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ABSTRACT

CHANGES IN
LAND VALUES IN THE UNITED STATES, 1925-1962

By Arne Larsen

During the last two-three decades the value of land has increased in the United States both relatively and absolutely. Land values have increased rapidly in the face of fluctuating or even declining net farm income and the increase in land values has varied greatly among areas and regions.

The two main objectives of this study were: (1) to delineate factors which have caused a major part of the variation of and increase in land values, and (2) to investigate the causes of regional variations in land value increases.

Time series correlation analyses for the period 1925-26 were carried out by state for the 48 states in the conterminous U.S. Combined cross-sectional and time series analyses were used for thirteen regions. Due to strong trends and multicollinearity problems in the original time series data, a model employing differences of first order was used throughout the study. The use of first differences also eliminated or reduced autocorrelation problems.

Land value per pasture acre equivalent was the dependent variable in the analyses. Independent variables were: (1) index of expected prices, (2) government expenditures on agricultural conservation, (3) government expenditures on the conservation reserve part

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of the soil bank program, (4) government expenditures on the acreage reserve part of the soil bank program, (5) output per man-hour in agriculture, (6) fertilizer use per pasture acre equivalent, (7) output per acre, (8) population density, and (9) personal per capita income.

The statistical analyses generally yielded the coefficient signs which would be expected from an economic point of view. The regional time series and cross-sectional analyses increased the significance of the estimated coefficients as compared with the time series analyses. However, inclusion of cross-sectional variation generally decreased the coefficient of multiple determination, indicating some heterogeneity among the cross-sectionally combined states.

The indices of expected prices were among the most important variables in the analyses. The indices were mainly important in explaining the annual variation, while they had little to do with the increase in land values.

Government expenditures on conservation were highly correlated with land value changes. The conservation expenditures were associated with a substantial part of the relative increase in land values.

Of the soil bank variables the conservation reserve variable was clearly most important. The coefficients of the conservation reserve program were larger and generally more significant than those of the acreage reserve program.

The output per man-hour variable had generally a high simple correlation with land values. However, due to intercorrelation problems, this variable was in many cases replaced by fertilizer use or output per acre variables.

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The largest coefficients for a unit change in population density were in areas with large relative increases in population. Personal income seems to have affected land values in only a few regions.

The importance of conservation practices in the analyses implies that large increases in land productivity are gained through conservation. Therefore, a main part of the conservation subsidy program is in conflict with government programs intended to reduce or stabilize the supply of agricultural products.

The relative changes which have occurred in the explanatory variables during the examined period indicate that the regional differences in relative land value increases are in large part caused by government subsidy programs. The capital gains or losses occurring from initiation or termination of government agricultural programs differ widely among regions.

LAND V

CHANGES IN
LAND VALUES IN THE UNITED STATES, 1925-1962

by

Arne Larsen

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Agricultural Economics

1966

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ACKNOWLEDGEMENTS

This thesis was written under the general supervision of Dr. David H. Boyne, my major professor. Dr. Boyne's guidance, criticisms, and encouragement throughout my graduate studies and particularly with regard to this thesis are gratefully acknowledged.

Dr. L. V. Manderscheid undertook careful review of earlier drafts of this thesis. His comments and suggestions are gratefully acknowledged. Dr. G. L. Johnson's comments and criticisms during the development of this thesis are greatly appreciated.

Discussions with a number of faculty members and fellow graduate students in the Department of Agricultural Economics assisted in the development of this thesis. Assistance was also extended by several individuals in the USDA, who sent comments or were helpful by sending unpublished materials.

I am particularly grateful to the W. K. Kellogg Foundation for the financial assistance which made possible my graduate studies at Michigan State University. For the financial support during the work on this thesis, I am grateful to the Department of Agricultural Economics and Resources for the Future, Inc.

Finally I wish to thank the students and faculty members at Michigan State University who, through our discussions, had a part in making my graduate studies a stimulating and rewarding experience.

Arne Larsen

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CHAPTER I

INTRODUCTION

This study focuses on an explanation of changes in land values. It is concerned directly with two government programs--agricultural conservation payments and the soil bank program. The effect of government price support programs is also considered by the inclusion of price expectations in the analyses.

The primary objectives are: (1) to explain changes in land values at state and regional levels, and (2) to investigate the causes of regional variation in land value increases. As the first objective indicates, we wish to study the structural relationships underlying land value determination. The second objective is to compare and analyze the differential impact among regions of the factors found important in explaining land value changes.

Secondary objectives include: (1) testing the explanatory power of Lerohl's price expectations as related to land values on a regional level, (2) testing the impact on land values of different conservation practices, and (3) testing the impact of soil bank programs on land value changes among regions.

This study is part of a larger project sponsored by Resources for the Future, Inc. The objective of the entire project is to evaluate the impact of selected U.S. agricultural policies and programs on resource use and

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resource use and allocation in U.S. agriculture for the period 1917-62. Four studies contributing to the parent study have been completed -- one on labor by Jones,[1] one on product price expectations by Lerohl,[2] one on farm real estate by Rossmiller,[3] and one by Chennereddy[4] on labor. Presently in progress are studies by C. L. Quance and Francis VanGigch on capital and resource flows respectively.

The problem

During the period 1925-1962, the index of value per acre of farm real estate in the U.S. increased almost twice as fast as the wholesale price index (WPI) of all commodities. From 1950 to 1962 farm real estate values increased more than five times as fast as the WPI.

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[1] Bob F. Jones, "Farm-Non-Farm Labor Flows, 1917-1962." (Unpulished Ph. D. dissertation, Michigan State University, 1964.)

