity and capital losses than are nonfarm produced durables such as farm machinery which does not have employment opportunities in the nonfarm sector.

After the mid-thirties, employment opportunities in the nonfarm sector for horses and mules were largely limited to rendering plants, and the author assumes that horses and mules are specialized to the farm sector and have zero salvage values for the farm sector; an assumption that obviously causes some error. Slaughter values of beef and milk cows in the nonfarm sector are used as salvage values. Acquisition costs for livestock are the farm sector's cost of producing them as equated with the demands for livestock of both the farm and nonfarm economies.

Two problems particularly important in the cases of beef and milk cows are aggregating across: 1) animals of different productive life expectancies, and 2) individual farms of differing resource and management restrictions. In order to accommodate the broader Resources for the Future project at Michigan State University, the decision was made to cover a broader range of capital inputs in the thesis as opposed to more detailed analyses of a few inputs.

Because thesis estimates of annual average capital gains and losses resulting from durable livestock are based on average data and assume that the average animal will remain in production five years, annual average capital gains or losses are approximations. Farmers can be viewed as reappraising ex ante capital values, acquisition costs, and salvage values of livestock from time to time and adjusting numbers accordingly. It is assumed that they would not knowingly keep a horse or cow in production over a five year period whose ex ante capital value does not cover its salvage value. Nor would farmers fail to expand animal numbers if their ex ante capital values exceeded acquisition costs. Because dividing the number of animals by the five year average life to

obtain annual average capital gains or losses recognizes this reality in a rather superficial way, the thesis estimates may over- or underestimate the true capital gains or losses. Further, while horses and mules have few employment opportunities in the nonfarm sector, their salvage values have never been zero, even in recent years. Thus thesis estimates of the capital values of horses and mules are underestimated by at least the discounted value of the carcass at the time of salvage.

The Farm Production Credit Association (PCA) requires a large equity in assets on which loans are made. This indicates that the risk involved in financing durables is greater than that covered by the PCA interest rate. Thus, use of the PCA rate for capitalization purposes tends to overestimate capital values. Also, when herd sizes are increasing, either in beef or milk production, the market prices used in the thesis as acquisition costs, are more nearly acquisition costs. But when herd sizes are decreasing, the market prices are more nearly salvage values. Thus estimates of capital gains based on the difference of ex post capital values and market prices, are biased upward in periods of herd expansions and in periods of herd contractions capital losses are biased downward. As the true discount rate, acquisition costs, and salvage values are unknown, these problems also have to be handled on an ad hoc basis in interpreting the estimates of capital values and capital gains and losses.

On the average and somewhat superficially, the estimates indicate (in part because of the low PCA interest rates used) that beef and milk cows earned more over their productive life from 1917 to 1960 than farmers paid for them, forewent in not selling them, or spent in producing

them. On the other hand, horses and mules consistently had ex post capital values below acquisition costs even when the PCA interest rates were used. Attention is now directed toward examining capital values of, and adjustments in numbers of each durable livestock category.

Horses and Mules

Horse and mule employment on United States farms reached a peak of nearly 27 million head in 1918. Numbers then continually declined to about 3 million head in 1964 as mechanical power replaced horsepower. The 1.04 estimated adjustment coefficient for horses and mules indicates that the adjustment in factor shares expressed in logarithms was 104 per cent of the desired adjustment. Resulting production elasticities and estimates of ex ante capital values substantiate underadjustment in the short run. However, recognition of the influence of the PCA interest rate indicates even greater short run underadjustments, and perhaps, no long run overadjustment. The additions took place mainly through a decrease in acquisition with liquidation taking place mainly through aging; hence the short run underadjustment.

Thesis estimates, averaged over specified periods in Table 5.1, indicate that average lifetime earnings of horses and mules for specified periods ran well below acquisition costs from 1917 to 1946 and perhaps, above acquisition costs on the average for specified periods after 1946.[1] This indicates farmers overcommitted horses and mules to farm production prior to 1946. After World War II, horses and mules were not a

[1]Complete time series of thesis estimates for horses and mules are in Appendix Table B.6.

TABLE 5.1.--Horses and mules on farms: employment and earnings statistics for specified periods, United States, 1917-1960

Period	Average levels of:					
	Horses and mules on farms	Annual change in the number of horses and mules on farms	Acquisition cost of a horse or mule	Ex ante capital value[2/]	Ex post capital value[2/]	Annual average capital gains[2/]
	(-million head--)		(-dollars per head-)		(--mil. dol.--)	
1917-1920 World War I	26.40	-.50	107.25	169.35	68.80	-203.00
1921-1929 Post World War I Farm Depression	22.50	-.67	73.44	284.85	58.70	-68.00
1930-1933 General Depression	18.20	-.60	62.25	345.20	59.51	-11.00
1934-1941 Recovery	15.50	-.40	90.87	199.83	76.83	-44.00
1942-1946 World War II	12.50	-.60	85.40	89.81	82.94	-5.00
1947-1954 Post World War II Boom, Korean Conflict and Adjustment	7.40	-.79	63.25	121.75	78.35	16.00
1955-1960[1/] General Growth and Expansion	3.60	-.28	81.67	260.99	91.38	26.00

[1/] Ex post capital values and annual average capital gains are for 1955 to 1956.

[2/] See page 96 for a discussion of possible biases due to the use of PCA interest rates and the omission of the carcass value in the capital values.

significant input in farm production and estimates for that period are rather meaningless. Prior to World War II, horses and mules were apparently variable downward as their ex ante capital values fell short of acquisition costs and farmers received estimated capital losses. Offsetting the influence of the low PCA interest rate is the omission in the capital values of the carcass value of horses and mules to rendering plants.

The data in Table 5.1 indicate that as farmers contracted the use of horses and mules, capital losses decreased. The smaller number of horses and mules on farms came more nearly earning ex post capital values sufficient to cover acquisition costs. Ex ante capital values were greater than ex post capital values which resulted in capital losses. It is not possible to tell whether the capital values and capital losses for horses and mules are underestimated or overestimated. But inasmuch as it would take a very large increase in the discount rate to offset the omission of the carcass values of horses and mules in their capital values, it is likely that capital values are underestimated and capital losses are overestimated.[1]

Substitution of Mechanical Power for Horsepower

One of the great phenomena in the farm sector is the virtually complete transition from horsepower to tractor power. After reaching a

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[1]For example, if a 1,500 pound horse were worth 2 cents per pound for dog food, the carcass value discounted five years to the time of acquisition would be $20.42. Even if the discount rate were doubled from, say, 6 per cent to 12 per cent, the decrease in the ex post capital value of a horse which earned an annual MVP of $20 would only be $12.15. Thus in this example the net result of these two sources of bias would be to underestimate the capital value $8.27.

peak of nearly 27 million head in 1918, numbers of horses and mules continually declined to about 3 million head in 1964. The data on tractor prices and MPPs relative to horse and mule prices and MPPs presented in Table 5.2 partly explain this transformation.

TABLE 5.2.--Acquisition costs and MPPs of tractors relative to acquisition costs and MPPs of horses and mules, United States average values for specified periods, 1917-1960.

Time period	Cost of the services of one tractor relative to the cost of the services of one horse or mule	MPP of one tractor relative to the MPP of one horse or mule
	(--average values for specified time periods-)	
1917-1920 World War I	4.50	115.49
1921-1929 Post World War I Farm Depression	6.75	40.80
1930-1933 General Depression	7.55	45.90
1934-1941 Recovery	5.70	10.05
1942-1946 World War II	9.80	42.69
1947-1954 Post World War II Boom, Korean Conflict and Adjustment	15.35	13.03
1955-1960 General Growth and Expansion	15.05	8.00

Average data for 1917 to 1920 indicate that the price of the services of one tractor cost the equivalent of the services of 4.5 horses and mules. But our estimates indicate that one tractor could replace 115 horses and mules in aggregate farm production without altering output. The estimates in Table 5.2 indicate that as tractors have been substituted for horses and mules, relative prices decreased and relative MPPs increased. But with relative MPPs generally much larger than relative prices up to World War II, it is evident that horses and mules could not profitably substitute for tractors as a source of power.

The substitution of mechanical power for horsepower on United States farms has also led to a type of specialization. The nonfarm sector produces mechanical power units at lower costs relative to productivity than the farm sector can produce horses and mules. Thus farmers were provided with a more profitable source of power which, at the same time freed 77 million acres of cropland for producing food and fiber for human consumption.

Beef Cows

Beef cows present an opportunity in this thesis effort to recognize rather fully the divergences between input acquisition costs and salvage values. Salvage values are used to value beef cows in computing factor shares when their numbers are decreasing and acquisition costs when numbers are increasing. For 1921-1929, when beef cow numbers decreased on the average, relevant statistics appear more reasonable using estimated salvage values than they would using acquisition costs. Adequate data are not available to permit analysis of beef cows prior to

1921. Thesis estimates for beef cows from Appendix Table B.11 are averaged over specified periods in Table 5.3.

The relatively high .64 estimated adjustment coefficient for beef cows indicates that cattlemen respond fairly fast to changes in prices and productivity. In estimating that beef producers consistently earned capital gains while the total number of cattle on farms has continually cycled, thesis estimates indicate that: 1) use of the PCA interest rate resulted in capital values being overestimated, 2) adding the discounted value of a canner-cutter to the discounted annual net MVPs to obtain capital values also contributes to upward bias because some aged cows die before they are salvaged, and 3) much could be gained from an analysis of beef cow capital values according to age cohorts.

To illustrate the information that could be gained from a disaggregation by cohorts, thesis estimates of expected five year average net MVPs of beef cows are discounted and summed over the expected life of a six year old beef cow and a first calf beef heifer. These expected capital values are then compared with salvage values in the case of the six year old cow and acquisition costs in the case of the first calf heifer and a decision recorded as to whether the farmer would sell the animal or keep it in the herd.

These data on first calf heifers and six year old cows, presented in Table 5.4, are useful in interpreting thesis estimates of ex ante capital values of beef cows in relation to acquisition costs, salvage values, and the cattle numbers cycle. The drop in beef cattle prices at the close of World War I coincided with a peak in the cattle numbers cycle. Decreasing capital values relative to acquisition costs caused

TABLE 5.3.--Beef cows on farms: employment and earnings statistics for specified periods, United States, 1921-1964

Period	Average levels of:					
	Number of beef cows on farms	Annual change in the number of beef cows on farms	Acquisition cost	Ex ante capital value[2/]	Ex post capital value[2/]	Annual average capital gains[2/]
	(-million head--)		(-dollars per head-)		(--mil. dol.---)	
1921-1929 Post World War I Farm Depression	10.80	-.41	85.00	113.20	107.29	52
1930-1933 General Depression	10.20	.58	59.25	102.22	80.91	46
1934-1941 Recovery	11.00	.01	80.25	109.30	124.69	97
1942-1946 World War II	15.00	1.25	139.20	189.50	217.81	238
1947-1954 Post World War II Boom, Korean Conflict and Adjustment	19.10	1.08	237.87	281.27	284.99	176
1955-1964[1/] General Growth and Expansion	26.90	.68	217.80	259.14	287.93	366

[1/] Ex post capital values and annual average capital gains are for 1955 to 1960.

[2/] See pages 96 and 102 for indications of possible biases in capital values due to the use of FCA interest rates and the value of canner-cutter cows as a certain final addition to the annual MVPs.

TABLE 5.4.--Ex ante capital values of an average six year old beef cow and a first calf beef heifer, United States, 1921-1960[1/]

Year	General situation	Expected 5 yr. avr. net MVP of a beef cow	Six year old cow			First calf beef heifer		
			Ex ante capital value[2/]	Salvage value	Salvage or keep in herd	Ex ante capital value[3/]	Acq. cost	Sell or keep for brood cow
		(-----dol. per head-----)			(action)	(-dol. per head-)		(action)
1921		16	49	56	sell	89	59	keep
1922		13	46	61	sell	79	69	keep
1923		10	51	56	sell	76	72	keep
1924	Post World	14	65	58	keep	100	74	keep
1925	War I Farm	18	65	74	sell	110	81	keep
1926	Depression	18	53	78	sell	98	86	keep
1927		14	41	74	sell	76	95	sell
1928		26	43	81	sell	108	118	sell
1929		22	40	82	sell	95	111	sell
1930		20	37	71	sell	87	85	keep
1931	General	17	52	50	keep	95	60	keep
1932	Depression	13	44	33	keep	77	48	keep
1933		12	45	31	keep	75	44	keep
1934		6	44	36	keep	59	44	keep
1935		13	54	61	sell	86	76	keep
1936		13	56	61	sell	88	72	keep
1937	Recovery	14	63	69	sell	98	83	keep
1938		13	64	61	keep	97	81	keep
1939		11	68	59	keep	95	90	keep
1940		26	70	58	keep	135	92	keep
1941		22	76	76	keep	131	104	keep
1942		25	99	99	keep	149	122	keep
1943		28	113	109	sell	169	139	keep
1944	World War II	30	129	102	keep	189	130	keep
1945		28	117	110	keep	173	143	keep
1946		27	140	132	keep	194	162	keep
1947		38	182	176	keep	258	201	keep
1948	Post World	24	149	193	sell	197	250	sell
1949	War II	32	121	167	sell	221	222	sell
1950	Boom,	40	130	182	sell	250	261	sell
1951	Korean	49	149	219	sell	296	317	sell
1952	Conflict	49	141	190	sell	288	266	keep
1953	and	49	147	155	sell	294	192	keep
1954	Adjustment	39	156	152	keep	273	194	keep
1955		41	158	132	keep	281	192	keep
1956		22	129	125	keep	195	178	keep
1957	General	31	146	147	sell	239	201	keep
1958	Growth	46	165	180	sell	303	245	keep
1959	and	41	155	168	sell	278	245	keep
1960	Expansion	45	145	158	sell	280	231	keep

1/See pages 96 and 102 for explanations of possible upward biases in capital values due to the use of PCA interest rates in discounting and the value of canner-cutters as a certain final addition to the annual MVPs.

2/Six year old cows are assumed to have been in production 4 years and have, on the average, .5 year of productive life remaining prior to 1942 and 1 year remaining from 1940 to 1960.

3/First calf beef heifers are assumed to have an average 3 years of productive life remaining prior to 1950 and 4 years from 1940 to 1960.

a contraction of beef cows from 1921 to 1928 at an average rate of .41 million head per year. Ex post capital values were greater than acquisition costs on the average, and cattlemen received an average 52 million dollars per year capital gains on beef cows. In 1928, 1929 and 1930, however, ex post capital values were less than acquisition costs, and farmers received estimated annual average capital losses on beef cows in these years of 17, 30, and 13 million dollars respectively.[1] Table 5.4 indicates that based on thesis estimates, a farmer would have salvaged six year old cows in every year from 1921 to 1929 except in 1924 when the 65 dollar ex ante capital value was 7 dollars greater than the value of the cow as a canner-cutter cow. On the other hand, a beef heifer with an expected three year productive life would have been maintained in the herd from 1921 to 1926, but sold as a slaughter animal from 1927 to 1929.

By 1929, numbers of cattle and calves on farms were at their lowest level of any time from 1917 to 1964, and capital values of beef cows began to increase relative to acquisition costs. The cattle cycle began an upswing and from 1930 to 1933 cattlemen received an estimated 46 million dollars capital gains on beef cows as ex post capital values of beef cows averaged an estimated $21.66 greater than their average $59.25 acquisition cost. Table 5.4 indicates that according to thesis estimates of ex ante capital values, a cattleman would have been expected to keep both six year old cows and first calf heifers in production in every year of the general depression except six year old cows in 1930.

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[1]It should be remembered throughout this section that the capital gains are likely overestimated and capital losses underestimated due to biases in the ex post capital values discussed on pages 96 and 102.

Estimated ex post capital values of beef cows increased from $84.12 in 1934 to $162.68 in 1941 compared to an increase in acquisition costs from $44.00 in 1934 to $104.00 in 1941. A short downswing in the cattle cycle occurred from 1935 to 1937 with thesis estimates in Table 5.4 indicating that cattlemen were salvaging older cows but keeping first calf heifers with at least three year life expectancies in the herd. In 1939, the cattle cycle began a strong upswing, and Table 5.4 indicates that, according to ex post capital values, cattlemen should have begun keeping both heifers and older cows in the herd. With ex post capital values of beef cows averaging 129 to 191 per cent of acquisition costs from 1934 to 1941, cattlemen received an estimated average 97 million dollars annual average capital gains per year in this recovery period.

Cows and calves on farms continued to increase in number until 1945 in response to favorable ex ante capital values of beef cows relative to acquisition costs. And from an ex post view, capital values were even greater than expected during World War II, as indicated in Table 5.3. With five year average prices received by farmers for beef cattle during the war greater than expected, estimated annual average capital gains on beef cows increased from 134 million dollars in 1941 to 400 million dollars in 1947, averaging 238 million dollars per year from 1942 to 1946.

At the close of World War II, the cattle cycle took a short downturn from 1946 to 1948, prices received for beef cattle increased, and ex post capital values of beef cows increased from $211.25 in 1945 to an all-time high of $322.30 in 1947. The number of cattle and calves on farms began to increase in 1950 although thesis estimates indicate that capital gains on beef cows were decreasing and were negative in 1951 and 1952 due to low MVPs and low canner-cutter prices in the mid-1950's not

providing discounted capital values sufficient to cover the high acquisition costs of beef cows in 1951 and 1952. On the average, ex post capital values of beef cows were $47.12 greater than the $237.87 average acquisition cost from 1947 to 1954, and cattlemen received an estimated average 176 million dollars per year in annual average capital gains on beef cows as indicated in Table 5.3. But the reader should keep in mind the likely upward bias in the capital gains estimates.

Beef cow numbers, which were increasing at an average annual rate of .68 million head per year from 1955 to 1964, averaged 26.9 million head per year. Prices received by farmers for beef cattle were generally higher than expected and average ex post capital values of beef cows exceeded both ex ante capital values and acquisition costs. On the average, cattlemen received an estimated 366 million dollars annual average capital gains per year on beef cows from 1955 to 1960. Table 5.4 indicates that according to thesis estimates, cattlemen should have kept first calf heifers in the herd every year from 1952 to 1960 while only when the cattle cycle was on a strong upswing as in 1954 to 1956 was it profitable, according to ex ante capital values, to keep six year old cows in the herd.

Substitution of Feed for Beef Cows

Over time as feed has become relatively cheaper than beef cows, feed has been substituted for cows. Although beef cows increased in number 163 per cent from their average numbers during the post World War I farm depression to their average number during 1955 to 1964, corn fed to beef cattle increased 300 per cent over the same time periods.

TABLE 5.5.--Costs and MPPs of corn relative to acquisition costs and MPPs of beef cows, United States average values for specified periods, 1921-1964

Time period	Acquisition cost of one ton of corn relative to the acquisition cost of the services of one beef cow	MPP of one ton of corn relative to the MPP of one beef cow
	(----average values for specified time periods----)	
1921-1929 Post World War I Farm Depression	1.68	2.03
1930-1933 General Depression	1.40	1.38
1934-1941 Recovery	1.65	2.26
1942-1946 World War II	1.53	1.47
1947-1954 Post World War II Boom, Korean Conflict and Adjustment	1.19	1.24
1955-1964 General Growth and Expansion	.95	1.05

Table 5.5 illustrates the substitution of corn for beef cows. On the average from 1921 to 1929, the price of one ton of corn could purchase the services of 1.68 beef cows. But one ton of corn would substitute for the services of 2.03 beef cows. Thus it was profitable to breed beef cattle that could convert corn to beef more efficiently and feed more corn to fewer cattle. Over time the price of corn has declined relative to the price of beef cows and while both inputs have increased due to demand expansion, more corn is being fed relative to the number of beef cows.

From 1955 to 1964, average data indicate that while the price of corn relative to beef cow acquisition costs had decreased to .95 from its 1.68 average value in 1921-1929, the resulting substitution of corn for beef cows caused the MPP of a ton of corn relative to the MPP of a beef cow to decrease to 1.05 from its average value of 2.03 during 1921-1929.

Milk Cows

Milk cows on farms reached one peak in numbers in 1934, then declined until the late 1940's; increased to an all-time high of 27.8 million head in 1955; then decreased steadily to 18.1 million head in 1964. Although milk cows can be salvaged as slaughter animals in the nonfarm sector, their numbers do not cycle as much as beef cattle. As much more capital is required for dairy barns and milking parlors than for beef cattle, milking herds are maintained at more uniform levels than beef herds.

The persistent decrease in numbers of milk cows after 1945 is partially due to increases in the milk producing capacity per cow. The only way the increased quality of milk cows is accounted for in the thesis is through increased cow prices. Sufficient data for analyzing milk cow employment and earnings are not available prior to 1921. Thesis results for milk cows from Appendix Table B.16 are summarized in Table 5.6. The ex ante capital values of a six year old milk cow and a first calf dairy heifer are presented in Table 5.7. Estimates for milk cows are probably biased for the same reasons cited earlier in the case of beef cows. The use of PCA interest rates in discounting, use of market

TABLE 5.6.--Milk cows on farms: employment and earnings statistics for specified periods, United States, 1921-1964

Period	Average levels of:					
	Number of milk cows on farms	Annual change in the number of milk cows on farms	Acquisition cost	Ex ante capital value 2/	Ex post capital value 2/	Annual average capital gains 2/
	(--million head-)		(-dollars per head-)		(--mil. dol.---)	
1921-1929 Post World War I Farm Depression	22.20	.14	74.11	101.43	99.53	113
1930-1933 General Depression	24.40	.88	53.50	84.72	73.73	98
1934-1941 Recovery	25.30	-.06	60.00	96.36	129.03	264
1942-1946 World War II	27.10	.22	121.60	158.29	190.82	375
1947-1954 Post World War II Boom, Korean Conflict and Adjustment	24.00	-.32	211.00	252.57	250.00	188
1955-1964 1/ General Growth and Expansion	20.78	-.58	219.50	240.81	262.16	251

1/ Ex post capital values and annual average capital gains are for 1955 to 1960.

2/ See pages 96 and 102 for indications of possible upward bias in capital values and capital gains due to the use of PCA interest rates and the value of canner-cutters as a certain final addition to the annual MVPs.

TABLE 5.7.--Ex ante capital values of an average six year old milk cow and a first calf dairy heifer, United States, 1921-1960[1/]

Year	General situation	Expected 5 yr. avr. net MVP of a milk cow	Six year old cow: Ex ante capital value[2/]	Six year old cow: Salvage value	Six year old cow: Salvage or keep in herd	First calf dairy heifer: Ex ante capital value[3/]	First calf dairy heifer: Acq. cost	First calf dairy heifer: Sell or keep for milk cow
		($ per head)			(action)	($ per head)		(action)
1921		12	53	53	keep	77	65	keep
1922		14	54	48	keep	82	59	keep
1923		9	55	50	keep	73	61	keep
1924	Post World	13	71	50	keep	97	61	keep
1925	War I Farm	12	68	52	keep	92	64	keep
1926	Depression	11	55	59	sell	77	72	keep
1927		13	47	67	sell	73	82	sell
1928		26	56	81	sell	108	99	keep
1929		15	44	85	sell	74	104	sell
1930		14	41	67	sell	74	82	sell
1931	General	13	57	46	keep	83	56	keep
1932	Depression	9	47	33	keep	65	40	keep
1933		7	46	30	keep	60	36	keep
1934		5	46	29	keep	56	36	keep
1935		10	57	42	keep	77	52	keep
1936		9	58	47	keep	76	58	keep
1937		10	66	51	keep	86	62	keep
1938	Recovery	19	77	51	keep	115	62	keep
1939		11	73	53	keep	95	64	keep
1940		11	68	55	keep	90	67	keep
1941		17	82	64	keep	116	79	keep
1942		19	93	81	keep	131	99	keep
1943		23	108	103	keep	154	125	keep
1944	World	22	121	96	keep	165	118	keep
1945	War II	25	114	100	keep	164	122	keep
1946		14	127	118	keep	155	144	keep
1947		29	173	137	keep	231	167	keep
1948	Post World	30	155	167	sell	215	204	keep
1949	War II	41	130	166	sell	212	202	keep
1950	Boom,	40	130	178	sell	210	218	sell
1951	Korean	43	143	222	sell	229	271	sell
1952	Conflict	34	126	219	sell	194	267	sell
1953	and	37	135	159	sell	209	195	keep
1954	Adjustment	34	151	134	keep	219	164	keep
1955		22	139	131	keep	183	160	keep
1956	General	24	131	138	sell	179	168	keep
1957	Growth	31	146	149	sell	208	183	keep
1958	and	49	168	189	sell	266	231	keep
1959	Expansion	40	164	210	sell	234	256	sell
1960		35	135	201	sell	205	245	sell

1/See pages 96 and 102 for explanations of possible upward biases in capital values due to the use of PCA interest rates in discounting and the value of canner-cutters as a certain final addition to annual MVPs.

2/A six year old milk cow is assumed to have been in production 4 years and is expected to have 1 year of productive life remaining.

3/A first calf dairy heifer is expected to have 3 years of productive life remaining.

prices as acquisition costs,[1] and the use of the market value of a canner-cutter as a certain final addition to the annual MVPs cause both ex post and ex ante capital values to be overestimated, capital gains to be overestimated, and capital losses to be underestimated.

Milk cow numbers averaged 22.2 million head per year from 1921 to 1929 and estimated ex post capital values increased from $89.30 in 1921 to a period high of $119.83 in 1925, and then decreased to $79.84 in 1929. Ex post capital values of milk cows while, on the average, less than expected, averaged $25.42 more than the $74.11 average acquisition cost. Estimated annual average capital gains on milk cows were 104 million dollars in 1921, increased to 252 million dollars in 1925, and then decreased to 108 million dollars capital losses in 1929 despite the upward bias in ex post capital values. Table 5.7 indicates that ex ante capital values of a six year old milk cow warranted keeping the cow in the herd from 1921 to 1925 while the cow should have been salvaged as a canner-cutter from 1926 to 1929. A first calf dairy heifer could have profitably been kept in the herd in every year from 1921 to 1929 except 1927 and 1929 according to estimated ex ante capital values in Table 5.7.

Capital values of milk cows were generally lower during the general depression of 1930 to 1933 than they were in the 1921 to 1929 period as indicated in Table 5.6. But acquisition costs of milk cows were at record lows, and dairymen received an estimated 98 million dollars annual average capital gains on milk cows per year from 1930 to 1933 although 53 million dollars capital losses were estimated for 1930.

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[1]The market prices of milk cows were increased 10 per cent to account for the generally younger age and higher quality of cows being acquired for the producing herd.

Estimates of ex ante capital values in Table 5.7 indicate that dairymen were justified in keeping both six year old cows and first calf heifers in the producing herd in every year of the general depression except 1930. Ex ante capital values of milk cows were generally less than ex post capital values during the depression as indicated by the average data in Table 5.6. Apparently there was less culling of milk cows from 1930 to 1933 because milk cow numbers increased and milk production per cow decreased. The result was a decrease in the net marginal value product of an average dairy cow from $15.13 in 1930 to $6.66 in 1933.

In 1935 slaughter values began to increase and dairymen began culling older and less productive cows from their herds. As a result milk production per cow began to increase as did ex post capital values of milk cows. By 1938 dairy herds were reduced such that the higher producing cows remaining earned capital values that were $56.60 greater than their $62 acquisition cost. Ex post capital values of milk cows were generally higher than acquisition costs from 1934 to 1941 as indicated in Table 5.6, and dairymen received an estimated average 264 million dollars per year in annual average capital gains on milk cows.

With capital values of milk cows staying well above acquisition costs going into World War II, milk cow numbers increased to an all-time high of 27.8 million head by 1945. According to Table 5.7, dairymen were probably keeping older cows in the herd as well as adding younger stock. Estimated ex post capital values of milk cows increased from $163.19 in 1942 to $225.63 in 1946 compared to an increase in acquisition costs from $99 in 1942 to $144 in 1946. Dairymen received an estimated average 375 million dollars per year in annual average capital gains on milk cows from

1942 to 1946 as they increased the number of milk cows an average .22 million head per year.

The most significant development in dairying after World War II was the continually decreasing number of milk cows. With dairymen breeding up milk producing capacity and culling low producers, milk production per cow increased steadily from 4,886 pounds in 1946 to 7,880 pounds in 1964, with total milk production also increasing. Table 5.7 indicates that dairymen's expectations about capital values of dairy cows were such that only in 1947 and 1955 did ex ante capital values justify keeping a six year old cow in the herd another year. Also, in 5 of the 14 years from 1947 to 1960, expectations did not even warrant the keeping of a first calf dairy heifer with an expected four year productive life.

Capital gains on milk cows, according to thesis estimates, decreased from 631 million dollars in 1947 to 210 million dollars capital losses in 1952 as the acquisition cost of an average milk cow increased from $167 in 1947 to $267 in 1952. Capital gains increased to 404 million dollars in 1955 and then decreased to 27 million dollars in 1960, the last year for which estimates were made.

Substitution of Feed for Milk Cows

The substitution of feed for livestock discussed above for beef cows is even more pronounced in milk production. By 1955-1964, the number of milk cows on farms had decreased by 24 per cent from their average 27.10 million head World War II level while corn fed to dairy cattle increased 35 per cent from its annual average 9.05 million tons during World War II. Table 5.8 illustrates the reason for and the result of the substitution of feed for milk cows.

TABLE 5.8.--Costs and MPPs of corn fed to dairy cattle relative to prices and MPPs of milk cows, United States, 1921-1960

Time period	Cost of one ton of corn relative to the price of the services of one milk cow	MPP of one ton of corn relative to the MPP of one milk cow
	(--average values for specified time periods---)	
1921-1929 Post World War I Farm Depression	1.96	3.09
1930-1933 General Depression	1.59	6.76
1934-1941 Recovery	2.17	6.49
1942-1946 World War II	1.70	2.29
1947-1954 Post World War II Boom, Korean Conflict and Adjustment	1.35	1.64
1955-1960 General Growth and Expansion	1.05	1.34

Average data for 1921 to 1929 indicate that the price of one ton of corn could purchase the services of 1.96 milk cows. But one ton of corn could replace 3.09 milk cows with output of milk held constant. Thus in the post World War I farm depression it was profitable to substitute corn for milk cows. Over time, as the price of corn has decreased relative to the acquisition cost of milk cows, the incentive to breed animals that are more efficient at converting feed to milk and to substitute corn for milk cows increased. By 1955-1960, the price of

corn relative to the acquisition cost of milk cows had decreased to 1.05 and the MPP of a ton of corn relative to the MPP of a milk cow had decreased to 1.34 as corn was substituted for milk cows. But relative MPPs still greater than relative prices indicates the process of substitution will continue.

This concludes the analysis of farm produced durable capital except for the summary and conclusions in Chapter VIII. Chapter VI focuses on analyzing employment and earnings of nonfarm produced durable capital.

CHAPTER VI

NONFARM PRODUCED DURABLE CAPITAL

Farmers must base their decisions concerning the purchase of farm machinery, motor trucks, and buildings on long run expectations about product prices and other important variables. Since estimates of farmers' 5 and 10 year average product price expectations presented in Chapter III were greater than actual 5 and 10 year average product prices received by farmers from 1917 through the general depression and after World War II, even under price support programs, the incentive was present for farmers to overinvest in nonfarm produced durables.

Whereas several farm produced durables, although subject to adjustment problems, have employment opportunities in the nonfarm economy, nonfarm produced durables, with the exception of motor trucks, are specialized to the farm sector. Once a piece of farm machinery is committed to farming, its employment opportunities in the nonfarm sector are usually limited to scrap iron. The machine will remain in farming, although its rate of use and capital value may be quite low in periods of unrealized expectations, with owners receiving capital losses. The average farmer may buy new or used machines and may pass on potential capital losses to other farmers or machinery dealers by selling used machines. But the farm sector cannot escape potential capital losses in

farm machinery. Aggregate numbers of farm machines increase only through a flow of new machines from nonfarm industries that more than offsets the number of scrapped machines. In the case of buildings, considerable expense may be involved in clearing buildings that are no longer in use.

Tractors in aggregate farm, corn, and wheat production; grain combines in aggregate farm and wheat production; corn pickers in corn production; and pickup balers, field forage harvesters, buildings and motor trucks in aggregate farm production are the nonfarm produced durable inputs studied in the thesis. Nonfarm produced durables show average employment increases during each specified period with the following exceptions: tractors in corn production from 1955 to 1964; tractors in wheat production from 1934 to 1941; and buildings from 1917 to 1920, 1930 to 1941, and 1947 to 1954.

A combination of factors make it difficult to estimate capital values of farm machinery and buildings. In addition to aggregating across inputs of different age and across farms with different asset and managerial restrictions, the ability to change the productive life span of nonfarm durables through changes in rate of use and maintenance are particularly important. Technical relationships such as the substitution of machinery for labor and the complementarity between different types of machines, are not fully accounted for in estimating elasticities of production, as constant annual elasticities of production are assured with respect to inputs. This, for reasons given on page 129, should cause the MVPs of labor and land substitutes to be underestimated, at least in the early stages of their introduction. Also, the upward bias in estimates of capital values caused by the use of PCA interest rates (which are lower than the true discount rate) in capitalizing annual MVPs, discussed on

page 96 with respect to farm produced durables, is also present in the estimates of capital values of nonfarm produced durables. The estimates do not adequately account for these and other problems, and results for nonfarm produced durables are subject to errors. However, when the estimates are interpreted carefully on an ad hoc basis they are consistent enough with economic theory and characteristics of the farm sector to warrant certain significant conclusions about the use and earnings of these important inputs.

Tractors

In Chapter V, MPPs and acquisition costs of tractors in aggregate farm production relative to those of horses and mules indicated that horses and mules can not profitably compete with tractors as a source of farm power. While horses and mules were an important source of power, their ex post capital values were consistently less than their acquisition costs. In providing a superior source of farm power, tractors have consistently had ex ante and realized ex post capital values greater than acquisition costs and provided capital gains.

Tractors are very complementary with plows, harrows, grain drills, and other implements. Thus, general excess of ex post capital values of tractors over their acquisition costs is logically attributable to the productivity of complementary machines being attributed to tractors. The use of PCA interest rates in discounting would also contribute to upward bias in estimated capital values of tractors. Estimates for tractors from Appendix Table B.1 are averaged over specified periods in Table 6.1.

Average data for specified periods in Table 6.1 illustrate the impact which unrealized expectations have on the number of tractors on

TABLE 6.1.--Tractors in aggregate farm production: employment and earnings statistics for specified periods, United States, 1917-1964

Period	Average levels of:					
	Number of tractors on farms	Change in the number of tractors on farms	Acquisition cost of a new tractor	Ex ante capital value[2/]	Ex post capital value[2/]	Annual average capital gains[2/]
	(-million tractors--)		(--dollars per tractor---)			(mil. dol.)
1917-1920 World War I	.14	.06	966	27,461	11.626	128.04
1921-1929 Post World War I Farm Depression	.57	.06	980	5,643	3,550	114.17
1930-1933 General Depression	.99	.05	931	6,648	2,187	120.92
1934-1941 Recovery	1.31	.08	1,020	1,861	2,897	248.71
1942-1946 World War II	2.18	.16	1,664	5,435	2,592	194.60
1947-1954 Post World War II Boom, Korean Conflict and Adjustment	3.48	.22	1,862	3,594	2,377	147.34
1955-1964[1/] General Growth and Expansion	4.61	.04	2,391	2,256	1,918	-47.10

[1/] Ex post capital values and annual average capital gains are for 1955 only.

[2/] See page 119 for explanations of possible upward biases in the estimates of capital values and capital gains. These biases would cause capital losses to be underestimated. Negative capital gains are capital losses.

farms and their earnings. If estimates of tractor capital values are biased upward, as the discussion on page 119 indicates, then capital gains for tractors are overestimated and capital losses underestimated.

In World War I, both ex post and ex ante capital values for tractors were greater than acquisition costs. However, the capital gains estimate of 128.04 million dollars per year on tractors in aggregate farm production is undoubtedly much too high. In the post World War I farm depression, ex post capital values decreased more than ex ante capital values, then stayed higher than acquisition costs while annual average capital gains decreased to an overestimated average of 114.17 million dollars. The number of tractors on farms increased an average .06 million tractors per year from 1917 to 1929. During the general depression, ex post capital values were less than ex ante capital values but greater than acquisition costs. Though the excess of ex post capital values over acquisition costs decreased, the increasing number of tractors on farms caused capital gains to increase to an average $120.92 million dollars per year; in 1932, capital gains decreased to a low 14.6 million dollars. This figure may be overestimated so much that the true value may be negative.

In the recovery period of 1934 to 1941, ex ante capital values of tractors were, on the average, less than ex post capital values due to high MVPs during World War II discounted to ex post capital values. Capital gains, however, increased sharply to an overestimated average of 248.71 million dollars per year from 1934 to 1941. World War II caused ex ante capital values of tractors to increase sharply to an average $5,435 from 1941 to 1946, and the number of tractors on farms increased .16 million tractors per year. Low MVPs in the later years of World

War II and after the war discounted to capital values during World War II caused ex post capital values to average only $2,592 per tractor. This, however, was considerably greater than the average $1,664 acquisition cost, and capital gains averaged an overestimated $194.6 million per year from 1941 to 1946.

After World War II, price support programs, the cold war, and the Korean conflict kept ex ante capital values from decreasing as fast as ex post capital values, when increasing surpluses caused farm prices to decrease following the Korean conflict. Even as estimated, herein, capital gains decreased to an average $147.34 million from 1947 to 1954. In 1955, when the ex post capital value of a tractor in aggregate farm production was $1,918 compared to an ex ante value of $2,256 and an acquisition cost of $2,391, farmers received an estimated $47.10 million capital losses on tractors on farms. This loss is probably underestimated significantly.

Tractors in Corn and Wheat Production

By assuming that tractors are perfect complements to land, the number of tractors used in corn and wheat production were estimated. The resulting employment and earnings estimates from Appendix Tables B.25 and B.27 for tractors in corn and wheat production respectively are averaged over specified periods in Tables 6.2 and 6.3.

These estimates indicate that ex post and ex ante capital values of tractors in corn and wheat production behave similarly to those of tractors in aggregate farm production, except that capital values of tractors in corn production are generally lower than those in aggregate farm production and capital values of tractors in wheat production are

TABLE 6.2.--Tractors in corn production: employment and earnings statistics for specified periods, United States, 1917-1964

Period	Average levels of:					
	Number of tractors in corn production	Change in the number of tractors in corn production	Acquisition cost of a new tractor	Ex ante capital value[2]	Ex post capital value[2]	Annual average capital gains[2]
	(--million tractors---)		(--dollars per tractor---)			(mil. dol.)
1917-1920 World War I	.04	.02	966	23,755	8,276	27.14
1921-1929 Post World War I Farm Depression	.16	.02	980	5,275	2,683	26.56
1930-1933 General Depression	.33	.03	931	6,573	2,276	42.53
1934-1941 Recovery	.41	.02	1,020	1,939	2,027	42.32
1942-1946 World War II	.58	.02	1,664	1,959	2,744	62.26
1947-1954 Post World War II Boom, Korean Conflict and Adjustment	.70	.03	1,862	4,075	2,796	60.12
1955-1964[1] General Growth and Expansion	.83	-.01	2,391	2,083	2,099	5.84

[1] Ex post capital values and annual average capital gains are for 1955 only.

[2] See page 119 for explanations of possible upward biases in the estimates of capital values and capital gains.

TABLE 6.3.--Tractors in wheat production: employment and earnings statistics for specified periods, United States, 1917-1964

Period	Average levels of:					
	Number of tractors in wheat production	Change in the number of tractors in wheat production	Acquisition cost of a new tractor	Ex ante capital value[2/]	Ex post capital value[2/]	Annual average capital gains[2/]
	(---1,000 tractors----)		(--dollars per tractor---)			(mil. dol.)
1917-1920 World War I	25.10	13	966	4,059	3,177	5.72
1921-1929 Post World War I Farm Depression	101.80	13	980	2,728	1,697	7.09
1930-1933 General Depression	204.60	33	931	4,222	1,321	6.76
1934-1941 Recovery	294.30	-7	1,020	1,232	1,135	3.32
1942-1946 World War II	245.90	10	1,664	1,154	1,530	-2.78
1947-1954 Post World War II Boom, Korean Conflict and Adjustment	330.40	0	1,862	2,119	2,109	8.18
1955-1964[1/] General Growth and Expansion	337.40	8	2,391	2,215	2,306	8.76

[1/] Ex post capital values and annual average capital gains are for 1955 only.