[2] Milburn L. Lerohl, "Expected Prices for U.S. Agricultural Commodities, 1917-1962." (Unpublished Ph. D. dissertation, Michigan State University, 1965.)

[3] George E. Rossmiller, "Farm Real Estate Value Patterns in the United States, 1930-1962." (Unpublished Ph. D. dissertation, Michigan State University, 1965.)

[4] Chennareddy Venkareddy, "Present Values of Expected Future Income Streams and their Relevance to the Mobility of Farm Workers to the Non-Farm Sector in the United States, 1917-62." (Unpublished Ph. D. dissertation, Michigan State University, 1965.)

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The relative increase in farm real estate values has not been homogeneous among states and regions throughout the country. The largest increases per acre in real estate values have occurred in the Southeast and the Pacific regions.[6] From 1940 to 1962[7] real estate values in these two regions increased about 365%. In the Northeastern region the increase in the same period was only 188%.

For the 10-year period 1952-62 the largest increases in real estate values took place in the southeast quarter of the country from Texas to the Atlantic Seaboard and south of the Mason-Dixon line and in the states on the Pacific Seaboard. The percentage increase per acre in the Southeastern region was almost three times as large as that occurring in the Corn Belt and the Northern Plains.

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[6]The ten regions referred to throughout the thesis are defined as follows:

Northeast--Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, and Maryland.
Corn Belt--Ohio, Indiana, Illinois, Iowa, and Missouri.
Lake States--Michigan, Minnesota, and Wisconsin.
Appalachians--Virginia, West Virginia, North Carolina, Kentucky, and Tennessee.
Southeast--South Carolina, Georgia, Florida, and Alabama.
Delta States--Mississippi, Arkansas, and Louisiana.
Southern Plains--Oklahoma, Texas.
Northern Plains--North Dakota, South Dakota, Nebraska, and Kansas.
Mountain--Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, and Nevada.
Pacific--Washington, Oregon, and California.

[7]Comparable data for the regions are not available previous to 1940.

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For individual states the larges land value increases from 1925 to 1962 occurred in Florida (305%), Mississippi (261%) and Georgia (251%). In South Dakota the average value per acre in 1962 was only 39% higher than the 1925 figure. Maines was also low with only a 61% increase.

Many agricultural economists have been concerned with the phenomenon of rapidly increasing farm real estate values in the face of fluctuating or even declining net farm income. Most of the suggested explanations for this phenomenon have been based on results obtained from aggregate U.S. data. The problem of explaining the regional differences in land value increases has received little attention.

Although some of the increases occurring in farm real estate prices are the results of inflation, the real wealth gains experienced on farm real estate have been very large.[8]

The real gains accruing from the change in the relative price of land are of specific interest to agricultural economists and agricultural policy makers. Are the gains due to the capitalization of certain government subsidized agricultural programs?

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[8]See David H. Boyne, Change in the Real Wealth Position of Farm Operators, 1940-1960, Technical Bulletin 294, (1964), Michigan State University, Agricultural Experiment Station. Boyne found that in the period 1940-59 farmers had experienced real wealth gains on farm real estate amounting to 36.47 billion dollars (1960 prices). The wealth gains differed widely among regions, being lowest in Northeast and Lake States and highest in Southeast, Delta States, and Souther Plains (p. 59). This led Boyne to suggest that regional analysis might show whether the differences are due to varying conventional income streams (p. 66).

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If so, then they could be controlled by policy makers. Assuming that some of the benefits from agricultural programs are capitalized into land values, then the policy makers are faced with the question of whether the benefits are distributed among farmers and among regions in a desirable pattern. In this thesis one of the major concerns will be the regional patterns in factors believed to influence land values. Therefore, we will also be concerned with the regional differences in benefits obtained through agricultural programs.

Instead of studying the variation in farm real estate values, this thesis is limited to a study of land value changes. By omitting building values we avoid concern with the changes in the proportion of building values to farm real estate values and concentrate on examining land value changes.

Outline of the work

Chapter II will review other studies which have investigated the price of land and related factors. A section is devoted to studies concerning the influence of conservation on land values. Chapter III is a discussion of the method used in the study and the features and limitations of the tools used in the statistical analysis. The reason for using first differences instead of original values is outlined, and the time aggregation carried out for the regional analyses is discussed.

Chapter IV deals with the variables. Data for some of the variables are not directly available, and their derivation is explained.

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The economic relationship between dependent and independent variables is discussed. Shortcomings of available data are pointed out.

In Chapter V the state and regional regression results are presented and discussed. Differences within regions are evaluated, and statistical problems are mentioned.

Chapter VI presents interregional comparisons. The coefficients obtained in the different regions are compared, and the regional changes in the variables over the 1925-62 period are discussed.

The conclusions are given in Chapter VII.

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CHAPTER II

LAND VALUES AND RELATED FACTORS

Through time, the problem of how to determine the value of land has received considerable attention. Much of the interest in assessing the value of land has been for taxation and mortgaging purposes. Few studies have been concerned with quantifying the economic forces underlying land value determination. Even fewer studies have looked into the interregional heterogeneity in the land market. In this chapter we discuss studies about and factors related to land values.

Research on Land Values in the U.S.

In 1924 Chambers[1] found a close relationship between past rates of change in cash rent to land and computed expected future changes in cash rent to land. Using a capitalization formula, and assuming the mortgage rate to be the proper discount rate, he computed the annual rate of change in the income to land that would justify present land prices.

The underlying assumption was that the computed income reflected the expected future changes in rent. The method also

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[1] C. R. Chambers, "Relation of Farm Land Income to Farm Land Value," American Economic Review, 34 (December, 1924) pp. 673-698.

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assumes that ex post information about changes in rent is used in forming expectations about future rent, and in fact they are extrapolated into the indefinite future. The factors influencing the returns to land (rent) are not brought into the study. Furthermore, the past cash rent figure is not an exact expression for income to land, but is itself arrived at by some expectational procedure, and it is likely that realized errors in former expectations would lead to revision of present and future expectations.

In 1935, Thomsen[2] related farm real estate values to wholesale prices of farm products and to real estate taxes per acre of land. An expression for price expectations at one point in time was found by using prices for the past ten years, giving them weights inversely related to distance (number of years) from that point in time. The same procedure was used to obtain an expectation of land taxes using the tax rates of the past five years. Thomsen found a curvelinear relationship between real estate values and agricultural product prices for the period 1912-1933. The curvelinear relationship, which gave sharper changes at extreme values, was rationalized by asserting that land received a proportionately higher or lower part of total income for "extremely" high or low product prices. The fixity of many agricultural inputs was suggested as the cause of the

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[2] F. L. Thomsen, "Factors Affecting Farm Real Estate Values in the United States," Journal of Farm Economics, 17 (May, 1935), pp. 379-382.

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curvelinearity. Comparing two periods, 1912-1923 and 1924-1933 respectively, Thomsen obtained a good curvelinear fit for each period. However, the two curves were at different levels and diverging for increasing values. This phenomenon was explained by changing tax rates. Inclusion of the tax expectation variable for the period 1912-1933 gave a squared correlation coefficient of .986. No constant term or significance levels were given.

Bean[3] found that neither Chambers' nor Thomsen's method was satisfactory when applied to periods other than those for which the studies were made. Bean regressed the index of land values for the United States on the index of current prices received by farmers and the index of prices received by farmers lagged from one through six past periods; i. e. Bean estimated the weights of influence of past years' prices. In the period studied, 1912-1937, Bean found that about one half of a given rise in land values was associated with prices of farm products in the current year. Using prices from the last two years explained about seventy-five percent of the changes in land values. Increasing the number of price variables, he found that the coefficient of multiple correlation increased.

In a model such as Bean's the price variables would most likely be highly intercorrelated and, thus, it would be difficult to get

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[3] Louis H. Bean, "Inflation and Price of Land," Journal of Farm Economics, 20 (February, 1938), pp. 310-320.

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significant coefficients. This problem was touched upon by Bean in his article, but the estimated equation and the standard deviations of coefficients were not given. Furthermore, this type of relationship would not catch the turning points in land values, and serial correlation in the disturbances would be expected. Actually, the graphs shown indicate serially correlated residuals. Bean was concerned with the "land boom and its aftermath of rural distress."[4] He found, like Thomsen, a curvelinear relationship between land values and product prices, the relationship being steeper for "extreme" values. This led him to the conclusion:

> Our study indicates how a land boom arises out of the current and anticipated profits that go with price inflation. It suggests that if we want to avoid a land boom we must avoid monetary price inflation or inordinate price advances for any other reason.[5]

This conclusion might be valid for the period considered by Bean, in which product prices appeared to be the main determinants of land values. However, the "land booms" which occurred after World War II, and especially those of the fifties, cannot be explained by inflation alone.[6]

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[4] Ibid, p. 320.

[5] Ibid, p. 319.

[6] See Boyne, Table 17, p. 55.

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For the period 1920-53, Renshaw[7] computed an "expected" gross income per acre and related it to farm real estate value per acre. The "expected" gross income was found by weighting gross income for the preceding ten years, the weights being derived by regressing gross income on itself lagged one through ten years. He also used a five year moving average of gross income which explained as much of the variation in real estate values as did the "expected" gross income (R^2 was about .80). Inclusion of the mortgage rate and a time variable in the analysis increased the squared correlation coefficient to .97. The trend variable had a large negative coefficient. Renshaw's predictions of real estate values for 1955 were much too small, and he concluded that farm real estate prices in 1955-1956 were too high.

Hoover[8] studied land prices in the United States, 1911-1958, using a model which postulated the change in expected returns to land as a function of the deviation between the previous year's actual returns and expected returns. Variables of returns to land included the price of crops, crop production, the rent-income ratio, expected price level changes, and the dividend-price ratio. The relationship was assumed to be linear in logarithms. Hoover obtained large multiple correlation coefficients which were, however, mainly due

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[7] Edward F. Renshaw, " Are Land Prices Too High: A Note on Behavior in the Land Market, " Journal of Farm Economics, 39 (May, 1957), pp. 505-510.

[8] Dale M. Hoover, "A Study of Land Prices in the United States, 1911-1958," (Unpublished Ph. D. thesis, University of Chicago).

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to the inclusion of lagged land prices among the explanatory variables. Omitting the correlation due to the lagged variable, Hoover's model explained a much larger portion of the land price variation for the years 1911-1941 than it did for latter years.

For the 1940-1957 period Scofield[9] found a closer relationship between gross national product and the price of farm real estate than between real estate prices and net farm income. He also pointed out the "belief that land offers safety and protection of capital from loss of purchasing power during periods of inflation."[10] Scofield also refers to the impact on land values brought about by conservation and soil improvement practices. He mentions the effect of an increase in population and the eventual land shortage it might bring about. In 1964, Scofield suggested three main reasons for rising land prices: (1) keeping up with inflation, (2) capturing the gains from new technology, and (3) economics of scale.[11,12] The importance of the expansion buyer in the land market is stressed, and references are made to the non-farmer investor buyer, credit availability, and impact of programs like the federal highway programs. Much

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[9]William H. Scofield, "Prevailing Land Market Forces," Journal of Farm Economics, 39 (December, 1957), pp. 1500-1510.