[2/] See page 119 for explanations of possible upward biases in the estimates of capital values and capital gains.

generally less than those in corn production. Capital values of tractors in corn and wheat production which are less than those of tractors in aggregate farm production emphasize the importance of utilizing the versatile farm tractor in several farm enterprises. The lower capital values of tractors in wheat production reflect the larger overproduction of wheat. If it were not for differing climate and soil requirements for corn as opposed to wheat, farmers in the wheat belt would grow more corn and less wheat.

Substitution of Tractors for Labor[1]

While the total index of inputs committed to farming has not changed much from 1917 to 1964, the composition of farm inputs has changed drastically. The index of farm labor decreased from 223 in 1917 to 79 in 1964 while the index of mechanical power and machinery increased from 28 in 1917 to 101 in 1964; both indices are on a 1957-59 = 100 basis.

Acquisition costs and MPPs of tractors in aggregate farm production relative to the farm wage rate and MPPs of labor for specified periods from 1917 to 1964 averaged over specified periods in Table 6.4 illustrate both the reason for, and result, of this substitution of tractors for labor on United States farms.[2]

Relative prices presented in Table 6.4 indicate that during World War I, the price of 1,000 hours of labor would purchase the services of 3 tractors. Relative MPPs, however, indicate that only .20 tractor

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[1]The substitution of tractors for horses is examined in the previous chapter.

[2]Labor MVPs were estimated using the same techniques employed by the thesis in estimating capital MVPs and are presented in Appendix Table A.5.

TABLE 6.4.--Acquisition costs and MPPs of labor relative to acquisition costs and MPPs of tractors in aggregate farm production, United States average values for specified periods, 1917-1964

Time Period	Cost of 1,000 hours of labor relative to the cost of the services of one tractor	MPP of 1,000 hours of labor relative to the MPP of the services of one tractor
	(--average values for specified time periods---)	
1917-1920 World War I	3.00	.20
1921-1929 Post World War I Farm Depression	2.83	1.79
1930-1933 General Depression	2.08	2.63
1934-1941 Recovery	1.93	2.02
1942-1946 World War II	3.14	6.89
1947-1954 Post World War II Boom, Korean Conflict and Adjustment	3.95	1.50
1955-1964 General Growth and Expansion	4.01	2.32

services were required to replace 1,000 hours of labor in production with output remaining constant. Thus, it was profitable for farmers to substitute tractors for labor.

Since 1917, the farm wage rate has increased relative to the acquisition costs of tractors, as indicated in Table 6.4. As tractors have been substituted for labor, the MPP of labor has been increasing

relative to the MPP of tractor services. In the period 1955 to 1964 the MPP of 1,000 hours of labor relative to the MPP of a tractor's services in aggregate farm production had increased to 2.32. But the cost of 1,000 hours labor relative to the cost of the services of a tractor had increased to 4.01. Thus the profit incentive to substitute tractors for labor remained. Ex post realized capital values of tractors relative to the acquisition cost of tractors, however, indicates that the tendency is not toward more tractors. Rather, the move is toward fewer but larger tractors. Tractor data indicate this tendency is underway with tractors on farms decreasing in number every year since 1961 and horsepower per tractor increasing from 34.8 in 1961 to 42.2 in 1965. The increased size of tractors is a form of substitution of tractor power for labor, as fewer operators are required to operate a given level of tractor horsepower. Prices and MPPs of other farm machines relative to the farm wage rate and MPPs of labor also indicate profitable substitution of nonfarm produced durables for labor.

In terms of the economic model presented in Chapter II, "area 5" of the factor-factor diagram in Figure 2.3 on page 30 has shifted toward zero with respect to labor and away from zero with respect to tractors over the respective time periods considered in Table 6.4. Area 5 has shifted toward zero with respect to labor due both to 1) the higher acquisition and salvage values of labor equating with a lower quantity of labor on a given MVP schedule, and 2) the MVP schedule of labor decreasing as more substitute tractors are employed. Area 5 has shifted away from zero with respect to tractors due to increases in the MVP schedules of tractors from both 1) increased quality and size of tractors and 2) the employment of less tractor-substituting labor.

Generally, in each of the specified time periods, the average farm has been organized in area 9 of Figure 2.3, page 30. Labor has been variable downward, and tractors variable upward. Here, the farm wage rate, used to price labor in this thesis, is viewed as the salvage value of labor inasmuch as a wage much closer to the industrial wage rate would have to be paid to attract a net flow of labor into the farm sector. However, during World War I, the general depression, and World War II, it appears that the average farm was organized in area 6 as on the average, the discounted MVP of labor, while certainly less than the industrial wage rate, was greater than the farm wage rate. In 1931 during the depression, labor on farms increased due to large scale unemployment in the nonfarm sector. Data for 1955 indicate that the average farm was organized in area 8 with labor variable downward and tractors economically fixed.

Grain Combines

Whereas versatile tractors are employed in many different land preparation, planting and harvesting operations for all crops, grain combines are specialized in harvest operations for a few crops. Most of the year combines sit idle. Grain combines are labor saving much more than horse- or mechanical power saving. Though the thesis estimates indicate superficially that the brief annual employment does not justify numbers of combines on farms from a profit maximizing viewpoint for the average farm, these estimates must be interpreted with care.[1] The

[1]Of course, the thesis estimates do not account fully for such factors as timeliness of operation, utility gained from owning nice machinery and other subjective factors.

estimates from Appendix Table B.3 for combines in aggregate farm production and from Appendix Table B.28 for combines in wheat production, in Tables 6.5 and 6.6 respectively, are averaged over specified periods.

Ex post capital values of combines consistently less than acquisition costs for specified period averages in Tables 6.5 and 6.6 are to be expected from a specification error in the estimation of factor shares for labor saving machines, such as grain combines. Because of the large range of substitutability between labor saving machines and labor, these machines should be measured in terms of a common denominator such as a "labor equivalent." The MVP of a labor equivalent would then be equal whether it was derived from a combine or from labor. When the two substitute inputs are measured separately, the factor share of the one used is unbiased only when none of the other input is used. In the case of combines gradually being substituted for labor, the factor share and the resulting capital values of combines depend not only on the labor equivalents derived from combines, but also on the labor equivalents provided by labor. For the earlier years of the study when few combines were employed relative to labor, the factor shares were small, and derived MVPs and capital values of combines were underestimated. The downward bias has likely been reduced, as the potential for substituting combines for labor has tended to be exhausted to a point at which labor and combines are more complementary. In earlier years, this downward bias is thought to have been so great as to more than offset the upward bias in capital values of combines caused by using PCA interest rates in discounting MVPs. This reasoning and these comments also apply to other labor saving machines discussed later in the chapter.

TABLE 6.5.--Grain combines in aggregate farm production: employment and earnings statistics for specified periods, United States, 1917-1964

Period	Average levels of:					
	Number of grain combines on farms	Change in the number of grain combines on farms	Acquisition cost of a new combine	Ex ante capital value[2/]	Ex post capital value[2/]	Annual average capital gains[2/]
	(--1,000 combines--)		(--dollars per combine--)			(mil. dol.)
1917-1920 World War I	3.50	1	1,708	1,453	1,912	.08
1921-1929 Post World War I Farm Depression	32.40	6	1,729	2,761	1,737	+.05
1930-1933 General Depression	80.50	11	1,646	3,009	1,510	-1.34
1934-1941 Recovery	160.50	16	1,719	1,939	1,319	-6.42
1942-1946 World War II	347.00	39	1,959	1,526	1,854	-3.13
1947-1954 Post World War II Boom, Korean Conflict and Adjustment	740.80	68	3,142	2,950	2,710	-37.73
1955-1964[1/] General Growth and Expansion	1,020.50	5	4,193	3,292	2,772	-74.22

[1/] Ex post capital values and annual average capital gains are for 1955 only.

[2/] See page 129 for possible downward bias in estimates of capital values and upward bias in estimates of capital losses.

TABLE 6.6.--Grain combines in wheat production: employment and earnings statistics for specified periods, United States, 1917-1964

Period	Average levels of:					
	Number of combines in wheat production	Change in the number of grain combines in wheat production	Acquisition cost of a new combine	Ex ante capital value[2/]	Ex post capital value[2/]	Annual average capital gains[2/]
	(--1,000 combines---)		(-dollars per combine--)			(mil. dol.)
1917-1920 World War I	.60	.02	1,708	4,443	1,901	.01
1921-1929 Post World War I Farm Depression	5.80	.95	1,729	1,520	1,401	-.18
1930-1933 General Depression	14.00	2.15	1,646	2,517	1,350	-.43
1934-1941 Recovery	28.00	2.47	1,719	1,536	1,255	-1.32
1942-1946 World War II	55.80	5.46	1,959	1,201	1,619	-1.85
1947-1954 Post World War II Boom, Korean Conflict and Adjustment	111.30	10.00	3,142	2,026	2,529	-7.39
1955-1964[1/] General Growth and Expansion	167.00	2.80	4,193	2,594	2,800	-10.91

[1/] Ex post capital values and annual average capital gains are for 1955 only.

[2/] See page 129 for possible downward bias in estimates of capital values and upward bias in estimates of capital losses.

Only during World Wars I and II, for grain combines in aggregate farm production, and World War II, for grain combines in wheat production, were ex post capital values of grain combines estimated to be greater than ex ante capital values. The estimates, thought too low for reasons given above, indicate that only during World War I and the post World War I farm depression (for combines in aggregate farm production) and during World War I (for combines in wheat production) did ex post capital values cover acquisition costs. Careful interpretation indicates, however, that these estimates of capital values of combines which are consistently less than acquisition costs for specified period averages in Tables 6.5 and 6.6 do not necessarily indicate irrationality on the part of farmers: 1) With the exception of the two world war periods, the ex ante capital estimates were such that the true ex ante capital values could easily have been large enough to cover acquisition costs. 2) From 1946 to 1948 when combine numbers increased sharply, realized ex post capital values of combines in aggregate farm production were estimated to be greater than acquisition costs. Large commercial farms and custom operators could employ combines on enough acres that their realized capital values are sufficiently larger than those enjoyed by the average farm, making the purchase of new machines from the nonfarm sector profitable while capital values of combines on average and below average farms do not cover acquisition costs.

Given the apparent downward bias in ex post capital values caused by the input specification bias in measuring factor shares of good substitutes, interpretation of estimates for combines indicate the following.

Ex ante capital values during World War I are underestimated and were approximately equal to acquisition costs. With the slight increase in the number of combines on farms, ex post capital values exceeded acquisition costs during World War I, and farmers received some capital gains. In the 1921-1929 period, average product price expectations were not realized, ex ante capital values on grain combines exceeded acquisition costs, and the number of combines on farms increased at an average rate of 6 thousand machines per year. Ex post capital values fell short of those expected, but were slightly higher than acquisition costs, with small capital gains resulting.

Actual product prices continued to lag expected product prices during the general depression from 1930 to 1933. Ex ante capital values exceeded acquisition costs and the average rate of increase in the number of combines on farms increased to 11 thousand machines per year. Ex post capital values may have fallen short of acquisition costs by 1932 with some capital losses resulting. As the economy recovered from the depression, expected capital values exceeded acquisition costs and the number of combines on farms increased an average of 16 thousand machines per year. Ex post capital values fell short of expectations, and farmers received some capital losses on combines that were probably less than those estimated.

During World War II, with the strong substitution of machines for labor, both the ex ante and ex post capital values of combines are underestimated. The number of combines on farms increased sharply, and ex post capital values were probably sufficient to cover acquisition costs. The estimated capital losses may actually have been zero or possibly small positive values.

Following World War II, farmers increased the number of combines sharply in response to ex ante present values that, if corrected for apparent downward bias, likely exceeded acquisition costs. Actual product prices received by farmers, however, fell short of expected product prices, and ex post capital values of combines probably failed to cover acquisition costs. This situation prevailed from 1947 to 1955, the last year for which estimates of ex post capital values were possible. Some underestimation of capital values of combines since World War II may have occurred due to the input specification bias. By the early 1950's, labor and combines probably enjoyed more of a complementary relationship and the capital loss estimates for grain combines since World War II appear more reasonable.

Corn Pickers

Corn producers consistently increased investments in corn pickers from 1917 to the present from an average 7 thousand corn pickers on farms during World War I to an average of 772.3 thousand pickers on farms in 1955-1964. (See Appendix Table B.26 and Table 6.7.) However, the large increases in numbers of corn pickers on farms began to occur during World War II.

Table 6.7 also illustrates that viable commercial farms or custom operators can profitably purchase new corn pickers from the nonfarm industry. With no employment opportunities in the nonfarm sector, corn pickers, once purchased, remain in farming. In 1920, 1921, 1931, 1937 and 1949, the estimated ex ante capital values of corn pickers were larger than acquisition costs.

TABLE 6.7.--Corn pickers: employment and earnings statistics for specified periods, United States, 1917-1964

Period	Average levels of:					
	Number of corn pickers on farms	Change in the number of corn pickers on farms	Acquisition cost of a new corn picker	Ex ante capital value[2/]	Ex post capital value[2/]	Annual average capital gains[2/]
	(-1,000 machines--)		(--dollars per machine--)			(mil. dol.)
1917-1920 World War I	7.00	2.00	666	826	531	-.09
1921-1929 Post World War I Farm Depression	30.00	4.00	673	564	564	-.31
1930-1933 General Depression	59.00	5.50	643	934	518	-.76
1934-1941 Recovery	95.50	6.50	670	608	489	-1.74
1942-1946 World War II	157.00	16.60	762	418	681	-1.17
1947-1954 Post World War II Boom, Korean Conflict and Adjustment	470.40	57.12	1,227	833	1,027	-10.96
1955-1964[1/] General Growth and Expansion	772.30	17.78	1,630	1,097	1,097	-19.14

[1/] Ex post capital values and annual average capital gains are for 1955 only.

[2/] See page 129 for possible downward bias in estimates of capital values and upward bias in estimates of capital losses.

Estimated ex post capital values consistently less than acquisition costs, except for 1946 and 1947, resulted in corn producers receiving capital losses on corn pickers ranging from a low of .06 million dollars in 1917 to a high of 19.14 million dollars in 1955. However, when the estimates of capital values are interpreted in view of the specification bias for substitutes discussed on page 129, it appears that: 1) corn pickers were employed at levels approximately equating acquisition costs with ex post capital values up to, and including most of World War II; 2) in the latter part of World War II and the early post World War II period, ex ante capital values lagged ex post capital values, and ex post capital values were sufficient to cover or exceed acquisition costs with small capital gains resulting; 3) after World War II, ex post capital values of corn pickers were slightly less than acquisition costs, with some overcommitment of corn pickers and capital losses following.

Pickup Balers and Field Forage Harvesters

Pickup balers and field forage harvesters represent recent advances in farm machinery technology. While the modern farm tractor maintains a design and method of operation roughly similar to the tractor of the 1920's, pickup balers and field forage harvesters did not begin to realize their potential until shortly before and after World War II, with important improvements in design and function still forthcoming. Data on pickup balers are available beginning in 1942 and on field forage harvesters in 1945. Thesis estimates for pickup balers from Appendix Table B.4 are averaged over specified periods in Table 6.8, and estimates for field forage harvesters from Appendix Table B.5 are averaged over specified periods in Table 6.9.

TABLE 6.8.--Pickup balers in aggregate farm production: employment and earnings statistics for specified periods, United States, 1943-1964

Period	Average levels of:					
	Number of pickup balers on farms	Change in the number of pickup balers on farms	Acquisition cost of a new pickup baler	Ex ante capital value[2/]	Ex post capital value[2/]	Annual average capital gains[2/]
	(--1,000 machines--)		(--dollars per machine--)			(mil. dol.)
1943-1946 World War II	40.30	8	1,260	2,131	6,186	20.33
1947-1954 Post World War II Boom, Korean Conflict and Adjustment	220.50	43	1,994	10,643	5,676	53.12
1955-1964[1/] General Growth and Expansion	641.30	38	2,656	3,382	2,892	29.23

[1/] Ex post capital values and annual average capital gains are for 1955 only.

[2/] See page 138 for possible biases in the estimates.

TABLE 6.9.--Field forage harvesters in aggregate farm production: employment and earnings statistics for specified periods, United States, 1947-1964

Period	Average levels of:					
	Number of harvesters on farms	Change in the number of harvesters on farms	Acquisition cost of a new harvester	Ex ante capital value[2/]	Ex post capital value[2/]	Annual average capital gains[2/]
	(--1,000 machines---)		(--dollars per machine---)			(mil. dol.)
1947-1954 Post World War II Boom, Korean Conflict and Adjustment	95.60	19	1,558	90,445	31,119	159.16
1955-1964[1/] General Growth and Expansion	278.00	17	2,075	4,761	4,149	48.45

[1/] Ex post capital values and annual average capital gains are for 1955 only.

[2/] See page 138 for possible biases in the estimates.

The specification bias for substitute inputs discussed previously with respect to labor and other machinery inputs was evidently not present to a significant degree in the cases of pickup balers and field forage harvesters. Labor has enjoyed a more complementary relationship with machinery in recent periods in which data are available on pickup balers and field forage harvesters. Estimates of capital values for pickup balers and field forage harvesters are overestimated rather than underestimated. A very low .09 estimated adjustment coefficient for field forage harvesters causes the derived MVPs, capital values, and capital gains to be high. Use of PCA interest rates also caused the capital values of both pickup balers and field forage harvesters to be overestimated. Even after admitting these sources of large upward bias, the estimates still indicate that despite significant increases in the number of pickup balers since 1943 and field forage harvesters since 1947, these machines have had ex post capital values exceeding acquisition costs and resulting capital gains for their owners through 1955.

According to estimates of prices and MPPs of labor relative to those of farm machines, similar to those estimated in Table 6.4 for tractors, pickup balers and field forage harvesters, as well as grain combines and corn pickers, have been profitable substitutes for labor.

Buildings

In the rapidly changing structure of American agriculture, there is perhaps no better example of the occurrence of economic fixity than the case of farm buildings. Methods of depreciation and measurement provide only rough estimates of the value of buildings on farms. Further, part of the buildings on farms may be abandoned or used as nonfarm

dwellings or enterprises, although remaining in the estimated stock of farm buildings.

Because buildings may last an indefinite period, the techniques used in this thesis are not capable of yielding good estimates of ex post MVPs, capital values, and capital gains and losses. As a 10 year planning horizon is reasonable, ex ante 10 year average MVPs and capital values may be reasonable indications of the profitability of investments in buildings. Unlike the case for shorter lived investments, the PCA interest rate is not considered to be too low a discount rate for use in obtaining ex ante capital values of investments in farm buildings. Thesis estimates of elasticities of production, expected MVPs, and ex ante capital values of investments in farm buildings from Appendix Table B.7 are averaged over specified periods in Table 6.10.

In response to favorable farm prices during World War I, farmers increased their investment in farm buildings. The value of farm buildings averaged 5.53 billion in constant 1910-1914 dollars from 1917 to 1920, increasing an average .09 billion in constant 1910-1914 dollars per year. The ex ante capital value of a dollar invested in buildings averaged $1.20 during this World War I period which is consistent with this expansion in investment.

According to Lerohl's estimates, expected 10 year average product prices did not decrease in this period as fast as actual product prices. On the basis of estimated ex ante capital values of a dollar invested in farm buildings of $1.80 per year from 1921 to 1929, farmers increased investments in farm buildings. During the depression, from 1930 to 1933, farmers decreased investments in farm buildings an estimated .226 billion

TABLE 6.10.--Buildings in aggregate farm production: employment and earnings statistics for specified periods, United States, 1917-1964

Period	Average levels of:		
	Constant 1910-1914 dollar value of farm buildings	Change in constant 1910-1914 dollar value of farm buildings	Ex ante capital value
	(----------million dollars----------)		($ per $)
1917-1920 World War I	5,528	+94.67	1.20
1921-1929 Post World War I Farm Depression	7,303	256.33	1.80
1930-1933 General Depression	8,169	-226.00	2.68
1934-1941 Recovery	7,131	-47.12	.56
1942-1946 World War II	7,159	246.60	.43
1947-1954 Post World War II Boom, Korean Conflict and Adjustment	6,821	-131.12	.74
1955-1964 General Growth and Expansion	6,867	34.80	.53

dollars per year. Due to unreasonably large estimates of production elasticities from 1930 to 1932, the estimated ex ante capital values of investments in farm buildings are unreasonably high and are inconsistent with a decrease in investment.

Ex ante capital values of investments in farm buildings seldom justified investments after the general depression. Investments in terms of constant 1910-1914 dollars have not been large, with averages for specified periods in Table 6.10 being negative in the recovery period of 1934 to 1941 and in the 1947 to 1954 period, but positive during World War II and from 1955 to 1964. Only in 1938, 1944, 1950, 1952 and 1954 was the ex ante capital value of a dollar invested in farm buildings greater than one dollar. In each of these years, except 1950, there was an increase in the constant dollar value of buildings on farms.

Motor Trucks

Farm trucks are nonfarm produced durable capital not specialized to farming. Farmers may purchase new or used trucks from the nonfarm sector and if farm earnings drop below used truck prices, they can sell used trucks in the nonfarm sector. Versatile motor trucks are used in almost all farm enterprises and in a variety of different operations within many enterprises. Thesis estimates for motor trucks in aggregate farm production from Appendix Table B.2 are averaged over specified time periods in Table 6.11.

From 1931 through 1939, in 1947, and after 1948 the ex post capital value of a new motor truck was less than its acquisition cost. But in 1931, 1932, 1934, 1936, 1938, 1949 and from 1952 to 1955, the ex ante capital value of a new truck exceeded its acquisition cost. This leaves the years 1933, 1935, 1937, 1939, 1947, 1950, 1951, and after 1955 in which new trucks were not profitable either from an ex post or an ex ante viewpoint according to estimated capital values of new trucks.

TABLE 6.11.--Motor trucks in aggregate farm production: employment and earning statistics for specified periods, United States, 1917-1964

Period	Average levels of:				
	Number of trucks on farms	Change in the number of trucks on farms	Acquisition cost of a new truck	Ex ante capital value	Ex post capital value
	(----1,000 trucks----)		(------dollars per truck------)		
1917-1920 World War I	99.8	26	1,042	1.821	1,723
1921-1929 Post World War I Farm Depression	491.30	78	831	2,223	1,068
1930-1933 General Depression	898.8	6	772	1,802	645
1934-1941 Recovery	985.3	29	827	1,043	757
1942-1946 World War II	1,373.0	91	1,231	951	1,280
1947-1954 Post World War II Boom, Korean Conflict and Adjustment	2,221.5	133	1,900	1,951	1,720
1955-1964[1/] General Growth and Expansion	2,806.8	31	2,413	1,912	1,647

[1/] Ex post capital values are for 1955 only.

Table 6.12 indicates that assuming a used truck remained productive four years, its ex ante capital value would cover its acquisition cost in all of the years in which new trucks appeared unprofitable except 1935, 1939, 1951, 1958 and 1961. In 1935, the number of trucks on farms only increased

TABLE 6.12.--Ex ante capital values and acquisition costs of used motor trucks, United States, 1917-1964

Year	Acquisition cost of a used motor truck	Ex ante capital value of a used motor truck	Year	Acquisition cost of a used motor truck	Ex ante capital value of a used motor truck
	(-----dollars per truck-----)			(-----dollars per truck-----)	
			1941	298	186
1917	233	419	1942	316	127
1918	298	768	1943	322	1,136
1919	304	928	1944	334	699
1920	316	1,463	1945	334	405
1921	304	5,041	1946	346	408
1922	275	823	1947	394	555
1923	280	339	1948	460	1,074
1924	298	499	1949	519	1,396
1925	292	493	1950	531	786
1926	292	899	1951	573	518
1927	298	618	1952	591	1,008
1928	292	700	1953	597	1,002
1929	292	338	1954	597	1,013
1930	292	1,287	1955	597	1,042
1931	286	1,604	1956	621	948
1932	275	548	1957	657	1,071
1933	263	87	1958	680	505
1934	275	471	1959	710	1,130
1935	280	113	1960	728	853
1936	286	502	1961	746	578
1937	292	334	1962	764	941
1938	304	1,206	1963	776	826
1939	298	70	1964	794	1,222
1940	292	1,056			

2 per cent and in 1939 the number of trucks on farms decreased by 2 per cent. In 1951 the ex ante capital value of a used truck would have covered its acquisition cost if its expected life were extended to 5 years and in 1958 and 1961 if its expected life were extended to 6 years. Thus, while thesis estimates for farm trucks are crude, they are generally consistent with changes in the number of trucks on farms, especially when

Lerohl's product price expectations are employed to estimate ex ante capital values. Ex post capital values of used trucks were not estimated because the proportion of farm trucks purchased as used trucks each year is not known. And since farmers often purchase used trucks, it is not possible to use thesis techniques in estimating capital gains and losses for farm trucks.

Table 6.11 illustrates the impact that World War I, the general depression, World War II, and the decade from 1955 to 1964 (with mounting farm surpluses and gradually decreasing farm prices) had on capital values and employment of motor trucks in farm production.

During World War I, ex ante capital values of new trucks were greater than acquisition costs and the number of trucks on farms increased an average 26 thousand trucks per year from 1917 to 1920. In the general depression from 1930 to 1933, ex ante capital values of new trucks decreased but remained greater than acquisition costs. The rate of increase in trucks on farms decreased to 6 thousand trucks per year with total truck numbers actually decreasing in 1932 and 1933. World War II caused the ex post farm capital value of trucks to exceed acquisition costs although the ex ante capital values averaged less than acquisition costs. Inconsistent with this price relationship, the number of trucks on farms increased an average 91 thousand trucks per year. Since World War II, mounting farm surpluses and the resulting lower farm prices have caused ex post capital values of farm trucks to fall short of ex ante capital values and acquisition costs. From 1947 to 1954, the $1,720 average ex post capital value of a new truck in aggregate farm production was $231 less than the average ex ante capital value and $180 less than the average

acquisition cost. Increases in the number of motor trucks on farms have continually decreased from 1948 to 1964 such that the stock of motor trucks on farms is stabilizing.

This concludes the analysis of nonfarm produced durables except for the summary and conclusions found in Chapter VIII. Marginal value products and employment of expendables are discussed in Chapter VII.

CHAPTER VII

EXPENDABLE FARM CAPITAL

The term expendable as used in this thesis refers to those farm and nonfarm produced capital inputs that are generally "used up" in one production period when committed to the production process. Some expendables are specialized to farm production while others have employment opportunities in the nonfarm sector. Expendables may also be stratified according to whether they are farm produced or nonfarm produced, and whether they are storable or nonstorable.

There are two important differences in the economics of farm produced as opposed to nonfarm produced expendables. First, prices of farm produced expendables fluctuate rather closely with prices received for farm products, whereas, prices of nonfarm produced expendables tend to be independent of farm prices. This tends to lessen the occurrence of rents for farm produced expendables. Second, nonfarm produced expendables are typically purchased as they are used, while the use of farm produced expendables is more dependent upon the quantity produced. This second consideration makes farm produced expendables more susceptible to rents than nonfarm produced expendables and overshadows the lessening of rents on farm produced expendables due to their acquisition costs fluctuating with product prices. This observation is substantiated by the generally higher estimated adjustment coefficients of nonfarm

produced expendables (simple average of .90) than of farm produced expendables (simple average of .49). It is also supported by more widely fluctuating estimates of rents, positive and negative, on farm produced expendables.

Nonstorable expendables are not subject to economic fixity inasmuch as their services are either used or lost. The flows of service from some kinds of durable capital or family labor are of this nature. None of the inputs studied in this thesis fit this definition exactly, but some of the livestock inputs come rather close. Feeder pigs, for example, must be fed in a relatively short period after they are weaned or they lose much of their potential as feeder pigs. Storable expendables are more susceptible to economic fixity and rents, especially when they are also specialized to the farm sector such as in the case of hay.

The simple average of .55 for the estimated adjustment coefficients for studied expendables indicates farmers' ability to adjust their use rapidly in response to economic change. When estimated adjustment coefficients are high, the estimated MVPs, by the nature of the calculation, must be close to acquisition costs. As shall be seen later, not all estimated adjustment coefficients for expendables are large.

Durable inputs were found in Chapters V and VI to be very susceptible to adjustment problems and resulting capital gains and losses. But according to thesis results, farmers apparently adjust the productivity of fixed durables by (1) feeding fixed livestock close to profit maximizing (or loss minimizing) quantities of feed and (2) adjusting the rate of use of machinery by using close to profit maximizing (or loss minimizing) quantities of expendable complements such as gasoline. In

short, they carry out the loss minimizing adjustments to the edge of area 5 as discussed in Chapter II on theory.

Estimated MVPs of most studied expendables are generally quite close to acquisition costs. There is a slight, but rather consistent excess of acquisition costs over ex post MVPs which are discounted for six months. This excess, and the resulting small to moderate negative rents estimated for many expendables may be due to: 1) the failure of farmers to discount expected MVPs of expendable inputs in making production decisions,[1] or 2) the practice followed in the thesis of using market values, which include marketing charges, as acquisition costs of expendables which are used on the farm or in the locality where produced.

Estimates for some expendables do yield MVPs that fluctuate around acquisition costs and are apparently subject to positive and negative rents. For these inputs, it appears to be a combination of (1) unreasonably low adjustment coefficients and (2) the lack of available data on acquisition costs versus salvage values which forced the use of a single price. Expendables such as hay have widely different acquisition costs and salvage values and are subject to economic fixity. The finding of rents for some expendables may also indicate that expendables are under- or overcommitted with complementary durables which were out of adjustment.

Differences in the relative movements of acquisition costs, discounted expected MVPs, and discounted ex post MVPs of expendables

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[1]MVPs of expendables are discounted for six months, which is a reasonable estimate of the time farmers have expendable capital tied up in the production cycle. The PCA interest rate is used in discounting, and whether or not it is the true discount rate makes little difference in the estimates.

over respective time periods were small. Average levels of estimated MVPs and rents, over specified time periods, for expendables, similar to the data presented in tabular form in the previous two chapters for durables, would not add significantly to the discussion. Rather, the estimates for expendables, from Appendix B, are interpreted in summary fashion.

Farm Produced Expendables

Steers, heifers, corn and hay in beef production; heifers, corn and hay in milk production; sows, feeder pigs, and corn in hog production; and chickens and corn in poultry production are the farm produced expendables studied in the thesis. Hay is specialized to the farm sector and thus its nonfarm opportunity cost is zero. The other farm produced expendables studied have opportunities in the nonfarm and export markets. While thesis estimates indicate that most farm produced expendables are quite variable, fluctuating rents, both positive and negative, estimated for corn and hay fed to dairy cows, hogs and poultry indicate that corn and hay are often economically fixed within their production cycle. This tendency of farm produced expendables to be variable tends to shift the incidence of price changes on rents and capital values back to the durable inputs with widely different acquisition costs and salvage values--mainly land, buildings, machinery, operator and family labor, and such farm produced durables as orchards.

Farm Produced Expendables in Beef Production

Steers and Beef Heifers.--Estimates for steers and heifers in beef production from Appendix Tables B.12 and B.13 respectively indicate that

these inputs are subject to fewer adjustment problems than are beef cows. The estimates of discounted MVPs for these inputs were nearly equated with acquisition costs from 1917 to 1964.

Numbers of steers fluctuate slightly over the cattle numbers cycle and trend upward as the demand for beef increases over time. But the depression of 1930 to 1933, World War II, the post World War II boom, and the post Korean conflict slump in farm prices caused major fluctuations in steer prices and MVPs. Ex post dis-MVPs of steers decreased from $82.26 per head in 1928 to $26.12 per head in 1933 and then increased to $249.71 in 1951 during the Korean conflict. In the decade from 1955 to 1964, acquisition costs and MVPs of steers were generally lower than those of the Korean conflict peak, fluctuated somewhat and were higher when more corn was fed to fewer steers.

Yearling beef heifers have potentials as (1) feeder livestock, (2) brood cows, or (3) slaughter animals. Cattlemen adjust the number of beef heifers among these alternative employment possibilities according to the expected MVPs and capital values in each alternative. Thesis estimates of MVPs and consequent capital values for beef heifers were very similar to those for steers, except that heifer acquisition costs and dis-MVPs were slightly less than those for steers.

Corn Fed to Beef Cattle.--The estimates in Appendix Table B.14 indicate that cattlemen are successful in feeding close to optimal levels of corn to beef cattle. World War I caused acquisition costs and dis-MVPs of corn fed to beef cattle to increase. But ex post dis-MVPs of corn fed to beef cattle dropped from $52.91 per ton in 1919 to $19.29 in 1921 as the end of hostilities brought falling farm product prices. Corn fed to

beef cattle began to decrease and ex post dis-MVPs rose to $35.07 per ton in 1924 compared to an acquisition cost of $37.86.

With low corn and livestock prices in the general depression from 1930 to 1933, the number of cattle and calves on farms increased, beef cattle were fed more corn, and ex post dis-MVPs of corn fed to beef cattle decreased from $20.43 in 1930 to $11.45 in 1931. After some recovery adjustments following the depression, estimated ex post dis-MVPs of corn fed to beef cattle increased from $17.47 per ton in 1938 to $77.44 in 1947, keeping within 1 per cent of acquisition costs, on the average, during World War II.

After World War II, MVPs and acquisition costs of corn fed to beef cattle went through an adjustment period from 1946 to 1951 and then began a slow decrease with estimated ex post dis-MVPs decreasing from $57.63 per ton in 1951 to $38.09 in 1963. From 1947 to 1964, ex post dis-MVPs of corn fed to beef cattle on the average kept within 3 per cent of acquisition cost. As acquisition and salvage values for corn on farms where corn is produced differ mainly by shelling and hauling costs, these small percentage differentials were to be expected and are consistent with the theory presented in Chapter II. As much corn is fed to beef on the farm which produced the corn, the MVP of corn should be expected to fall between off-farm acquisition costs and salvage values.

Hay Fed to Beef Cattle.--Thesis estimates for hay fed to beef cattle from Appendix Table B.15 indicate that acquisition costs, MVPs, and quantities of hay fed to beef cattle behave similarly to those of corn fed to beef cattle from 1917 to 1964 with dis-MVPs of hay fluctuating around the price of hay more than in the case of corn. It is difficult

to make valid comparison between MVPs and acquisition costs and hence to compute economic rents for hay as (1) published hay price data tend to be near off-farm acquisition costs in years of short hay crops and nearer off-farm salvage values in years of long crops and (2) data on off-farm acquisition costs and salvage values are unavailable. Whereas rents on corn fed to beef cattle were usually negative and of a magnitude comparable to discounting or marketing costs, estimated rents for hay fed to beef cattle fluctuated widely and were both negative and positive as the theory in Chapter II would imply given the poor available data on hay prices. This indicates that MVPs of hay fed to beef cattle were more dependent on quantities of hay produced and cattle prices than in the case of corn where the MVPs are rather closely bound by off-farm acquisition costs and salvage values.

Farm Produced Expendables in Milk Production

Although a slight upward trend in output of dairy products from 1917 to 1964 coincides with an upward trend in employment, acquisition costs and MVPs of farm produced expendables used in producing milk, considerable fluctuations in prices received for dairy products due to World War I, the depression and World War II have caused shorter run fluctuations in employment, acquisition costs, MVPs and economic rents of inputs in milk production.

Dairy Heifers.--Whereas milk cows were found in Chapter V to be subject to considerable economic fixity, dairy heifers, while not actually expendable inputs, have better opportunities as slaughter animals, are not committed to a producing cow herd, and are not subject to prolonged economic fixity as heifers in milk production. Ex post

dis-MVPs of dairy heifers are alternately lower and then higher than acquisition costs according to thesis estimates in Appendix Table B.17. Acquisition costs were estimated as 80 per cent of the market value of a dairy cow. As the market value of a dairy cow can be presumed to be nearer acquisition costs when herds are expanding and nearer salvage values when they are contracting, relationships between MVPs and market prices must be interpreted with great care.

During the post World War I farm depression, nondiscounted ex post MVPs of dairy heifers were less than 80 per cent of dairy cow market values in 1921, 1922, 1923, 1925 and 1929, but were greater in 1924, 1926, 1927 and 1928. On the average, ex post dis-MVPs of dairy heifers were 92 per cent of market values and dairymen received an estimated negative 17.85 million dollars rent per year on dairy heifers in this period with respect to market values. The use of market prices in lieu of acquisition costs and salvage values causes positive rents to be overestimated and negative rents to be underestimated (that is to be estimated as less negative than they were).

The general economic collapse triggered in 1929 and the resulting drop in milk prices resulted in a fall of ex post dis-MVPs from $95.76 in 1928 to $18.07 in 1934. With dis-MVPs averaging 86 per cent of market prices and still less of acquisition costs, an average 5.02 million head of dairy heifers per year suffered an average of over 26.92 million dollars of negative rents per year from 1930 to 1933.

In the recovery period of 1934 to 1941, ex post dis-MVPs of dairy heifers were on the average 3 per cent greater than market prices. When milk prices increased rapidly in the early part of World War II, ex post dis-MVPs of dairy heifers moved above market prices. However, milk

prices leveled off in 1944, and ex post dis-MVPs of heifers dropped below market prices. On the average, ex post dis-MVPs of dairy heifers were 97 per cent of market prices from 1942 to 1946. Dairymen received more than an estimated average 21.4 million dollars negative rent per year on dairy heifers in this period.

Ex post dis-MVPs of dairy heifers continued to increase after World War II as did market prices of dairy heifers and prices received by farmers for dairy products. Reaching a peak during the Korean conflict in 1951, ex post dis-MVPs of dairy heifers were 112 per cent of their $217 market price. Then, prices received by farmers for dairy products decreased and ex post dis-MVPs of dairy heifers fell to 83 per cent of their $141 market price in 1954.

As both expected and ex post dis-MVPs of dairy heifers were generally lower than market prices after 1955, the number of dairy heifers on farms decreased from 5,786 thousand head in 1955 to 4,558 thousand head in 1964. In 1964, with the $148 expected dis-MVP $35 less than the market prices for dairy heifers, there was incentive for dairymen to further reduce the number of dairy heifers on farms. In this period negative economic rents were at least 144.7 million dollars.

Corn Fed to Dairy Cattle.--Estimates of the elasticities of production and MVPs for corn and hay fed to dairy cattle are less stable than those for beef cattle. Rather high estimated adjustment coefficients (.81 for corn and .62 for hay) for these inputs in beef production in contrast to low adjustment coefficients for these inputs in milk production are the main cause of the more stable results for corn and hay fed to beef cattle. Estimated adjustment coefficients for corn and hay in milk

production were .17 and .24 respectively. Inasmuch as fluctuations in milk prices or input employment do not substantiate the strong fluctuations in MVPs of corn and hay fed to dairy cattle, the adjustment coefficients for these inputs are probably underestimated and the fluctuations in elasticities of production and MVPs overestimated. The technical advances which increased the productive capacity of cows plus aggregation problems involving kind and size of dairy farms as well as cohorts of different age groups of cows of steadily increasing capacity probably reduced the reliability of the adjustment coefficients for corn and hay fed to dairy cows. For this reason, average levels of MVPs are more realistic than estimates for individual years. Thesis estimates for corn fed to dairy cattle from Appendix Table B.18 indicate that generally dairymen fed close to profit maximizing (or loss minimizing) levels of corn during World War I and after World War II up to 1954. But generally, based on averages, dairymen underutilized corn from 1921 to 1941, and from 1955 to 1964.