[10]Ibid, p. 1501.

[11]It should be noted that economics of scale has not been revealed in cross-sectional Cobb-Douglas studies.

[12]William H. Scofield, "Dominant Forces and Emerging Trends in the Farm Real Estate Market," (Paper prepared for seminar on land prices, North Central Regional Land Economics Committee, Chicago, Illinois, November 12, 1964).

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Scofield attaches highest research priority to a comprehensive depth study in the area of the "economics of farm enlargement," and although he recognizes the connection between economics of farm enlargement and technological advances, he finds little connection between his technology measure and land prices. In testing the influence of changing technology on land values, he uses net return per acre to labor, land, and capital as an expression for technological change. This does not seem to be an adequate test of the influence of technology. We would expect many technological changes to reduce labor and/or capital requirements per unit of land, leaving a relatively larger part of the returns to land. Only in the cases where the technological changes have brought about increased output, but unchanged labor and capital requirements, would Scofield's test be appropriate.

The influence of the soil bank is also discussed by Scofield. The benefits derived from the conservation reserve part of the soil bank, which are more closely associated with ownership of land, are suggested to have had more influence on land prices than did the acreage reserve part of the program. The conservation reserve program might encourage farmers eligible for payments to retain ownership of some land that might otherwise be sold, i.e. increase the demand for land.

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Warranted Values

In 1948 Larsen[13] computed "warranted" values of land for the years 1910-1948. The warranted value for any year was the capitalized actual net rents for the succeeding ten years, plus the capitalized average (1910-48) net rents for the entire period beyond ten years to infinity. The capitalization rate was approximated by the average mortgage rate plus one percent. The one percent was added to reflect the additional risk an owner has as compared with a mortgage holder.

For actual land values to be equal to the warranted values we would have to assume that farmers had perfect foresight of net rents for the next ten years and that beyond ten years to infinity, they would expect the average 1910-48 net returns. A poor relationship between warranted values and actual values indicates that the rent expectations were different from those which actually occurred. From the figures shown it appears that a change in warranted values precedes a change in land values by three to four years. This is not too surprising since a change in actual returns would probably precede a change in expected returns. Actual land values, as compared with Larsen's estimates, indicated that an extremely high capitalization rate was used during the war years. This indicates a changing risk expectation, and questions the feasibility of using the mortgage rate

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[13] Harold C. Larsen, "The Relationship of Land Values to Warranted Values, 1910-1948," Journal of Farm Economics, 30 (August, 1948) pp. 579-588.

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Rossmiller[14] computed the marginal value product of farm real estate by fitting a restricted form of the Cobb-Douglas function (linear in logarithms) for the years 1930-1962. The dependent variable was the value of total farm output, and the independent variables were farm real estate, labor, operating expenses, and time. Data were obtained from representative type farms in 19 different areas, and nineteen zero- one variables were included to account for area differences.

For each area, an ex post farm real estate value series was computed by capitalizing the marginal value products of farm real estate for 34 years ahead. In cases where less than 34 MVP terms were available, the average from 1958 to 1962 was substituted for the remaining terms. The capitalization rates used were the rates charged for new loans by the Federal Land Banks in the respective areas. An ex ante farm real estate value series was computed for each area by capitalizing an average of the MVP's for the past five years. The ex post series were consistently below the ex ante series in the production function model. The ex post series indicated that in most areas market prices are below what could be paid to real estate under the assumptions of the production function model.

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[14]George E. Rossmiller, "Farm Real Estate Value Patterns in the United States, 1930-1962." (Unpublished Ph. D. dissertation, Michigan State University, 1965.)

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It is not surprising that the ex post series were below the ex ante series. This is inherent in the model used. As mentioned by Rossmiller, the capitalization of the 34 first terms of an infinite series, using a 5 percent capitalization rate, only accounts for 81 percent of the "true" capitalized value. Also, there should be no long run trends in the MVP's. However, the downward bias in the ex post series would put them consistently below their comparable ex ante series, which were capitalized for infinite MVP series.

An important point in relation to Rossmiller's MVP derived series, is that he did not subtract taxes and depreciation from the MVP's before they were capitalized. It might be difficult to find a reasonable figure for depreciation, but the fact that no allowance was made would tend to lead to overestimated farm real estate values. The average tax rate per $100 of farm real estate value in the U.S. has varied considerably over time, but would for the period 1930-62 average close to $1.00.[15] Thus, using a capitalization rate of 5 percent, the capitalized value of taxes would be close to -$20 per $100 farm real estate value. Therefore, the upward bias in the ex post series because of failure to adjust for taxes would on the average be offset by the downward bias caused by using 34 terms only. However, this applies to the ex post series only, the ex ante series are still biased upwards.

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[15] U.S. Department of Agriculture, "Land Values and Farm Finance," Major Statistical Series of the USDA, 2, Agricultural Handbook No. 118. (Washington: U.S. Government Printing Office, 1957) p. 34.

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Since taxes vary considerably among states,[16] Rossmiller's regional comparisons would probably need some revaluation.

Rossmiller's conclusion, based on <u>ex post</u> series, that market prices are below what could be paid to real estate is valid only if marginal value products of real estate do not fall below the 1958-62 average and if the coefficients derived by the aggregate production function model are reasonably reliable.