Hay Fed to Dairy Cattle.--Estimates for hay fed to dairy cattle from Appendix Table B.19 generally indicate underutilization and positive rents relative to market prices for hay fed to dairy cattle prior to the general depression of 1930 to 1933, during the recovery from 1934 to 1941, and after World War II. During the general depression and World War II, hay was overutilized in milk production and negative rents relative to market prices resulted. As market prices for hay can be presumed to be nearer off-farm acquisition costs in short hay crop years and near salvage values in long crop years, economic rents relative to acquisition costs are less positive than with respect to market prices in favorable years; conversely they are even more negative in unfavorable years.

It is interesting to note that while thesis estimates for individual inputs in milk production were estimated independently, the conclusion reached after studying milk cows--that it was profitable to substitute feed for cows--is substantiated by the estimates for corn and hay fed to dairy animals. It has been profitable to increase the total quantities of corn and hay fed to dairy cows although the number of milk cows on farms has been decreasing since 1945.

Farm Produced Expendables in Hog Production

The general level of MVPs of sows, feeder pigs, and corn fed to hogs rises and falls with major economic disturbances such as wars and depressions, but they also fluctuate from year to year as farmers' adjustments in hog numbers and feed inputs lag hog prices. Sow, feeder pig and corn MVPs, dependent on both the level of inputs and prices received for hogs, sometimes exceed and at other times are less than acquisition costs.[1]

Hog production cycles with inputs and their MVPs tend to behave in the following fashion. When hog numbers are on the increase, farmers are having more sows bred. With fewer hogs on feed, the quantity and MVP of corn fed to hogs decrease while the MVPs of sows increase. As the larger numbers of pigs are placed on feed, the quantity and MVP of corn fed to hogs increase and the MVPs of sows decrease. When the fed hogs, including sows, begin flowing to market, the quantity of corn fed and number of hogs on farms decrease as well as the MVP of feeder pigs.

During 1917 and 1918, more sows were bred in response to favorable price expectations for hogs. Quantities of corn fed to hogs had been low

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[1]Thesis estimates for sows, feeder pigs, and corn fed to hogs are found in Appendix Tables B.20, B.21, and B.22 respectively.

and remained so during the initial expansion. The adjustment coefficient for corn fed to hogs is based on annual data despite the two crop nature of hog production. This tends to cause the adjustment to be underestimated which, in turn, makes the MVP estimates unstable.

Beginning in 1918, hog numbers began decreasing as more hogs were fed and placed on the market, and from 1917 to 1921, hog production had completed a four-year cycle.

In the next hog cycle, from 1921 to 1927, more sows were kept for breeding and the number of sows on farms increased from 25,483 thousand in 1921 to 29,037 thousand in 1923. Fed hogs, including sows, began flowing to market in larger numbers in 1924, and ex post dis-MVPs of sows increased from $15.21 per head in 1924 to $29.81 in 1927. In the heavy feeding and marketing phase of the 1921 to 1927 hog cycle, corn fed to hogs did not increase as much as in the previous cycle due to low corn production which was down from 3,070 million bushels in 1920 to 1,860 million bushels in 1924. The result was an increase in the ex post dis-MVPs of corn fed to hogs from 1925 to 1927.

The next hog cycle occurred from approximately 1927 to 1931 in the general depression. Hog numbers increased from 52,105 thousand in 1926 to 61,873 thousand in 1928. Corn fed to hogs decreased from 30.93 million bushels in 1927 to 24.83 million bushels in 1930.

With unfavorable hog-corn price ratios from 1929 to 1931, fewer hogs were fed and placed on the depressed market. Hog numbers did not decrease as much as in the previous cycle. In 1932 and 1933, the failure of hog numbers to contract sufficiently on the downswing of the previous cycle provided breeding stock and pig crops far in excess of what market conditions warranted. But dis-MVPs of sows and feeder pigs remained

depressed through 1934. Hog supply reduction programs of the federal government in 1934 and 1935 aided in reducing hog numbers from 58,621 thousand head in 1934 to 39,066 thousand head in 1935.

The cycle in hog numbers from 1935 to 1941 found hog numbers expanding much more than they contracted in the previous cycle due to expected dis-MVPs of sows and feeder pigs generally above acquisition costs during the recovery period from 1934 to 1941. The entry of the United States into World War II caught the hog cycle just as hog numbers were starting a downswing. With large numbers of breeding animals available, the downswing of the recovery period hog cycle was aborted and hog numbers increased to 83,741 thousand head by 1944.

Sow and feeder pig dis-MVPs decreased from their World War II peak in 1944 and 1945 respectively, but with the large number of hogs on farms, the quantity of corn fed to hogs remained high after moderate decreases in 1943 and 1944.

Hog numbers and MVPs of inputs in hog production moved through four more cycles from 1948 to 1964 of three to seven years length. But generally, hog numbers have leveled off in the last decade and dis-MVPs and prices of feeder pigs and corn in hog production have stabilized somewhat with dis-MVPs of sows still fluctuating.

Farm Produced Expendables in Poultry Production

Thesis estimates for chickens and corn fed to poultry are in Appendix Tables B.23 and B.24 respectively.

Generally, the upward trend in output of poultry is associated with lower costs of production and the growth of the U. S. population. The MVPs of chickens and poultry corn have trended upward while the

market price of corn decreased from 1946 to 1964. This has caused more corn to be fed to poultry and the dis-MVP of corn fed to poultry to decrease. Estimated dis-MVPs of chickens and corn fed to poultry have fluctuated around the acquisition cost of chickens and the market value of corn, moving up as wars caused prices received for poultry and eggs to increase and down when prices received for poultry and eggs decreased sharply.

The estimates for chickens and corn fed to poultry indicate that up to the World War II period, generally too little corn was fed to too many chickens from a profit maximizing viewpoint. In the latter part of World War II, as the numbers of farms began to decrease and specialization in the poultry industry--including caged layer houses and broiler factories--began to replace family farm flocks, farmers began to decrease the number of laying hens and increase the quantity of corn fed to poultry. The number of chickens on farms decreased from 582 million birds in 1944 to 369 million in 1964, and corn fed to poultry increased from 9.2 million tons in 1947 to 15.01 million tons in 1964. Technology in poultry production has changed such that while the total number of chickens on farms, not including commercial broilers, has decreased, the turnover of broilers is much more rapid and a much greater number of broilers are produced each year. Corn and broilers have been substituted for laying flocks.

As a result of feeding more optimal levels of corn to poultry, the estimated ex post dis-MVP of corn fed to poultry relative to acquisition costs decreased from an average level of 1.47 during World War II to 1.12 in the 1955-1964 period according to thesis estimates. Average farm dis-MVPs of chickens remained slightly less than acquisition cost on the average for specified periods.

Nonfarm Produced Expendable Capital

In addition to nonfarm produced durable capital inputs discussed in Chapter VI, expendable capital inputs from the nonfarm economy are being used increasingly and are replacing farm produced inputs. Some expendables such as gasoline and electricity complement farm machinery in replacing farm produced horses and mules and labor. Others such as fertilizer provide, within limits, an effective substitute for scarce land. Still other nonfarm produced expendables such as insecticides, pesticides, and feed additives serve both as complements and substitutes for farm produced seed, feed, and livestock. In general, nonfarm produced expendables embody more superior technology than the inputs they have replaced. Also, the replacing of farm with nonfarm produced inputs represents a large movement toward specialization. The nonfarm sector is exercising its comparative advantage in providing fuel and oil, chemicals, building materials, and processing services, thus freeing the farm sector to exercise its comparative advantage in producing raw food and fiber.

The nonfarm produced expendables studied in the thesis are gasoline, electricity, and fertilizer in aggregate farm production.

Gasoline

As mechanical power has replaced horses and mules on farms, more and more gasoline is used to fuel the machines. The estimated adjustment coefficient of .78 for gasoline indicates that farmers adjust gasoline quite rapidly toward profit maximizing or loss minimizing levels. Thesis estimates for gasoline are found in Appendix Table B.10.

Farm machinery, a durable with few employment opportunities in the nonfarm sector, was found in Chapter VI to be very susceptible to adjustment problems and resulting capital gains and losses. But farmers apparently adjust the rate of use of durable machines by using profit maximizing or loss minimizing quantities of gasoline. This involves a movement to the edge of area 5 in the factor-factor diagram in Figure 2.2, page 25, where the durable machine is economically fixed but its rate of use is adjusted by using more or less gasoline. For example, the general depression from 1930 to 1933 was associated with a decrease in the quantity of gasoline used in farming from 1976 million gallons in 1930 to 1773.8 million gallons in 1933 even though the number of tractors on farms increased from 920 to 1019 thousand over the same period. Thus farmers adjusted the rate of use of some economically fixed tractors downward in response to low product prices and ex post dis-MVPs of gasoline which decreased from 18 cents per gallon in 1930 to 14 cents in 1933. And during World War II, the quantity of gasoline used in farm production tended to increase faster than the index of mechanical power and farm machinery. Thus within rationed limits, available machinery was used more intensely as the ex post dis-MVP of a gallon of gasoline increased from an estimated 16 cents in 1942 to 20 cents in 1947.

In the decade from 1955 to 1964 which was free of major disturbances, the index of mechanical power and farm machinery leveled off as did gasoline use, prices, and earnings.

Electricity

The very low .02 estimated adjustment coefficient for electricity resulted in very erratic and unreasonable elasticities of production and

MVPs for electricity in aggregate farm production. Estimates from Appendix Table B.9 result from arbitrarily using an adjustment coefficient of .5 which is more in line with estimated adjustment coefficients of other expendable inputs. The results for electricity are not discussed here in great detail due to the arbitrary selection of a reasonable adjustment coefficient. But generally the estimates indicate that as electricity used on farms increased from 861 million kw-hrs in 1927 to 21,046 million kw-hrs in 1955, both prices and ex post dis-MVPs remained at about 3 to 4 cents per kw-hr from 1927 to 1955.

Fertilizer

An estimated adjustment coefficient of 1.02 for fertilizer in aggregate farm production illustrates the variability of fertilizer. Because farmers typically purchase fertilizer either spread on the field by fertilizer dealers or in bags just before using it, salvage values are ignored, though actually salvage values of fertilizer would probably be negative. Thesis estimates for fertilizer are in Appendix Table B.8.

Fertilizer use, measured in tons of principle plant nutrients, remained fairly low prior to World War II, ranging from a low of .79 million tons in 1921 to a high of 1.6 million tons in 1937. But ex post farm dis-MVPs of fertilizer increased from $266 in 1917 to a World War I high of $377 in 1919, then decreased throughout the post World War I farm and general depression to a low $125 per ton in 1933. Following the general depression of 1930 to 1933, dis-MVPs of fertilizer increased through the World War II period.

The strong increase in fertilizer use beginning in 1940 continued through 1964 and was associated with fertilizer prices which after reaching

a peak of $368 per ton of principle plant nutrients in 1945 have since continually declined to $206 per ton in 1964. Ex post dis-MVPs of fertilizer ranged from 96.5 to 99.7 per cent of fertilizer acquisition costs from 1917 to 1964.

This indicated small excess use of fertilizer may be only the result of difficulties in the data and calculating methods. Small annual negative rents on fertilizer increased from a low of 1.15 million dollars in 1919 to a high of 54.93 million dollars in 1964 with values for specified periods averaged in Table 7.15.

Substitution of Fertilizer for Land.--As was pointed out above, use of fertilizer remained low until World War II. The reason for the continual increase in the use of fertilizer since early in World War II concerns the availability and prices of land. The average value of all farm land increased from $32 per acre in 1941 to $137 per acre in 1964.[1] Over the same period, fertilizer prices generally decreased after increasing during World War II. The result was a decrease in the price of fertilizer relative to the price of land from 12.77 in 1942 to 2.26 in 1962.

On the average during World War II, the price of a ton of fertilizer could purchase the services of 11.0 times the value of an acre of land. But an investment in land only 10.56 times the value of an acre of land was required to replace a ton of fertilizer in production

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[1] Agricultural Finance Review, XXV (December supplement, 1964), Table 35, p. 63.

(see Table 7.1).[1] Thus, it was slightly profitable year by year for farmers to substitute land for fertilizer, yet over time it was profitable to substitute fertilizer for land. With limited land, land prices were bid up rapidly while fertilizer prices were decreasing. By 1955 to 1962, the price of fertilizer relative to land prices had decreased to an average 3.05. But the continual substitution of fertilizer for land caused the MPP of a ton of fertilizer to decrease relative to the MPP of land investments to an average level of 2.93 per year from 1955 to 1966. Thus in recent years, as in every year for which estimates were made, fertilizer seems to have been slightly overcommitted relative to land; although, since World War II, decreasing fertilizer prices relative to land prices justify the substitution.

The apparent short run overcommitment of fertilizer is indicated by the 1.02 adjustment coefficient of fertilizer and, if real, may be caused by both: 1) acreage allotments restricting the number of acres a farmer can plant but not the amount of fertilizer he can use; and 2) insufficient land being available at recorded market prices in the vicinity of individual farmer's current land holdings.

This concludes the analysis of expendable farm capital except for the summary and conclusions in Chapter VIII, which follows.

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[1]The marginal value products of land from Appendix Table A.5 used to calculate the relative MPPs of fertilizer and land were estimated by Shyamalendu Sarkar, Dept. of Agri. Econ., Michigan State University. Sarkar estimated land MVPs using the current value of land as a measure of land and the farm mortgage interest rate as the acquisition cost of land investments. Estimating techniques were identical to those employed in this thesis.

TABLE 7.1.--Acquisition costs and MPPs of fertilizer relative to the acquisition costs and MPPs of land, average values for specified periods, United States, 1917 to 1964

Time period	Acquisition cost of a ton of fertilizer relative to the acquisition cost of an acre of land	MPP of a ton of fertilizer relative to the MPP of a land investment equivalent to the value of an acre of land
	(-------average ratio for specified time periods-------)	
1917-1920 World War I	7.18	6.75
1921-1929 Post World War I Farm Depression	5.58	5.16
1930-1933 General Depression	5.64	5.31
1934-1941 Recovery	9.04	8.46
1942-1946 World War II	11.00	10.56
1947-1954 Post World War II Boom, Korean Conflict and Adjustment	6.25	6.03
1955-1964 General Growth and Expansion	3.05	2.93

CHAPTER VIII

SUMMARY AND CONCLUSIONS

The chronic adjustment problem in the United States farm sector is usually attributed to: 1) an inelastic demand for farm products, both with respect to price and income; 2) atomistic structure; 3) rapid technological change; and 4) imperfect knowledge. To this list must be added 5) a family farm structure which results in children being born into the farm labor force, 6) large space and specialized input requirements which widen differences between acquisition costs and salvage values, thereby making inputs more subject to economic fixity. The following characteristics of the farm sector's adjustment and institutional environment are also important: 7) four wars from 1917 to 1964; 8) a severe depression between World Wars I and II; 9) unstable international demand; 10) government farm price support and other farm programs; and 11) variable weather.

While several past attempts to analyze the "farm problem" contribute significantly toward understanding impacts of one or more of the above characteristics, past efforts fail to account adequately for resource fixity. An analysis of adjustments in the farm sector should recognize the combined impacts of the several characteristics presented above.

This thesis, while recognizing past contributions on agricultural supply analysis, also employs a more recently advanced modification of classical economic theory to more adequately account for the divergencies between acquisition costs and salvage values of capital inputs in the farm sector.

A Nerlove adjustment model was employed to estimate equilibrium factor shares which were used as parameters in assumed underlying Cobb-Douglas production functions in lieu of the more conventional method of obtaining production parameters from a direct least squares estimating procedure. This adjustment-equilibrium factor share model lends itself to implementing the modification of neo-classical theory which recognizes the divergence between input acquisition costs and salvage values. Estimated salvage values were used to value durable inputs in computing factor shares when durables were contracting at rates greater than warranted from normal depreciation; and acquisition costs were used when durables were expanding. In the absence of appropriate values for durable inputs that were stable, implying that the inputs' present values were bounded by acquisition costs and salvage values, averages of acquisition costs and salvage values were employed in computing factor shares.

In reality, adjustment coefficients probably change over time rather than remaining constant as assumed in the thesis. But the results obtained from assuming that actual annual changes in factor shares are a constant proportion of desired adjustments are generally consistent with economic theory. Adjustment coefficients were estimated from logarithmic values of studied variables to permit a curvalinear relationship.

The resulting estimates of elasticities of production along with price and quantity components of factor shares; Lerohl's estimates of

product price expectations, and estimates of actual and expected overhead costs from this thesis were used to estimate the following actual or ex post and expected or ex ante: 1) MVPs, both gross and net of overhead costs; 2) present values of discounted future net MVPs; 3) annual average capital gains from durable inputs; and 4) economic rents from expendable inputs.

Advantages of Estimating Techniques Used in the Thesis

The Nerlove adjustment model offers a promising new approach to estimate production functions and adjustments. Its advantages over traditional direct least squares estimation of Cobb-Douglas production function parameters are: 1) the multicollinearity problem encountered from time series clustering around expansion paths is avoided; 2) while the direct least squares estimated production parameters are constant over time and different input combinations, the adjustment-factor share technique yields different elasticity estimates for each observation, thus yielding a dynamic model in the time dimension; 3) the adjustment-factor share technique lends itself to incorporating the Johnsonian modification of neo-classical economic theory in the analysis which recognizes the divergence between input acquisition costs and salvage values; and 4) estimating techniques are related directly with the underlying economic theory whereas the traditional direct least squares technique is more dependent on statistical procedures. The resulting Johnsonian-adjustment-factor share model more nearly approximates farm managers' resource adjustment decisions than the alternative neo-classical model in which by assumption farm managers can instantaneously adjust resources to a single high profit point without receiving rents and capital gains or losses.

Shortcomings of Estimating Techniques

While the theoretical model used in the thesis realistically explains farm managers' behavior in allocating resources at the farm level, there are serious aggregation problems involved in applying the Johnsonian-adjustment-factor share model at the aggregate farm sector level. While most farm managers can be assumed to attempt to maximize profit, they are in very different initial situations of resource ownership and control, which makes a greater difference when acquisition costs exceed salvage values than when the two are equal. In adjusting to new high profit positions in response to changing economic environment, some farmers expand employment of a given resource, others contract it and still others hold the resource constant. Thus an aggregate farm sector production function concept is of questionable applicability. The thesis estimates of production elasticities and input earnings are construed as estimates of the average of elasticities and earnings on individual farms. Adjustments in aggregate resource use are viewed with respect to their average earnings in the farm sector and their acquisition and salvage prices for the farm sector.

Another serious problem is encountered in aggregating across durable inputs of different characteristics, quality and life expectancies. With durables specialized to the farm sector such as farm machinery and buildings, productive life is a function not only of the initial stock but also of the rate of use and maintenance. But the only way the farm sector can obtain such specialized machines as grain combines and pickup balers is to buy new machines from the nonfarm sector. Once committed to farming, these machines will remain in farm production as long as their

expected future MVPs net of overhead costs are greater than their value as scrap iron. And while an individual with superior managerial ability may pass on any inherent capital losses in the machine over its productive life to a used machinery dealer or another farmer, someone in the farm sector will sustain any inherent capital losses, or for that matter capital gains. On the other hand, future expected MVPs of durables not specialized to the farm sector such as beef cows, milk cows, and motor trucks may be compared with salvage values on a periodic basis as the input moves through its productive life and potential capital losses may be cut short by salvaging the inputs in the nonfarm sector. A brief investigation into the expected capital values of two different ages of beef cows, dairy cows, and motor trucks indicated that expected and realized capital values, acquisition costs, salvage values, and use of these durables not specialized in farming would be more realistic if estimated according to cohorts than for the average input on the average farm. The latter had to be done in this thesis due to the absence of data by cohorts.

Because research in agricultural economics has been oriented around an economic theory of the firm which has not stressed acquisition costs and salvage values, available data on resource prices are not specific as to whether they represent acquisition costs or salvage values. With most price data at the farm level, it is not clear as to whether they represent acquisition costs, salvage values, or marginal value products. Thus the author had to resort to (1) the crude approximations of acquisition costs and salvage values indicated in Appendix Table A.1, and (2) ad hoc interpretations of the relationships among estimated MVPs, acquisition costs, reported market prices, and capital gains and losses.

Another weakness is the use of a logarithmic adjustment equation to estimate production elasticities. With current factor shares usually correlated with lagged factor shares, the estimated coefficient of the lagged factor share in the equation predicting the current factor share is often overestimated. The estimated adjustment coefficient, which is equal to one minus the estimated coefficient of the lagged factor share, would then be underestimated. An unusually small estimated adjustment coefficient results in extreme fluctuations in estimated elasticities of production, MVPs and capital values. Also a large percentage change in the factor share from year t-1 to year t can cause large fluctuations in the results. Fortunately, only a few such cases are encountered in the thesis and the extreme fluctuations are usually averaged out over specific time periods.

World Wars I and II and the Korean conflict produced economic shocks which should be reflected in thesis estimates. Following these major disturbances, realized product prices, less than those expected, caused ex post capital values of durables to fall short of values expected at the time of acquisition, thus contributing to low returns and capital losses. In some cases, thesis results do agree; in others, they do not. Part of the disagreement is due to the following: when the estimated elasticities, which are assumed constant over the life of a durable for purposes of estimating expectations, also fluctuate unreasonably due to underestimated adjustment coefficients and/or high percentage changes in actual factor shares, estimates of ex ante capital values are subject to wide distortion. Actually, it appears that Lerohl's five and ten year average expected product price series relative to actual five and ten year average product prices are a more consistent indication of ex ante relative to ex post capital values than are the estimates provided in this thesis.

In studying the estimates of MVPs, capital values, capital gains and losses, and employment data for farm inputs, two possible sources of bias are apparent. First, the PCA interest rates, which were used in discounting annual MVPs, may be lower than the true discount rate for expendables and short lived durables but too high for buildings. This contributes to overestimation of capital values for some farm and nonfarm produced durables. Second, input specification bias between labor and labor saving technology such as grain combines and corn pickers caused the capital values for these inputs to be underestimated, even when low PCA interest rates were used in discounting. These suspected biases were accounted for in an ad hoc manner in interpreting the estimates.

Conclusions for Farm Capital Earnings and Adjustments

Despite the above shortcomings, the thesis provides much new information on capital earnings and adjustments in the farm sector. While the occurrence and disappearance of asset fixity is not entirely accounted for, the author recognizes this important phenomenon of the farm sector and in attempting to account for it goes much further in this direction than most previous empirical work. Though the thesis results are as crude as the data used in their construction and are more gross than their detailed appearance implies, they do provide sufficient evidence especially when suspected biases are carefully interpreted, ad hoc, to support the following conclusions about farm capital employment and earnings.

Traditional methods of imputing returns to farm labor and management have indicated that if investments in land and capital were paid a going rate of return, residual returns to labor and management would very often be low and often negative on typical farms. This thesis provides

substantial evidence that investments in farm capital in many cases do not earn a going rate of return and account for much of the negative rent, capital losses, and low income in the farm sector. Conclusions substantiated by thesis estimates concerning the use and earnings of the major capital categories delineated in the thesis are presented below and encompass the objectives of the thesis stated in Chapter I, page 15.

Durables

Durable inputs are subject to considerable adjustment problems because they: 1) last more than one production period, 2) must be committed to farm production on the basis of expected product prices and input earnings which usually either fall short of, or exceed realized product prices and input earnings, and 3) characteristics of durables, the farm sector, and the farm sector's environment can cause the divergence between acquisition costs and salvage values of durables to be large.

Problems of adjusting durables toward equilibrium levels and toward levels at which the durables earn ex post capital values that cover acquisition costs vary in severity, depending mainly on whether the durables are farm produced or nonfarm produced, and whether they are specialized to the farm sector or have competing employment opportunities in the nonfarm economy.

Farm Produced Durables.--Prices of farm produced durables are correlated closely with prices received by farmers while prices paid for nonfarm produced durables are fairly independent of prices received. This tends to make farm produced durables less subject to extended fixity and adjustment problems than are nonfarm produced durables. Adjustment

coefficients for farm produced durable livestock are generally larger than those for studied nonfarm produced durables, thus substantiating this conclusion. But, within the farm produced category, durables may be more or less subject to adjustment problems because they are specialized or nonspecialized to the farm sector. The responsiveness of acquisition costs and salvage values of farm produced durables to changing conditions tends to shift the incidence of capital losses or gains to land, buildings, farm and operator labor, orchards, etc.

Farm Produced Durables Unspecialized to the Farm Sector.--When there is a competing demand for farm produced durables in the nonfarm sector, their ex ante capital values in farming may be compared to their nonfarm opportunity cost and their use adjusted accordingly; thus ex post capital values of these durables are kept more in line with acquisition costs and a reasonable rate of return. The two inputs studied in the thesis which fall in this classification--beef and milk cows--have tended to earn more over their productive life than the economy valued them at when committed to farm production. While trending upward, cattle numbers continue to cycle and the opportunity to sell unproductive cows in the nonfarm sector as canner-cutters tends to place a floor under the profitability of beef and milk cows. However, during the depression, and in the early 1950's, estimated ex post capital values of beef and milk cows were not sufficient to cover acquisition costs, and capital losses resulted. Considering the likely upward bias in ex post capital values of beef and milk cows, the true capital losses in these periods were probably more numerous and severe than the estimates indicate. Underutilization, and capital gains for beef and milk cows tend to exist during periods of high

consumer demand such as during World War II, and in the nonfarm expansion of the mid- and late 1950's.

Farm Produced Durables Specialized to the Farm Sector.--Due to lack of data, some interesting inputs in this category (fruit trees, for example) were not studied in the thesis. Inputs in this category often have long productive lives and remain in production many years despite ex post earnings that fail to cover acquisition costs simply because farmers minimize losses by keeping the durables in production rather than salvaging them. A durable in this situation can contribute significantly to the production of farm commodities in excess of that level which yields input earnings equal to acquisition costs.

Horses and mules are one studied input category qualifying as a farm produced durable specialized to the farm sector. As anticipated, estimated ex post capital values of horses and mules were consistently less than acquisition costs.[1] Farmers have continuously decreased the number of horses and mules on farms since World War I, but given inaccurate expectations, the lack of off-farm opportunities, and durable nature of horses and mules, thesis estimates indicate that horses and mules were a source of capital losses from 1917 to 1949. The capital losses may be overestimated due to the omission of the carcass value of horses and mules in the capital values more than offsetting the upward bias in capital values caused by the low PCA interest rates.

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[1]Thesis estimates indicate that after World War II, horses and mules earned ex post capital values in excess of acquisition costs. But by this time, horses and mules were a very insignificant input.

Nonfarm Produced Durables.--Farmers must base their decisions concerning the purchase of farm machinery, motor trucks, buildings, and other nonfarm produced durables on long run expectations about product prices and other important variables. Since farmers cannot forecast future product prices with a large degree of accuracy, they encounter considerable adjustment problems with nonfarm produced durables. In addition, acquisition costs of nonfarm produced durables are generally independent of prices received by farmers. This causes the divergence between acquisition costs and salvage values, on one hand, and the MVPs, on the other, of nonfarm produced durables to fluctuate more and thus increases adjustment problems for these important inputs. But, as with farm produced durables, the severity of adjustment problems for nonfarm produced durables varies, depending on whether the durable is specialized to farm production or has employment opportunities in the nonfarm economy.

Nonfarm Produced Durables Unspecialized to the Farm Sector.--Farmers may purchase new or used nonfarm produced durables, such as motor trucks, which have employment opportunities in the nonfarm sector; and if the ex ante capital values of these durables in farm production drop below their net opportunity cost in the nonfarm sector, the inputs may be salvaged in the nonfarm sector. Thus, these unspecialized durables are less subject to adjustment problems than are durables which do not have competing demands in the nonfarm sector.

In studying the use and earnings of motor trucks on farms, limited data prevented the estimation of ex post capital values of used trucks and therefore capital gains and losses for motor trucks. But estimates of ex post and expected MVPs of motor trucks in aggregate farm production tended to justify the continual increase in the number of motor trucks on

farms from 1917 to 1964 except during a few years in the general depression when the number of trucks on farms decreased and in the early 1960's when the number of trucks on farms appeared to be stabilizing. While the preceeding comment generally applies to used motor trucks, estimates of expected capital values of new motor trucks justified their acquisition from 1917 to 1955 except during the years 1933, 1935, 1937, 1939, 1947, 1950 and 1951.

Nonfarm Produced Durables Specialized to the Farm Sector.--Nonfarm produced durables such as farm machinery and buildings, which are specialized to the farm sector, are more susceptible to asset fixity and capital losses than are nonfarm produced durables such as motor trucks which have employment opportunities in the nonfarm sector. And the more specialized a durable is within the farm sector, the more likely its ex post capital value will fall short of its acquisition cost for the farm sector. Versatile tractors in aggregate farm production have often had estimated ex post capital values greater than acquisition costs while more specialized machines such as corn pickers and grain combines were often subject to economic fixity and capital losses, even when apparent biases in the estimates were considered.

In the rapidly changing structure of the farm sector, there is perhaps no more pronounced example of economic fixity at work than farm buildings. Thesis estimates indicate that ex ante capital values of investments in farm buildings seldom covered acquisition costs from 1933 to 1964. And the constant dollar value (1910-1914 = 100) of buildings on farms decreased from 8,799 million dollars in 1931 to 7,188 million dollars in 1964, despite an expanding farm sector in terms of productive capacity.

With the exception of buildings, nonfarm produced durables specialized to the farm sector have generally increased in use from 1917 to the present.

Expendables

Expendable inputs are "used up" in one production period when committed to farm production and farmers can base their decisions on the use of expendables on expectations of one year or less. These factors tend to make expendables in farm production less susceptible to economic fixity and rents. The simple average .55 of estimated adjustment coefficients for studied expendables indicates farmers' ability to adjust their use rapidly in response to economic change. But other characteristics, such as source of supply and nonfarm employment opportunities, bear upon adjustment problems for expendables.

Farm Produced Expendables.--Major economic disturbances cause the prices, use, and MVPs of farm produced expendables to fluctuate and increased demand for livestock products (and therefore for feed inputs) have caused the use of farm produced expendables to trend upward over time. But prices of these expendables are closely correlated with prices received for farm products. This tends to lessen the occurrence of imbalance and rents for farm produced expendables.

Estimated rents on farm produced expendables are usually quite small, especially on a per unit of input basis, and are sometimes caused by computational error. When the estimated rents are real, they may be of a sizable amount when small per unit rents are multiplied by the total quantity of the input. But their impact is small compared to the capital losses which can occur on economically fixed durables used to produce the expendables. When changes occur in the acquisition costs and salvage

values of the expendables, the capital values of the durables can change significantly. But adjustment problems for farm produced expendables may exist, depending largely on whether or not the inputs have employment opportunities in the nonfarm sector.

Farm Produced Expendables Unspecialized to the Farm Sector.--Steers, heifers, sows, feeder pigs, and chickens have enjoyed estimated ex post dis-MVPs that generally fell short of market prices by not more than the cost of discounting or marketing charges. These inputs all have employment opportunities in the nonfarm sector which tend to keep their farm earnings at or above slaughter market prices. Use of these expendable livestock inputs have trended upward as nonfarm demands for livestock products have increased due to rising per capita income and population increases. The expendable inputs in beef and pork production fluctuate over their respective cycles while dairy heifers and chickens on farms at a point in time have decreased in number since World War II due to the substitution of feed for heifers, broilers, and laying hens.

Farm Produced Expendables Specialized to the Farm Sector.--Inputs such as hay and corn are storables and quite specialized to farm production.[1] Use, MVPs and prices of these inputs are more dependent upon quantities produced than are the use, MVPs and prices of other farm produced expendables. The generally lower estimated adjustment coefficients, fluctuating MVPs, and rents for these farm produced expendables specialized to the farm sector support this conclusion.

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[1]This ignores the demand for corn for food and industrial uses which is relatively minor, and the export demand for corn which was rather minor until after World War II.

Nonfarm Produced Expendables.--Whereas prices of farm produced expendables fluctuate with prices received for farm products, prices of nonfarm produced expendables tend to be independent of farm prices. This would tend to make nonfarm produced expendables more susceptible to adjustment problems, imbalance, and rents than farm produced expendables. But this factor is more than offset by the fact that nonfarm produced expendables are typically purchased as they are used. And whether nonfarm produced expendables are specialized to farming (such as with fertilizer) or have competing nonfarm opportunities (such as with gasoline), thesis estimates indicate that these inputs are not subject to large adjustment problems or rents.

Conclusions About Substitution and Relative Input Prices

While the total index of inputs committed to farm production has not changed much from 1917 to 1964, the composition of farm inputs has changed drastically. The index of farm labor decreased from 223 in 1917 to 79 in 1964 while the index of mechanical power and machinery increased from 28 in 1917 to 101 in 1964. Similarly, the index of land used for crops remained about level in decreasing from 100 in 1917 to 94 in 1964 while the index of fertilizer and liming materials increased from 12 in 1917 to 155 in 1964. (All indices are on a 1957-59 = 100 basis.) Estimates of relative MPPs can be compared with relative prices to show the causes and results of this changing composition of farm resources.

Substitution of Nonfarm Produced Capital for Labor.--Estimated MPPs of labor relative to MPPs of tractors in aggregate farm production increased from an average .20 in the World War I period to an average 2.32 in the 1955-1964 period as tractors were substituted for relatively

more expensive labor. As the nonfarm economy has expanded, the salvage value of farm labor (farm wage rate) has increased relative to the acquisition cost of tractors' services from an average 3.00 during World War I to an average 4.01 during the 1955-1964 period. Since tractors remain a relatively cheaper source of productivity than labor, which continues to increase in value, the substitution of tractors for labor will likely continue. Estimates of prices and MPPs of labor relative to those of other types of farm machinery indicate a similar incentive to substitute capital for labor as did tractor MPPs and prices.

Substitution of Mechanical Power for Horsepower.--One of the great phenomena in the farm sector has been the virtually complete transition from horsepower to tractor power from 1917 to World War II. After reaching a peak of nearly 27 million head in 1918, numbers of horses and mules continually declined to about 3 million head in 1960. Average estimates for 1917 to 1920 indicate that the price of the services of one tractor cost the equivalent of the services of 4.5 horses and mules. But estimates of relative MPPs indicate that one tractor could replace 115 horses and mules in aggregate farm production without altering output. As tractors were substituted for horses and mules, relative prices decreased and relative MPPs increased. However, with relative MPPs of tractors generally much larger than their relative prices up to World War II, it is evident that horses and mules could not profitably be substituted for tractors as a source of power.

The substitution of mechanical power for horsepower on United States farms has led to a type of specialization. The nonfarm sector produces mechanical power units at lower cost relative to productivity

than could the farm sector produce horses and mules. Thus farmers were provided with a more profitable source of power which, at the same time, freed 77 million acres of cropland for producing food and fiber for human consumption.

Substitution of Feed for Livestock.--The development of new inputs which profitably substitute for older inputs and labor has been more dramatic in the production of crops than in the production of livestock. The demand for many crops is for feed inputs in the production of livestock. Livestock products have enjoyed increases in demand due to increases in per capita income and in population. Feed prices have decreased relative to acquisition costs of livestock inputs. This has provided incentive to breed livestock that are more efficient at converting feed to livestock products and to feed fewer animals more feed. In comparing MPPs and prices of corn relative to MPPs and prices of livestock inputs, the author found this incentive to substitute corn for livestock in beef, milk, hog, and poultry production. This development has been very dramatic in milk production where the number of milk cows decreased 24 per cent from their World War II level to the present, and corn fed to dairy animals increased 35 per cent over the same period.

Substitution of Fertilizer for Land.--As was pointed out earlier, the use of cropland remained fairly constant from 1917 to 1964 despite large increases in the productive capacity of the farm sector. This phenomenon involves the use, relative prices, and MPPs of land and fertilizer. The use of fertilizer remained relatively low until World War II. Since then the continual increase in the use of fertilizer is influenced by the unavailability of and increasing price of land.

On the average during World War II, the acquisition cost of a ton of fertilizer nutrients (elemental N, P and K) could purchase the equivalent of 11.0 acres. But a land investment equivalent to only 10.56 acres of land was required to replace a ton of fertilizer in production. Thus, it was slightly profitable for farmers to substitute land for fertilizer. With limited land, the acquisition cost of land was bid up rapidly, while acquisition costs of fertilizer were decreasing. By 1955 to 1962, the acquisition cost of a ton of elemental fertilizer nutrients relative to the acquisition cost of land had decreased to an average 3.05. But the continual substitution of fertilizer for land caused the MPP of a ton of fertilizer to decrease relative to the MPP of land investments to an average level of 2.93 from 1955 to 1962. Thus, fertilizer seems to have been overcommitted relative to land in the short run, although, since World War II, decreasing fertilizer costs relative to land costs have justified the use of fertilizer in lieu of land. The apparent short run overcommitment of fertilizer relative to land probably resulted from 1) acreage allotments restricting the number of acres a farmer could plant but not the amount of fertilizer he could use, and 2) insufficient land being available at recorded market prices in the vicinity of individual farmers' current holdings.

Technological Advances.--Much controversy surrounds the discussion of technological advances and their impacts on adjustments in the farm sector. In estimating different elasticities of production for each year for each studied input, the thesis recognizes technological advances embodied in studied inputs over time, along with other factors which might cause changes in the elasticities of production. Changes in input

quality and productivity due to technological advances are recognized through changes over time in an input's earnings relative to its own acquisition cost and relative to earnings and acquisition costs of substitute inputs. There are many sources of technological advances in capital inputs not studied in the thesis. These include hybrid seeds, insecticides, pesticides, and great advances in farm service facilities.

Impact of Errors in Committing Resources to Farm Production.--
Thesis estimates of ex post MVPs and capital values of durable inputs indicate that considerable errors have been made in committing resources (especially durables) to farm production. In accordance with the theory presented in Chapter II, these errors result in: 1) expansion in resource use, positive rents and capital gains, and an increase in output to that level where discounted input earnings cover acquisition costs, in those cases where resources were undercommitted; 2) stabilized resource use, negative rents and capital losses, and a stabilizing of output at a level where discounted input earnings are less than acquisition costs in those cases where resources became economically fixed; and 3) contracting resource use, negative rents and capital losses, and decreases in output to a level where the discounted earnings of resources are sufficient only to cover salvage values.

It is rather simple to conclude which of the above three cases most nearly describes the situation for specific land, labor and capital inputs for specified periods from 1917 to 1964. But it is the combination of situations for the many different inputs combined that determines output for the farm sector, net farm income, and capital gains and losses for farmers. Because considerable evidence in the thesis indicates that

several important capital inputs in aggregate farm, beef, milk, pork, poultry, corn and wheat production have been overcommitted to farming with resulting earnings that failed to cover acquisition costs, it is reasonably safe to conclude that the average farm is, and has been since 1917, organized at a level of input use and output that fails to provide returns sufficient to cover acquisition costs of all inputs. Thus farmers have often received low incomes and capital losses.

Two additional factors which contribute significantly to the over-commitment of resources to farming are 1) unforeseen (by individual farmers) price consequences of aggregate increases in output resulting from individual farmers reacting to apparent profit incentives often have repercussions on farm prices and adjustment problems, and 2) large viable farms may profitably acquire nonfarm produced durables which are specialized to farm production. But the specialized inputs which they replace often remain in farming for lack of off-farm opportunities, earning low returns and capital losses for their owners.

Impacts of Major Disturbances

Part of the blame for adjustment problems in the farm sector can be attributed to World War I, the farm and general depressions, World War II, and the Korean conflict. Although the capital gains are likely over-estimated and the capital losses underestimated, these data serve to summarize the impact of major economic disturbances on adjustments in the farm sector.