Different <u>ex ante</u> and <u>ex post</u> series were computed in a similar manner using residual returns to farm real estate in place of marginal value products. The residual return is net farm income less an imputed return for operator and family labor and non-real estate capital inputs. The series derived from the computed residual returns have, since early post World War II, with few exceptions, had the opposite trend of the market value series. Rossmiller argues that the imputed returns to labor and capital are probably too high. Hence, since these are subtracted from net farm income in order to obtain returns to land, the returns to land are underestimated.

Rossmiller suggests that the main reason for increasing marginal products of farm real estate is due to the technological revolution going on in agriculture, and that "current land prices are below what expansion buyers could afford to pay for farm real estate."[17]

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[16]For instance, in 1957 the tax per $100 farm real estate was .46 in Arkansas and 2.32 in Maine. (From photostats of USDA worksheets on farm real estate.)

[17]<u>Ibid</u>, p. 136.

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Like Scofield, Rossmiller[18] discussed several factors which might affect land values. These included conservation, soil bank programs, price support, and farm consolidation. However, no quantitative relationships between the factors and land values were reported.

Studies on a State Level

In a Minnesota[19] study, covering the period 1939-1957, farm real estate value per acre was regressed on net income per farm, man years of labor available divided by labor requirements, total farm output divided by total farm inputs, debt as percentage of farm assets, voluntary farm sales, and security yields divided by the farm mortgage interest rate. Only the output/input and the voluntary farm sales variables showed any reasonable significance.

In a cross-sectional study of Indiana land values Scharlach and Schuh[20] regressed value of land and buildings per acre on population density, farm expenditures, distance from Chicago, farm wage rate, property tax, land capability, fertilizer, and average size of farms. With the exception of the coefficient for fertilizer and average size, all the estimated coefficients were significant

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[18] Ibid, Chapter III.

[19] Report on the Governors Study Commission on Agriculture, Minnesota, (St. Paul: Office of the Governor, 1958) pp. 194-195.

[20] Wesley C. Scharlach and G. Edward Schuh, "The Land Market as a Link Between the Rural and Urban Sectors of the Economy," Journal of Farm Economics, 44 (August, 1962), pp. 1406-1411.

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at the .05 level. The multiple correlation coeffient was .89.

Some of the coefficients seem unreasonable. For instance, a one dollar increase in farm expenditure per acre increased the real estate value by twenty dollars. A one dollar increase in taxes per acre decreased the real estate values by two and one half dollars only, indicating a capitalization rate of about 40%. It is interesting to note the significant, though small, influence of population density and distance from a large city on real estate values.

Price Support, Allotments, and Land Values

A few studies report on the influence of price support and production control programs on land values.

In a study of flue-cured tobacco allotments Maier, Hedrick, and Gibson[21] found, using a multiple regression analysis, that for the period 1954-57 the market value of an acre of flue-cured tobacco allotment (without associated land and buildings) could be as much as $2,500.

Regressing sale value of farms on several variables including acres of peanut allotment, acres of cropland, and acres of non-cropland, Boxley and Gibson[22] found that an acre of peanut allotment, independent

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[21] F. H. Maier, J. L. Hedrick, and W. L. Gibson, Jr., The Sale Value of Flue-Cured Tobacco Allotments, Technical Bulletin No. 148, Virginia Polytechnic Institute, 1960.

[22] R. F. Boxley, Jr. and W. L. Gibson, Jr., Peanut Acreage Allotments and Farm Land Values, Technical Bulletin 175, Virginia Polytechnic Institute, 1964.

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Conservation and Land Values

Many agricultural conservation practices not only conserve land so as to retain its production potential for the future, but almost immediately increase land productivity. Practices such as drainage, irrigation, and treatments with fertilizers give rapid production responses. Increased productivity of land would be expected to increase the relative price of land. While a number of publications deal with the profitability of carrying out conservation practices, little has been done to quantify the impact of different practices on land values. Since most conservation practices are heavily supported with federal money, the differential gains which occur between individual farmers as well as between various regions become highly important for policy determination. Cotner found that, although the maximum benefits from the conservation program would involve a shift in the allocation of funds, the allocation of funds among states and counties was practically fixed over time.[23]

Hathaway found that "a very high proportion of the expenditures [conservation payments] go for inputs which increase farm output in

[23]Melvin S. Cotner, "The Impact of the Agricultural Conservation Assistance Program in Selected Farms Policy Problem Areas," (Unpublished manuscript, Michigan State University, 1962), p. 15.

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the short run and will sustain the increase in the long run."[24] Further he discussed how the subsidized conservation practices may increase output and thereby bring about lower farm commodity prices and subsequently reduce returns to other agricultural inputs. Since the conservation practices are built into the land input, the immediate result will be higher returns to land, at least in physical output. The secondary effects, however, namely lower product prices, may lead to lower returns to all agricultural resources including land.

In his study of real wealth gains, Boyne[25] suggests that some of the real wealth gains shown in the farm real estate sector might be due to a change in the quality of land. Such quality changes could occur as a result of conservation practices.

In a discussion of land values and government programs Rossmiller refers specifically to the Agricultural Conservation Program and states: "Effects of this program [conservation] then to a greater extent than effects of others in this category tend to be directly capitalized into land values."[26] However, he made no attempt to quantify the relationships. Scofield has on several occasions made references to the relation between land values and conservation practices and states:

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[24]Dale E. Hathaway, Government and Agriculture (New York: The Macmillan Co., 1963) p. 312.

[25]Boyne, p. 46.

[26]Rossmiller, p. 88.

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> No systematic attempt has been made to develop a capital account for land. . . . that recognizes both private and public investments that have become capitalized into market values.[27]

The problem of obtaining data for conservation investments over time is also pointed out by Scofield.[28] As mentioned earlier, the Soil Bank conservation programs are also stated as factors influencing land values.

As already pointed out, little quantification of the relationships between land values and conservation practices has been carried out. Therefore, one of the tasks of this study is to test the statistical relationship between conservation investments and land values. There exists a problem of getting adequate data for such a test. This problem will receive further attention in Chapter IV.

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[27]W. H. Scofield, "Investment in Farm Real Estate," Journal of Farm Economics," XLV (May, 1963), p. 405.

[28]Ibid., p. 404.

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CHAPTER III

STATISTICAL METHODS: EVALUATION AND INTERPRETATION

Referring to a distinction made by Pigou[1] between tool makers and tool users, this thesis is essentially concerned with the use of well-known tools in a particular area of research. Thus, it might not seem necessary to devote much space to a discussion of the tools involved since detailed discussion of these has been carried out elsewhere. However, in order to appraise the results and to be able to compare them with those obtained by other methods it is important to have a clear understanding of the method which is used. Also a discussion of the pros and cons inherent in using the given method is essential for an evaluation of the results. Therefore, the chapter includes a discussion of the problems and benefits arising from using a given set of tools for a specific problem.

The chapter includes the following sections: Supply Function for Land, The Model, The Use of a Difference Model of First Order, Features of Time Series Data, Selection of Time Period, and Aggregation Problems. The reader who is familiar with the use of first differences and general statistical problems may prefer to read

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[1] A. C. Pigou, "The Function of Economic Analysis," Sidney Ball Lecture, 1929, reprinted in Economic Essays and Addresses, p. 3, quoted by J. Robinson, "The Economics of Imperfect Competition," (London: MacMillan, 1961) p. 1.

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Supply Function for Land

The value of land at a specific point in time can be thought of as an intersection between a demand and a supply curve. The identification problem thus arising would call for the use of a simultaneous equation system. However, supply of land is such that an alternative approach seems justified.

In the period considered, the estimated quantity of land[2] used in agriculture has changed very slowly. Only in a few states has the quantity of land been halved or doubled during the entire period. In most states the difference between the lowest and highest quantity of land is less than twenty percent. More important than the long-run change is the year to year variation. Since the variation in quantity is distributed over a long time period, in many cases over the entire time period, the yearly variation is indeed very small. It seems reasonable to conclude that, since the supply of land is almost perfectly inelastic at a given point in time and only changes slowly and rather constantly over time, the influence of price of land on supply of land is negligible.

Thus, with a constant supply of land, we assume that the change in land value is caused by shifts in the demand for land. This approach lacks some of the appeal of the simultaneous equations approach, but it is considerably easier to handle empirically as well

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The model

The capitalization formula is the basis for the model used in this study. In a perfect knowledge situation the value of a capital stock is equal to the discounted value of the perfectly known income streams:

$$(1) \qquad \text{Land Value (LV)} = \sum_{i=1}^{\infty} \frac{R_i}{(1+r_i)^i}$$

R_i = Net returns to land in year i.

r_i = The capitalization rate in year i.

For a fixed income stream and a fixed capitalization rate the formula reduces to:

$$(2) \qquad LV = \frac{R}{r}$$

This formula is used, assuming that most patterns of income can be expressed in terms of a fixed income stream, and that a steady capitalization rate is applicable for future time periods.

The land value (LV) expressed in (2) is nonlinear with respect to the capitalization rate. Instead of entering r as an individual variable, we rearrange (2):

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The income stream to land (R) logically depends on a number of variables. Letting these variables be X_1, X_2, ..., X_n, and being concerned with the changes in land values, the following difference model of first order was tested:

(4) $\Delta\ (r \times LV)_{ts} = f(a,\ \Delta X_1,\ \Delta X_2,\ \ldots,\ \Delta X_n)_{ts} + u_{ts}$

u = Disturbance term

a = A constant

t = Year: 1925-1962

s = 1, 2, ..., n (number of states in a given region).

The relationship is assumed to be linear. The variables are described in Chapter IV.

Modified model--Using the average farm mortgage rate as a proxy for the capitalization rate and equation (4), ordinary least squares regressions were carried out for a sample of states. The results were not encouraging. Compared with analyses using value of land alone as the dependent variable, the analyses using the farm mortgage rate times value of land as the dependent variable came out short. The coefficients of multiple determination were generally lower, and the significance of the estimated coefficients was not increased. Also the Durbin-Watson statistics generally decreased, indicating serial correlation in disturbances in some cases. This occurred in spite of using first differences. The average farm mortgage rate used fluctuated relatively little, but in a model using first di

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Given the relatively small variation over time (but relatively big variation from year to year) in the farm mortgage rate, and the lack of estimates concerning the varying risk attached to ownership of land, it was decided to avoid the difficulties of approximating the capitalization rate by using the following model:

$$(5) \qquad \Delta (LV)_{ts} = f(a, \Delta X_1, \Delta X_2, \ldots, \Delta X_n)_{ts} + u_{ts}$$

This model relates the changes in land values directly with the factors assumed to express the expected returns to land and assumes no effect from changing mortgage rates.

Time series data are obtained for each of the 48 states in the conterminous U.S. for the period 1925-1962. Using ordinary least square regression, the model is fitted to the time series data for each state. Combined time series and cross-sectional analyses are carried out for regions as defined in fn. 6, p. 3. However, due to dissimilarities among states within regions, some of the regions are subdivided for the combined analyses. Since intraregional heterogeneities are small as compared with interregional heterogeneities, the state time series data are not combined cross-sectionally for the entire nation.