Estimates are not available for beef and milk cows during World War I; but estimated capital gains for machinery were high as the wartime demand provided MVPs and ex post capital values for farm machinery above

acquisition costs. At the close of World War I, farm prices fell sharply. There were no price supports or government storage programs and capital values of durable livestock and machinery decreased as did capital gains. Farm prices recovered somewhat in the mid-1920's, capital gains on durable livestock increased through 1924, and on machinery through 1930. Low ex post capital values relative to acquisition costs caused substantial capital losses on beef and milk cows in 1929. Farm machinery, a profitable substitute for labor as well as for horses and mules, continued to increase in use despite decreases in capital gains. Five and ten year average product prices expected by farmers were not realized in the period 1917 to 1933. These adjustment problems were worked out in the free market with farmers receiving the full brunt in the form of low prices. By 1934, farmers had either gone broke or weathered the adjustment problems that far.

From 1934 through World War II, actual five and ten year average product prices received by farmers were approximately equal to or greater than expected five and ten year average product prices. Capital values of durables generally increased relative to their acquisition costs and capital gains increased, remaining high through World War II.

Following World War II, realized five and ten year average prices received by farmers began to fall short of those expected as 1) the number of machines on farms increased, 2) ex post capital values decreased relative to but remained higher than acquisition costs, and 3) capital gains began to decrease. Capital losses for beef and milk cows reached an estimated high of 245 million dollars (which is probably underestimated) in 1952. Following the Korean conflict, low MVPs did not provide ex post capital values sufficient to cover high acquisition costs during the Korean

conflict. Capital gains on machinery began to decrease from their overestimated 445.71 million dollar peak in 1947, and by 1950 had become capital losses.

Beef and dairy cows earned significant capital gains in the mid-1950's which decreased from an overestimated 865 million dollar peak in 1957 to 314 million dollars in 1960. Ex post capital values of beef and milk cows were prevented from falling by strong salvage markets for canner-cutter cows, especially in the last decade for which estimates were made. Capital losses on machinery increased from 2.11 million dollars in 1950 to 140.46 million dollars in 1955.

During the post World War I farm and general depressions, the farm sector had only partially accomplished its potential mechanization. In these earlier years, horses and mules and labor made up a much greater portion, relative to later years, of farm inputs than did such machines as tractors, grain combines, and corn pickers. Thus horses and mules, labor, land, and livestock took more of the brunt of the adjustment problems during the 1920's and early 1930's than did the farm machinery inputs studied in the thesis. By the early 1950's, however, tractors had replaced horses and mules as a source of farm power and the labor input had decreased to almost half its World War I level. According to thesis estimates, tractors and other farm machinery, which are specialized to farming, accounted for a large share of the low returns and capital losses due to adjustment problems of the late 1950's.

Evidence in the thesis indicates that conditions in the farm sector have been such, in the 1950's and early 1960's, that most durables were fixed in farming on the basis of their 1) average ex post capital values, 2) acquisition costs, and 3) salvage values for the farm sector.

Most durables, except beef cows which still cycle, stabilized in number or decreased as higher capacity units replaced lower capacity units which were salvaged. The ex post capital values of nonfarm produced durables were generally less than acquisition costs for the farm sector in the late 1950's and early 1960's. With the huge stock of productive capacity presently on farms, changes in public farm policy, the world food situation, and the cold and hot wars against communism, can increase or decrease the pressure and worsen or improve the consequences of adjustment in the farm sector.

Concluding Comment

Although the above conclusions are consistent with a priori expectations based on a historical perspective of characteristics of the farm sector and its environment, and economic theory, the conclusions follow from a basically partial analysis. Empirical analyses in the thesis are primarily concerned with the markets for one of three major categories of farm resources--capital. Land and labor inputs were given only passing attention. The estimates of capital earnings and conclusions about capital use presented in this thesis will achieve their full usefulness only when integrated with major studies of farm land and labor markets in the overall Resources for the Future study at Michigan State University.

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APPENDICES

APPENDIX A

IDENTIFICATION AND SOURCES OF SECONDARY AND ESTIMATED DATA USED TO ESTIMATE ADJUSTMENT COEFFICIENTS, PRODUCTION ELASTICITIES, AND EARNINGS OF FARM CAPITAL, UNITED STATES FARM SECTOR, 1917-1964

A large quantity and variety of secondary data on capital inputs, output and prices in the farm sector provided by the USDA is utilized in the study. USDA publications used for data sources include:

A) For capital input series:

(1) Agricultural Handbook No. 118, Vol. 2, "Agricultural Production and Efficiency" (AH 118)

(2) Statistical Bulletin No. 233, "Changes in Farm Production and Efficiency: A Summary Report," Annual revisions released in July (SB 233)

(3) Farm Income Situation No. 164, July, 1957 and FIS No. 199, July, 1965 (FIS 164, 199)

(4) Statistical Bulletin Nos. 230 and 333 with 1964 Supplement, "Livestock and Meat Statistics" (SB 230, 333)

(5) Production Research Report Nos. 21 and 79, "Consumption of Feed by Livestock, 1909-56 and 1940-59," and SB No. 337, "Livestock-Feed Relaships: 1909-1963" (PRR 21, 79)

(6) Agricultural Statistics, 1957, 1962 and current issues (AS, 1957, 1962, 1965)

(7) Current Development in the Farm Real Estate Market, ARS 43-101, May, 1959 (CD-52)

B) For product prices and output:

(8) Number (6) above

(9) "Agricultural Prices, 1964 Annual Summary," Crop Reporting Board, Pr 1-3 (65), June, 1965 (Pr 1-3)

(10) Poultry and Egg Situation, USDA, May, 1966 (ERS 232)

C) For input prices and overhead costs:

(11) Numbers (6) and (9) above

(12) Statistical Bulletin No. 319, "Prices Paid by Farmers for Commodities and Services, U. S. 1910-1960" (SB 319)

(13) Statistical Bulletin No. 244, "Farmers' Expenditures in 1955 by Regions for Production and Farm Living" (SB 224)

(14) Statistical Bulletin No. 243, "Farmers' Expenditures for Motor Vehicles and Machinery with Related Data, 1955" (SB 243)

(15) Agricultural Finance Review, Vol. 25, Supplement, December, 1964 (AFR)

(16) Handbook of Basic Economic Statistics, January 15, 1966 (HBES)

(17) Dairy Situation, DS-310, USDA, May, 1966

APPENDIX TABLE A-1.--Identification and sources of secondary data used in estimating adjustment coefficients, production elasticities, and earnings of studied inputs, United States farm sector, 1957-1964.

Name of Input or Variable Code	Description	Data Source	Comments
		Input Series	
Aggregate Farm Production			
Tractors	Number of tractors on farms, U. S. (1,000 tractors)	SB 233, 1965 and 1963, table 13	
Motor Trucks	Number of motor trucks on farms, U. S. (1,000 trucks)	SB 233, 1965 and 1963, table 13	
Grain Combines	Number of grain combines on farms, U. S. (1,000 combines)	SB 233, 1965 and 1963, table 13	
Pickup Balers	Number of pickup balers on farms, U. S. (1,000 balers)	SB 233, 1965, table 13	
Field Forage Harvesters	Number of field forage harvesters on farms, U. S. (1,000 harvesters)	SB 233, 1965, table 13	
Horses and Mules	Number of horses and mules on farms, U. S. (mil. head)	SB 230, table 6, SB 233, table 6	
Buildings	Buildings on farms, U. S. (mil. dollars)	CD-52, table 2, page 13	Prior to 1930, linear interpolation of census year data on value of farm buildings as percentage of value of land and buildings multiplied by value of land and buildings. After 1959, data is from USDA worksheets obtained by Dave Boyne.
Fertilizer	Fertilizer used, U. S. (1,000 tons of principle plant nutrients)	SB 233, 1965 and 1963, table 8	

continued

APPENDIX TABLE A-1.--Continued

Name of Input or Variable Code	Description	Data Source	Comments
Aggregate Farm Production (cont'd.)		Input Series (cont'd)	
Electricity	Electricity used on farms, U. S. (mil. kwh.)	AH 118, vol. 2, table 12 page 17	
Gasoline	Gasoline used by farmers for farm work (mil. gallons)	FIS 199, table 17H and FIS 164, table 18	Farm Income Situation expenditures on fuel and oil divided by estimated price of gasoline.
Labor	Labor (mil. man hours)	SB 233, 1965 and 1963, table 16	
Beef Production			
Beef Cows	Beef cattle, cows and heifers 2 years and older on farms (mil. head)	AS 1964, table 457, SB 230, table 7	
Beef Heifers	Number of heifers 1-2 years old other than those kept for milk on farms (1,000 head)	SB 230, table 7, SB 333, 1964 supl., table 7	
Steers	Number of steers 1 year and older on farms (1,000 head)	SB 230, table 7, SB 333, 1964 supl., table 7	
Corn	Corn fed to beef cattle (1,000 ton)	PRR 21, p. 99; PRR 79, p. 66; SS 337, p. 22	
Hay	Hay fed to beef cattle (1,000 ton)	PRR 21, table 50	
Milk Production			
Milk Cows	Number of cows and heifers 2 years old and over kept for milk on farms (mil. head)	SB 230, table 7 AS 1965, table 457	

continued

APPENDIX TABLE A-1.--Continued

Name of Input or Variable Code	Description	Data Source	Comments
Milk Production (cont'd)		Input Series (cont'd)	
Dairy Heifers	Heifers 1-2 years old on farms kept for milk (1,000 head)	SB 230, table 7 SB 233, 1964 supl., table 7	
Corn	Corn fed to dairy cattle (1,000 ton)	PRR No. 21, table 45 PRR No. 79, page 63	
Hay	Hay fed to dairy cattle (1,000 ton)	PRR No. 21, table 44 Prr No. 79, table 48 SB 337, table 27	
Hog Production			
Sows	Number of sows and gilts 6 months and over on farms (mil. head)	SB 230, table 9	
Feeder Pigs	Number of hogs on farms under 6 months (1,000 head)	SB 230, table 9; SB 233, 1964 supl., table 9	
Corn	Corn fed to hogs (1,000 ton)	PRR No. 21, table 61	
Poultry Production			
Chickens	Number of chickens on farms (mil. chickens)	AS, 1965, table 592; 1962, table 595	Does not include commercial broilers.
Corn	Corn fed to poultry (1,000 ton)	PRR No. 21, table 57; PRR No. 79, table 57; SB 337, table 27	
Corn Production			
Tractors	Number of tractors used in corn production (1,000 tractors)	Estimated	Estimated by multiplying the number of tractors per acre of cropland in the U. S. by the number of acres in corn production.

continued

APPENDIX TABLE A-1.--Continued

Name of Input or Variable Code	Description	Data Source

APPENDIX TABLE A-1.--Continued

Name of Input or Variable Code	Description	Data Source	Comments
Corn Production (cont'd)		Input Series (cont'd)	
Corn Pickers	Corn pickers on farms (1,000 pickers)	SB 233, 1965 and 1963 table 13	
Wheat Production			
Tractors	Number of tractors used in wheat production (1,000 tractors)	Estimated	Estimated by multiplying the number of tractors per acre of cropland in the U.S. by the number of acres in wheat production.
Grain Combines	Number of grain combines used in wheat production (1,000 combines)	Estimated	Estimated by multiplying the number of combines per combined acre of crops in U. S. by the number of acres in wheat production.
		Input Acquisition Costs	
Tractors*	Price paid for an average new tractor (dollars per tractor)	Estimated from data in SB 319, and Index of tractor prices, Worksheets from the ERS, USDA	Estimated by multiplying the index of prices paid for tractors (1955 = 100) by the average price of a new tractor in 1955 ($2027)

*Salvage values for the farm sector are assumed zero.

continued

APPENDIX TABLE A-1.--Continued

Name of Input or Variable Cost	Description	Data Source	Comments
		Input Acquisition Costs (cont'd)	
Motor Trucks	Price paid for an average new farm motor truck (dollars per truck)	Estimated from data in SB 319, and Index of motor truck prices, Worksheets from the ERS, USDA	Estimated by multiplying the index of prices paid for motor trucks (1955=100) by the average price of new farm trucks in 1955 ($1958)
Grain Combines*	Price paid for an average new grain combine (dollars per combine)	Estimated from data in SB 319, and AS, 1965, table 684; 1957, table 681	Estimated by multiplying the index of prices paid for farm machinery (1955=100) by the average price of new grain combines in 1955 ($3529)
Pickup Balers*	Price paid for an average new pickup baler (dollars per baler)	Estimated from data in SB 319, and AS, 1965, table 684; and 1957, table 681	Estimated by multiplying the index of prices paid for farm machinery (1955=100) by the average price of new pickup balers in 1955 ($2240)
Field Forage Harvesters*	Price paid for an average new field forage harvester (dollars per machine)	Estimated from data in SB 319 and AS: 1965, table 684; 1962, table 681	Estimated by multiplying the index of prices paid for farm machinery (1955=100) by the average price of new field forage harvesters in 1955 ($1750)
Horses and Mules*	Average value of horses and mules on farms (dollars per head)	SB 230, table 6; SB 333, table 6	

*Salvage values for the farm sector are assumed zero.

continued

APPENDIX TABLE A-1.--Continued

Name of Input or Variable Code	Description	Data Source	Comments
		Input Acquisition Costs (cont'd)	
Buildings*	The acquisition price of a dollar for investing in buildings is $1.00.		
Fertilizer**	The acquisition price of a ton of principle plant nutrients and its lime complement (dollars per ton)	FIS 199, table 14H, p. 62, SB 233, 1965 and 1963 table 8	Estimated by dividing total expenditures on fertilizer and lime by total plant nutrients used
Electricity**	Cost per kwh. of electricity used on farms (dollars per kwh.)	AH 118, Vol. 2, p. 17	Estimated by dividing total cost of electricity used by total kwh's used
Gasoline**	Price paid for gasoline (dollars per gallon)	AS, 1965, table 684; 1957, table 681; SB 224, table 12	Estimated by multiplying the average price paid by farmers for gasoline in 1955 by the index of prices paid for motor supplies (1955=100)
Labor**	Farm wage rate (dollars per hour)	AS: 1965, table 649 and table 684; 1957, table 681	
Beef Cows*	Price of an average 2 year old beef cow	AS: 1965, table 685; 1957, table 681	Estimated by multiplying the 1957-59=100 base price of beef ($23.13 per cwt.) by the average cow weight (1,000 lbs.) and then multiplying the product by the index of prices paid for livestock (1957-59=100)

*Salvage values for the farm sector are assumed zero.
**Salvage values are assumed equal to acquisition costs in computing factor shares.

continued

APPENDIX TABLE A-1.--Continued

Name of Input or Variable Code	Description	Data Source	Comments
		Input Acquisition Costs (cont'd)	
Beef Heifers**	Price of an average replacement beef heifer	SB 230, tables 152 and 131	Estimated by subtracting .37 from annual prices received for feeder steers (table 152); and multiplying the result by the average weight of feeder steers (Chicago, table 131)
Beef Steers**	Steer prices (dollars per head)	SB 230, tables 131 and 132	Average weight of steers (table 131) multiplied by average prices (table 132)
Corn**	Season average price of corn (dollars per ton)	AS: 1965, table 40; 1962, table 38	
Hay**	Season average price received by farmers for hay (dollars per ton)	AS: 1965, table 369; 1962, table 397	
Milk Cows	Prices paid by farmers for milk cows (dollars per head)	SB 303, table 266, AP, 1964 annual summary, June, 1965, p. 58	Prices in the references were inflated 10% to allow for age and quality differences between average milk cows and those just entering the herd.
Dairy Heifers**	Prices of dairy heifers (dollars per head)	Estimated	Estimated as 80% of the price of dairy cows

** Salvage values are assumed equal to acquisition costs in computing factor shares.

continued

APPENDIX TABLE A-1.--Continued

Name of Input or Variable Code	Description	Date Source	Comments
		Input Acquisition Costs (cont'd)	
Sows**	Average price of sows (dollars per head)	SB 230, table 4, SB 333, table 4	Estimated from index of average value of hogs on farms and the average price per cwt. for sows in 1957-59 assuming the average sow weights 350 lbs.
Feeder Pigs**	Prices of feeder pigs (dollars per head)	SB 319, table 71	Estimated by multiplying the price per cwt. paid for feeder pigs in 1930 ($10.60) and multiplying by the index of the average value of hogs times an assumed 50 lb. average weight
Chickens**	Farm value of chickens (dollars per head)	AS: 1965, table 592; 1962, table 595	
Corn Pickers*	Prices paid for average new corn pickers (dollars per machine)	SB 319, table 90; and AS: 1965, table 684, 1962, table 681	Estimated by multiplying the average price of a corn picker in 1955 by the index of prices paid for machinery, 1955=100
		Input Salvage Values	
Motor Trucks	Average price of used motor trucks (dollars per truck)	SB 319, table 84A	Index of prices paid for trucks (1955 = 100) times the average used truck price in 1955 ($468)

*Salvage values for the farm sector are assumed zero.
**Salvage values are assumed equal to acquisition costs in computing factor shares.

continued

APPENDIX TABLE A-1.--Continued

Name of Input or Variable Code	Description	Data Source	Comments
		Input Salvage Values (cont'd)	
Beef Cows	Value of an average utility grade cow (dollars per he	Estimated	

APPENDIX TABLE A-1.--Continued

Name of Input or Variable Code	Description	Data Source	Comments
		Input Salvage Values (cont'd)	
Beef Cows	Value of an average utility grade cow (dollars per head)	Estimated	1957-59 base price of utility grade cows ($15 per cwt.) times an assumed avr. 1100 lb. weight, multiplied by the index of prices received for meat animals
Milk Cows	Value of milk cows as slaughter animals	SB 303, table 266, AP: 1964 annual summary, June, 1965, p. 58	Prices received by farmers for milk cows minus 10% to allow for age and lower quality of culled animals
Canner-Cutter Cows	Value of unproductive beef or milk cows as slaughter animals	Dairy Situation, May, 1966, p. 6.	Values were extended back to 1917 from 1947 by using the index of prices received for meat animals
		Value of Output	
Aggregate Farm Production	Value of aggregate farm output, including government payments (mil. dollars)	FIS 199, July, 1965, table 10H, p. 58	
Beef Production	Value of beef production (mil. dollars)	AS: 1965, table 459; 1962, table 463; 1957, table 454; data prior to 1930 is from FIS 199, table 12H	
Milk Production	Farm value of milk produced (mil. dollars)	AS: 1965, table 563; 1962, table 568; 1957, table 558, FIS 199, table 12H	

continued

APPENDIX TABLE A-1.--Continued

Name of Input or Variable Code	Description	Data Source	Comments
		Value of Output (cont'd)	
Hog Production	Farm value of hog production (mil. dollars)	AS: 1965, table 479; 1957, table 472; 1942, table 514; 1937, table 348	
Poultry Production	Gross farm income from poultry and eggs (mil. dollars)	ERS 232; FIS 199, table 12H	Prior to 1940, FIS data is adjusted upward by 1.2189 to account for home consumption.
Wheat Production	Farm value of wheat produced annually (mil. dollars)	AS: 1965, table 1; 1962, table 1	
Corn Production	Farm value of corn (mil. dollars)	AS: 1965, table 40; 1962, table 38	
		Determinants of Factor Shares and Adjustment Coefficients	
RNIPF	Purchasing power of realized net income per farm	FIS 199, table 9H, FIS 169, table 10	
PRF	Index of prices received for farm products, 1910-14 = 100	AS: 1965, table 683; 1957, table 680	
FWR	Index of wage rates for hired farm labor, 1910-14 = 100	AS: 1965, table 684; 1957, table 681	
FMP	Index of prices paid by farmers for farm machinery, 1910-14=100	AS: 1965, table 684; 1957, table 681	
FVHM	Index of farm value of horses and mules, per head, 1910-14 = 100	SB 230, table 6; SB 333, table 6	
PBFM	Index of prices paid by farmers for building and fencing materials, 1910-14 = 100	AS: 1965, table 684; 1957, table 681	

continued

APPENDIX TABLE A-1.--Continued

Name of Input or Variable Code	Description	Data Source	Comments
Determinants of Factor Shares and Adjustment			

APPENDIX TABLE A-1.--Continued

Name of Input or Variable Code	Description	Data Source	Comments
	Determinants of Factor Shares and Adjustment Coefficients (cont'd)		
PPL	Index of prices paid by farmers for livestock, 1910-14 = 100	AS: 1965, table 684; 1957, table 681	
PRMA	Index of prices received by farmers for meat animals, 1910-14 = 100	AS: 1965, table 683; 1957, table 680	
PMC	Index of prices received by farmers for milk cows, 1910-14= 100	SB 303, table 266; AP, 1964 annual summary, June, 1965, p. 58	
PWM	Index of average price received for whole milk, 1910-14 = 100	SB 303, table 249; AS: 1965, table 563	
PPE	Index of prices received by farmers for poultry and eggs, 1910-14 = 100	AS: 1964, table 683; 1957, table 680	
PRC	Index of prices received for chickens, 1910-14 = 100	SB 357, table 1	
AVHF	Index of average value of hogs on farms, 1910-14 = 100	SB 230, table 4, SB 333, 1964 supplement, table 4	
PRH	Index of prices for hogs, 1910-14 = 100	AS: 1965, table 479; 1957, table 472; USDA Yearbook of Agric., 1931, table 383	
PW	Index of prices received for wheat, 1910-14 = 100	AS: 1965, table 1; 1962, table 1	
PC	Index of prices received for corn, 1910-14 = 100	AS: 1965, table 40; 1962, table 38	
PF	Index of prices paid for fertilizer, 1910-14 = 100	AS: 1965, table 684; 1957, table 681	

continued

APPENDIX TABLE A-1.--Continued

Name of Input or Variable Code	Description	Data Source
Determinants of Factor		

APPENDIX TABLE A-1.--Continued

Name of Input or Variable Code	Description	Data Source	Comments
	Determinants of Factor Shares and Adjustment Coefficients (cont'd)		
VLR	Index of average value of all farm land and real estate	AFR, table 35, p. 63	
PE	Prices paid for electricity	AH 118, Vol. 2, p. 17	
PG	Index of prices paid for motor supplies, 1910-14 = 100	AS: 1965, table 684; 1957, table 681	
PH	Index of hay prices, 1910-14 = 100	AS: 1965, table 396; 1962, table 397	
CPI	United States consumer price index	HBES	
R	Production-Credit Association average cost of loans	AS: 1965, table 708; 1957, table 705	
PPC	Index of prices paid by farmers for all commodities bought for use in production, 1910-14 = 100	AS: 1965, table 684; 1957, table 681	
	Overhead Costs		
Tractors	Overhead costs associated with keeping one tractor in use for one year	SB 243, table 59	Estimated by multiplying the acquisition price series of tractors by a constant .03897, the percent of the 1955 tractor price expended for maintenance according to SB 243
Motor Trucks	Overhead costs associated with keeping one truck in use one year	FIS 199, table 17H; SB 233, 1965 and 1962, table 13, and C.A., Vol. III, pt. 11, table 7	Average maintenance costs per motor vehicle were computed from data in FIS and

continued

APPENDIX TABLE A-1.--Continued

Name of Input or Variable Code	Description	Data Source	Comments
	Overhead C...		

APPENDIX TABLE A-1.--Continued

Name of Input or Variable Code	Description	Data Source	Comments
		Overhead Costs (cont'd)	
			SB 233. This series was then weighted by the average maintenance cost per farm truck from the 1955 census of agriculture. Overhead costs include maintenance, registration fees and insurance costs.
Grain Combines Pickup balers, and Field Forage Harvesters	Overhead cost associated with keeping one machine in use one year	SB 243, table 59	Estimated by multiplying acquisition price series by .03897, the percent of the 1953 tractor price expended for maintenance according to SB 243
Horses and Mules	Value of land used to feed horses and mules (dollar per head)	SB 233, 1965 and 1963 issues, table 3	Total value of land used to feed horses and mules divided by the number of horses and mules on farms.
Beef Cows, Beef Heifers and Dairy Heifers	Miscellaneous costs associated with keeping beef cows in production (dollars per head)	SB 368, table 76	Average "other livestock expense per head" for 1957-59 from SB 368, table 76 ($1.40) times index of prices paid for livestock, 1957-59 = 100.

continued

APPENDIX TABLE A-1.--Continued

Name of Input or Variable Code	Description	Data Source	Comments
		Overhead Costs (cont'd)	
Milk Cows	Mi		

APPENDIX TABLE A-1.--Continued

Name of Input or Variable Code	Description	Data Source	Comments
		Overhead Costs (cont'd)	
Milk Cows	Miscellaneous cost associated with keeping dairy cows in the herd (dollars per head)	SB 368	Average other livestock expense per head for 1957-59 from SB 368, table 4 ($11.61) times index of prices paid for livestock, 1957-59 = 100
Buildings	Taxes, building repairs and accidental damage (dollars per dollar invested)	FIS 199, table 17H, AS, 1965, table 701, 1957, table 699.	Taxes per dollar invested in real estate plus expenses for repair and operation of buildings per dollar invested in buildings.

APPENDIX TABLE A-2.--Regression equations for estimating adjustment coefficients of capital inputs, United States farm sector, 1917-1964[1]

Tractors, U. S., 1917-1964:

$$\text{Log}(FTF)_t = -.936258 - \underset{(.1914)}{.027731}\ \text{Log}(RNIPF)_{t-1} - \underset{(.2679)}{.680730}\ \text{Log}\left(\frac{ITP}{PRF}\right)_{t-1} - \underset{(.1903)}{.276840}\ \text{Log}\left(\frac{FWR}{ITP}\right)_{t-1} + \underset{(.0955)}{.839148}\ \text{Log}(FTF)_{t-1} + \underset{(.4136)}{.542358}\ \text{Log}(TIM)_t;\ \bar{R}^2 = .961,\ \hat{g} = .16085$$

Motor Trucks, U. S., 1917-1964:

$$\text{Log}(FSK)_t = -.477912 - \underset{(.1863)}{.465911}\ \text{Log}(RNIPF)_{t-1} - \underset{(.1295)}{.426886}\ \text{Log}\left(\frac{MTP}{PRF}\right)_{t-1} + \underset{(.0742)}{.271933}\ \text{Log}\left(\frac{FWR}{MTP}\right)_{t-1} + \underset{(.1202)}{.714003}\ \text{Log}(FSK)_{t-1} + \underset{(4355)}{.884204}\ \text{Log}(TIM)_t;\ \bar{R}^2 = .986,\ \hat{g} = .28600$$

Grain Combines, U. S., 1917-1964:

$$\text{Log}(FGC)_t = -1.543284 - \underset{(.1444)}{1.263685}\ \text{Log}(RNIPF)_{t-1} - \underset{(.1467)}{.665631}\ \text{Log}\left(\frac{FMP}{PRF}\right)_{t-1} + \underset{(.1192)}{.301787}\ \text{Log}\left(\frac{FWR}{FMP}\right)_{t-1} + \underset{(.0817)}{.514529}\ \text{Log}(FGC)_{t-1} + \underset{(.4647)}{2.870531}\ \text{Log}(TIM)_t;\ \bar{R}^2 = .995,\ \hat{g} = .48547$$

Pickup Balers, U. S., 1943-1964:

$$\text{Log}(FPB)_t = -4.633104 - \underset{(.4679)}{.654597}\ \text{Log}(RNIPF)_{t-1} - \underset{(.3347)}{1.420309}\ \text{Log}\left(\frac{FMP}{PRF}\right)_{t-1} - \underset{(.3529)}{.646721}\ \text{Log}\left(\frac{FWR}{FMP}\right)_{t-1} + \underset{(.1501)}{.819879}\ \text{Log}(FPB)_{t-1} + \underset{(1.8780)}{3.898743}\ \text{Log}(TIM)_t;\ \bar{R}^2 = .994,\ \hat{g} = .18012$$

Forage Harvesters, U. S., 1946-1964:

$$\text{Log}(FFH)_t = -3.935972 - \underset{(.5133)}{.181209}\ \text{Log}(RNIPF)_{t-1} - \underset{(.4072)}{1.301342}\ \text{Log}\left(\frac{FMP}{PRF}\right)_{t-1} - \underset{(.1969)}{.848008}\ \text{Log}\left(\frac{FWR}{FMP}\right)_{t-1} + \underset{(.1969)}{.910019}\ \text{Log}(FFH)_{t-1} + \underset{(2.0301)}{2.684827}\ \text{Log}(TIM)_t;\ \bar{R}^2 = .991,\ \hat{g} = .08998$$

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[1]See Appendix Table A-1 for variable identification and data sources.

continued

APPENDIX TABLE A-2.--Continued

Horses and Mules, U. S., 1917-1964: $Log(FHM)_t = 2.211904 - .901079\ Log(RNIPF)_{t-1} + .467426\ Log(\frac{FVHM}{PRF})_{t-1} + .3384\ Log(\frac{FWR}{FMP})_{t-1} - .042450\ Log(FHM)_{t-1} - 2.045576\ Log(TIM)_t$; $\bar{R}^2 = .934$, $\hat{g} = 1.04250$

(.2170) (.1704) (.3128) (.0460) (.2064)

Buildings, U. S., 1917-1964: $Log(FBF)_t = .923102 - .458883\ Log(RNIPF)_{t-1} - .271291\ Log(\frac{PBFM}{PRF})_{t-1} + .291763\ Log(\frac{FWR}{PBFM})_{t-1} + .71554\ Log(FBF)_{t-1} + .184283\ Log(TIM)_t$; $\bar{R}^2 = .816$, $\hat{g} = .28466$

(.1883) (.1768) (.1226) (.2301) (.2212)

Beef Cows, 1921-1964: $Log(FBC)_t = -.927335 - .004286\ Log(RNIPF)_{t-1} + .425346\ Log(\frac{PPL}{PRMA})_{t-1} + .158816\ Log(\frac{FWR}{PPL})_{t-1} + .357930\ Log(FBC)_{t-1} + .186351\ Log(TIM)_t$; $\bar{R}^2 = .496$, $\hat{g} = .64207$

(.2796) (.1058) (.3349) (.1145) (.1615) (.1882)

Beef Heifers, 1923-1964: $Log(FBH)_t = -.863016 - .035322\ Log(RNIPF)_{t-1} + .002979\ Log(\frac{PPL}{PRMA})_{t-1} + .015563\ Log(\frac{FWR}{PPL})_{t-1} + .410224\ Log(FBH)_{t-1} + .336896\ Log(TIM)_t$; $\bar{R}^2 = .682$, $\hat{g} = .58978$

(.0743) (.2314) (.0799) (.1392) (.1292)

Milk Cows, 1921-1964: $Log(FMC)_t = -.488471 + .171302\ Log(RNIPF)_{t-1} - .008841\ Log(\frac{PMC}{PWM})_{t-1} - .203727\ Log(\frac{FWR}{PMC})_{t-1} + .421001\ Log(FMC)_{t-1} - .276001\ Log(TIM)_t$; $\bar{R}^2 = .568$, $\hat{g} = .57900$

(.0836) (.1718) (.1153) (.1967) (.2088)

Dairy Heifers, 1921-1964: $Log(FDH)_t = -.824715 + .174365\ Log(RNIPF)_{t-1} + .023262\ Log(\frac{PMC}{PWM})_{t-1} - .089340\ Log(\frac{FWR}{PMC})_{t-1} + .586507\ Log(FDH)_{t-1} - .047388\ Log(TIM)_t$; $\bar{R}^2 = .705$, $\hat{g} = .41349$

(.0807) (.2426) (.1124) (.2033) (.1830)

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continued

APPENDIX TABLE A-2.--Continued

Chickens, 1917-1964: $Log(FCK)_t = .178594 - \underset{(.1147)}{.106129}\ Log(RNIPF)_{t-1} - \underset{(.3356)}{.173807}\ Log(\frac{PC}{PPE})_{t-1} - \underset{(.2833)}{.233929}$

$Log(\frac{FWR}{PC})_{t-1} + \underset{(.4060)}{.343127}\ Log(FCK)_{t-1} - \underset{(.2546)}{.134245}\ Log(TIM)_t$; $\bar{R}^2 = .706$, $\hat{g} = .65687$

Sows, 1921-1961: $Log(FSS)_t = - .278610 + \underset{(.1843)}{.222582}\ Log(RNIPF)_{t-1} + \underset{(.3188)}{.244068}\ Log(\frac{AVHF}{PRH})_{t-1} - \underset{(.2750)}{.058962}$

$Log(\frac{FWR}{AVHF})_{t-1} + \underset{(.1662)}{.232282}\ Log(FSS)_{t-1} - \underset{(.2719)}{.665467}\ Log(TIM)_t$; $\bar{R}^2 = .4500$, $\hat{g} = .767718$

Tractors in Wheat Production, 1917-1964: $Log(FTW)_t = .200679 - \underset{(.2992)}{.430524}\ Log(RNIPF)_{t-1} + \underset{(.2391)}{.072872}$

$Log(\frac{ITP}{PW})_{t-1} + \underset{(.2580)}{.135771}\ Log(\frac{FWR}{ITP})_{t-1} + \underset{(.1316)}{.729424}\ Log(FTW)_{t-1} + \underset{(.5411)}{.523255}\ Log(TIM)_t$; $\bar{R}^2 = .922$, $\hat{g} = .27058$

Grain Combines in Wheat Production, 1917-1964: $Log(FCW)_t = -5.058396 - \underset{(.4838)}{.645033}\ Log(RNIPF)_{t-1}$

$+ \underset{(.3812)}{.422164}\ Log(\frac{FMP}{PW})_{t-1} - \underset{(.3961)}{.026061}\ Log(\frac{FWR}{FMP})_{t-1} + \underset{(.1472)}{.220066}\ Log(FCW)_{t-1} + 3.487348\ Log(TIM)_t$; $\bar{R}^2 = .939$, $\hat{g} = .779934$

Tractors in Corn Production, 1917-1964: $Log(FTC)_t = .025566 - \underset{(.2683)}{.212646}\ Log(RNIPF)_{t-1} - \underset{(.1811)}{.139604}$

$Log(\frac{ITP}{PC})_{t-1} + \underset{(.1942)}{.225586}\ Log(\frac{FWR}{ITP})_{t-1} + \underset{(.1372)}{.832915}\ Log(FTC)_{t-1} + \underset{(.5458)}{.289652}\ Log(TIM)_t$; $\bar{R}^2 = .944$, $\hat{g} = .16708$

continued

APPENDIX TABLE A-2.--Continued

Corn Pickers, 1917-1964: $\text{Log}(FCP)_t = -3.341074 - \underset{(.3518)}{.902924}\ \text{Log}(RNIPF)_{t-1} + \underset{(.2154)}{.233767}\ \text{Log}\left(\frac{FMP}{PC}\right)_{t-1}$

$+ \underset{(.2851)}{.681187}\ \text{Log}\left(\frac{FWR}{FMP}\right)_{t-1} + \underset{(.1386)}{.315260}\ \text{Log}(FCP)_{t-1} + \underset{(.6264)}{2.990407}\ \text{Log}(TIM)_t$; $\bar{R}^2 = .963$, $\hat{g} = .68474$

Corn Fed to Beef Cattle, 1917-1964: $\text{Log}(FCB)_t = -.713108 - \underset{(.2176)}{.314097}\ \text{Log}(RNIPF)_{t-1} + \underset{(.3447)}{.141013}$

$\text{Log}\left(\frac{PC}{PRMA}\right)_{t-1} - \underset{(.2747)}{.203478}\ \text{Log}\left(\frac{FWR}{PC}\right)_{t-1} + \underset{(.1797)}{.184307}\ \text{Log}(FCB)_{t-1} + \underset{(.3318)}{.592823}\ \text{Log}(TIM)_t$; $\bar{R}^2 = .099$, $\hat{g} = .81569$

Corn Fed to Dairy Cattle, 1917-1964: $\text{Log}(FCD)_t = -.352384 + \underset{(.2031)}{.063504}\ \text{Log}(RNIPF)_{t-1} - \underset{(.5395}{.496923}$

$\text{Log}\left(\frac{PC}{PWM}\right)_{t-1} - \underset{(.3563)}{.035219}\ \text{Log}\left(\frac{FWR}{PC}\right)_{t-1} + \underset{(.1700)}{.832296}\ \text{Log}(FCD)_{t-1} - \underset{(.2554)}{.046021}\ \text{Log}(TIM)_t$; $\bar{R}^2 = .527$, $\hat{g} = .16770$

Corn Fed to Hogs, 1917-1964: $\text{Log}(FCH)_t = .867648 - \underset{(.1068)}{.163970}\ \text{Log}(RNIPF)_{t-1} - \underset{(.2031)}{.239747}\ \text{Log}\left(\frac{PC}{PRH}\right)_{t-1}$

$+ \underset{(.1912)}{.138475}\ \text{Log}\left(\frac{FWR}{PC}\right)_{t-1} + \underset{(.1169)}{.726140}\ \text{Log}(FCH)_{t-1} + \underset{(.1628)}{.291934}\ \text{Log}(TIM)_t$; $\bar{R}^2 = .692$, $\hat{g} = .27386$

Gasoline, U. S., 1917-1964: $\text{Log}(FGS)_t = -1.270377 - \underset{(.4474)}{.555034}\ \text{Log}(RNIPF)_{t-1} - \underset{(.5720)}{.263455}\ \text{Log}\left(\frac{PG}{PRF}\right)_{t-1}$

$- \underset{(.3801)}{.101412}\ \text{Log}\left(\frac{FWR}{PG}\right)_{t-1} + \underset{(.1678)}{.217930}\ \text{Log}(FGS)_{t-1} + \underset{(.4881)}{1.222760}\ \text{Log}(TIM)_t$; $\bar{R}^2 = .518$, $\hat{g} = .782065$

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continued

APPENDIX TABLE A-2.--Continued

Beef Steers, 1923-1964: $Log(FBS)_t = -.336760 + \underset{(.0632)}{.044321}\ Log(RNIPF)_{t-1} + \underset{(.1958)}{.14157}\ Log(\frac{PPL}{PRMA})_{t-1}$

$+ \underset{(.0755)}{.132302}\ Log(\frac{PWR}{PPL})_{t-1} + \underset{(.1355)}{.370968}\ Log(FBS)_{t-1} - \underset{(.1017)}{.114477}\ Log(TIM)_t$; $\bar{R}^2 = .286$, $\hat{g} = .62903$

Feeder Pigs, 1921-1964: $Log(FFP)_t = -.043947 - \underset{(.0908)}{.092099}\ Log(RNIPF)_{t-1} - \underset{(.2710)}{.677958}\ Log(\frac{PPL}{PRH})_{t-1}$

$- \underset{(.1447)}{.072687}\ Log(\frac{FWR}{PPL})_{t-1} + \underset{(.1464)}{.408205}\ Log(FFP)_{t-1} - \underset{(.1157)}{.037915}\ Log(TIM)_t$; $\bar{R}^2 = .379$, $\hat{g} = .59180$

Corn Fed to Poultry, 1917-1964: $Log(FCP)_t = .086490 - \underset{(.1111)}{.099200}\ Log(RNIPF)_{t-1} - \underset{(.2301)}{.513574}\ Log(\frac{PC}{PPE})_{t-1}$

$+ \underset{(.1265)}{.143102}\ Log(\frac{FWR}{PC})_{t-1} + \underset{(.2457)}{1.157735}\ Log(FCP)_{t-1} + \underset{(.1700)}{.195082}\ Log(TIM)_t$; $\bar{R}^2 = .477$, $\hat{g} = -.15773$

Hay Fed to Beef Cattle, 1917-1964: $Log(FHB)_t = -1.738296 + \underset{(.2518)}{.255352}\ Log(RNIPF)_{t-1} + \underset{(.2974)}{.027435}$

$Log(\frac{PH}{PRMA})_{t-1} + \underset{(.2242)}{.036552}\ Log(\frac{PC}{PH})_{t-1} + \underset{(.2684)}{.378258}\ Log(FHB)_{t-1} + \underset{(.2042)}{.195092}\ Log(TIM)_t$; $\bar{R}^2 = .290$, $\hat{g} = .62174$

Hay Fed to Dairy Cattle, 1917-1964: $Log(FHD)_t = -.276910 + \underset{(.2850)}{.044911}\ Log(RNIPF)_{t-1} - \underset{(.4815)}{1.049030}$

$Log(\frac{PH}{PWM})_{t-1} + \underset{(.2392)}{.006470}\ Log(\frac{PC}{PH})_{t-1} + \underset{(.4502)}{1.242367}\ Log(FHD)_{t-1} + \underset{(.3264)}{.058568}\ Log(TIM)_t$; $\bar{R}^2 = .304$, $\hat{g} = -.24237$

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continued

APPENDIX TABLE A-2.--Continued

Labor, U. S., 1917-1964: $Log(FLA)_t = .335552 - \underset{(.0884)}{.136127}\ Log(RNIPF)_{t-1} - \underset{(.1702)}{.528712}\ Log(\frac{FWR}{PRF})_{t-1} - \underset{(.1689)}{.436916}$

$Log(\frac{PPC}{FWR})_{t-1} + \underset{(.0897)}{.798844}\ Log(FLA)_{t-1} + \underset{(.0619)}{.029741}\ Log(TIM)_t$; $\bar{R}^2 = .941$, $\hat{g} = .20115$

Fertilizer, U. S., 1917-1964: $Log(FSF)_t = -2.945301 + \underset{(.4223)}{.056198}\ Log(RNIPF)_{t-1} - \underset{(.5854)}{.094094}\ Log(\frac{PF}{PRF})_{t-1}$

$+ \underset{(.2544)}{.426395}\ Log(\frac{VLR}{PF})_{t-1} - \underset{(.1537)}{.019632}\ Log(FSF)_{t-1} + \underset{(.2077)}{.076811}\ Log(TIM)_t$; $\bar{R}^2 = .098$, $\hat{g} = 1.01963$

Electricity, U. S., 1927-1955: $Log(FSE)_t = .002194 - \underset{(.2674)}{.101136}\ Log(RNIPF)_{t-1} - \underset{(.2636)}{.382099}\ Log(\frac{PE}{PRF})_{t-1}$

$- \underset{(.1917)}{.069112}\ Log(\frac{FWR}{PE})_{t-1} + \underset{(.3011)}{.973361}\ Log(FSE)_{t-1} - \underset{(1.0778)}{.486555}\ Log(TIM)_t$; $\bar{R}^2 = .937$, $\hat{g} = .02664$

APPENDIX TABLE A-3.--Regression equations for estimating expected overhead costs of specified capital inputs, United States farm sector, 1917-1964[1]

	a_0	a_1	a_2	$\bar{R}^2$
Tractors	4.808310	.702725	.364650	.784
10 year avg. life	(4.5619)	(.2195)	(.2238)	
Trucks	-10.652719	2.025049	-.804069	.826
10 year avg. life	(11.0702)	(.4799)	(.5147)	
Grain Combines	-4.152853	1.887058	-.688190	.832
10 year avg. life	(7.8233)	(.4943)	(.5280)	
Buildings	.002451	.387271	-.012846	.192
10 year avg. life	(.0005)	(.1821)	(.1824)	
Corn Pickers	-1.540473	1.770900	-.571590	.825
10 year avg. life	(3.1017)	(.4810)	(.5146)	
Pickup Balers	33.579702	.968238	-.206645	.895
10 year avg. life	(4.8916)	(.3817)	(.3942)	
Forage Harvesters	35.464550	.518983	.109073	.939
10 year avg. life	(2.8438)	(.2380)	(.2368)	
Horses and Mules	40.631824	1.365793	-.621029	.699
5 years avg. life	(13.0625)	(.2561)	(.2618)	
Beef Cows	.185631	.911794	-.078590	.702
5 year avg. life	(.0758)	(.2322)	(.2382)	
Milk Cows	1.511235	.876998	-.035858	.701
5 year avg.	(.6532)	(.2261)	(.2321)	
Beef and Dairy Heifers	.073399	1.168730	-.242271	.890
1 year avg. life	(.0467)	(.1461)	(.1473)	

[1]The coefficients are for the equation $Pt_n = a_0 + a_1 Pt_{-1} + a_2 Pt_{-2}$ where $\hat{P}t_n$ is the expected average overhead cost associated with using one unit of the capital input in the current and next n-1 years with n the expected life in years of the input. Overhead costs for studied inputs not listed above are assumed zero. See Lerohl, op. cit., chapter 4 for a detailed explanation of the expectations model.

APPENDIX TABLE A-4.--Salvage values of specified capital inputs, United States farm sector, 1916-1964

Year	General Situation	Salvage Price (dollars)[1]		
		Motor Trucks	Beef Cows	Milk Cows
1916		201	64	55
1917		197	94	65
1918	World War I	215	109	75
1919		257	110	83
1920		271	92	80
1921		220	56	53
1922		201	61	48
1923		187	56	50
1924	Prosperity in the	182	58	50
1925	Nonfarm Sector	173	74	52
1926		178	78	59
1927		173	74	67
1928		187	81	81
1929		187	82	85
1930		183	71	67
1931	The Big Depression	178	50	46
1932		168	33	33
1933		168	31	30
1934		168	36	29
1935		168	61	42
1936		173	61	47
1937	Recovery	178	69	51
1938		192	61	51
1939		197	59	53
1940		201	58	55
1941		215	76	64
1942		225	99	81
1943		267	109	103
1944	World War II	285	102	96
1945		285	110	100
1946		328	132	118
1947		370	176	137
1948	Post World War II Boom and Korean Conflict	402	193	167
1949		417	167	166
1950		416	182	178
1951		440	219	222
1952		463	190	219
1953		459	155	159
1954		463	152	134

[1]Studied durable inputs not listed above are specialized to the farm sector and their salvage values are assumed zero. Salvage values of expendable inputs are assumed equal to acquisition costs in computing factor shares, and are in Appendix Tables B-1 through B-28.

continued

APPENDIX TABLE A-4.--Continued

Year	General Situation	Salvage Price (dollars)		
		Motor Trucks	Beef Cows	Milk Cows
1955		468	132	131
1956		477	125	138
1957		510	147	149
1958	General Economic	534	180	189
1959	Growth and Expansion	562	168	210
1960		562	158	201
1961		562	160	202
1962		580	167	198
1963		585	155	193
1964		608	145	187

APPENDIX TABLE A-5.--Marginal value products of labor and land in the farm sector used to compute MPPs of tractors relative to labor and MPPs of fertilizer relative to land, United States, 1917-1964

Year	Discounted MVP of an hour of labor	Discounted MVP of the value of an acre of land[1]	Year	Discounted MVP of an hour of labor	Discounted MVP of the value of an acre of land
	(----------dollars----------)			(----------dollars----------)	
			1941	.20	23.14
1917	.18	43.24	1942	.34	25.52
1918	.28	45.87	1943	.48	27.64
1919	.39	48.43	1944	.82	30.86
1920	.43	56.84	1945	.55	35.27
1921	.36	51.95	1946	.41	39.57
1922	.19	53.68	1947	.37	44.22
1923	.33	45.70	1948	.72	47.08
1924	.27	46.25	1949	.69	46.92
1925	.22	43.60	1950	.49	47.00
1926	.37	40.54	1951	.65	55.78
1927	.24	39.85	1952	.83	52.01
1928	.28	38.76	1953	.86	61.90
1929	.25	37.61	1954	.71	61.50
1930	.43	35.45	1955	.74	64.84
1931	.26	31.35	1956	.70	68.49
1932	.12	26.40	1957	.72	73.85
1933	.05	23.16	1958	.53	78.48
1934	.08	22.69	1959	1.12	84.07
1935	.19	22.81	1960	.81	93.14
1936	.13	23.54	1961	.83	96.32
1937	.39	23.71	1962	.91	101.80
1938	.20	23.24	1963	.93	
1939	.17	22.93	1964	.88	
1940	.16	22.37			

[1]Computed by Shyamalendu Sarkar of Michigan State University using the estimating techniques employed in this thesis and treating the current value of farm land in the United States as the input and the farm mortgage credit rate of interest as the cost of a dollar invested in land. The author multiplied Sarkar's MVPs by the price of an acre of land.

APPENDIX B

THESIS ESTIMATES

APPENDIX TABLE B.1.--TRACTORS IN AGGREGATE FARM PRODUCTION: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1917-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	NO. OF TRACTORS ON FARMS	ACQUISITION COST	EX POST			EX ANTE			ANNUAL AVR. CAP. GAINS
					MVP	NET MVP	CAPITAL VALUE	MVP	NET MVP	CAPITAL VALUE	
			(1,000)	----------DOLLARS PER TRACTOR----------							($1,000)
	1917	0.00138	51.0	784.00	359.65	328.65	11584.94	362.92	330.92	2240.68	55085
WORLD WAR I	1918	0.01910	85.0	994.00	3696.50	3657.50	14340.70	3779.19	3743.19	25345.26	113447
	1919	0.08011	158.0	1026.00	9037.71	8997.71	13683.26	9184.58	9140.58	61891.18	199085
	1920	0.04265	246.0	1058.00	2764.14	2723.14	6896.84	3054.73	3007.73	20365.45	143636
	1921	0.09401	343.0	1026.00	2897.76	2857.76	5076.95	4793.91	4745.91	31560.14	138947
	1922	0.00207	372.0	912.00	61.54	25.54	2960.95	83.08	35.08	234.33	76221
	1923	0.00849	428.0	950.00	241.24	204.24	3231.80	299.69	254.69	1716.72	97661
POST WORLD	1924	0.00153	496.0	994.00	39.47	0.47	3267.13	47.88	3.88	26.30	112747
WAR I FARM	1925	0.04424	549.0	994.00	1105.38	1066.38	3604.21	1259.75	1213.75	8255.75	143300
DEPRESSION	1926	0.01440	621.0	994.00	308.42	269.42	3209.91	392.38	346.38	2366.75	137608
	1927	0.01204	693.0	994.00	231.60	192.60	3235.21	296.19	250.19	1709.48	155316
	1928	0.01339	782.0	994.00	232.85	193.85	3566.25	278.57	232.57	1596.36	201150
	1929	0.02637	827.0	962.00	444.36	407.36	3800.22	531.61	485.61	3318.11	234721
	1930	0.13763	920.0	969.00	1716.19	1678.19	3608.48	2316.85	2271.85	15523.21	242832
GENERAL	1931	0.11680	997.0	950.00	986.54	949.54	1994.90	1652.45	1607.45	10983.45	104176
DEPRESSION	1932	0.00999	1022.0	918.00	62.58	26.58	1061.04	112.38	67.38	460.39	14618
	1933	0.00095	1019.0	886.00	6.64	-28.36	2083.92	10.63	-33.37	-230.13	122068
	1934	0.00426	1016.0	918.00	35.94	-0.06	2773.44	50.65	8.65	59.91	188513
	1935	0.06248	1048.0	969.00	578.05	540.05	3027.08	715.34	672.34	4856.05	215686
	1936	0.02144	1125.0	1033.00	204.96	164.96	2676.69	266.93	221.93	1610.46	184916
RECOVERY	1937	0.05910	1230.0	1064.00	546.21	505.21	2750.86	704.00	657.00	4767.57	207484
	1938	0.03958	1370.0	1128.00	293.23	249.23	2543.98	447.99	399.99	2930.08	193989
	1939	0.01201	1445.0	1033.00	87.95	47.95	2758.44	131.42	80.42	597.52	249326
	1940	0.00560	1567.0	982.00	39.49	1.49	3103.92	56.57	7.57	56.81	332906
	1941	0.00460	1665.0	1033.00	38.23	-1.77	3539.22	46.95	0.95	7.22	417286
	1942	0.22439	1860.0	1829.00	2267.27	2196.27	4201.29	2582.38	2535.38	19295.39	441246
	1943	0.09423	2055.0	1817.00	1072.85	1001.85	2497.79	1134.80	1065.80	8150.51	139902
WORLD WAR II	1944	0.01036	2160.0	1931.00	117.29	42.29	1799.80	126.93	46.93	358.85	-28340
	1945	0.00314	2354.0	1485.00	34.45	-23.55	2001.94	34.95	-48.05	-365.66	121688
	1946	0.00344	2480.0	1256.00	40.93	-8.07	2459.63	38.53	-34.47	-262.34	298501
	1947	0.04332	2613.0	1485.00	566.11	508.11	3155.37	520.05	460.05	3484.37	436469
POST WORLD	1948	0.09306	2821.0	1667.00	1145.39	1080.39	3196.33	1098.92	1035.92	7771.08	431423
WAR II BOOM,	1949	0.07410	3123.0	1848.00	750.49	678.49	2343.38	853.27	782.27	5757.60	154707
KOREAN	1950	0.03923	3394.0	1868.00	373.05	300.05	2012.03	395.82	316.82	2331.85	48885
CONFLICT AND	1951	0.02759	3678.0	1995.00	277.94	199.94	2086.15	262.81	180.81	1324.47	33524
ADJUSTMENT	1952	0.04681	3907.0	2014.00	440.38	362.38	2188.41	457.42	371.42	2695.23	68143
	1953	0.05506	4100.0	2040.00	469.81	390.81	2096.06	533.11	445.11	3214.86	22986
	1954	0.04386	4243.0	1982.00	347.24	270.24	1940.98	390.27	301.27	2175.97	-17403
	1955	0.05372	4345.0	2027.00	409.71	330.71	1918.60	485.06	397.06	2936.32	-47098
	1956	0.05946	4480.0	2123.00	454.87	371.87		514.47	426.47	3109.31	
	1957	0.05543	4570.0	2244.00	412.39	325.39		465.96	373.96	2663.34	
GENERAL	1958	0.02752	4620.0	2839.00	225.82	134.82		238.83	142.83	1017.20	
GROWTH AND	1959	0.06438	4673.0	2454.00	516.19	420.19		558.53	458.53	3296.28	
EXPANSION	1960	0.04033	4684.0	2467.00	326.46	230.46		355.40	250.40	1742.54	
	1961	0.04304	4700.0	2473.00	362.49	266.49		390.59	283.59	2029.19	
	1962	0.03494	4690.0	2550.00	340.96	241.96		373.16	266.16	1922.35	
	1963	0.03284	4670.0	2569.00	295.84	195.84		318.77	209.77	1522.23	
	1964	0.04245	4657.0	2664.00	384.58	280.58		434.54	323.54	2325.85	

APPENDIX TABLE B.2.--MOTOR TRUCKS IN AGGREGATE FARM PRODUCTION: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1917-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	NO. OF TRUCKS ON FARMS	ACQUISITION COST OF A NEW TRUCK	EX POST			EX ANTE		
					MVP	NET MVP	CAPITAL VALUE	MVP	NET MVP	CAPITAL VALUE
			(1,000)	----------	----------	----------	DOLLARS PER TRUCK	----------	----------	----------
	1917	0.00106	60.0	871.00	235.04	134.04	1377.42	237.18	126.18	854.35
WORLD WAR I	1918	0.00182	89.0	954.00	336.32	236.32	1641.64	343.84	230.84	1563.03
	1919	0.00239	111.0	1140.00	383.44	281.44	1846.79	389.68	278.68	1886.92
	1920	0.00438	139.0	1202.00	502.33	404.33	2026.81	555.14	440.14	2980.18
	1921	0.01934	207.0	974.00	988.03	895.03	1730.19	1634.55	1528.55	10164.80
	1922	0.00614	263.0	891.00	258.08	165.08	1048.31	348.40	249.40	1666.00
	1923	0.00428	316.0	829.00	164.81	79.81	1015.71	204.74	101.74	685.78
POST WORLD	1924	0.00554	363.0	808.00	195.22	110.22	1013.65	236.85	149.85	1014.62
WAR I FARM	1925	0.00814	459.0	767.00	243.19	154.19	1055.69	277.15	184.15	1252.54
DEPRESSION	1926	0.01221	559.0	788.00	290.53	202.53	1006.50	369.62	268.62	1835.47
	1927	0.01090	662.0	767.00	219.52	134.52	920.70	280.74	184.74	1262.27
	1928	0.01388	753.0	829.00	250.72	162.72	891.91	299.95	208.95	1434.28
	1929	0.01009	840.0	829.00	167.49	80.49	929.99	280.38	101.38	692.72
	1930	0.02790	900.0	808.00	355.65	268.65	886.17	480.13	385.13	2631.54
GENERAL	1931	0.03754	920.0	788.00	343.61	257.61	741.39	575.55	479.55	3276.66
DEPRESSION	1932	0.02040	910.0	746.00	143.60	58.60	496.61	257.87	163.87	1119.73
	1933	0.00900	865.0	746.00	73.93	-5.07	455.50	118.29	26.29	181.27
	1934	0.01600	875.0	746.00	156.63	77.63	570.20	220.70	139.70	967.76
	1935	0.00884	890.0	746.00	96.32	24.32	629.81	118.95	32.95	238.00
	1936	0.01433	923.0	767.00	167.02	83.02	709.48	217.53	145.53	1056.85
RECOVERY	1937	0.01346	990.0	788.00	154.55	74.55	752.28	199.19	97.19	705.29
	1938	0.02912	1042.0	850.00	283.66	200.66	780.31	433.37	349.37	2559.23
	1939	0.00729	1020.0	871.00	75.70	-10.30	728.77	113.11	20.11	149.42
	1940	0.02438	1047.0	891.00	278.60	192.60	905.02	399.08	302.08	2266.07
	1941	0.00948	1095.0	954.00	119.89	34.89	979.48	147.26	53.26	403.35
	1942	0.00695	1160.0	995.00	112.62	22.62	1051.18	128.28	36.28	276.07
	1943	0.01348	1280.0	1182.00	246.42	140.42	1261.37	260.65	157.65	1205.58
WORLD WAR II	1944	0.01726	1385.0	1264.00	304.74	189.74	1306.97	329.79	197.79	1512.57
	1945	0.01434	1490.0	1264.00	248.41	132.41	1314.94	252.01	115.01	875.24
	1946	0.01384	1550.0	1451.00	263.79	140.79	1467.03	248.33	116.33	885.29
	1947	0.01645	1700.0	1638.00	330.36	196.36	1721.83	303.48	158.48	1200.30
POST WORLD	1948	0.02674	1900.0	1783.00	488.67	342.67	1883.91	468.84	306.84	2301.83
WAR II BOOM,	1949	0.03330	2065.0	1845.00	510.04	366.04	1709.49	579.89	402.89	2965.34
KOREAN	1950	0.02523	2207.0	1845.00	368.87	221.87	1602.46	391.40	227.40	1673.65
CONFLICT AND	1951	0.02133	2325.0	1949.00	339.90	176.90	1708.15	321.39	150.39	1101.66
ADJUSTMENT	1952	0.03147	2430.0	2052.00	476.08	304.08	1763.29	494.49	293.49	2129.76
	1953	0.03181	2535.0	2032.00	438.98	269.98	1704.16	498.12	292.12	2109.88
	1954	0.03372	2610.0	2052.00	433.96	265.96	1666.04	487.73	294.73	2128.72
	1955	0.03369	2675.0	2073.00	417.40	246.40	1647.13	494.16	300.16	2219.70
	1956	0.03334	2707.0	2114.00	422.16	234.16		477.47	275.47	2008.44
	1957	0.03913	2745.0	2260.00	484.68	290.68		547.64	313.64	2233.73
GENERAL	1958	0.02626	2775.0	2363.00	358.79	160.79		379.46	148.46	1057.35
GROWTH AND	1959	0.03697	2800.0	2488.00	521.53	315.53		564.30	330.30	2374.49
EXPANSION	1960	0.03424	2826.0	2488.00	459.33	247.33		500.04	253.04	1760.93
	1961	0.02815	2850.0	2488.00	390.94	184.94		421.25	168.25	1203.87
	1962	0.03260	2875.0	2570.00	465.65	251.65		509.62	273.62	1976.27
	1963	0.03171	2900.0	2591.00	460.06	242.06		495.73	238.73	1732.37
	1964	0.03759	2915.0	2695.00	544.02	314.02		614.68	355.68	2556.93

APPENDIX TABLE B.3.--GRAIN COMBINES IN AGGREGATE FARM PRODUCTION: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1917-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	NO. OF COMBINES ON FARMS	ACQUISITION COST	EX POST			EX ANTE			ANNUAL AVR. CAP. GAINS
					MVP	NET MVP	CAPITAL VALUE	MVP	NET MVP	CAPITAL VALUE	
			(1,000)	----------DOLLARS PER COMBINE----------							($1,000)
	1917	0.00003	3.0	1391.00	140.09	86.09	1404.02	141.36	88.36	598.31	4
	1918	0.00004	3.0	1753.00	219.29	151.29	1765.29	224.20	159.20	1077.94	4
WORLD WAR I	1919	0.00009	4.0	1810.00	410.92	339.92	2117.78	417.59	330.59	2238.46	123
	1920	0.00008	4.0	1878.00	328.54	255.54	2359.31	363.08	280.08	1896.43	193
	1921	0.00089	10.0	1810.00	936.60	865.60	2177.20	1549.46	1464.46	9738.60	367
	1922	0.00038	15.0	1617.00	280.19	217.19	1565.44	378.26	298.26	1992.35	-77
	1923	0.00054	21.0	1674.00	314.37	249.37	1658.39	390.54	324.54	2187.58	-33
POST WORLD	1924	0.00066	27.0	1753.00	312.42	244.42	1642.67	379.03	304.03	2058.96	-298
WAR I FARM	1925	0.00064	32.0	1742.00	274.88	206.88	1663.77	313.27	234.27	1593.48	-250
DEPRESSION	1926	0.00084	38.0	1742.00	295.75	227.75	1714.09	376.26	299.26	2044.79	-186
	1927	0.00094	44.0	1753.00	283.63	215.63	1700.80	362.72	285.72	1952.26	-230
	1928	0.00100	50.0	1742.00	271.00	203.00	1710.89	324.21	247.21	1696.89	-196
	1929	0.00102	55.0	1730.00	257.98	190.98	1797.58	308.64	231.64	1582.77	372
	1930	0.00173	61.0	1719.00	324.89	257.89	1814.56	438.61	363.61	2484.46	583
GENERAL	1931	0.00347	74.0	1697.00	395.34	329.34	1644.24	662.19	586.19	4005.36	-390
DEPRESSION	1932	0.00457	87.0	1606.00	336.33	273.33	1372.11	603.99	529.99	3621.37	•2035
	1933	0.00306	100.0	1561.00	217.52	156.52	1208.72	348.03	279.03	1924.07	•3523
	1934	0.00291	113.0	1629.00	220.46	157.46	1251.49	318.65	242.65	1680.88	•4266
	1935	0.00306	126.0	1674.00	235.70	170.70	1299.89	291.68	218.68	1579.46	•4714
	1936	0.00302	138.0	1697.00	235.38	169.38	1314.83	306.56	231.56	1680.34	•5274
	1937	0.00338	151.0	1730.00	254.49	187.49	1355.43	328.01	252.01	1828.71	•5696
RECOVERY	1938	0.00508	164.0	1787.00	314.62	245.62	1319.95	480.67	403.67	2957.05	•7660
	1939	0.00415	177.0	1753.00	247.91	179.91	1264.70	370.45	290.45	2158.15	•8643
	1940	0.00417	190.0	1730.00	242.93	175.93	1327.88	347.98	270.98	2032.78	•7640
	1941	0.00378	225.0	1753.00	232.54	164.54	1419.15	285.62	210.62	1595.23	•7912
	1942	0.00359	275.0	1855.00	245.22	173.22	1603.10	279.30	201.30	1532.02	•6927
	1943	0.00355	320.0	1923.00	259.34	184.34	1761.76	274.31	189.31	1447.71	•5160
WORLD WAR II	1944	0.00408	345.0	1968.00	289.40	212.40	1849.41	313.19	225.19	1722.08	•4891
	1945	0.00420	375.0	1991.00	288.89	210.89	1926.20	293.07	203.07	1545.44	•2430
	1946	0.00410	420.0	2058.00	288.56	208.56	2128.18	271.64	181.64	1382.37	2947
	1947	0.00481	465.0	2330.00	353.50	262.50	2518.51	324.73	231.73	1755.13	8766
POST WORLD	1948	0.00778	535.0	2715.00	505.05	399.05	2782.97	484.56	372.56	2794.79	3636
WAR II BOOM,	1949	0.01217	620.0	3054.00	620.99	501.99	2690.75	706.04	573.04	4217.62	•22822
KOREAN	1950	0.01124	714.0	3133.00	508.21	386.21	2583.13	539.24	392.24	2886.91	•39261
CONFLICT AND	1951	0.01091	810.0	3371.00	498.95	367.95	2739.78	471.78	327.78	2401.07	•51129
ADJUSTMENT	1952	0.01347	887.0	3484.00	558.04	422.04	2803.14	579.62	420.62	3052.27	•60392
	1953	0.01453	930.0	3518.00	546.46	409.46	2786.33	620.09	458.09	3308.56	•68046
	1954	0.01538	965.0	3529.00	535.34	397.34	2773.38	601.68	440.68	3182.83	.•72917
	1955	0.01456	980.0	3529.00	492.23	354.23	2771.61	582.76	420.76	3111.53	•74225
	1956	0.01582	1005.0	3687.00	539.55	395.55		610.25	449.25	3275.41	
	1957	0.01721	1015.0	3868.00	576.40	425.40		651.27	479.27	3413.34	
GENERAL	1958	0.01443	1030.0	4038.00	530.98	373.98		561.57	379.57	2703.29	
GROWTH AND	1959	0.01753	1045.0	4208.00	628.39	464.39		679.93	491.93	3536.44	
EXPANSION	1960	0.01662	1040.0	4321.00	605.93	437.93		659.64	462.64	3219.53	
	1961	0.01565	1035.0	4423.00	598.44	426.44		644.84	444.84	3182.96	
	1962	0.01513	1025.0	4592.00	606.09	431.09		663.33	458.33	3310.36	
	1963	0.01479	1020.0	4581.00	609.94	430.94		657.23	449.23	3259.90	
	1964	0.01604	1010.0	4683.00	669.84	487.84		756.84	543.84	3909.96	

APPENDIX TABLE B.4.--PICKUP BALERS IN AGGREGATE FARM PRODUCTION: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1943-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	NO. OF BALERS ON FARMS	ACQUISITION COST	EX POST			EX ANTE			ANNUAL AVR. CAP. GAINS
					MVP	NET MVP	CAPITAL VALUE	MVP	NET MVP	CAPITAL VALUE	
			(1,000)	----------DOLLARS PER BALER----------							($1,000)
	1943	0.00055	31.0	1220.00	414.20	366.20	5511.91	438.12	369.12	2822.75	13385
	1944	0.00029	34.0	1249.00	209.46	160.46	5805.15	226.68	156.68	1198.17	15491
WORLD WAR II	1945	0.00069	42.0	1264.00	421.78	372.78	6343.15	427.88	356.88	2716.06	21332
	1946	0.00059	54.0	1307.00	325.05	274.05	7083.37	305.99	234.99	1788.40	31192
	1947	0.00083	65.0	1479.00	438.26	380.26	8496.18	402.59	329.59	2496.32	45612
	1948	0.00511	90.0	1723.00	1973.13	1906.13	9562.94	1893.09	1814.09	13608.58	70559
POST WORLD	1949	0.01914	135.0	1938.00	4484.50	4408.50	8264.03	5098.68	5012.68	36893.77	85401
WAR II BOOM,	1950	0.00943	196.0	1989.00	1552.91	1474.91	4644.56	1647.72	1554.72	11442.84	52049
KOREAN	1951	0.00353	240.0	2139.00	544.38	461.38	3918.12	514.73	421.73	3089.35	42699
CONFLICT AND	1952	0.00813	298.0	2211.00	1002.85	916.85	3943.83	1041.64	943.64	6847.64	51638
ADJUSTMENT	1953	0.00782	345.0	2233.00	793.02	706.02	3447.82	899.87	799.87	5777.13	41911
	1954	0.00827	395.0	2240.00	703.12	616.12	3127.64	790.24	690.24	4985.35	35062
	1955	0.00786	448.0	2240.00	581.23	494.23	2892.47	688.13	588.13	4349.25	29831
	1956	0.00871	505.0	2340.00	591.36	500.36		668.85	568.85	4147.42	
	1957	0.01175	560.0	2455.00	713.22	617.22		805.86	701.86	4998.67	
	1958	0.00569	600.0	2563.00	359.25	259.25		379.95	271.95	1936.83	
GENERAL	1959	0.01128	645.0	2671.00	655.25	551.25		709.00	599.00	4306.09	
GROWTH AND	1960	0.00940	680.0	2743.00	524.10	417.10		570.55	456.55	3177.18	
EXPANSION	1961	0.00797	715.0	2807.00	441.46	332.46		475.69	359.69	2573.68	
	1962	0.00738	735.0	2857.00	412.35	301.35		451.29	334.29	2414.44	
	1963	0.00767	750.0	2908.00	430.45	317.45		463.82	345.82	2509.49	
	1964	0.00965	775.0	2972.00	525.33	409.33		593.56	473.56	3404.32	

APPENDIX TABLE B.5.--FIELD FORAGE HARVESTERS IN AGGREGATE FARM PRODUCTION: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1946-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	NO. OF HARVESTERS ON FARMS	ACQUISITION COST	EX POST			EX ANTE			ANNUAL AVR. CAP. GAINS
					MVP	NET MVP	CAPITAL VALUE	MVP	NET MVP	CAPITAL VALUE	
			(1,000)	---DOLLARS PER HARVESTER---							($1,000)
WORLD WAR II	1946	0.00029	25.0	1021.00	341.83	301.83	61481.46	321.79	262.79	1999.97	131191
	1947	0.00067	30.0	1155.00	757.55	712.55	74360.29	695.90	635.90	4816.29	219616
	1948	0.05592	45.0	1346.00	43151.37	43099.37	84461.04	41400.89	41337.89	310100.36	374818
	1949	0.07010	60.0	1514.00	36952.08	36893.08	45937.37	42012.91	41945.91	308725.52	266540
POST WORLD WAR II BOOM, KOREAN CONFLICT AND ADJUSTMENT	1950	0.01123	81.0	1554.00	4475.55	4414.55	12253.93	4748.79	4676.79	34421.62	86669
	1951	0.00357	102.0	1671.00	1296.17	1231.17	9565.69	1225.57	1151.57	8435.65	80828
	1952	0.00877	124.0	1727.00	2600.67	2533.67	9292.92	2701.26	2625.26	19050.46	93817
	1953	0.01170	148.0	1744.00	2765.87	2697.87	7565.04	3138.53	3061.53	22112.21	86191
	1954	0.01056	175.0	1750.00	2027.44	1959.44	5517.33	2278.67	2200.67	15894.54	65928
	1955	0.00696	202.0	1750.00	1141.19	1073.19	4148.55	1351.06	1273.06	9414.39	48491
	1956	0.00433	220.0	1828.00	674.13	603.13		762.47	694.47	5063.26	
	1957	0.00796	240.0	1918.00	1127.64	1052.64		1274.11	1206.11	8589.93	
	1958	0.00199	258.0	2002.00	293.03	215.03		309.91	238.91	1701.91	
GENERAL GROWTH AND EXPANSION	1959	0.00578	270.0	2086.00	802.13	721.13		867.92	792.92	5700.18	
	1960	0.00550	290.0	2143.00	718.66	634.66		782.35	704.35	4901.68	
	1961	0.00319	305.0	2193.00	414.12	329.12		446.23	365.23	2613.33	
	1962	0.00326	320.0	2232.00	417.93	330.93		457.40	373.40	2696.90	
	1963	0.00304	330.0	2272.00	387.27	299.27		417.29	332.29	2411.30	
	1964	0.00518	345.0	2322.00	632.91	542.91		715.12	628.12	4515.44	

APPENDIX TABLE B.6.--HORSES AND MULES ON FARMS: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1917-1960

GENERAL SITUATION	YEAR	ELAST. OF PROD.	NO. OF HORSES AND MULES	ACQUISITION COST	EX POST			EX ANTE			ANNUAL AVR. CAP. GAINS
					MVP	NET MVP	CAPITAL VALUE	MVP	NET MVP	CAPITAL VALUE	
			(MILLION)	----------DOLLARS PER HORSE OR MULE----------							(MIL. DOL.)
	1917	0.34327	26.7	106.00	171.12	24.12	67.38	172.67	29.67	119.11	-206
WORLD WAR I	1918	0.30153	26.7	109.00	185.74	24.74	66.82	189.90	33.90	136.06	-225
	1919	0.29040	26.5	106.00	195.34	18.34	66.08	198.51	29.51	118.45	-212
	1920	0.37584	25.7	108.00	233.17	18.17	74.94	257.68	75.68	303.77	-170
	1921	0.52287	25.1	92.00	220.25	15.25	64.49	364.37	140.37	557.52	-138
	1922	0.44335	24.6	75.00	199.31	16.31	58.62	269.07	82.07	326.80	-81
POST WORLD	1923	0.39192	24.0	74.00	198.69	16.69	55.64	246.83	83.83	335.60	-88
WAR I FARM	1924	0.35155	23.3	71.00	192.90	16.90	55.40	234.02	58.02	232.90	-73
DEPRESSION	1925	0.31154	22.6	69.00	189.07	12.07	54.72	215.48	47.48	191.07	-65
	1926	0.30040	22.0	70.00	181.63	11.63	58.30	231.08	58.08	234.35	-51
	1927	0.28079	21.2	67.00	176.63	11.63	60.54	225.88	62.88	253.75	-27
	1928	0.27040	20.4	70.00	180.24	17.24	61.34	215.63	55.63	225.08	-35
	1929	0.25078	19.7	73.00	177.37	15.37	59.26	212.20	51.20	206.59	-54
	1930	0.28825	19.1	74.00	173.13	15.13	60.04	233.73	72.73	293.47	-53
GENERAL	1931	0.34733	18.5	63.00	158.10	13.10	59.13	264.82	108.82	439.10	-14
DEPRESSION	1932	0.36916	17.8	56.00	132.84	9.84	56.25	238.55	98.55	397.68	1
	1933	0.27349	17.3	56.00	112.35	11.35	62.63	179.76	61.76	250.54	23
	1934	0.23151	17.0	71.00	116.68	14.68	70.16	164.41	62.41	253.86	-3
	1935	0.21078	16.7	83.00	122.38	17.38	76.46	151.44	34.44	143.52	-22
	1936	0.18113	16.2	104.00	120.26	15.26	79.34	156.63	35.63	148.87	-88
RECOVERY	1937	0.18000	15.8	108.00	129.50	22.50	85.09	166.91	47.91	200.17	-72
	1938	0.18000	15.2	100.00	120.19	18.19	75.72	183.62	61.62	258.85	-74
	1939	0.16077	14.8	94.00	114.98	19.98	72.02	171.82	58.82	249.11	-65
	1940	0.15039	14.5	88.00	114.70	19.70	75.86	164.31	57.31	244.05	-35
	1941	0.11140	14.1	79.00	109.43	18.43	79.98	134.41	23.41	100.24	3
	1942	0.08104	13.6	76.00	112.00	14.00	87.46	127.56	21.56	92.58	31
WORLD WAR II	1943	0.07038	13.2	93.00	124.75	17.75	92.58	131.96	13.96	60.09	-1
	1944	0.07957	12.6	96.00	154.38	31.38	93.10	167.07	41.07	176.84	-7
	1945	0.07038	12.0	84.00	151.40	26.40	76.85	153.59	11.59	49.76	-17
	1946	0.06038	11.1	78.00	160.68	22.68	64.71	151.26	16.26	69.80	-30
	1947	0.05037	10.1	82.00	170.30	16.30	64.19	156.44	5.44	23.30	-36
POST WORLD	1948	0.05000	9.3	77.00	186.68	21.68	79.70	179.10	14.10	60.07	5
WAR II BOOM,	1949	0.05000	8.5	71.00	186.34	15.34	60.03	211.86	41.86	176.34	-19
KOREAN	1950	0.04037	7.8	61.00	167.00	9.00	63.23	177.20	5.20	21.90	3
CONFLICT AND	1951	0.04000	7.0	55.00	211.74	18.74	86.99	200.21	50.21	210.93	45
ADJUSTMENT	1952	0.04000	6.2	54.00	237.15	36.15	114.33	246.33	40.33	168.90	75
	1953	0.03035	5.4	53.00	196.66	-3.34	71.48	223.15	28.15	117.32	20
	1954	0.03000	4.8	53.00	209.93	21.93	86.86	235.94	46.94	195.61	33
	1955	0.03000	4.3	56.00	231.20	33.20	86.22	273.71	100.71	425.40	26
	1956	0.03000	4.0	63.00	257.05	54.05	96.54	290.74	96.74	405.29	27
GENERAL	1957	0.02033	3.6	72.00	192.04	-20.96		216.98	21.98	90.86	
GROWTH AND	1958	0.02000	3.4	84.00	223.01	11.01		235.85	30.85	127.53	
EXPANSION	1959	0.02000	3.2	102.00	234.17	24.17		253.38	55.38	230.15	
	1960	0.02000	3.1	113.00	244.61	57.61		266.29	70.29	286.68	

APPENDIX TABLE B.7.--BUILDINGS IN AGGREGATE FARM PRODUCTION: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1917-1964

GENERAL SITUATION	YEAR	HIST. OF PROD.	CURRENT DOLLAR INVEST.	ACQUISITION COST	EX ANTE		
					MVP	NET MVP	CAPITAL VALUE
		(MIL. DOL.)			----------DOLLARS PER DOLLAR INVESTED----------		
	1917	0.01587	8103.0	1.00	0.03	-0.02	-0.10
	1918	0.02648	8846.0	1.00	0.05	0.01	0.06
WORLD WAR I	1919	0.05514	9543.0	1.00	0.10	0.06	0.43
	1920	0.45079	11485.0	1.00	0.69	0.65	4.40
	1921	1.20798	11443.0	1.00	1.85	1.80	12.00
	1922	0.05435	10756.0	1.00	0.08	0.04	0.26
	1923	0.06546	11105.0	1.00	0.09	0.05	0.34
POST WORLD	1924	0.07570	11309.0	1.00	0.10	0.06	0.43
WAR I FARM	1925	0.07223	11745.0	1.00	0.10	0.06	0.39
DEPRESSION	1926	0.12400	11956.0	1.00	0.18	0.14	0.94
	1927	0.08962	11920.0	1.00	0.13	0.09	0.62
	1928	0.09591	12216.0	1.00	0.13	0.09	0.62
	1929	0.09849	12620.0	1.00	0.13	0.09	0.63
	1930	0.42688	12949.0	1.00	0.51	0.47	3.23
GENERAL	1931	0.62802	12143.0	1.00	0.73	0.69	4.74
DEPRESSION	1932	0.40718	10697.0	1.00	0.44	0.40	2.73
	1933	0.02808	9143.0	1.00	0.03	0.00	0.01
	1934	0.05502	9734.0	1.00	0.07	0.03	0.23
	1935	0.07166	10245.0	1.00	0.08	0.05	0.36
	1936	0.06483	10535.0	1.00	0.09	0.05	0.37
	1937	0.08444	10820.0	1.00	0.11	0.08	0.56
RECOVERY	1938	0.21829	10808.0	1.00	0.31	0.28	2.02
	1939	0.06837	10520.0	1.00	0.10	0.06	0.48
	1940	0.07207	10405.0	1.00	0.11	0.07	0.53
	1941	0.02016	10386.0	1.00	0.03	-0.01	-0.05
	1942	0.01384	11026.0	1.00	0.03	-0.01	-0.11
	1943	0.02241	11923.0	1.00	0.05	0.01	0.05
WORLD WAR II	1944	0.09570	13591.0	1.00	0.19	0.15	1.12
	1945	0.07378	14906.0	1.00	0.13	0.09	0.69
	1946	0.05373	16724.0	1.00	0.09	0.05	0.40
	1947	0.04506	18521.0	1.00	0.08	0.04	0.28
	1948	0.08686	20062.0	1.00	0.15	0.11	0.80
POST WORLD	1949	0.14788	20778.0	1.00	0.26	0.21	1.58
WAR II BOOM,	1950	0.06053	20803.0	1.00	0.10	0.06	0.43
KOREAN	1951	0.04903	22768.0	1.00	0.08	0.03	0.25
CONFLICT AND	1952	0.12531	24950.0	1.00	0.19	0.15	1.08
ADJUSTMENT	1953	0.11457	25454.0	1.00	0.18	0.14	1.00
	1954	0.06746	23942.0	1.00	0.11	0.07	0.48
	1955	0.09803	24534.0	1.00	0.16	0.11	0.85
	1956	0.05079	23919.0	1.00	0.08	0.04	0.29
	1957	0.09457	24594.0	1.00	0.15	0.11	0.75
GENERAL	1958	0.06457	26936.0	1.00	0.10	0.05	0.38
GROWTH AND	1959	0.12163	28596.0	1.00	0.17	0.13	0.95
EXPANSION	1960	0.04630	26741.0	1.00	0.07	0.03	0.22
	1961	0.05681	26913.0	1.00	0.09	0.05	0.35
	1962	0.05591	26938.0	1.00	0.09	0.05	0.38
	1963	0.05900	26962.0	1.00	0.10	0.06	0.42
	1964	0.08342	27888.0	1.00	0.14	0.10	0.73