The Use of a Difference Model of First Order

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is possible to work with first differences of some variables, combined with actual data of other variables. However, in this study all the variables are entered as first differences.[3] When year to year change is of more interest than deviation from a long-term average, a first difference model is appropriate. The pre-World War II average is of limited use for the post-war period. This reason is most important when working with undeflated data. With respect to the use of first differences instead of original values Ezekiel and Fox state:

> If two or more economic time series are intercorrelated as the result of trends which may not reflect logical or causal relations between them, the use of first differences will typically reduce intercorrelation and increase the probability that the regression coefficients obtained will represent meaningful relationships.[4]

In this study some initial analyses indicated that the original values would not yield logical results. A model using original values, linear in logarithms, yielded highly significant coefficients of the independent variables, but more than half of the signs were opposite those expected from an economic point of view. The model was also tested using first differences of logarithms, but this functional form did not yield results which were any better than when first differences of original values were used. Also, first differences of logarithms are cumbersome to work with when observations for some of the variables

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[3]The yearly government investments in agricultural conservation are treated as being first differences in themselves.

[4]M. Ezekiel and K. A. Fox, Methods of Correlation and Regression Analysis, (New York: John Wiley and Sons, Inc., Third Edition, 1963), pp. 340-342.

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Multicollinearity--Correlation among the independent variables is referred to as multicollinearity. Multicollinearity is a general problem when time series are considered. When multicollinearity is present the variances of the estimated coefficients increase, and it is difficult to get significant coefficients. In data showing pronounced trends, as time series frequently do, we would expect the independent variables to be intercorrelated. Using first differences will generally reduce multicollinearity; in this study the multicollinearity was reduced substantially.[5] However, use of first differences does not cure all the "evils" of multicollinearity. Some of the variables used to express technological changes show similar second order trends, and multicollinearity becomes a problem even in first differences. Government conservation payments is one variable affected by this problem, but it has been kept in the analyses consistently. However, other variables such as output per acre, fertilizer use and output per man-hour have been deleted or included in the analyses according to their significance in the analyses, and according to their intercorrelation with each other and with the conservation payments. When some variables are deleted because of intercorrelation, the estimated coefficient for a correlated variable will be biased. The estimated coefficient for a

[5]A rather typical example of the reduced intercorrelation between independent variables is the following found in Minnesota data. The simple correlation between the index of price expectations and the index of output per man-hour was .70. Using first differences the correlation fell to -.03.

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given variable will include, beside what it is designed to estimate, part of the effects due to a deleted but correlated variable. This suggests that the estimated coefficients for conservation practices and other variables reflecting technological advances may be somewhat biased.

Constant term--If a constant term is included in a model using first differences, the constant term will represent the linear effects of time. This implies that the dependent variable would change, even if there were no change in the independent variables. The constant measures the effect of variables changing at a constant rate over time. Such variables cannot be included when using first differences (when using actual data, one such variable can be included), and their combined effect will be measured by the constant term. Erosion losses, for which linear estimates are available, is one variable of this kind.

Serial correlation--Another problem which often apears when time series are used is that of serial correlation. Serial correlation in the unexplained disturbances violates the assumption of independence among successive disturbances. A study by Cochran and Orcutt concerned with this problem was published in 1949.[6] They discuss possibilities for avoiding serial correlation by changing some of the

[6] D. Cochran and G. H. Orcutt, "Application of Least Square Regression to Relationships Containing Autocorrelated Error Terms," Journal of the American Statistical Association, 44 (March, 1949), pp. 31-61.

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variables, adding additional variables, or modifying the form of the relationship. However, this is not a way out if one has arrived at a form of relationship and a selection of variables which are judged to be a reasonable choice. Where this is the case, they suggest using first differences:

> If we prove to be right about the nature of most error terms in current formulations of economic relations, then the residuals of the first difference transformation will turn out to be sufficiently random and no further steps will be necessary.[7]

This paper led to a large increase in the percent of statistical studies using first differences. The joy of having found an easy way to avoid the problem involved in serially correlated disturbances was dampened somewhat by the findings of Hildreth and Lu in 1960.[8] They recalculated seventeen time series equations in which the assumption of independence in disturbance terms was rejected or found indeterminate by the Durbin-Watson test. The estimated coefficients of original values and of first differences were compared to estimates found by the maximum likelihood method using a statistical model in which the random disturbances in successive time period were assumed to be generated by a first order autoregressive process. In cases where the estimated autocorrelation

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[7] *Ibid*, p. 54.

[8] C. Hildreth and J. Y. Lu, *Demand Relations with Autocorrelated Disturbances*, Technical Bulletin 276, (November, 1960) Michigan State University, Agricultural Experiment Station, East Lansing, Michigan.

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coefficients were negative, the agreement between the maximum likelihood method estimates and original estimates was closer than that between maximum likelihood and first differences. This was in agreement with expectations. However, in cases of positive autocorrelation the performance of first differences, as compared with estimated coefficients by maximum likelihood, could not be judged better than that of the original analysis. The conclusion was: "To use trend terms, first differences, or lagged variables as a routine precaution <u>against autocorrelation</u> [italics mine] is clearly dangerous."[9] As pointed out earlier in this chapter, first differences are not used as a precaution against autocorrelated disturbances but (1) as a remedy for illogical relationships caused by trend effects and (2) as a means to decrease multicollinearity. Nevertheless, in the test analyses carried out on original data, the hypothesis of independent disturbances could not be accepted. Durbin-Watson statistics on the residuals indicated positive serial correlation in the disturbances.