APPENDIX TABLE B.8.--FERTILIZER IN AGGREGATE FARM PRODUCTION: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1917-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	PRINCIPLE PLANT NUTR. USED	ACQUISITION COST	EX POST			EX ANTE			ECONOMIC RENT
					MVP	NET MVP	DISCOUNTED NET MVP	MVP	NET MVP	DISCOUNTED NET MVP	
			(1,000 TON)	----------	----------	DOLLARS PER TON	----------	----------	----------	----------	($1,000)
	1917	0.01751	842.0	274.00	276.73	276.73	266.34	276.73	276.73	266.34	-8130
	1918	0.01884	898.0	350.00	349.34	349.34	336.23	355.31	355.31	341.98	-12231
WORLD WAR I	1919	0.02082	948.0	378.00	391.48	391.48	376.78	388.54	388.54	373.96	-1154
	1920	0.02435	1145.0	441.00	339.02	339.02	326.29	371.61	371.61	357.66	-16842
	1921	0.02359	791.0	315.00	315.27	315.27	302.85	413.27	413.27	397.00	-9611
	1922	0.02120	933.0	251.00	251.33	251.33	241.55	268.61	268.61	258.16	-8815
	1923	0.02169	1058.0	249.00	249.43	249.43	239.95	259.50	259.50	249.64	-9574
POST WORLD	1924	0.02054	1141.0	231.00	230.18	230.18	221.54	237.12	237.12	228.22	-10798
WAR I FARM	1925	0.02170	1242.0	241.00	239.61	239.60	230.72	234.23	234.23	225.55	-12769
DEPRESSION	1926	0.02237	1247.0	235.00	234.83	234.83	226.23	261.36	261.36	251.79	-11110
	1927	0.02074	1217.0	219.00	219.64	219.64	211.60	242.87	242.87	233.98	-9010
	1928	0.02343	1451.0	219.00	219.55	219.55	211.61	225.53	225.53	217.38	-10721
	1929	0.02157	1464.0	205.00	205.32	205.32	197.81	209.80	209.80	202.12	-10533
	1930	0.02564	1526.0	195.00	195.05	195.05	187.90	221.76	221.76	213.64	-10827
GENERAL	1931	0.02464	1147.0	171.00	170.53	170.53	164.29	206.77	206.77	199.20	-6779
DEPRESSION	1932	0.01850	819.0	144.00	144.71	144.71	139.41	164.01	164.01	158.00	-3755
	1933	0.01603	926.0	130.00	129.92	129.92	125.20	139.41	139.41	134.44	-4366
	1934	0.02049	1048.0	165.00	164.40	164.40	158.61	179.34	179.34	173.03	-6825
	1935	0.01724	1216.0	137.00	137.46	137.46	133.20	136.78	136.78	132.54	-4619
	1936	0.02415	1373.0	191.00	189.17	189.17	183.40	204.94	204.94	198.68	-9065
	1937	0.02454	1622.0	172.00	171.95	171.95	166.69	194.11	194.11	188.18	-8605
RECOVERY	1938	0.02545	1521.0	170.00	169.83	169.83	164.80	191.53	191.53	185.86	-7985
	1939	0.02575	1082.0	252.00	251.95	251.95	244.85	276.43	276.43	268.63	-7737
	1940	0.02785	1178.0	260.00	259.59	259.59	252.52	286.25	286.25	278.45	-8811
	1941	0.02414	1279.0	261.00	261.48	261.48	254.60	247.84	247.84	241.32	-8181
	1942	0.02227	1346.0	310.00	311.01	311.01	302.98	305.74	305.74	297.85	-9448
	1943	0.02166	1580.0	320.00	320.76	320.76	312.64	312.18	312.18	304.27	-11636
WORLD WAR II	1944	0.02355	1786.0	323.00	322.38	322.38	314.21	336.07	336.07	327.56	-15693
	1945	0.02544	1787.0	368.00	367.51	367.51	358.02	354.94	354.94	345.77	-17830
	1946	0.02316	1895.0	360.00	361.07	361.07	351.75	319.56	319.56	311.31	-15643
	1947	0.02210	2192.0	344.00	344.26	344.26	335.21	327.38	327.38	318.78	-19275
POST WORLD	1948	0.02379	2431.0	340.00	339.72	339.72	330.47	328.19	328.19	319.25	-23164
WAR II BOOM,	1949	0.02823	2658.0	337.00	335.86	335.86	326.08	367.26	367.26	356.56	-29822
KOREAN	1950	0.03019	2772.0	352.00	351.49	351.49	341.25	330.40	330.40	320.78	-29795
CONFLICT AND	1951	0.02866	3315.0	322.00	321.33	321.33	311.87	301.25	301.25	292.33	-33646
ADJUSTMENT	1952	0.03216	3698.0	320.00	319.64	319.64	309.80	335.32	335.32	325.08	-37413
	1953	0.03362	4074.0	289.00	288.73	288.73	279.78	309.40	309.40	299.81	-37558
	1954	0.03500	4328.0	279.00	278.65	278.65	270.01	284.71	284.71	275.88	-38919
	1955	0.03577	4507.0	263.00	263.03	263.03	255.49	279.35	279.35	271.35	-33849
	1956	0.03408	4471.0	261.00	261.27	261.27	253.41	261.87	261.87	254.00	-33917
	1957	0.03423	4750.0	245.00	245.00	245.00	237.08	249.78	249.78	241.89	-37735
GENERAL	1958	0.03189	4898.0	247.00	247.37	247.37	239.35	237.69	237.69	229.99	-37387
GROWTH AND	1959	0.03447	5614.0	230.00	230.03	230.03	222.79	228.22	228.22	221.04	-48477
EXPANSION	1960	0.03432	5643.0	231.00	230.62	230.62	222.61	228.26	228.26	220.33	-47367
	1961	0.03460	5986.0	228.00	228.84	228.84	221.53	221.64	221.64	214.56	-38719
	1962	0.03565	6482.0	226.00	225.87	225.87	218.84	222.86	222.86	215.95	-46249
	1963	0.03701	7350.0	212.00	211.87	211.87	205.40	211.87	211.87	205.40	-48502
	1964	0.03965	8131.0	206.00	205.72	205.72	199.24	205.72	205.72	199.24	-54930

APPENDIX TABLE B.9.--ELECTRICITY IN AGGREGATE FARM PRODUCTION: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1927-1955

GENERAL SITUATION	YEAR	ELAST. OF PROD.	QUANTITY OF ELEC. USED	ACQUISITION COST	EX POST			EX ANTE			ECONOMIC RENT
					MVP	NET MVP	DISCOUNTED NET MVP	MVP	NET MVP	DISCOUNTED NET MVP	
			(MIL. KW-HR)	----------	DOLLARS PER KW-HR	----------		----------		----------	(MIL. DOL.)
	1927	0.00231	861.0	0.04	0.04	0.04	0.03	0.04	0.04	0.04	-1
	1928	0.00373	1387.0	0.03	0.04	0.04	0.04	0.04	0.04	0.04	5
	1929	0.00317	1602.0	0.03	0.03	0.03	0.03	0.03	0.03	0.03	-7
	1930	0.00567	1789.0	0.03	0.04	0.04	0.04	0.04	0.04	0.04	7
GENERAL DEPRESSION	1931	0.00890	1878.0	0.03	0.04	0.04	0.04	0.05	0.05	0.05	12
	1932	0.00900	1579.0	0.04	0.04	0.04	0.04	0.04	0.04	0.04	-0
	1933	0.00581	1633.0	0.03	0.03	0.03	0.02	0.03	0.03	0.03	-15
	1934	0.00504	1857.0	0.03	0.02	0.02	0.02	0.03	0.03	0.02	-17
	1935	0.00434	1693.0	0.03	0.02	0.02	0.02	0.02	0.02	0.02	-17
	1936	0.00608	2138.0	0.03	0.03	0.03	0.03	0.03	0.03	0.03	-7
RECOVERY	1937	0.00812	2389.0	0.03	0.04	0.04	0.04	0.04	0.04	0.04	11
	1938	0.00836	2528.0	0.03	0.03	0.03	0.03	0.04	0.04	0.04	-6
	1939	0.01054	3328.0	0.03	0.03	0.03	0.03	0.04	0.04	0.04	-1
	1940	0.00957	3355.0	0.03	0.03	0.03	0.03	0.03	0.03	0.03	14
	1941	0.00740	3614.0	0.04	0.03	0.03	0.03	0.03	0.03	0.03	-34
	1942	0.00597	4285.0	0.04	0.03	0.03	0.03	0.03	0.03	0.03	-48
	1943	0.00582	4819.0	0.04	0.03	0.03	0.03	0.03	0.03	0.03	-41
WORLD WAR II	1944	0.00629	5135.0	0.03	0.03	0.03	0.03	0.03	0.03	0.03	-31
	1945	0.00742	5908.0	0.03	0.03	0.03	0.03	0.03	0.03	0.03	20
	1946	0.00728	7278.0	0.03	0.03	0.03	0.03	0.03	0.03	0.03	38
	1947	0.00782	8974.0	0.03	0.03	0.03	0.03	0.03	0.03	0.02	-54
POST WORLD	1948	0.01046	11393.0	0.03	0.03	0.03	0.03	0.03	0.03	0.03	11
WAR II BOOM,	1949	0.01923	13841.0	0.03	0.03	0.03	0.03	0.04	0.04	0.04	52
KOREAN	1950	0.00938	12309.0	0.03	0.02	0.02	0.02	0.02	0.02	0.02	-78
CONFLICT AND	1951	0.01133	15978.0	0.03	0.03	0.03	0.03	0.02	0.02	0.02	-59
ADJUSTMENT	1952	0.01337	17479.0	0.03	0.03	0.03	0.03	0.03	0.03	0.03	-31
	1953	0.01566	19468.0	0.03	0.03	0.03	0.03	0.03	0.03	0.03	-8
	1954	0.01706	21846.0	0.03	0.03	0.03	0.03	0.03	0.03	0.03	-2
	1955	0.01589	21646.0	0.03	0.02	0.02	0.02	0.03	0.03	0.03	-54

APPENDIX TABLE B.10.--GASOLINE IN AGGREGATE FARM PRODUCTION: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1917-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	QUANTITY OF GAS. USED	ACQUISITION COST	EX POST			EX ANTE			ECONOMIC RENT
					MVP	NET MVP	DISCOUNTED NET MVP	MVP	NET MVP	DISCOUNTED NET MVP	
			(MIL. GAL.)	----------	DOLLARS PER GALLON	----------					(MIL. DOL.)
	1917	0.00611	502.2	0.16	0.16	0.16	0.16	0.16	0.16	0.16	-2
WORLD WAR I	1918	0.00702	697.8	0.16	0.17	0.17	0.16	0.17	0.17	0.16	-1
	1919	0.00874	867.4	0.17	0.18	0.18	0.17	0.18	0.18	0.17	2
	1920	0.01475	1219.5	0.17	0.19	0.19	0.19	0.21	0.21	0.20	20
	1921	0.01709	945.6	0.18	0.19	0.19	0.18	0.25	0.25	0.24	3
	1922	0.01439	906.5	0.18	0.18	0.18	0.17	0.19	0.19	0.18	-10
	1923	0.01498	952.1	0.19	0.19	0.19	0.18	0.20	0.20	0.19	-6
POST WORLD	1924	0.01595	1004.3	0.20	0.20	0.20	0.19	0.21	0.21	0.20	-5
WAR I FARM	1925	0.01839	1160.8	0.21	0.22	0.22	0.21	0.21	0.21	0.20	-1
DEPRESSION	1926	0.02306	1317.3	0.22	0.23	0.23	0.22	0.26	0.26	0.25	6
	1927	0.03755	2223.8	0.20	0.23	0.23	0.22	0.25	0.25	0.24	38
	1928	0.02869	1643.4	0.19	0.17	0.17	0.17	0.18	0.18	0.17	-41
	1929	0.02622	1865.1	0.19	0.20	0.20	0.19	0.20	0.20	0.19	-2
	1930	0.03274	1976.8	0.18	0.19	0.19	0.18	0.22	0.22	0.21	6
GENERAL	1931	0.03387	1865.1	0.15	0.15	0.15	0.15	0.19	0.19	0.18	-5
DEPRESSION	1932	0.04338	1747.8	0.15	0.16	0.16	0.15	0.18	0.18	0.17	6
	1933	0.03692	1773.8	0.15	0.15	0.15	0.14	0.16	0.16	0.15	-16
	1934	0.03399	1858.6	0.16	0.16	0.16	0.15	0.17	0.17	0.16	-16
	1935	0.03340	2041.2	0.16	0.16	0.16	0.15	0.16	0.16	0.15	-13
	1936	0.03023	2088.4	0.16	0.16	0.16	0.15	0.17	0.17	0.16	-18
	1937	0.03341	2334.7	0.16	0.16	0.16	0.16	0.18	0.18	0.18	-5
RECOVERY	1938	0.03908	2386.9	0.16	0.17	0.17	0.16	0.19	0.19	0.18	3
	1939	0.03615	2413.8	0.16	0.16	0.16	0.15	0.17	0.17	0.17	-14
	1940	0.03618	2667.3	0.15	0.15	0.15	0.15	0.17	0.17	0.16	-12
	1941	0.03386	2973.8	0.16	0.16	0.16	0.15	0.15	0.15	0.15	-19
	1942	0.02626	3878.1	0.17	0.16	0.16	0.16	0.16	0.16	0.15	-43
	1943	0.02208	3195.5	0.17	0.16	0.16	0.16	0.16	0.16	0.15	-40
WORLD WAR II	1944	0.02535	3378.1	0.18	0.18	0.18	0.18	0.19	0.19	0.19	-4
	1945	0.02523	3606.4	0.18	0.18	0.18	0.18	0.17	0.17	0.17	-15
	1946	0.02566	4193.3	0.18	0.18	0.18	0.18	0.16	0.16	0.16	-16
	1947	0.02938	4865.8	0.20	0.21	0.21	0.20	0.20	0.20	0.19	4
POST WORLD	1948	0.03550	5341.1	0.22	0.23	0.23	0.22	0.22	0.22	0.22	24
WAR II BOOM,	1949	0.04361	5921.5	0.22	0.23	0.23	0.23	0.25	0.25	0.25	33
KOREAN	1950	0.04411	6897.6	0.23	0.23	0.23	0.23	0.22	0.22	0.21	-20
CONFLICT AND	1951	0.03891	6104.1	0.24	0.23	0.23	0.23	0.22	0.22	0.21	-80
ADJUSTMENT	1952	0.04128	6854.1	0.24	0.24	0.24	0.23	0.25	0.25	0.25	-33
	1953	0.04495	6371.9	0.24	0.24	0.24	0.24	0.26	0.26	0.25	-19
	1954	0.04909	6438.2	0.25	0.26	0.26	0.25	0.26	0.26	0.25	-18
	1955	0.04958	6521.9	0.25	0.25	0.25	0.24	0.27	0.27	0.26	-34
	1956	0.04737	6547.6	0.25	0.25	0.25	0.24	0.25	0.25	0.24	-62
	1957	0.04976	6449.8	0.26	0.26	0.26	0.25	0.27	0.27	0.26	-48
GENERAL	1958	0.04297	6410.6	0.26	0.25	0.25	0.24	0.24	0.24	0.23	-105
GROWTH AND	1959	0.04510	6462.8	0.26	0.26	0.26	0.25	0.26	0.26	0.25	-44
EXPANSION	1960	0.04624	6449.8	0.27	0.27	0.27	0.26	0.27	0.27	0.26	-49
	1961	0.04280	6371.9	0.27	0.27	0.27	0.26	0.26	0.26	0.25	-88
	1962	0.04201	6436.7	0.27	0.27	0.27	0.26	0.26	0.26	0.26	-66
	1963	0.04055	6378.0	0.27	0.27	0.27	0.26	0.27	0.27	0.26	-68
	1964	0.04074	6371.9	0.27	0.27	0.27	0.26	0.27	0.27	0.26	-56

APPENDIX TABLE B.11.--BEEF COWS ON FARMS: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1921-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	NO. OF BEEF COWS	ACQUISITION COST	EX POST			EX ANTE			ANNUAL AVR. CAP. GAINS
					MVP	NET MVP	CAPITAL VALUE	MVP	NET MVP	CAPITAL VALUE	
			(MIL. HD.)	----------		DOLLARS PER COW		----------			(MIL. DOL.)
	1921	0.16560	12.3	59.00	11.89	11.47	89.82	16.79	16.09	118.90	78
	1922	0.14134	12.2	69.00	12.01	11.59	88.64	13.63	13.17	92.44	48
	1923	0.10954	12.0	72.00	9.55	9.12	96.58	10.63	10.09	80.37	59
	1924	0.13144	11.9	74.00	12.34	11.91	122.42	14.29	13.75	96.17	115
POST WORLD WAR I FARM DEPRESSION	1925	0.14185	11.2	81.00	15.84	15.37	130.57	18.21	17.65	115.04	111
	1926	0.12732	10.3	86.00	15.71	15.19	122.77	18.62	18.02	116.72	76
	1927	0.09736	9.4	95.00	13.84	13.27	112.01	14.53	13.91	99.12	32
	1928	0.15952	8.9	118.00	27.89	27.18	108.37	26.37	25.71	115.00	-17
	1929	0.13722	9.0	111.00	22.79	22.12	94.42	22.87	22.08	145.08	-30
	1930	0.16718	9.2	85.00	18.75	18.23	78.18	20.67	19.93	125.44	-13
	1931	0.16610	9.8	60.00	12.63	12.27	88.11	17.12	16.51	116.64	55
GENERAL DEPRESSION	1932	0.17843	10.4	48.00	10.24	9.95	78.11	13.25	12.78	87.59	63
	1933	0.18165	11.3	44.00	9.23	8.96	79.22	12.31	11.89	79.21	80
	1934	0.13870	12.7	44.00	4.99	4.72	84.12	6.34	5.93	59.14	102
	1935	0.17992	11.2	76.00	13.48	13.02	97.02	13.39	12.98	94.08	47
	1936	0.15839	11.0	72.00	12.34	11.91	107.05	13.78	13.20	98.16	77
	1937	0.15430	10.7	83.00	14.05	13.55	122.47	14.05	13.51	101.43	84
RECOVERY	1938	0.12898	10.1	81.00	11.90	11.41	129.90	13.38	12.77	99.63	99
	1939	0.10104	10.0	90.00	11.03	10.48	143.87	11.59	11.00	99.59	108
	1940	0.21312	10.7	92.00	23.80	23.24	150.38	26.76	26.11	167.20	125
	1941	0.15682	11.4	104.00	20.80	20.17	162.68	22.40	21.75	155.14	134
	1942	0.15715	12.6	122.00	24.92	24.18	186.07	25.36	24.64	172.81	161
	1943	0.18505	14.0	139.00	30.19	29.35	212.92	29.17	28.36	191.13	207
	1944	0.20158	15.5	130.00	28.16	27.38	221.82	31.28	30.39	204.87	205
WORLD WAR II	1945	0.21045	16.4	143.00	30.45	29.58	211.25	29.14	28.31	190.57	224
	1946	0.19460	16.4	162.00	32.89	31.84	257.00	27.73	26.81	188.11	312
	1947	0.31335	16.5	201.00	48.81	47.59	322.30	39.31	38.30	251.00	400
	1948	0.11554	16.0	250.00	29.78	28.27	313.34	25.49	24.27	212.34	203
POST WORLD	1949	0.13583	15.9	222.00	33.09	31.75	295.37	33.42	31.95	257.58	202
WAR II BOOM,	1950	0.20615	16.7	261.00	61.35	59.77	295.21	40.81	39.52	264.48	114
KOREAN	1951	0.18261	18.5	317.00	65.54	63.62	299.05	50.36	48.84	350.16	-66
CONFLICT AND	1952	0.19437	20.9	266.00	56.10	54.49	257.64	50.79	48.98	343.64	-35
ADJUSTMENT	1953	0.22243	23.3	192.00	41.88	40.72	240.88	50.10	48.60	319.52	228
	1954	0.24224	25.0	194.00	42.03	40.85	266.16	40.38	39.26	251.59	361
	1955	0.23673	25.7	192.00	39.97	38.81	266.29	42.27	41.10	266.61	382
	1956	0.13215	25.5	178.00	21.24	20.16	260.35	23.52	22.37	188.73	420
	1957	0.16726	24.7	201.00	30.94	29.72	295.00	32.38	31.30	238.37	464
	1958	0.23542	24.4	245.00	57.30	55.82	318.19	47.10	45.89	295.67	357
GENERAL	1959	0.19042	25.1	245.00	48.94	47.46	302.17	42.23	40.79	280.49	287
GROWTH AND	1960	0.22468	26.3	231.00	49.95	48.55	285.55	46.52	45.10	284.95	287
EXPANSION	1961	0.21382	27.1	231.00	47.58	46.18		43.57	42.22		
	1962	0.20621	28.3	234.00	47.57	46.11		44.66	43.31		
	1963	0.20483	30.0	217.00	44.45	43.14		39.48	38.07		
	1964	0.22954	31.8	204.00	44.27	43.05		42.67	41.35		

APPENDIX TABLE B.12.--STEERS: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1923-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	NO. OF STEERS ON FARMS	ACQUISITION COST	EX POST			EX ANTE			ECONOMIC RENT
					MVP	NET MVP	DISCOUNTED NET MVP	MVP	NET MVP	DISCOUNTED NET MVP	
			(1,000 HD.)	----------	DOLLARS PER STEER	----------					($1,000)
	1923	0.40135	8717.0	51.00	47.98	47.98	46.15	49.29	49.29	47.42	-42248
	1924	0.34920	8253.0	51.00	47.35	47.35	45.57	50.67	50.67	48.77	-44813
POST WORLD	1925	0.28537	7197.0	55.00	49.64	49.64	47.80	48.43	48.43	46.63	-51792
WAR I FARM	1926	0.30233	6736.0	58.00	57.05	57.05	54.96	59.16	59.16	56.99	-20491
DEPRESSION	1927	0.30449	6093.0	67.00	66.76	66.76	64.32	61.77	61.77	59.51	-16330
	1928	0.29930	5457.0	86.00	85.34	85.34	82.26	77.36	77.36	74.57	-20417
	1929	0.30647	5623.0	81.00	81.48	81.48	78.50	81.74	81.74	78.75	-14059
	1930	0.34839	5608.0	61.00	64.11	64.11	61.76	74.84	74.84	72.10	4289
	1931	0.33653	5798.0	43.00	43.24	43.24	41.66	54.74	54.74	52.73	-7775
GENERAL	1932	0.32094	5560.0	35.00	34.46	34.46	33.20	40.54	40.54	39.06	-10012
DEPRESSION	1933	0.27105	5765.0	29.00	27.08	27.08	26.12	28.89	28.89	27.86	-16629
	1934	0.45502	6069.0	29.00	34.26	34.26	33.06	33.85	33.85	32.66	24621
	1935	0.29199	5323.0	51.00	46.87	46.02	44.60	38.10	38.10	36.92	-34090
	1936	0.27098	5637.0	44.00	41.20	41.20	39.94	44.24	44.24	42.89	-22890
	1937	0.29872	5325.0	54.00	54.64	54.64	52.97	48.78	48.78	47.29	-5485
RECOVERY	1938	0.35883	5555.0	56.00	60.20	60.20	58.42	59.84	59.84	58.06	13455
	1939	0.28814	5192.0	64.00	60.60	60.60	58.89	57.29	57.29	55.68	-26512
	1940	0.27782	5283.0	65.00	62.84	62.84	61.13	66.50	66.50	64.69	-20442
	1941	0.32015	6119.0	76.00	79.11	79.11	77.03	74.00	74.00	72.05	6295
	1942	0.28600	4596.0	89.00	86.63	86.63	84.40	79.75	79.75	77.69	-30366
	1943	0.31896	7361.0	94.00	98.97	98.97	96.46	95.64	95.64	93.22	3379
	1944	0.31902	7849.0	87.00	87.99	87.99	85.76	97.77	97.77	95.29	-9698
WORLD WAR II	1945	0.41954	8329.0	94.00	119.53	119.53	116.45	103.63	103.63	100.95	170291
	1946	0.30846	7727.0	119.00	110.42	110.42	107.57	89.48	89.48	87.17	-88341
	1947	0.48799	7109.0	153.00	176.41	176.41	171.78	146.21	146.21	142.37	133484
	1948	0.25884	4672.0	192.00	159.99	159.99	155.83	140.82	140.82	136.98	-242653
POST WORLD	1949	0.30691	7270.0	164.00	163.13	163.13	158.38	177.13	177.13	171.97	-40885
WAR II BOOM,	1950	0.27828	6805.0	211.00	203.24	203.24	197.32	163.99	163.99	159.21	-93081
KOREAN	1951	0.27240	7029.0	263.00	257.33	257.33	249.71	215.19	215.19	208.82	-93405
CONFLICT AND	1952	0.30332	8400.0	211.00	217.81	217.81	211.16	246.50	246.50	238.97	1360
ADJUSTMENT	1953	0.27444	9147.0	135.00	131.63	131.63	127.54	161.34	161.34	156.34	-68203
	1954	0.26837	8229.0	144.00	141.47	141.47	137.09	138.38	138.38	134.09	-56890
	1955	0.29080	8444.0	146.00	149.43	149.43	145.15	153.26	153.26	148.87	-7178
	1956	0.31502	9560.0	138.00	135.87	135.87	131.81	138.24	138.24	134.09	9659
	1957	0.31872	9105.0	157.00	159.94	159.94	154.75	144.13	144.13	139.46	-20443
	1958	0.33632	9252.0	218.00	219.78	219.70	208.71	181.92	181.92	176.02	-11910
GENERAL	1959	0.34301	9931.0	219.00	222.81	222.81	215.80	223.60	223.60	216.56	-31801
GROWTH AND	1960	0.35679	10574.0	193.00	197.29	197.29	190.43	198.26	198.26	191.37	-27125
EXPANSION	1961	0.35541	10977.0	194.00	195.24	195.24	189.00	188.47	188.47	182.45	-54854
	1962	0.32805	11060.0	199.00	193.63	193.63	187.62	190.81	190.81	184.89	-125829
	1963	0.36127	12129.0	189.00	193.91	193.91	187.99	192.16	192.16	186.29	-12306
	1964	0.28996	12574.0	152.00	141.43	141.43	136.98	138.99	138.99	134.62	-188672

APPENDIX TABLE B.13.--BEEF HEIFERS: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1923-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	NO. OF BEEF HEIFERS ON FARMS	ACQUISITION COST	EX POST			EX ANTE			ECONOMIC RENT
					MVP	NET MVP	DISCOUNTED NET MVP	MVP	NET MVP	DISCOUNTED NET MVP	
			(1,000 HD.)	----------	DOLLARS PER HEIFER	----------					($1,000)
	1923	0.16388	3727.0	48.00	45.59	45.16	43.45	46.84	46.36	44.60	-16970
POST WORLD WAR I FARM DEPRESSION	1924	0.14848	3653.0	48.00	45.48	45.03	43.34	48.68	48.21	46.40	-17014
	1925	0.12014	3208.0	52.00	46.89	46.40	44.68	45.74	45.24	43.56	-23487
	1926	0.12428	2882.0	55.00	54.77	54.25	52.27	56.80	56.26	54.20	-7879
	1927	0.12423	2655.0	64.00	62.51	61.94	59.67	57.84	57.28	55.18	-11487
	1928	0.13004	2569.0	83.00	78.76	78.05	75.23	71.40	70.79	68.23	-19960
	1929	0.15289	2704.0	78.00	84.53	83.86	80.79	84.80	84.04	80.96	7552
	1930	0.17125	2799.0	58.00	63.14	62.62	60.33	73.71	73.03	70.35	6520
GENERAL DEPRESSION	1931	0.09589	3015.0	40.00	23.69	23.33	22.48	29.99	29.47	28.39	-52824
	1932	0.22717	3113.0	33.00	43.57	43.28	41.69	51.26	50.89	49.02	27060
	1933	0.16354	3414.0	28.00	27.99	27.32	26.35	29.43	29.11	28.07	-5643
	1934	0.24599	3656.0	26.00	30.75	30.48	29.41	30.38	30.07	29.01	12452
	1935	0.19027	3362.0	49.00	47.48	47.02	45.56	39.31	38.99	37.78	-11551
	1936	0.15730	3493.0	42.00	38.99	38.16	37.00	41.44	40.90	39.66	-17473
	1937	0.17483	3229.0	52.00	52.73	52.23	50.64	47.88	46.62	45.20	-4392
RECOVERY	1938	0.18422	3136.0	53.00	54.75	54.26	52.65	54.42	53.87	52.27	-1085
	1939	0.16725	3058.0	61.00	59.72	59.17	57.51	56.46	55.94	54.37	-10682
	1940	0.17804	3357.0	62.00	63.38	62.82	61.11	67.07	66.47	64.66	-2995
	1941	0.19533	3789.0	74.00	77.85	77.32	75.28	72.91	72.32	70.42	4862
	1942	0.16879	4855.0	86.00	83.16	82.42	80.30	76.56	75.89	73.93	-23126
	1943	0.19471	4547.0	93.00	97.80	96.96	94.50	94.51	93.73	91.36	6843
WORLD WAR II	1944	0.20434	4971.0	85.00	88.99	88.21	85.98	98.88	98.00	95.52	4862
	1945	0.20670	5049.0	94.00	96.77	95.90	93.42	83.89	83.11	80.97	-2936
	1946	0.20749	4859.0	116.00	118.21	117.13	114.11	95.71	94.81	92.37	-9185
	1947	0.33593	4636.0	151.00	186.23	185.01	180.14	154.35	153.34	149.30	135104
POST WORLD WAR II BOOM, KOREAN CONFLICT AND ADJUSTMENT	1948	0.17245	4918.0	189.00	157.41	155.90	151.66	138.55	137.29	133.55	-168709
	1949	0.18632	4697.0	161.00	154.96	153.62	149.14	168.26	166.72	161.86	-55228
	1950	0.20422	4754.0	208.00	213.50	211.92	205.75	172.26	170.99	166.01	-10717
	1951	0.20314	5122.0	260.00	263.34	261.42	253.69	220.22	218.62	212.15	-32341
	1952	0.21308	5971.0	208.00	215.26	213.65	207.12	243.60	241.67	234.29	-5239
	1953	0.19161	4535.0	132.00	128.63	127.47	123.52	157.67	156.18	151.34	-55429
	1954	0.21607	6365.0	141.00	147.26	146.08	141.55	144.04	143.00	138.56	3495
	1955	0.22202	6914.0	143.00	147.89	146.73	142.52	151.68	150.51	146.20	-3115
	1956	0.18364	6238.0	128.00	120.67	119.59	115.99	123.51	122.37	118.69	-74888
	1957	0.21014	6817.0	154.00	159.57	158.35	153.22	143.80	142.75	138.12	-4697
GENERAL GROWTH AND EXPANSION	1958	0.20949	5903.0	207.00	210.90	209.11	202.33	177.61	176.37	170.65	-27565
	1959	0.23108	6597.0	216.00	227.34	225.86	218.75	228.15	226.64	219.50	18054
	1960	0.23707	7036.0	198.00	197.88	195.60	188.81	197.97	196.53	189.70	-8390
	1961	0.22226	7069.0	191.00	189.60	188.20	182.18	183.03	181.68	175.87	-62325
	1962	0.21925	7333.0	196.00	195.18	193.72	187.71	192.43	191.06	185.13	-60789
	1963	0.23179	7909.0	186.00	190.79	189.42	183.63	189.07	187.63	181.90	-18736
	1964	0.18900	8326.0	149.00	139.87	138.00	133.66	136.82	135.50	131.24	-127733

APPENDIX TABLE B.14.--CORN FED TO BEEF CATTLE: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1917-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	QUANTITY OF CORN FED	ACQUISITION COST	EX POST			EX ANTE			ECONOMIC RENT
					MVP	NET MVP	DISCOUNTED NET MVP	MVP	NET MVP	DISCOUNTED NET MVP	
			(1,000 TON)	----------			DOLLARS PER TON			----------	($1,000)
	1917	0.09418	3220.0	51.78	48.29	48.29	46.48	45.23	45.23	43.54	-17081
WORLD WAR I	1918	0.08247	3200.0	54.98	52.89	52.29	50.33	50.60	50.60	48.70	-12640
	1919	0.09501	3320.0	53.93	54.97	54.97	52.91	54.59	54.59	52.54	-3391
	1920	0.05347	3960.0	22.86	20.63	20.63	19.86	22.51	22.51	21.66	-11883
	1921	0.09068	3955.0	18.97	20.89	20.09	19.29	24.97	24.97	23.99	2866
	1922	0.08276	3300.0	26.07	26.01	26.01	25.00	28.14	28.14	27.05	-3547
	1923	0.08302	2990.0	28.93	28.93	28.93	27.83	29.73	29.73	28.60	-3280
POST WORLD	1924	0.06740	2070.0	37.86	36.44	36.44	35.07	38.99	38.99	37.53	-5778
WAR I FARM	1925	0.07527	3720.0	25.00	25.33	25.33	24.39	24.71	24.71	23.80	-2252
DEPRESSION	1926	0.04890	2540.0	26.43	24.47	24.47	23.58	25.38	25.38	24.45	-7251
	1927	0.06607	2785.0	30.36	31.69	31.69	30.53	29.32	29.32	28.25	486
	1928	0.04442	2460.0	30.00	28.10	28.10	27.08	25.47	25.47	24.55	-7181
	1929	0.06664	3275.0	28.97	30.44	30.44	29.33	30.54	30.54	29.42	2474
	1930	0.05907	2875.0	21.43	21.20	21.20	20.43	24.75	24.75	23.84	-2887
GENERAL	1931	0.07368	4670.0	11.43	11.88	11.88	11.45	15.04	15.04	14.49	78
DEPRESSION	1932	0.11017	5305.0	11.43	12.40	12.40	11.94	14.59	14.59	14.05	2728
	1933	0.12452	3720.0	18.97	19.28	19.28	18.59	20.57	20.57	19.83	83
	1934	0.11159	1765.0	29.28	28.89	28.89	27.88	28.54	28.54	27.54	-2480
	1935	0.10537	3800.0	23.97	23.26	23.26	22.54	19.26	19.26	18.66	-3902
	1936	0.08218	1990.0	37.14	35.39	35.39	34.31	38.01	38.01	36.85	-5630
RECOVERY	1937	0.07535	4052.0	18.97	18.11	18.11	17.56	16.17	16.17	15.68	-4094
	1938	0.09000	4660.0	17.50	18.00	18.00	17.47	17.89	17.89	17.36	-154
	1939	0.09191	4885.0	20.36	20.55	20.55	19.97	19.42	19.42	18.88	-1923
	1940	0.10366	5463.0	22.14	22.68	22.68	22.06	24.00	24.00	23.34	-447
	1941	0.09625	5485.0	26.78	26.53	26.53	25.84	24.82	24.82	24.17	-5179
	1942	0.10136	6115.0	32.86	33.82	33.12	32.26	30.49	30.49	29.70	-3651
	1943	0.10949	6155.0	40.00	40.63	40.63	39.60	39.26	39.26	38.27	-2458
WORLD WAR II	1944	0.10603	6260.0	36.78	36.67	36.67	35.74	40.74	40.74	39.71	-6511
	1945	0.14505	7400.0	43.93	46.52	46.52	45.31	40.33	40.33	39.29	10247
	1946	0.14097	7082.0	54.64	54.90	54.90	53.48	44.49	44.49	43.34	-8192
	1947	0.16509	9335.0	77.14	79.53	79.53	77.44	65.91	65.91	64.18	1590
POST WORLD	1948	0.07290	7570.0	45.71	39.50	39.50	38.42	34.76	34.76	33.82	-55180
WAR II BOOM,	1949	0.08596	7485.0	44.28	44.48	44.48	43.19	48.30	48.30	46.89	-8194
KOREAN	1950	0.10648	9365.0	54.28	56.51	56.51	54.86	45.60	45.60	44.27	5478
CONFLICT AND	1951	0.10331	11551.0	59.28	59.39	59.39	57.63	49.66	49.66	48.19	-19063
ADJUSTMENT	1952	0.08830	10097.0	54.28	52.75	52.75	51.14	59.70	59.70	57.87	-31715
	1953	0.12244	9618.0	52.86	55.85	55.85	54.12	68.46	68.46	66.33	12081
	1954	0.11385	9702.0	51.07	50.90	50.90	49.32	49.79	49.79	48.25	-16931
	1955	0.13730	11945.0	48.21	49.87	49.87	48.44	51.15	51.15	49.69	2801
	1956	0.12397	11170.0	46.07	45.49	45.49	44.13	46.56	46.56	45.16	-21719
	1957	0.06141	8075.0	39.64	34.75	34.75	33.62	31.31	31.31	30.30	-48609
GENERAL	1958	0.06675	9992.0	40.00	39.64	39.64	38.36	34.87	34.87	33.74	-16411
GROWTH AND	1959	0.06425	11257.0	37.14	36.82	36.82	35.66	36.95	36.95	35.79	-16658
EXPANSION	1960	0.07572	12048.0	35.71	36.75	36.75	35.47	36.93	36.93	35.64	-2881
	1961	0.08561	13016.0	38.97	39.66	39.66	38.39	38.28	38.28	37.06	-2317
	1962	0.08464	14023.0	39.28	39.40	39.40	38.18	38.85	38.85	37.64	-15442
	1963	0.08875	14704.0	38.93	39.29	39.29	38.09	38.94	38.94	37.75	-12292
	1964	0.09806	14479.0	40.71	41.54	41.54	40.23	40.82	40.82	39.54	-6961

APPENDIX TABLE B.15.--HAY FED TO BEEF CATTLE: EMPLOYMENT AND EARNINGS[1] STATISTICS, UNITED STATES, 1917-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	QUANTITY OF HAY FED	ACQUISITION COST	EX POST			EX ANTE			ECONOMIC RENT
					MVP	NET MVP	DISCOUNTED NET MVP	MVP	NET MVP	DISCOUNTED NET MVP	
			(1,000 TON)	----------			DOLLARS PER TON				($1,000)
	1917	0.09044	10114.0	16.53	14.76	14.76	14.21	13.83	13.83	13.31	-23466
	1918	0.08367	9300.0	19.62	18.25	18.25	17.57	17.66	17.66	17.00	-19078
WORLD WAR I	1919	0.15966	11800.0	20.92	25.99	25.99	25.02	25.81	25.81	24.84	40342
	1920	0.08946	9500.0	16.50	14.39	14.39	13.85	15.69	15.69	15.10	-25193
	1921	0.19254	11450.0	11.61	14.73	14.73	14.15	18.32	18.32	17.59	29088
	1922	0.07763	11500.0	11.63	7.80	7.80	6.73	7.57	7.57	7.28	-56376
	1923	0.15349	10400.0	13.08	15.38	15.38	14.79	15.80	15.80	15.20	17828
	1924	0.10565	10100.0	12.68	11.70	11.70	11.27	12.53	12.53	12.06	-14286
POST WORLD WAR I FARM DEPRESSION	1925	0.08494	9300.0	12.80	11.43	11.43	11.01	11.15	11.15	10.74	-16641
	1926	0.08832	8200.0	13.27	12.45	12.45	11.99	12.91	12.91	12.44	-10469
	1927	0.05888	8800.0	10.29	8.93	8.93	8.60	8.26	8.26	7.96	-14868
	1928	0.05464	8177.0	11.28	10.40	10.40	10.02	9.43	9.43	9.08	-10291
	1929	0.07359	9300.0	10.98	11.83	11.83	11.40	11.87	11.87	11.43	4618
	1930	0.10350	8200.0	11.10	13.03	13.03	12.55	15.20	15.20	14.65	11879
GENERAL DEPRESSION	1931	0.08676	7450.0	8.73	8.68	8.68	8.36	10.98	10.98	10.58	-2771
	1932	0.09397	8800.0	6.20	6.38	6.38	6.14	7.50	7.50	7.23	-513
	1933	0.15385	8995.0	8.09	9.85	9.85	9.50	10.51	10.51	10.13	12688
	1934	0.18893	9610.0	13.20	15.36	15.36	14.82	15.17	15.17	14.64	9072
	1935	0.06151	9900.0	7.52	5.21	5.21	5.05	4.32	4.32	4.18	-24441
	1936	0.05845	8900.0	1.20	4.86	4.86	4.71	5.22	5.22	5.06	31233
	1937	0.09616	8850.0	8.74	10.58	10.58	10.26	9.45	9.45	9.16	13452
RECOVERY	1938	0.06629	9861.0	6.78	6.27	6.27	6.08	6.23	6.23	6.04	-6988
	1939	0.13161	11200.0	10.28	12.83	12.83	12.47	12.13	12.13	11.79	25432
	1940	0.10045	12413.0	9.82	9.67	9.67	9.41	10.23	10.23	9.95	-5123
	1941	0.08850	11580.0	12.20	11.97	11.97	11.26	10.82	10.82	10.53	-10861
	1942	0.13021	16750.0	13.70	15.53	15.53	15.13	14.30	14.30	13.93	23967
	1943	0.17080	18050.0	18.60	21.61	21.61	21.06	20.89	20.89	20.36	44485
WORLD WAR II	1944	0.18662	17250.0	21.40	23.42	23.42	22.83	26.03	26.03	25.37	24652
	1945	0.19477	21650.0	20.30	21.35	21.35	20.80	18.51	18.51	18.03	10794
	1946	0.18842	22810.0	22.70	22.65	22.65	22.26	18.52	18.92	18.04	-18969
	1947	0.21083	22620.0	22.90	23.95	23.95	23.32	19.85	19.85	19.33	9598
	1948	0.09252	22970.0	24.30	16.61	16.61	16.16	14.62	14.62	14.22	-187803
POST WORLD WAR II BOOM, KOREAN CONFLICT AND ADJUSTMENT	1949	0.12670	23082.0	21.18	21.26	21.26	20.64	23.08	23.08	22.41	-10628
	1950	0.11921	28681.0	21.18	20.68	20.68	20.08	16.68	16.68	16.20	-29340
	1951	0.13585	33062.0	25.78	27.28	27.28	26.48	22.82	22.82	22.14	-25657
	1952	0.15978	33168.0	26.90	29.86	29.06	28.17	32.88	32.88	31.88	42118
	1953	0.19959	34419.0	21.98	25.44	25.44	24.65	31.18	31.18	30.22	94662
	1954	0.18823	36520.0	21.98	22.36	22.36	21.67	21.87	21.87	21.19	-8575
	1955	0.21928	39993.0	22.50	24.82	24.82	23.33	24.64	24.64	23.93	32998
	1956	0.20699	38100.0	22.20	22.27	22.27	21.60	22.79	22.79	22.11	-22898
	1957	0.15938	41604.0	19.30	17.90	17.90	16.94	15.77	15.77	15.26	-98335
GENERAL GROWTH AND EXPANSION	1958	0.15620	51550.0	18.80	17.98	17.98	17.40	18.16	18.16	14.67	-72389
	1959	0.14728	46494.0	22.38	20.43	20.43	19.79	20.51	20.51	19.86	-116650
	1960	0.15315	41267.0	21.70	21.70	21.70	20.95	21.81	21.81	21.05	-31143
	1961	0.16972	47787.0	20.60	21.42	21.42	20.73	20.67	20.67	20.01	6293
	1962	0.12418	41605.0	21.60	19.47	19.47	18.87	13.06	13.06	12.66	-113685
	1963	0.18444	43696.0	24.60	27.48	27.48	26.64	27.22	27.22	26.39	89121
	1964	0.17072	43624.0	23.70	24.80	24.00	23.25	23.59	23.59	22.84	-19818

[1]DUE TO REASONS GIVEN ON PAGE 152, ESTIMATES OF MVPs AND RENTS FOR HAY ARE SUBJECT TO LARGE ERROR.

APPENDIX TABLE B.16.--MILK COWS ON FARMS: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1921-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	NO. OF MILK COWS	ACQUISITION COST	EX POST			EX ANTE			ANNUAL AVR. CAP. GAINS
					MVP	NET MVP	CAPITAL VALUE	MVP	NET MVP	CAPITAL VALUE	
			(MIL. HD.)	----------	----------	----------	DOLLARS PER COW	----------	----------	----------	(MIL. DOL.)
	1921	0.24436	21.4	65.00	13.70	10.80	89.30	17.87	11.99	96.63	104
	1922	0.24513	21.8	59.00	15.32	11.84	85.87	18.22	14.35	97.14	117
	1923	0.21970	22.1	61.00	14.17	10.57	93.72	13.37	8.91	75.67	145
POST WORLD WAR I FARM DEPRESSION	1924	0.25865	22.3	61.00	16.28	12.56	117.24	17.97	13.43	94.91	251
	1925	0.25[illegible]	22.6	64.00	16.80	12.74	119.83	16.94	12.30	92.51	252
	1926	0.21639	22.4	72.00	15.13	10.83	111.50	15.57	10.63	86.90	177
	1927	0.24584	22.2	82.00	18.64	13.88	102.56	18.20	13.06	95.70	91
	1928	0.40665	22.2	99.00	32.17	26.25	95.93	31.92	26.39	157.75	-14
	1929	0.2[illegible]8	22.4	104.00	21.57	16.00	79.84	21.32	14.79	115.67	-108
	1930	0.21245	23.0	82.00	19.43	15.13	70.47	20.67	14.49	103.45	-53
GENERAL DEPRESSION	1931	0.18256	23.8	56.00	12.98	9.96	80.43	18.44	13.36	103.91	116
	1932	0.19478	24.9	40.00	10.33	7.89	71.76	12.91	8.91	71.94	158
	1933	0.17058	25.9	36.00	8.87	6.66	72.26	10.58	7.04	59.56	172
	1934	0.15319	26.9	36.00	8.76	6.55	81.68	8.76	5.40	56.96	219
	1935	0.23026	26.1	52.00	13.24	9.41	92.15	13.85	10.48	83.67	210
	1936	0.18650	25.2	58.00	14.08	10.48	95.68	14.23	9.44	82.43	190
RECOVERY	1937	0.17353	24.6	62.00	13.99	9.81	110.66	14.06	9.53	84.81	239
	1938	0.20958	24.7	62.00	19.56	15.44	118.60	24.24	19.19	126.61	280
	1939	0.24655	24.6	64.00	14.54	10.01	126.17	16.35	11.43	101.41	306
	1940	0.19228	24.9	67.00	14.91	10.27	128.81	15.98	10.64	101.30	308
	1941	0.26058	25.4	79.00	24.26	19.04	149.45	22.16	16.74	133.67	358
	1942	0.24056	26.3	99.00	26.26	20.11	163.19	24.63	18.70	147.29	338
	1943	0.25976	27.1	125.00	33.12	26.15	180.65	29.73	23.01	168.06	302
WORLD WAR II	1944	0.22264	27.7	118.00	28.68	22.18	194.76	29.03	21.63	167.15	425
	1945	0.24247	27.8	122.00	32.10	24.90	189.89	31.70	24.74	175.22	377
	1946	0.19549	26.5	144.00	26.48	18.35	225.63	21.17	13.58	131.31	433
	1947	0.20774	25.8	167.00	39.18	29.08	289.37	37.83	29.45	213.12	631
POST WORLD WAR II BOOM, KOREAN CONFLICT AND ADJUSTMENT	1948	0.22497	24.6	204.00	48.42	35.88	285.02	39.69	29.61	235.10	399
	1949	0.24848	23.9	202.00	46.66	36.09	245.06	53.16	41.01	295.74	206
	1950	0.2845A	23.8	218.00	52.99	39.87	241.40	50.15	39.82	265.75	111
	1951	0.29168	23.6	271.00	63.11	47.20	246.05	55.92	43.28	326.83	-118
	1952	0.22039	23.1	267.00	51.77	38.42	221.51	49.28	34.29	282.28	-210
	1953	0.21151	23.5	195.00	45.81	36.17	219.64	49.47	36.82	270.41	116
	1954	0.20665	23.9	164.00	41.13	31.38	251.98	42.99	33.50	227.59	373
	1955	0.15014	23.5	160.00	30.87	21.23	245.90	31.25	21.53	183.94	404
	1956	0.18213	23.2	168.00	35.47	26.53	248.41	33.70	24.08	195.87	373
GENERAL GROWTH AND EXPANSION	1957	0.18447	22.9	183.00	41.66	31.50	270.55	40.33	31.33	238.48	401
	1958	0.24134	22.3	231.00	59.03	46.72	285.06	58.60	48.55	306.67	241
	1959	0.21358	20.1	256.00	53.45	41.14	271.15	51.66	39.72	276.07	61
	1960	0.18215	19.5	245.00	48.13	36.52	251.88	46.88	35.02	243.81	27
	1961	.18724	19.4	246.00	51.02	39.41		49.81	38.56		
	1962	.19214	19.2	242.00	51.81	39.74		52.06	40.79		
	1963	.17419	18.7	235.00	48.03	36.65		46.98	35.30		
	1964	.14978	18.1	229.00	43.84	33.74		42.47	31.41		

APPENDIX TABLE B.17.--DAIRY HEIFERS: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1921-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	NO. OF DAIRY HEIFERS	ACQUISITION COST	EX POST			EX ANTE			ECONOMIC RENT
					MVP	NET MVP	DISCOUNTED NET MVP	MVP	NET MVP	DISCOUNTED NET MVP	
			(1,000 HD.)	----------		DOLLARS PER HEIFER					($1,000)
	1921	0.13249	4166.0	92.00	38.16	37.81	36.32	48.12	47.48	45.61	-65302
	1922	0.13535	3973.0	47.00	39.89	39.47	37.94	48.21	47.88	46.02	-36007
	1923	0.12360	4159.0	49.00	42.35	41.92	40.33	39.12	38.64	37.17	-36078
POST WORLD	1924	0.14898	4154.0	49.00	50.39	49.94	48.07	56.75	56.28	54.16	-3883
WAR I FARM	1925	0.13616	4177.0	51.00	49.38	48.89	47.08	48.76	48.26	46.47	-16369
DEPRESSION	1926	0.17182	4111.0	58.00	65.45	64.93	62.55	69.03	68.49	65.98	10722
	1927	0.17567	4110.0	66.00	72.02	71.45	68.83	70.59	70.03	67.46	11649
	1928	0.23930	4197.0	79.00	100.86	99.35	95.76	103.64	103.03	99.30	70355
	1929	0.11631	4450.0	83.00	62.62	61.95	59.69	64.11	63.35	61.03	-103748
	1930	0.15054	4851.0	66.00	65.29	64.77	62.40	66.47	65.79	63.38	-17463
GENERAL	1931	0.10902	4962.0	45.00	37.13	36.77	35.42	43.94	43.42	41.83	-47520
DEPRESSION	1932	0.10945	5020.0	32.00	28.78	28.49	27.45	31.48	31.11	29.97	-22859
	1933	0.10313	5250.0	29.00	26.42	26.15	25.22	27.44	27.12	26.15	-19852
	1934	0.06646	5380.0	29.00	19.80	18.73	18.07	18.14	17.83	17.20	-58804
	1935	0.18747	4995.0	42.00	64.74	64.28	62.29	65.50	65.18	63.15	101344
	1936	0.10790	4772.0	46.00	43.81	42.58	41.28	42.78	42.24	40.95	-22534
	1937	0.13751	4899.0	50.00	55.66	55.16	53.48	56.50	56.04	54.33	17025
RECOVERY	1938	0.15326	4808.0	50.00	56.96	56.47	54.80	69.81	69.26	67.21	23091
	1939	0.17955	5122.0	51.00	60.72	60.17	58.47	65.03	64.51	62.69	30260
	1940	0.16145	5525.0	54.00	56.43	55.87	54.35	56.74	56.14	54.61	1914
	1941	0.14801	5676.0	63.00	61.67	61.04	59.44	57.73	57.14	55.64	-20220
	1942	0.18090	5889.0	79.00	88.07	87.33	85.07	83.63	82.96	80.82	35771
	1943	0.19640	6067.0	100.00	112.17	111.33	108.51	97.43	96.65	94.20	51611
WORLD WAR II	1944	0.15822	6352.0	94.00	88.87	88.09	85.86	89.43	88.55	86.30	-51709
	1945	0.17126	6307.0	98.00	99.73	98.86	96.31	100.98	100.20	97.62	-10646
	1946	0.12178	5758.0	115.00	95.45	94.47	92.03	76.79	75.89	73.93	-132253
	1947	0.16168	5524.0	134.00	142.43	141.21	137.49	143.83	142.82	139.06	19295
	1948	0.20335	5558.0	163.00	194.81	192.90	187.26	161.81	160.55	156.17	134621
POST WORLD	1949	0.22958	5327.0	162.00	190.85	188.71	183.21	237.20	235.66	228.80	112993
WAR II BOOM,	1950	0.24746	5394.0	174.00	203.33	201.75	195.87	184.53	183.26	177.92	117972
KOREAN	1951	0.27009	5493.0	217.00	251.86	249.24	241.86	238.44	236.84	229.83	136548
CONFLICT AND	1952	0.21148	5694.0	214.00	201.93	199.92	193.81	206.16	204.23	197.99	-114940
ADJUSTMENT	1953	0.13368	5893.0	156.00	115.74	114.58	111.02	133.13	131.64	127.55	-265038
	1954	0.14032	5873.0	131.00	113.66	112.48	108.99	117.65	116.61	113.00	-129275
	1955	0.14310	5786.0	128.00	119.98	118.42	115.02	116.03	114.86	111.57	-75084
	1956	0.13435	5480.0	134.00	124.42	123.34	119.63	119.69	118.55	114.99	-78720
	1957	0.16425	5377.0	144.00	157.83	156.61	151.54	156.35	155.30	150.26	29777
GENERAL	1958	0.27138	5126.0	185.00	266.72	265.24	256.64	271.24	270.00	261.25	367237
GROWTH AND	1959	0.22687	5850.0	205.00	226.29	224.81	217.73	221.43	219.92	213.00	64307
EXPANSION	1960	0.17817	5879.0	196.00	180.77	179.37	173.14	179.05	177.61	171.44	-116121
	1961	0.18519	5863.0	197.00	193.89	191.95	185.82	192.43	191.08	184.98	-56624
	1962	0.18305	4965.0	194.00	190.87	189.41	183.54	194.59	193.22	187.23	-91950
	1963	0.16338	4823.0	188.00	174.69	173.32	168.03	171.72	170.28	165.08	-96311
	1964	0.13540	4598.0	183.00	157.38	156.16	151.24	154.35	153.03	148.22	-144744

APPENDIX TABLE B.18.--CORN FED TO DAIRY CATTLE: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1917-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	QUANTITY OF CORN FED	ACQUISITION COST	EX POST			EX ANTE			ECONOMIC RENT
					MVP	NET MVP	DISCOUNTED NET MVP	MVP	NET MVP	DISCOUNTED NET MVP	
			(1,000 TON)		DOLLARS PER TON						($1,000)
	1917	0.04542	4280.0	51.78	10.93	10.93	10.52	8.68	8.68	8.35	-176591
	1918	0.12982	2900.0	54.28	55.96	55.96	53.86	48.58	48.58	46.76	-1226
WORLD WAR I	1919	0.45600	4410.0	53.93	157.38	157.38	151.47	136.33	136.33	131.21	430147
	1920	0.00093	4425.0	22.86	0.32	0.32	0.31	0.31	0.31	0.30	-99788
	1921	0.15375	4925.0	18.57	37.46	37.46	35.99	47.23	47.23	45.37	85776
	1922	0.27937	5155.0	26.07	63.46	63.46	60.99	76.69	76.69	73.71	180018
	1923	0.26603	5550.0	28.93	68.31	68.31	65.71	63.09	63.09	60.70	204129
	1924	0.09702	3730.0	37.86	21.48	21.48	20.67	24.19	24.19	23.28	-64107
POST WORLD WAR I FARM DEPRESSION	1925	0.04143	9250.0	25.00	11.96	11.96	11.51	11.81	11.81	11.37	-70804
	1926	0.05207	4713.0	26.43	17.80	17.80	16.67	18.24	18.24	17.58	-46015
	1927	0.32295	9584.0	30.36	97.45	97.45	93.88	95.51	95.51	92.01	354715
	1928	0.11015	9976.0	30.00	32.35	32.35	31.18	33.50	33.50	32.29	7044
	1929	0.00074	3745.0	28.57	0.47	0.47	0.45	0.48	0.48	0.46	-105297
	1930	0.00130	2422.0	21.43	1.13	1.13	1.09	1.15	1.15	1.11	-49268
GENERAL DEPRESSION	1931	0.18697	3646.0	11.43	86.66	86.66	83.49	102.56	102.56	98.81	262739
	1932	0.21146	9421.0	11.43	51.49	51.49	49.60	56.32	56.32	54.26	206947
	1933	0.26377	4941.0	18.57	78.13	78.13	75.34	81.13	81.13	78.24	257785
	1934	0.32231	4334.0	29.28	114.38	114.38	110.35	109.21	109.21	105.37	351361
	1935	0.00148	3076.0	23.57	0.83	0.83	0.80	0.84	0.84	0.81	-70031
	1936	0.24018	2883.0	37.14	158.46	158.46	153.62	157.61	157.61	152.80	335803
	1937	0.01054	3468.0	18.57	6.03	6.03	5.84	6.12	6.12	5.93	-44134
RECOVERY	1938	0.14039	9304.0	17.50	47.30	47.30	45.90	57.96	57.96	56.25	150627
	1939	0.34870	6081.0	20.36	99.32	99.32	96.52	106.37	106.37	103.37	463118
	1940	0.09105	6493.0	22.14	27.08	27.08	26.34	27.23	27.23	26.48	27266
	1941	0.22722	7927.0	26.78	67.79	67.79	66.01	63.46	63.46	61.79	310966
	1942	0.14484	8486.0	32.86	48.94	48.94	47.67	46.47	46.47	45.27	125695
	1943	0.18344	9371.0	40.08	67.83	67.83	66.11	58.92	58.92	57.42	244675
WORLD WAR II	1944	0.07251	9813.0	36.78	26.36	26.36	25.70	26.53	26.53	25.86	-108762
	1945	0.12893	8809.0	43.93	53.76	53.76	52.37	54.43	54.43	53.03	74356
	1946	0.10930	8756.0	54.64	56.33	56.33	54.88	45.32	45.32	44.15	2090
	1947	0.15375	7748.0	77.14	96.56	96.56	94.02	97.51	97.51	94.94	130787
	1948	0.07183	8642.0	45.71	44.01	44.01	42.81	36.70	36.70	35.70	-25061
POST WORLD WAR II BOOM, KOREAN CONFLICT AND ADJUSTMENT	1949	0.04955	9353.0	44.28	23.77	23.77	23.08	29.67	29.67	28.81	-198266
	1950	0.18790	8486.0	54.28	97.92	97.92	95.07	88.87	88.87	86.28	346158
	1951	0.08279	8620.0	59.28	49.06	49.06	47.60	46.57	46.57	45.19	-100643
	1952	0.09170	9855.0	54.28	50.49	50.49	48.95	51.65	51.65	50.07	-52566
	1953	0.11266	9731.0	52.86	59.07	59.07	57.23	67.94	67.94	65.83	42569
	1954	0.08781	9176.0	51.07	45.52	45.52	44.11	47.12	47.12	45.66	-63879
	1955	0.14428	10532.0	48.21	66.23	66.23	64.34	64.27	64.27	62.43	169846
	1956	0.10737	11612.0	46.07	46.92	46.92	45.51	45.14	45.14	43.78	-6461
	1957	0.03023	11144.0	39.64	14.02	14.02	13.56	13.88	13.88	13.43	-290606
GENERAL GROWTH AND EXPANSION	1958	0.08226	10698.0	40.00	38.74	38.74	37.48	39.40	39.40	38.12	-26916
	1959	0.09527	11744.0	37.14	40.86	40.86	39.57	39.98	39.98	38.72	28575
	1960	0.07597	12224.0	35.71	32.02	32.02	30.91	31.72	31.72	30.62	-58665
	1961	0.18516	13236.0	38.57	73.94	73.94	71.58	73.59	73.59	71.24	436953
	1962	0.12806	13346.0	39.28	49.68	49.68	48.14	50.65	50.65	49.08	118201
	1963	0.11517	13706.0	39.93	43.33	43.33	42.01	42.60	42.60	41.30	28527
	1964	0.13770	14127.0	40.71	51.64	51.64	50.02	50.65	50.65	49.05	131461

APPENDIX TABLE B.1[illegible].--HAY FED TO DAIRY ANIMALS: EMPLOYMENT AND EARNINGS[1] STATISTICS, UNITED STATES, 1[illegible]-1[illegible]

GENERAL SITUATION	YEAR	ELAST. OF PROD.	QUANTITY OF HAY FED	ACQUISITION COST	EX POST			EX ANTE			ECONOMIC RENT
					MVP	NET MVP	DISCOUNTED NET MVP	MVP	NET MVP	DISCOUNTED NET MVP	
			(1,000 TON)		DOLLARS PER TON						($1,000)
	1917	0.47662	33100.0	16.53	14.83	14.83	14.27	11.78	11.78	11.34	-74654
	1918	0.70824	31600.0	19.62	28.02	28.02	26.96	24.32	24.32	23.41	232078
WORLD WAR I	1919	0.50801	35827.0	20.92	21.58	21.58	20.77	18.70	18.70	17.99	-5329
	1920	1.77428	33447.0	16.50	81.11	81.11	78.07	79.35	79.35	76.37	2059172
	1921	0.40227	34339.0	11.61	13.28	13.28	12.76	16.75	16.75	16.09	41814
	1922	0.25959	38100.0	11.63	7.98	7.98	7.67	9.64	9.64	9.27	-150951
	1923	0.51818	38200.0	13.08	19.33	19.33	18.60	17.85	17.85	17.18	210688
POST WORLD	1924	0.37928	38120.0	12.68	13.98	13.98	13.45	15.74	15.74	15.15	29528
WAR I FARM	1925	0.65006	34900.0	12.80	28.22	28.22	27.17	27.86	27.86	26.83	501616
DEPRESSION	1926	0.36242	33100.0	13.27	17.15	17.15	16.52	18.08	18.08	17.42	107529
	1927	0.36462	43100.0	10.29	14.26	14.26	13.73	13.97	13.97	13.46	148400
	1928	0.44909	42200.0	11.28	18.68	18.68	18.00	19.34	19.34	18.64	283657
	1929	0.50312	42100.0	10.90	28.63	28.63	27.59	29.31	29.31	28.24	702458
	1930	0.15902	37976.0	11.10	8.81	8.81	8.49	8.97	8.97	8.64	-99207
GENERAL	1931	0.21375	38180.0	8.73	9.46	9.46	9.12	11.20	11.20	10.79	14708
DEPRESSION	1932	0.18177	42830.0	6.20	5.60	5.60	5.40	6.13	6.13	5.90	-34389
	1933	0.08327	41418.0	8.09	2.70	2.70	2.61	2.81	2.81	2.71	-227070
	1934	0.39432	34125.0	13.20	17.77	17.77	17.15	16.97	16.97	16.37	134656
	1935	0.48197	42409.0	7.52	19.60	19.60	19.00	19.83	19.83	19.22	486707
	1936	0.31167	40771.0	1.20	14.54	14.54	14.10	14.46	14.46	14.02	525762
	1937	0.10813	40820.0	8.74	5.25	5.25	5.09	5.33	5.33	5.17	-148891
RECOVERY	1938	0.18563	47060.0	6.78	7.05	7.05	6.84	8.64	8.64	8.38	2839
	1939	0.02403	49294.0	10.20	0.84	0.84	0.82	0.90	0.90	0.88	-462346
	1940	0.48473	50414.0	9.82	18.57	18.57	18.06	18.67	18.67	18.16	415447
	1941	0.18160	54032.0	12.20	7.95	7.95	7.74	7.44	7.44	7.24	-241000
	1942	0.27931	58300.0	13.70	13.74	13.74	13.38	13.04	13.04	12.71	-18606
	1943	0.15141	60164.0	18.60	8.72	8.72	8.50	7.57	7.57	7.38	-607718
WORLD WAR II	1944	0.21553	59392.0	21.40	12.95	12.95	12.62	13.03	13.03	12.70	-521465
	1945	0.52507	58668.0	20.30	32.87	32.87	32.02	33.28	33.28	32.43	687829
	1946	0.38798	61720.0	22.70	28.37	28.37	27.64	22.82	22.82	22.23	304721
	1947	0.41212	61590.0	22.90	32.56	32.56	31.70	32.88	32.88	32.02	542233
	1948	0.38282	59040.0	24.30	34.33	34.33	33.40	28.63	28.63	27.85	537169
POST WORLD	1949	0.24323	59158.0	21.10	18.45	18.45	17.92	23.03	23.03	22.36	-188397
WAR II BOOM,	1950	0.21332	62300.0	21.10	15.18	15.18	14.73	13.77	13.77	13.37	-396621
KOREAN	1951	0.20943	64100.0	25.70	16.69	16.69	16.20	15.84	15.84	15.38	-609248
CONFLICT AND	1952	0.37661	62700.0	26.90	32.59	32.59	31.60	33.34	33.34	32.32	294470
ADJUSTMENT	1953	0.53801	63400.0	21.90	43.30	43.30	41.95	49.80	49.80	48.26	1271347
	1954	0.22206	62100.0	21.90	17.81	17.81	16.48	17.61	17.61	17.06	-336408
	1955	0.26691	62466.0	22.50	20.66	20.66	20.07	20.05	20.05	19.47	-151958
	1956	0.42808	60503.0	22.20	35.91	35.91	34.83	34.54	34.54	33.50	764040
	1957	0.40542	63898.0	19.30	32.78	32.78	31.72	32.47	32.47	31.42	793673
GENERAL	1958	0.25230	63104.0	18.80	20.14	20.14	19.49	20.48	20.48	19.82	43508
GROWTH AND	1959	0.09089	66991.0	22.30	6.83	6.83	6.62	6.69	6.69	6.48	-1050492
EXPANSION	1960	0.41518	64916.0	21.70	32.96	32.96	31.81	32.64	32.64	31.51	656416
	1961	0.31050	68014.0	20.60	24.13	24.13	23.36	24.02	24.02	23.25	187799
	1962	0.19213	68682.0	21.60	14.48	14.48	14.03	14.76	14.76	14.31	-519724
	1963	0.15786	69413.0	24.60	11.73	11.73	11.37	11.53	11.53	11.18	-918317
	1964	0.43412	69315.0	23.70	33.18	33.18	32.14	32.54	32.54	31.52	584830

[1]DUE TO REASONS GIVEN ON PAGE 155, ESTIMATES OF MVPs AND RENTS FOR HAY ARE SUBJECT TO LARGE ERROR.

APPENDIX TABLE B.20.--SOWS: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1921-1961

GENERAL SITUATION	YEAR	ELAST. OF PROD.	NO. OF SOWS ON FARMS	ACQUISITION COST	EX POST			EX ANTE			ECONOMIC RENT
					MVP	NET MVP	DISCOUNTED NET MVP	MVP	NET MVP	DISCOUNTED NET MVP	
			(MIL. HD.)	DOLLARS PER SOW							(MIL. DOL.)
	1921	0.42964	11.8	29.00	29.24	29.24	28.09	45.18	45.18	43.40	-11
	1922	0.47746	12.8	23.00	23.61	23.61	22.69	22.21	22.21	21.34	-4
POST WORLD	1923	0.42083	14.1	26.00	25.40	25.40	24.43	41.04	41.04	39.48	-22
WAR I FARM	1924	0.16804	12.1	22.00	15.80	15.80	15.21	15.09	15.09	14.53	-82
DEPRESSION	1925	0.15226	10.1	28.00	23.22	23.22	22.35	18.64	18.64	17.95	-57
	1926	0.21713	10.5	34.00	36.29	36.29	34.96	37.71	37.71	36.33	10
	1927	0.29217	11.2	38.00	41.32	41.32	39.81	47.49	47.49	45.76	20
	1928	0.18114	11.0	28.00	22.81	22.81	21.98	24.36	24.36	23.48	-66
	1929	0.16908	10.7	28.00	23.12	23.12	22.27	23.51	23.51	22.65	-61
GENERAL	1930	0.18956	9.6	29.00	26.46	26.46	25.49	31.79	31.79	30.62	-34
DEPRESSION	1931	0.26395	9.8	24.00	26.02	26.02	25.07	40.55	40.55	39.06	10
	1932	0.22175	9.8	13.00	12.72	12.72	12.25	22.39	22.39	21.57	-7
	1933	0.13182	10.0	9.00	7.94	7.94	7.65	11.02	11.02	10.62	-13
	1934	0.12750	8.6	9.00	7.71	7.71	7.44	10.50	10.50	10.13	-13
	1935	0.06949	6.1	13.00	10.33	10.33	10.01	6.45	6.45	6.25	-18
	1936	0.21921	7.7	27.00	34.05	34.05	33.01	38.15	38.15	36.99	46
RECOVERY	1937	0.12242	7.1	25.00	20.28	20.28	19.66	18.23	18.23	17.67	-38
	1938	0.17620	7.6	24.00	25.62	25.62	24.86	32.44	32.44	31.48	7
	1939	0.23123	9.5	24.00	25.95	25.95	25.22	32.69	32.69	31.77	12
	1940	0.13850	9.4	17.00	13.96	13.56	13.19	18.26	18.26	17.76	-36
	1941	0.07353	8.6	18.00	13.48	13.48	13.13	9.85	9.85	9.59	-42
	1942	0.14479	10.7	33.00	37.00	37.00	36.04	31.70	31.70	30.88	33
WORLD WAR II	1943	0.20516	13.3	48.00	53.47	53.47	52.11	50.97	50.97	49.68	55
	1944	0.12078	10.8	37.00	29.90	29.90	29.15	28.69	28.69	27.97	-85
	1945	0.13686	9.2	44.00	39.83	39.23	38.22	35.75	35.75	34.83	-53
	1946	0.14997	9.4	51.00	52.17	52.17	50.82	43.23	43.23	42.11	-2
	1947	0.17493	9.5	77.00	80.21	80.21	78.10	59.58	59.58	58.01	10
POST WORLD	1948	0.17012	8.7	92.00	82.82	82.22	79.98	84.79	84.79	82.48	-105
WAR II BOOM,	1949	0.24893	9.8	82.00	89.64	89.64	87.03	96.03	96.03	93.23	49
KOREAN	1950	0.14685	10.2	58.00	52.38	52.38	50.85	47.60	47.60	46.22	-73
CONFLICT AND	1951	0.17495	10.4	71.00	72.18	72.18	70.05	69.55	69.55	67.49	-10
ADJUSTMENT	1952	0.14680	9.4	64.00	54.94	54.94	53.26	61.67	61.67	59.78	-101
	1953	0.09816	7.8	56.00	45.11	45.11	43.71	33.60	33.60	32.56	-96
	1954	0.18898	8.4	78.00	88.66	88.66	85.92	92.28	92.28	89.42	66
	1955	0.20439	9.1	65.00	68.17	68.17	66.21	88.66	88.66	86.12	11
	1956	0.08883	8.6	38.00	28.31	28.31	27.46	24.93	24.93	24.18	-91
GENERAL	1957	0.12142	8.2	53.00	48.42	48.42	46.85	44.85	44.85	43.40	-50
GROWTH AND	1958	0.16152	8.7	65.00	69.90	69.90	67.63	66.55	66.55	64.39	23
EXPANSION	1959	0.21772	8.8	68.00	74.12	74.12	71.79	96.36	96.36	93.33	33
	1960	0.06969	7.5	40.00	27.40	27.40	26.45	20.90	20.90	20.18	-102
	1961	0.15269	7.8	58.00	65.72	65.72	63.62	69.20	69.20	66.99	44

APPENDIX TABLE B.21.--FEEDER PIGS: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1921-1963

GENERAL SITUATION	YEAR	ELAST. OF PROD.	NO. OF FEEDER PIGS	ACQUISITION COST	EX POST			EX ANTE			ECONOMIC RENT
					MVP	NET MVP	DISCOUNTED NET MVP	MVP	NET MVP	DISCOUNTED NET MVP	
			(1,000 HD.)	----------			DOLLARS PER FEEDER PIG				($1,000)
	1921	0.11888	29483.0	4.88	3.75	3.75	3.60	5.79	5.79	5.56	-32582
	1922	0.19561	25571.0	4.48	4.84	4.84	4.65	4.55	4.55	4.38	6488
	1923	0.12552	29037.0	4.24	3.68	3.68	3.54	5.94	5.94	5.72	-20355
POST WORLD	1924	0.16160	27880.0	6.30	6.60	6.60	6.35	6.30	6.30	6.06	1216
WAR I FARM	1925	0.08093	23197.0	7.00	5.37	5.37	5.17	4.31	4.31	4.15	-42253
DEPRESSION	1926	0.06056	21665.0	6.15	4.91	4.91	4.73	5.10	5.10	4.91	-30851
	1927	0.07870	23647.0	5.20	5.27	5.27	5.08	6.03	6.03	5.81	-2744
	1928	0.13054	26011.0	5.62	6.95	6.95	6.70	7.42	7.42	7.15	28083
	1929	0.08636	25371.0	5.41	4.98	4.98	4.80	5.06	5.06	4.88	-15410
	1930	0.10042	24685.0	5.30	5.45	5.45	5.25	6.55	6.55	6.31	-1190
GENERAL	1931	0.08188	24338.0	3.49	3.25	3.25	3.13	5.06	5.06	4.87	-8810
DEPRESSION	1932	0.10566	27340.0	2.02	2.17	2.17	2.09	3.82	3.82	3.68	2115
	1933	0.10950	29719.0	2.12	2.22	2.22	2.14	3.08	3.08	2.97	561
	1934	0.15586	27581.0	2.49	2.92	2.92	2.82	3.98	3.98	3.84	9113
	1935	0.06699	19425.0	5.20	3.94	3.94	3.81	2.46	2.46	2.38	-21289
	1936	0.09827	20824.0	5.62	5.87	5.87	5.69	6.58	6.58	6.36	1412
	1937	0.11838	21234.0	5.73	6.11	6.11	5.92	5.49	5.49	5.32	4181
RECOVERY	1938	0.07990	21025.0	4.67	4.20	4.20	4.08	5.32	5.32	5.16	-12401
	1939	0.08863	29111.0	3.77	3.76	3.76	3.66	4.74	4.74	4.61	-2723
	1940	0.11919	30844.0	3.23	3.65	3.65	3.55	4.92	4.92	4.78	9475
	1941	0.08234	26328.0	5.46	4.93	4.93	4.80	3.60	3.60	3.51	-17317
	1942	0.08789	31898.0	7.84	7.73	7.73	7.53	6.62	6.62	6.45	-9806
	1943	0.09228	38401.0	8.21	8.33	8.33	8.12	7.94	7.94	7.74	-3723
WORLD WAR II	1944	0.15392	42337.0	7.84	9.72	9.72	9.48	9.33	9.33	9.09	69028
	1945	0.06801	27221.0	8.42	6.59	6.59	6.42	6.01	6.01	5.85	-54613
	1946	0.10357	38849.0	10.50	11.27	11.27	10.98	9.34	9.34	9.10	14596
	1947	0.08346	26754.0	14.42	13.90	13.99	13.23	10.09	10.09	9.83	-31651
POST WORLD	1948	0.08058	24099.0	13.88	13.95	13.95	13.57	14.39	14.39	13.99	-8471
WAR II BOOM,	1949	0.08736	28925.0	10.92	10.66	10.66	10.35	11.42	11.42	11.09	-16554
KOREAN	1950	0.09867	31704.0	10.81	11.32	11.32	10.99	10.29	10.29	9.99	5795
CONFLICT AND	1951	0.09698	34186.0	12.63	12.17	12.17	11.81	11.73	11.73	11.38	-7415
ADJUSTMENT	1952	0.11814	34197.0	10.71	11.33	11.33	10.98	12.72	12.72	12.33	9552
	1953	0.10344	28861.0	12.88	12.85	12.85	12.45	9.57	9.57	9.27	-12411
	1954	0.07642	24272.0	12.98	11.46	11.46	11.11	11.93	11.93	11.56	-49297
	1955	0.09034	29906.0	9.01	9.17	9.17	8.91	11.93	11.93	11.58	-3115
	1956	0.12242	34862.0	8.64	9.85	9.85	9.55	8.67	8.67	8.41	31156
	1957	0.10846	32995.0	10.71	10.75	10.75	10.40	9.96	9.96	9.64	-18037
GENERAL	1958	0.09858	32732.0	11.77	11.33	11.33	10.96	10.79	10.79	10.44	-26251
GROWTH AND	1959	0.11253	38836.0	8.48	8.82	8.82	8.54	11.46	11.46	11.10	2279
EXPANSION	1960	0.12974	38747.0	9.17	9.87	9.87	9.53	7.53	7.53	7.27	14803
	1961	0.10449	37308.0	9.96	9.40	9.40	9.10	9.90	9.90	9.58	-32209
	1962	0.11333	38801.0	9.01	9.90	9.90	9.59	9.01	9.01	9.58	-8135
	1963	0.11494	39946.0	8.96	9.05	9.05	8.77	9.40	9.40	9.11	-7583

APPENDIX TABLE B.22.--CORN FED TO HOGS: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1917-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	QUANTITY OF CORN FED	ACQUISITION COST	EX POST			EX ANTE			ECONOMIC RENT
					MVP	NET MVP	DISCOUNTED NET MVP	MVP	NET MVP	DISCOUNTED NET MVP	
			(1,000 TON)		----------	----------	DOLLARS PER TON	----------	----------	----------	($1,000)
	1917	2.30124	39913.0	51.78	52.41	52.41	50.44	37.70	37.70	36.29	-41415
	1918	0.24465	28752.0	54.28	10.76	10.76	10.35	10.03	10.03	9.66	-1263026
WORLD WAR I	1919	0.69153	29808.0	53.93	35.40	35.40	34.07	31.52	31.52	30.33	-576029
	1920	0.75149	31790.0	22.86	28.44	28.44	27.37	34.86	34.86	32.78	143393
	1921	2.08404	34858.0	18.57	49.15	49.15	47.21	75.94	75.94	72.95	975268
	1922	2.13575	33860.0	26.07	39.93	39.93	38.37	37.55	37.55	36.09	416576
	1923	0.58741	32373.0	28.93	15.44	15.44	14.85	24.95	24.95	24.00	-455661
	1924	0.51864	26921.0	37.86	21.92	21.92	21.10	20.94	20.94	20.15	-451167
POST WORLD WAR I FARM DEPRESSION	1925	0.08962	29374.0	25.00	4.70	4.70	4.52	3.77	3.77	3.63	-601449
	1926	0.36967	29531.0	26.43	21.97	21.97	21.16	22.83	22.83	21.99	-155492
	1927	1.27035	30929.0	30.36	65.04	65.06	62.68	74.78	74.78	72.04	999566
	1928	0.71073	29760.0	30.00	34.23	34.23	32.99	36.55	36.55	35.23	85987
	1929	0.42625	29753.0	28.57	21.69	21.69	20.89	22.06	22.06	21.25	-220697
	1930	0.15892	24833.0	21.43	8.58	8.58	8.26	10.30	10.30	9.93	-327014
GENERAL DEPRESSION	1931	0.25598	29777.0	11.43	8.30	8.30	8.00	12.94	12.94	12.47	-102131
	1932	4.01084	33728.0	11.43	66.85	66.85	64.40	117.68	117.68	113.38	1786152
	1933	1.31415	29807.0	18.57	26.54	26.54	25.59	36.84	36.84	35.53	209377
	1934	1.43452	16965.0	29.28	43.97	43.97	42.42	59.90	59.90	57.79	222944
	1935	0.12331	20984.0	23.57	5.33	5.33	5.16	3.33	3.33	3.22	-386222
	1936	0.90948	28200.0	37.14	53.85	53.85	52.20	60.34	60.34	58.50	304289
	1937	0.13574	24121.0	18.57	6.11	6.11	5.92	5.49	5.49	5.33	-330309
RECOVERY	1938	0.48171	27176.0	17.50	19.59	19.99	19.01	24.80	24.80	24.07	40958
	1939	1.22062	29981.0	20.36	43.40	43.40	42.18	54.69	54.69	53.14	654100
	1940	1.00130	27729.0	22.14	33.22	33.22	32.32	44.75	44.75	43.53	282188
	1941	0.31755	32863.0	26.78	15.62	15.62	15.21	11.41	11.41	11.11	-371040
	1942	0.33711	39732.0	32.86	23.20	23.20	22.60	19.88	19.88	19.36	-407725
	1943	0.33294	37481.0	40.00	30.79	30.79	30.01	29.35	29.35	28.61	-374497
WORLD WAR II	1944	0.49677	32665.0	36.78	40.67	40.67	39.64	39.02	39.02	38.03	93276
	1945	0.63901	39705.0	43.93	47.19	47.19	45.98	43.01	43.01	41.90	73054
	1946	0.76195	33326.0	54.64	74.76	74.76	72.83	61.95	61.95	60.35	606313
	1947	0.46704	29969.0	77.14	67.89	67.89	66.10	50.42	50.42	49.10	-330849
	1948	0.55069	30920.0	45.71	74.89	74.89	72.85	77.23	77.23	75.12	839208
POST WORLD WAR II BOOM, KOREAN CONFLICT AND ADJUSTMENT	1949	0.54123	34865.0	44.28	54.78	54.78	53.19	58.69	58.69	56.98	310547
	1950	0.54521	34165.0	54.28	54.84	54.84	53.25	49.85	49.85	48.40	-37341
	1951	0.39934	35968.0	59.28	47.64	47.64	46.23	45.90	45.90	44.54	-469352
	1952	0.27010	27251.0	54.28	34.87	34.87	33.80	39.14	39.14	37.94	-557990
	1953	0.46995	29400.0	52.86	57.30	57.30	55.53	42.68	42.68	41.36	78440
	1954	0.64142	29523.0	51.07	85.62	85.62	82.97	89.11	89.11	86.35	941713
	1955	0.54444	31399.0	48.21	52.62	52.62	51.12	68.45	68.45	66.49	91269
	1956	0.60931	31346.0	46.07	53.28	53.28	51.68	46.92	46.92	45.51	175792
	1957	0.17762	32267.0	39.64	18.00	18.00	17.42	16.68	16.68	16.13	-717085
GENERAL GROWTH AND EXPANSION	1958	0.41929	37526.0	40.00	42.07	42.07	40.70	40.05	40.05	38.75	26416
	1959	0.64686	40753.0	37.14	47.95	47.95	46.06	61.82	61.82	59.88	363431
	1960	0.55166	39619.0	35.71	41.06	41.06	39.64	31.32	31.32	30.23	155507
	1961	0.48346	41843.0	38.57	38.79	38.79	37.55	40.84	40.84	39.54	-42751
	1962	0.55026	42154.0	39.28	43.32	43.32	41.98	42.93	42.93	41.60	114872
	1963	0.47487	39750.0	39.93	37.94	37.56	36.41	39.02	39.02	37.83	-139827
	1964	0.59986	38330.0	40.71	47.80	47.00	45.52	45.89	45.89	44.44	184273

APPENDIX TABLE B.23.--CHICKENS: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1917-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	NO. OF CHICKENS ON FARMS	ACQUISITION COST	EX POST			EX ANTE			ECONOMIC RENT
					MVP	NET MVP	DISCOUNTED NET MVP	MVP	NET MVP	DISCOUNTED NET MVP	
			(MIL. BIRDS)	----------		DOLLARS PER BIRD		----------			(MIL. DOL.)
	1917	0.20507	359.5	0.59	0.91	0.91	0.89	0.90	0.90	0.89	-34
	1918	0.27939	363.4	0.77	0.77	0.77	0.74	0.69	0.69	0.67	-10
WORLD WAR I	1919	0.28740	391.4	0.96	0.99	0.99	0.95	0.85	0.85	0.82	-3
	1920	0.25722	381.1	0.97	0.94	0.94	0.91	0.76	0.76	0.73	-23
	1921	0.36875	370.1	0.89	1.00	1.00	0.96	1.46	1.46	1.40	25
	1922	0.33036	395.0	0.81	0.81	0.81	0.78	0.91	0.91	0.87	-12
	1923	0.26672	415.1	0.75	0.70	0.70	0.67	0.68	0.68	0.66	-33
POST WORLD	1924	0.30370	434.8	0.76	0.77	0.77	0.74	0.78	0.78	0.75	-7
WAR I FARM	1925	0.25900	435.0	0.79	0.75	0.75	0.73	0.70	0.70	0.67	-28
DEPRESSION	1926	0.30339	438.0	0.89	0.92	0.92	0.89	0.96	0.96	0.92	0
	1927	0.36502	461.0	0.91	0.98	0.98	0.95	1.12	1.12	1.08	17
	1928	0.27664	475.0	0.86	0.80	0.80	0.77	0.75	0.75	0.72	-41
	1929	0.31676	449.0	0.91	0.93	0.93	0.90	0.86	0.86	0.83	-5
	1930	0.38712	468.5	0.93	1.00	1.00	0.97	1.10	1.10	1.06	18
GENERAL	1931	0.33984	449.7	0.70	0.69	0.69	0.66	0.86	0.86	0.83	-17
DEPRESSION	1932	0.42800	436.8	0.62	0.67	0.67	0.64	0.78	0.78	0.75	10
	1933	0.28485	444.5	0.45	0.40	0.40	0.39	0.42	0.42	0.41	-28
	1934	0.20934	433.9	0.42	0.36	0.36	0.35	0.32	0.32	0.31	-30
	1935	0.20222	390.0	0.54	0.51	0.51	0.49	0.43	0.43	0.42	-18
	1936	0.36461	403.4	0.75	0.90	0.90	0.87	0.95	0.95	0.92	50
	1937	0.24678	423.9	0.66	0.61	0.61	0.60	0.66	0.66	0.64	-27
RECOVERY	1938	0.32634	389.6	0.76	0.82	0.82	0.79	0.80	0.80	0.78	12
	1939	0.31687	418.6	0.70	0.71	0.71	0.69	0.92	0.92	0.89	-4
	1940	0.22780	438.3	0.60	0.54	0.54	0.52	0.60	0.60	0.58	-33
	1941	0.17179	422.8	0.65	0.57	0.57	0.55	0.49	0.49	0.48	-41
	1942	0.19320	476.9	0.83	0.83	0.83	0.80	1.04	1.04	1.02	-12
	1943	0.18782	542.0	1.04	1.03	1.03	1.00	0.91	0.91	0.89	-20
WORLD WAR II	1944	0.27543	582.2	1.18	1.34	1.34	1.31	1.55	1.55	1.51	74
	1945	0.17172	516.5	1.21	1.07	1.07	1.05	0.88	0.88	0.86	-84
	1946	0.21811	523.2	1.27	1.32	1.32	1.29	1.26	1.26	1.23	10
	1947	0.19322	467.2	1.44	1.40	1.40	1.36	1.24	1.24	1.21	-35
POST WORLD	1948	0.20263	499.6	1.44	1.45	1.45	1.41	1.39	1.39	1.35	-15
WAR II BOOM,	1949	0.20448	430.9	1.66	1.67	1.67	1.62	1.69	1.69	1.64	-18
KOREAN	1950	0.19256	456.5	1.36	1.34	1.34	1.30	1.59	1.59	1.54	-29
CONFLICT AND	1951	0.13834	431.0	1.46	1.28	1.28	1.24	1.02	1.02	0.99	-95
ADJUSTMENT	1952	0.19228	420.6	1.53	1.67	1.67	1.62	1.84	1.84	1.79	37
	1953	0.12711	398.2	1.41	1.25	1.25	1.21	1.10	1.10	1.07	-78
	1954	0.19206	396.8	1.43	1.58	1.58	1.53	1.88	1.88	1.83	41
	1955	0.09585	390.7	1.05	0.86	0.86	0.83	0.80	0.80	0.78	-85
	1956	0.15014	383.7	1.26	1.37	1.37	1.33	1.26	1.26	1.22	27
	1957	0.14027	391.4	1.17	1.18	1.18	1.14	1.26	1.26	1.22	-12
GENERAL	1958	0.12916	374.3	1.26	1.23	1.23	1.19	1.21	1.21	1.17	-27
GROWTH AND	1959	0.16949	387.0	1.26	1.37	1.37	1.33	1.60	1.60	1.55	27
EXPANSION	1960	0.09720	369.5	1.06	0.90	0.90	0.87	0.88	0.88	0.85	-70
	1961	0.14882	361.7	1.25	1.37	1.37	1.32	1.31	1.31	1.26	27
	1962	0.12238	368.4	1.15	1.12	1.12	1.08	1.06	1.06	1.03	-25
	1963	0.12308	366.8	1.16	1.15	1.15	1.11	1.03	1.03	1.00	-18
	1964	0.12616	369.0	1.16	1.17	1.17	1.13	1.14	1.14	1.10	-10

APPENDIX TABLE B.24.--CORN FED TO POULTRY: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1917-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	QUANTITY OF CORN FED	ACQUISITION COST	EX POST			EX ANTE			ECONOMIC RENT
					MVP	NET MVP	DISCOUNTED NET MVP	MVP	NET MVP	DISCOUNTED NET MVP	
			(1,000 TON)	DOLLARS PER TON							($1,000)
	1917	0.49782	7840.0	91.78	61.98	61.95	59.63	48.71	48.71	46.88	96816
	1918	1.73892	6690.0	94.28	279.83	279.83	269.47	248.24	248.24	238.93	1412885
WORLD WAR I	1919	0.10778	4860.0	93.93	21.16	21.16	20.37	18.19	18.19	17.51	-238228
	1920	0.76281	8175.0	22.86	130.94	130.94	125.64	105.03	105.03	101.09	842239
	1921	0.60769	8189.0	18.97	74.79	74.79	71.88	109.68	109.68	105.36	432874
	1922	0.12952	8818.0	26.07	15.68	15.68	15.07	17.97	17.97	16.88	-88881
	1923	0.13329	8700.0	28.93	16.61	16.61	15.98	16.29	16.29	15.68	-112692
POST WORLD	1924	0.16817	7150.0	37.86	26.86	26.86	25.88	26.35	26.35	25.36	-91360
WAR I FARM	1925	0.76991	9310.0	25.00	104.69	104.69	100.81	96.77	96.77	93.19	705815
DEPRESSION	1926	0.16886	10642.0	24.43	20.74	20.74	19.98	21.53	21.53	20.75	-68588
	1927	0.15189	10712.0	30.36	17.61	17.61	16.97	20.00	20.00	19.26	-143472
	1928	0.27193	9885.0	30.00	37.01	37.01	36.34	35.34	35.34	34.07	64621
	1929	0.24464	9735.0	28.97	33.20	33.20	31.98	30.63	30.63	29.51	33206
	1930	0.76194	6689.0	21.43	138.91	138.91	133.44	151.96	151.96	146.39	740268
GENERAL	1931	0.29067	9411.0	11.43	28.11	28.11	27.08	39.13	39.13	33.85	147259
DEPRESSION	1932	0.11086	9970.0	11.43	7.97	7.97	7.29	8.80	8.80	8.48	-41228
	1933	0.01858	8719.0	10.97	0.76	0.76	0.73	0.80	0.80	0.77	-199522
	1934	0.22253	7973.0	29.28	22.10	22.10	21.32	19.50	19.50	18.81	-68288
	1935	0.85877	9147.0	23.97	91.26	91.26	88.43	77.61	77.61	75.20	5944560
	1936	0.24798	6870.0	37.14	35.82	35.22	34.14	37.16	37.16	36.02	-28593
	1937	0.55681	7177.0	10.97	81.03	81.93	79.43	88.47	88.47	85.76	436761
RECOVERY	1938	0.71093	8398.0	17.58	82.93	82.93	80.09	81.31	81.31	78.91	525128
	1939	0.05558	8138.0	20.36	6.40	6.40	6.22	8.28	8.28	8.05	-114932
	1940	0.03388	10713.0	22.14	3.28	3.28	3.19	3.66	3.66	3.56	-203841
	1941	0.29167	11928.0	26.78	35.45	35.45	34.91	38.47	38.47	29.67	89096
	1942	0.28928	13893.0	32.84	45.02	45.02	43.85	56.95	56.95	55.48	143945
	1943	0.53966	11283.0	40.00	141.96	141.96	138.36	126.27	126.27	123.07	1109790
WORLD WAR II	1944	0.22418	13570.0	36.78	46.80	46.80	45.62	93.86	93.86	92.49	119916
	1945	0.20119	12697.0	43.93	51.23	51.23	49.90	42.12	42.12	41.04	75863
	1946	0.04073	12581.0	94.64	10.27	10.27	10.01	9.78	9.78	9.53	-561529
	1947	0.25794	9268.0	77.14	94.40	94.40	91.92	83.36	83.36	81.17	136859
	1948	0.36157	12786.0	45.71	101.04	101.04	98.29	96.97	96.97	94.33	672256
POST WORLD	1949	0.18975	19397.0	44.28	43.27	43.27	42.01	43.84	43.84	42.57	-34981
WAR II BOOM,	1950	0.10136	12545.0	54.28	25.97	25.97	24.83	30.36	30.36	29.48	-369492
KOREAN	1951	0.53690	12911.0	59.28	170.88	170.88	165.83	136.13	136.13	132.11	1333810
CONFLICT AND	1952	0.09938	13025.0	54.28	26.23	26.23	25.43	29.00	29.00	28.12	-398871
ADJUSTMENT	1953	0.29464	14439.0	92.86	80.16	80.16	77.67	78.98	78.98	68.39	350232
	1954	0.35869	11325.0	91.07	101.17	101.17	98.03	120.92	120.92	116.78	531818
	1955	0.18378	12737.0	40.81	50.82	50.32	48.80	47.14	47.14	45.79	8518
	1956	0.16583	13505.0	44.07	43.00	43.00	41.71	39.39	39.39	38.21	-98897
	1957	0.43122	12793.0	39.64	118.66	118.66	107.07	118.68	118.68	114.83	862695
	1958	0.23977	12023.0	40.98	66.95	66.95	64.39	69.68	69.68	63.59	312763
GENERAL	1959	0.17638	11772.0	37.14	46.93	46.93	45.49	54.85	54.85	53.12	97833
GROWTH AND	1960	0.15418	13200.0	39.71	40.06	40.06	38.67	38.95	38.95	37.60	39879
EXPANSION	1961	0.05249	13790.0	38.57	12.66	12.66	12.28	12.09	12.09	11.78	-362916
	1962	0.14868	13769.0	39.28	36.07	36.07	34.95	34.35	34.35	33.28	-59633
	1963	0.10407	14174.0	39.93	39.95	39.95	38.34	35.93	35.93	34.44	-22472
	1964	0.08464	15012.0	40.71	19.87	19.87	18.67	18.82	18.82	18.22	-330934

APPENDIX TABLE B.25.--TRACTORS IN CORN PRODUCTION: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1917-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	NO. OF TRACTORS	ACQUISITION COST	EX POST			EX ANTE			ANNUAL AVR. CAP. GAINS
					MVP	NET MVP	CAPITAL VALUE	MVP	NET MVP	CAPITAL VALUE	
			(1,000)	----------			DOLLARS PER TRACTOR				($1,000)
	1917	0.00119	17.8	784.00	283.67	252.67	7758.42	212.24	180.24	1220.44	12414
	1918	0.02233	25.5	994.00	3526.14	3487.14	9541.74	2772.28	2736.28	18527.42	20087
WORLD WAR I	1919	0.01976	42.2	1026.00	1898.18	1858.18	7737.35	1542.27	1498.27	10144.86	29166
	1920	0.14128	68.9	1058.00	4014.89	3973.89	7864.50	9665.47	9618.47	65126.99	46897
	1921	0.19516	98.0	1026.00	2990.48	2950.48	4322.82	5265.85	5217.85	34698.51	32639
	1922	0.00953	105.4	912.00	179.29	143.29	1973.54	155.91	107.91	720.82	11187
	1923	0.02070	122.4	950.00	395.78	358.78	2503.99	364.51	319.51	2153.65	19021
POST WORLD	1924	0.00864	140.6	994.00	145.28	106.28	2338.38	102.79	58.79	398.09	18902
WAR I FARM	1925	0.04351	154.0	994.00	554.01	515.01	2591.34	724.48	678.48	4614.91	24599
DEPRESSION	1926	0.02669	172.0	994.00	292.47	253.47	2283.45	324.96	278.96	1906.11	22179
	1927	0.00693	190.8	994.00	103.76	64.76	2346.28	103.76	57.76	394.63	25802
	1928	0.12467	217.7	994.00	253.68	214.68	2660.92	247.54	201.34	1382.02	36289
	1929	0.02414	224.0	962.00	216.62	179.62	3123.29	222.32	176.32	1204.74	48413
	1930	0.13458	275.4	969.00	607.92	569.92	3097.11	773.72	728.72	4979.23	58608
GENERAL	1931	0.28983	332.5	950.00	720.00	683.00	2544.23	1613.78	1568.78	10719.26	53008
DEPRESSION	1932	0.32215	351.5	918.00	849.60	813.60	1843.84	1611.51	1566.31	10702.36	32543
	1933	0.00712	354.8	886.00	25.01	-9.99	1617.96	28.07	-15.93	-109.84	25970
	1934	0.06615	365.0	918.00	221.71	185.71	1829.27	180.14	138.14	956.93	33079
	1935	0.00542	314.9	969.00	25.90	-12.10	1902.04	28.78	-14.22	-102.69	29381
	1936	0.07282	360.9	1033.00	308.48	268.48	2034.60	239.59	194.59	1412.09	36148
	1937	0.11096	474.1	1064.00	405.76	364.76	1937.13	662.47	615.47	4466.20	32664
RECOVERY	1938	0.26773	437.4	1128.00	758.99	714.99	1807.35	1130.42	1082.42	7929.06	29715
	1939	0.01688	463.7	1033.00	53.32	13.32	1884.61	69.12	18.12	134.65	39489
	1940	0.03267	478.9	982.00	103.63	65.63	2309.54	120.90	71.90	539.36	63576
	1941	0.01543	502.8	1033.00	61.10	21.10	2514.86	69.59	23.35	176.87	74908
	1942	0.22743	545.3	1829.00	1173.64	1102.64	3054.81	1173.64	1126.64	8574.23	66844
	1943	0.03106	600.0	1817.00	172.27	101.27	2328.60	151.53	82.53	631.16	30496
WORLD WAR II	1944	0.05142	581.4	1931.00	296.53	221.53	2917.45	273.50	193.50	1479.72	34096
	1945	0.00531	572.2	1485.00	33.87	-24.13	2645.80	26.16	-56.84	-432.59	46421
	1946	0.00213	591.2	1256.00	18.10	-30.90	3171.40	12.77	-60.23	-458.35	113239
	1947	0.05521	596.1	1485.00	470.79	412.79	3979.47	261.55	201.55	1526.50	148695
	1948	0.23999	625.2	1667.00	2178.45	2113.45	4406.92	2127.40	2064.40	15486.28	171300
POST WORLD	1949	0.19176	672.2	1848.00	1045.81	973.81	2621.00	1012.07	941.07	6926.39	51961
WAR II BOOM,	1950	0.02214	674.5	1868.00	138.56	65.56	2079.57	109.39	30.39	223.66	14270
KOREAN	1951	0.08763	729.5	1995.00	482.45	404.45	2428.05	377.83	295.83	2167.02	31591
CONFLICT AND	1952	0.04545	764.7	2014.00	294.71	216.71	2259.35	283.00	197.00	1429.52	18762
ADJUSTMENT	1953	0.07422	787.6	2040.00	414.88	335.88	2361.99	378.43	290.43	2097.68	24716
	1954	0.10193	800.5	1982.00	493.03	416.03	2227.80	468.73	379.73	2742.61	19677
	1955	0.07285	809.3	2027.00	344.08	265.08	2099.17	331.34	243.34	1799.53	5841
	1956	0.06412	808.3	2123.00	315.46	232.46		293.45	209.45	1497.92	
	1957	0.18439	788.9	2244.00	793.03	706.03		800.18	708.18	5043.65	
GENERAL	1958	0.06617	824.5	2339.00	301.45	210.45		296.06	200.06	1424.85	
GROWTH AND	1959	0.15990	951.5	2454.00	668.83	572.83		662.46	562.46	4043.45	
EXPANSION	1960	0.08307	932.3	2467.00	347.75	251.75		361.66	256.66	1786.15	
	1961	0.03382	804.9	2473.00	164.41	68.41		164.41	57.41	410.77	
	1962	0.08884	838.4	2550.00	428.55	329.55		436.54	329.34	2378.70	
	1963	0.05242	808.3	2569.00	182.61	82.61		172.56	63.56	461.23	
	1964	0.07634	722.4	2564.00	428.40	324.40		387.06	276.06	1984.56	

APPENDIX TABLE B.26.--CORN PICKERS: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1917-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	NO. OF CORN PICKERS	ACQUISITION COST	EX POST			EX ANTE			ANNUAL AVR. CAP. GAINS
					MVP	NET MVP	CAPITAL VALUE	MVP	NET MVP	CAPITAL VALUE	
			(1,000)	----------	----------	DOLLARS PER CORN PICKER	----------	----------	----------	----------	($1,000)
	1917	0.00003	4.0	536.00	30.26	9.26	393.46	22.64	1.64	11.08	-57
	1918	0.00021	6.0	688.00	131.77	104.77	525.19	103.60	78.60	532.20	-98
WORLD WAR I	1919	0.00023	8.0	710.00	115.70	87.70	562.87	94.01	60.01	406.32	-118
	1920	0.00081	10.0	729.00	158.08	130.08	643.77	380.56	347.56	2353.34	-85
	1921	0.00116	14.0	701.00	125.54	98.54	552.20	221.06	189.06	1257.26	-208
	1922	0.00076	18.0	632.00	83.48	58.48	514.09	72.59	42.59	284.51	-212
	1923	0.00086	22.0	646.00	91.38	66.38	540.16	84.16	57.16	385.29	-233
POST WORLD	1924	0.00116	26.0	688.00	105.80	78.80	550.22	74.86	46.86	317.28	-358
WAR I FARM	1925	0.00165	30.0	674.00	107.76	81.76	572.26	140.92	108.92	740.83	-389
DEPRESSION	1926	0.00183	34.0	678.00	101.19	75.19	578.80	112.43	83.43	570.06	-337
	1927	0.00205	38.0	688.00	119.65	92.65	583.52	119.65	89.65	612.53	-397
	1928	0.00170	42.0	674.00	90.67	64.67	576.93	88.41	57.41	394.04	-408
	1929	0.00234	46.0	674.00	102.05	76.05	607.38	104.73	75.73	517.48	-306
	1930	0.00486	50.0	674.00	120.79	94.79	603.58	153.74	123.74	845.48	-352
GENERAL	1931	0.00796	56.0	660.00	117.45	91.45	543.80	263.25	233.25	1593.75	-651
DEPRESSION	1932	0.00573	62.0	632.00	85.72	60.72	473.23	162.56	132.56	905.79	-984
	1933	0.00411	68.0	605.00	75.46	51.46	450.09	84.70	56.70	390.99	+1053
	1934	0.00601	74.0	632.00	95.97	70.97	473.87	77.97	50.97	353.11	+1170
	1935	0.00444	80.0	646.00	83.63	58.63	481.11	92.92	63.92	461.68	+1319
	1936	0.00516	86.0	660.00	94.31	68.31	491.96	73.25	45.25	328.36	+1445
	1937	0.00696	92.0	674.00	103.43	77.43	500.85	168.86	138.86	1007.66	+1593
RECOVERY	1938	0.00841	98.0	701.00	106.41	79.41	483.50	158.48	128.48	941.15	+2132
	1939	0.00643	104.0	688.00	90.62	63.62	466.92	117.47	86.47	642.54	+2299
	1940	0.00674	110.0	674.00	93.10	67.10	495.17	108.61	77.61	582.22	+1967
	1941	0.00536	120.0	688.00	89.00	62.00	522.53	101.03	72.03	545.55	+1986
	1942	0.00422	130.0	729.00	91.42	63.42	592.70	91.42	60.42	459.83	+1772
	1943	0.00412	138.0	742.00	99.25	70.25	648.40	87.31	54.31	415.29	+1292
WORLD WAR II	1944	0.00485	146.0	770.00	111.29	81.29	678.08	102.65	68.65	524.99	+1342
	1945	0.00504	168.0	770.00	109.66	79.66	704.64	84.70	49.70	378.21	+1098
	1946	0.00429	203.0	798.00	106.28	75.28	780.80	75.02	41.02	312.18	-349
	1947	0.00660	236.0	908.00	142.11	107.11	926.44	78.95	42.95	325.31	435
	1948	0.00681	299.0	1059.00	167.25	126.25	1021.22	163.33	120.33	902.64	+1130
POST WORLD	1949	0.02423	372.0	1196.00	238.81	191.81	1013.98	231.11	180.11	1325.62	+6771
WAR II BOOM,	1950	0.01913	456.0	1224.00	177.12	129.12	966.36	139.83	81.83	602.26	+11748
KOREAN	1951	0.02370	522.0	1320.00	198.15	147.15	1046.58	155.18	99.18	726.52	+14272
CONFLICT AND	1952	0.02566	588.0	1361.00	198.83	145.83	1069.88	190.93	129.93	942.87	+17118
ADJUSTMENT	1953	0.03002	630.0	1375.00	204.46	150.46	1085.37	186.50	123.50	891.99	+18247
	1954	0.03496	660.0	1375.00	205.09	151.09	1089.77	194.98	130.98	946.02	+18825
	1955	0.03499	688.0	1375.00	195.74	141.74	1096.85	188.49	125.49	928.00	+19137
	1956	0.03665	715.0	1430.00	203.35	147.35		189.16	126.16	919.84	
	1957	0.05132	740.0	1512.00	235.31	176.31		237.43	170.43	1213.79	
GENERAL	1958	0.04286	755.0	1568.00	213.24	152.24		209.43	138.43	985.89	
GROWTH AND	1959	0.04457	775.0	1636.00	228.89	164.89		226.71	153.71	1105.02	
EXPANSION	1960	0.04892	795.0	1678.00	240.17	175.17		249.77	172.77	1202.34	
	1961	0.04960	800.0	1719.00	242.28	175.28		242.28	165.28	1182.63	
	1962	0.05028	815.0	1760.00	247.14	178.14		251.63	171.63	1239.62	
	1963	0.04360	820.0	1788.00	238.54	168.54		225.41	143.41	1040.66	
	1964	0.05436	820.0	1829.00	268.57	197.57		242.65	159.65	1147.73	

APPENDIX TABLE B.27.--TRACTORS IN WHEAT PRODUCTION: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1917-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	NO. OF TRACTORS	ACQUISITION COST	EX POST			EX ANTE			ANNUAL AVR. CAP. GAINS
					MVP	NET MVP	CAPITAL VALUE	MVP	NET MVP	CAPITAL VALUE	
			(1,000)	----------DOLLARS PER TRACTOR----------							($1,000)
	1917	0.00057	7.0	784.00	104.03	73.03	2624.31	77.00	45.00	304.72	1288
WORLD WAR I	1918	0.00475	14.0	994.00	628.24	589.24	3312.95	557.75	521.75	3532.80	3247
	1919	0.01935	33.3	1026.00	1196.56	1156.56	3579.71	1052.53	1008.53	6828.79	8504
	1920	0.02500	46.2	1058.00	833.17	792.17	3189.52	869.79	822.79	5571.14	9848
	1921	0.12963	65.0	1026.00	1681.21	1641.21	2597.82	2383.08	2335.08	15528.19	10217
	1922	0.01088	70.5	912.00	126.23	90.23	1319.83	128.86	80.86	540.16	2875
	1923	0.02204	70.5	950.00	219.75	182.75	1532.27	277.07	232.07	1564.26	4105
POST WORLD	1924	0.00522	78.0	994.00	70.14	31.14	1526.01	65.05	21.05	142.54	4150
WAR I FARM	1925	0.02815	93.8	994.00	288.36	249.36	1695.22	262.14	216.14	1470.16	6577
DEPRESSION	1926	0.01578	105.0	994.00	152.25	113.25	1632.80	163.57	117.57	803.34	6707
	1927	0.02783	127.4	994.00	227.44	188.44	1653.11	240.93	194.93	1331.94	8397
	1928	0.05617	154.4	994.00	331.78	292.78	1597.69	402.16	356.16	2444.69	9321
	1929	0.02437	151.8	962.00	137.09	100.09	1717.68	151.73	105.73	722.41	11471
	1930	0.13772	168.2	969.00	487.17	449.17	1897.01	738.14	693.14	4736.13	15609
GENERAL	1931	0.21663	170.1	950.00	468.66	431.66	1465.70	1183.97	1138.97	7782.43	8772
DEPRESSION	1932	0.22512	194.9	918.00	333.81	297.81	1005.61	614.91	569.91	3894.09	1707
	1933	0.08269	285.0	886.00	119.24	84.24	918.81	112.80	68.80	474.38	935
	1934	0.06437	276.8	918.00	103.71	67.71	1028.36	104.95	62.95	436.06	3055
	1935	0.05523	278.3	969.00	103.60	65.60	1124.07	102.35	59.35	428.65	4315
	1936	0.04309	281.8	1033.00	98.62	58.62	1141.53	87.02	42.02	304.89	3059
RECOVERY	1937	0.03055	294.2	1064.00	87.32	46.32	1195.73	86.41	39.41	286.00	3876
	1938	0.23923	257.5	1128.00	480.31	436.31	1226.06	786.72	738.72	5411.37	2925
	1939	0.24591	380.6	1033.00	330.81	290.81	1127.63	426.69	375.69	2791.53	3601
	1940	0.04960	353.6	982.00	77.99	39.99	1063.23	104.77	55.77	418.35	2872
	1941	0.00383	231.4	1033.00	14.74	-25.26	1174.16	16.59	-29.41	-222.78	3266
	1942	0.08443	195.0	1829.00	461.09	390.09	1616.86	486.47	439.47	3344.60	-4137
	1943	0.05972	226.2	1817.00	303.37	232.37	1434.50	285.39	216.39	1654.79	-8652
WORLD WAR II	1944	0.04235	266.7	1931.00	237.89	162.89	1418.21	227.77	147.77	1130.05	-13676
	1945	0.01128	259.5	1485.00	72.23	14.23	1396.14	63.02	-19.98	-152.06	-2306
	1946	0.00834	282.0	1256.00	65.07	16.07	1782.91	46.24	-26.76	-203.68	14859
	1947	0.01309	291.3	1485.00	139.69	81.69	2325.59	97.60	37.60	284.78	24486
POST WORLD	1948	0.12491	356.5	1667.00	902.95	837.95	2635.51	798.06	735.06	5514.15	34927
WAR II BOOM,	1949	0.09119	341.5	1848.00	550.58	478.58	2038.36	512.51	441.51	3249.55	6501
KOREAN	1950	0.02613	293.0	1868.00	182.14	109.14	1927.60	163.93	84.93	625.08	1746
CONFLICT AND	1951	0.13371	396.5	1995.00	704.48	626.48	2132.76	651.06	569.06	4168.54	5462
ADJUSTMENT	1952	0.01969	296.5	2014.00	181.24	103.24	1839.55	169.10	83.10	603.04	-5172
	1953	0.06482	387.6	2040.00	399.85	320.85	1976.26	382.21	294.21	2124.98	-2470
	1954	0.02080	280.2	1982.00	154.56	77.56	1995.91	142.17	53.17	384.00	390
	1955	0.09353	313.9	2027.00	553.60	474.60	2305.98	570.29	482.29	3566.59	8757
	1956	0.09563	384.6	2123.00	491.31	408.31		461.38	373.38	2722.27	
	1957	0.04109	311.5	2244.00	243.78	156.78		239.99	147.99	1053.99	
GENERAL	1958	0.03874	300.3	2339.00	328.22	237.22		346.98	250.98	1787.49	
GROWTH AND	1959	0.10718	346.9	2454.00	610.18	514.18		606.71	506.71	3642.67	
EXPANSION	1960	0.02583	329.5	2467.00	185.43	89.43		174.83	69.83	485.95	
	1961	0.06813	345.8	2473.00	444.86	348.86		402.61	295.61	2115.21	
	1962	0.04630	327.7	2550.00	328.42	229.42		281.73	174.73	1262.01	
	1963	0.08953	354.0	2560.00	535.14	435.14		497.54	388.54	2819.47	
	1964	0.13694	359.4	2664.00	685.83	581.83		486.20	375.20	2697.25	

APPENDIX TABLE B.[illegible]--GRAIN COMBINES IN WHEAT PRODUCTION: EMPLOYMENT AND EARNINGS STATISTICS, UNITED STATES, 1917-1964

GENERAL SITUATION	YEAR	ELAST. OF PROD.	NO. OF COMBINES	ACQUISITION COST	EX POST			EX ANTE			ANNUAL AVR. CAP. GAINS
					MVP	NET MVP	CAPITAL VALUE	MVP	NET MVP	CAPITAL VALUE	
			(1,000)	----------			DOLLARS PER COMBINE				($1,000)
	1917	0.00158	0.7	1391.00	3079.54	3025.54	3593.61	2279.52	2226.32	15074.48	143
	1918	0.00004	0.6	1753.00	127.88	59.88	1071.79	113.54	48.54	528.64	-39
WORLD WAR I	1919	0.00006	0.7	1810.00	249.58	178.58	1353.35	219.53	132.53	897.39	-30
	1920	0.00013	0.7	1878.00	287.78	214.78	1586.07	300.43	217.43	1472.20	-21
	1921	0.00083	1.6	1810.00	386.60	315.60	1441.09	547.99	462.99	3078.88	-66
	1922	0.00077	2.6	1617.00	241.31	178.31	1276.93	246.34	166.34	1111.13	-88
	1923	0.00146	3.8	1674.00	274.05	209.05	1327.39	345.54	279.54	1884.24	-132
	1924	0.00122	5.3	1755.00	241.80	173.80	1317.78	224.25	149.25	1010.56	-231
POST WORLD WAR I FARM DEPRESSION	1925	0.00153	5.8	1742.00	253.90	185.90	1390.46	230.81	151.81	1032.61	-204
	1926	0.00173	7.0	1742.00	251.01	183.01	1429.52	269.68	192.68	1316.57	-219
	1927	0.00190	7.9	1753.00	250.92	182.92	1439.03	265.81	188.81	1290.09	-248
	1928	0.00245	8.4	1742.00	255.22	187.22	1461.98	309.36	232.36	1594.91	-235
	1929	0.00273	9.3	1730.00	250.55	183.55	1527.00	277.31	200.31	1368.68	-189
	1930	0.00477	10.4	1719.00	273.13	206.13	1544.05	413.84	338.84	2315.21	-182
GENERAL DEPRESSION	1931	0.00992	12.8	1697.00	285.12	219.12	1423.74	705.29	629.29	4299.83	-350
	1932	0.01258	14.8	1606.00	245.67	182.67	1251.64	452.55	378.55	2586.58	-524
	1933	0.00895	17.9	1561.00	205.54	144.54	1181.52	194.43	125.43	864.90	-679
	1934	0.01249	23.2	1629.00	240.20	177.20	1241.08	243.06	175.06	1212.70	-900
	1935	0.00963	22.6	1674.00	222.40	157.40	1252.89	219.72	146.72	1059.69	-952
	1936	0.00862	24.4	1697.00	227.93	161.93	1272.22	201.11	126.11	915.15	•1036
	1937	0.00714	24.1	1730.00	249.23	182.23	1309.89	246.63	170.63	1238.19	•1012
RECOVERY	1938	0.01459	26.3	1787.00	286.73	217.73	1262.11	469.65	392.65	2876.29	•1380
	1939	0.01590	31.8	1753.00	256.08	188.08	1206.77	330.30	250.30	1859.81	•1737
	1940	0.01461	34.1	1730.00	238.25	171.25	1214.05	320.03	243.03	1823.12	•1759
	1941	0.00932	37.7	1753.00	220.13	152.13	1281.17	247.64	172.64	1307.57	•1779
	1942	0.01168	47.0	1855.00	264.55	192.55	1453.07	279.12	201.12	1530.59	•1889
	1943	0.01283	53.7	1923.00	274.49	199.49	1540.75	298.23	173.23	1324.70	•2053
WORLD WAR II	1944	0.00926	54.1	1968.00	256.39	179.39	1584.70	245.48	157.48	1204.33	•2074
	1945	0.00983	59.0	1991.00	276.63	198.63	1666.69	241.35	151.35	1151.85	•1913
	1946	0.00808	65.0	2058.00	273.68	193.68	1851.41	194.46	104.46	794.96	•1343
	1947	0.00703	70.2	2330.00	311.42	220.42	2191.87	217.59	124.59	943.61	-970
	1948	0.01319	79.1	2715.00	429.87	323.87	2445.74	379.93	267.93	2009.92	•2130
POST WORLD WAR II BOOM, KOREAN CONFLICT AND ADJUSTMENT	1949	0.02153	91.2	3054.00	486.89	367.89	2405.10	453.22	320.22	2356.85	•5918
	1950	0.02417	107.3	3133.00	460.05	338.05	2419.50	414.04	267.04	1965.45	•7656
	1951	0.02478	122.1	3371.00	492.39	361.39	2591.23	455.05	311.05	2278.53	•9521
	1952	0.02328	135.9	3484.00	467.43	331.43	2663.77	436.12	277.12	2010.94	•11147
	1953	0.03001	139.7	3518.00	513.60	376.60	2742.85	490.94	328.94	2375.81	•10829
	1954	0.03596	145.0	3529.00	516.28	378.28	2775.42	474.88	313.88	2267.05	•10927
	1955	0.04121	149.7	3529.00	511.47	373.47	2800.02	526.89	364.89	2698.37	•10913
	1956	0.04259	161.5	3687.00	521.08	377.08		489.34	328.34	2393.85	
	1957	0.04512	160.4	3868.00	554.46	403.46		545.84	373.84	2662.47	
GENERAL GROWTH AND EXPANSION	1958	0.03230	158.9	4038.00	517.19	360.19		546.74	364.74	2597.72	
	1959	0.05454	167.1	4208.00	644.68	480.68		641.01	453.01	3256.63	
	1960	0.04137	169.6	4321.00	576.85	408.85		543.89	346.89	2414.01	
	1961	0.04884	174.6	4423.00	631.66	459.66		571.67	371.67	2659.42	
	1962	0.05176	181.0	4502.00	637.12	462.12		546.55	341.55	2466.87	
	1963	0.05293	174.2	4581.00	642.92	463.92		597.74	389.74	2828.17	
	1964	0.06891	173.0	4683.00	686.13	504.13		486.41	273.41	1965.51	