Since other reasons, as stated above, led us to decide in favor of using first differences, the indication of serial correlation in the disturbances did not cause us to investigate (empirically) the feasibility of other methods used to avoid the problem of serial correlation. Such other methods as the iterative procedure discussed

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[9] <u>Ibid</u>, p. 43.

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by Johnston[10] or the "crude" method suggested by Hildreth and Lu[11] would very likely solve the problem of serial correlation in a more satisfactory manner than do first differences. The variation between the procedures is due to different assumptions about or estimates of the size of serial correlation. For the sake of correcting serial correlation the first difference approach assumes original serial correlation of 1.0, while other methods estimate or assume the serial correlation to be between -1.0 and 1.0. Thus, the effects of linear trends in the variables will be best handled by the first differences, since the first differences eliminate at least as large a part of the linear trend as other methods.

One of the reasons for serially correlated disturbances, when the original data were used in this study, could be the problem of errors in the data. There is little doubt that the dependent variable (land values) in this study is particularly subject to estimation errors. If the land value assessors tend to be overly optimistic in some periods and too pessimistic in other periods, this could lead to serially correlated disturbances. The same would happen if the buyers of land followed cycles of optimism and pessimism about returns to land. The problem of timing is also of importance for

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[10] J. Johnston, Econometric Methods, (New York: McGraw-Hill Book Company, Inc., 1963) pp. 193-194.

[11] Hildreth and Lu, pp. 13-14.

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serial correlation. Land values are estimated March first of each year. Other variables are not measured on this date, but may be lagged some months relative to land values. If perfect timing is required in the relationship among the variables, the lag introduced, when the explanatory variables are measured 0 - 6 months ahead of or behind the dependent variables, could cause serial correlation in the disturbances.

Even though the first difference approach might not be the best tool to solve the problem of serially correlated disturbances, the other reasons stated for using this approach appear to be important enough to justify its use in this study.

Multiple correlation coefficient--It is generally observed that correlation analyses utilizing first differences tend to have a lower multiple correlation coefficient than when original data of the same variables are used in the analyses. A main reason for this is that first differences eliminate correlation due to time trends of first order.

Cochran and Orcutt give the multiple correlation coefficients, using original data and first differences respectively, of eleven demand studies from the time period 1920-38.[12] Only in one case

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[12]Cochran and Orcutt, p. 55. The analyses were carried out by Richard Stone, who published the analysis using original data in: "The Analysis of Market Demand," Journal of the Royal Statistical Society, 108 (1945), pp. 286-391.

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out of eleven did the first differences give a higher multiple correlation coefficient. In the other cases the multiple correlation coefficient fell from a few percentage points in some cases up to more than twenty percentage points in other cases. Other examples are provided by Foote, who shows the simple correlation between prices of cotton seed oil and prices of butter, lard, and other fats and oils respectively.[13] The time period was 1922-40. Changing from actual data to first differences decreased the simple correlation by at least .17, and as much as .49 in one case. When deflated data were used the simple correlation between actual values fell, while it increased when first differences were used, thus leaving less difference in the correlation coefficients between the two methods. However, the estimates using actual data still showed the highest correlation coefficients.

Almost no literature is available to explain why a conversion to first differences should yield a lower multiple correlation coefficient. However, since a main reason for using first differences is to eliminate spurious correlation due to long-run trends, it seems obvious that this must be one reason for the reduced correlation

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[13] Richard F. Foote, Analytical Tools for Studying Demand and Price Structures, Agricultural Handbook No. 146. ERS, U.S. Department of Agriculture (Washington: U.S. Government Printing Office, 1958), p. 34.

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coefficient.[14] Heifner found that first difference analysis would yield a higher multiple correlation coefficient only if the serial correlation in the disturbances exceeds a weighted sum of the serial correlations in the independent variables.[15] With strong trends in the time series, it seems most likely that serial correlation in the independent variables would exceed the serial correlation in the disturbances. Serial correlations in time series are often of the magnitude .8 to .9, while serial correlations of disturbances are in most cases below .5.[16]

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[14]Let Y_t be the dependent variable in year t and $Y' = Y - \overline{Y}$. Also $\tilde{u}_t$ = unexplained residual in year t. For original values the squared multiple correlation coefficient (R_A^2) is $\Sigma(Y_t'^2 - \tilde{u}_t^2)/\Sigma Y_t'^2$. For first differences the squared multiple correlation coefficient (R_B^2) is $\Sigma[(Y_t' - Y_{t-1}')^2 - (\tilde{u}_t - \tilde{u}_{t-1})^2]/\Sigma(Y_t' - Y_{t-1}')^2$. Now, $\Sigma(Y_t' - Y_{t-1}')^2 < \Sigma Y_t'^2$ if the autocorrelation in Y exceeds .5. $\Sigma(\tilde{u}_t - \tilde{u}_{t-1})^2 = \Sigma \tilde{u}_t^2$, given an autocorrelation of .5 in residuals. Thus, assuming the autocorrelation in Y to exceed .5 (which is most likely in a time series), and the autocorrelation in residuals to be less than or equal to .5, the $R_B^2 < R_A^2$.

[15]Richard Heifner, "A Note on the Relationship Between Coefficients of Determination for Regressions Computed in First Differences and in Original Values," (Unpublished paper, Michigan State University, 1965).

[16]Hildreth and Lu, p. 17. Out of 17 estimations of serial correlation in disturbances only 3 exceeded .5.

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The indications are, that first difference analysis yields a lower degree of multiple determination that would be found by using original values. However, we shall be happy to give up some of the proud feelings with which one can point to high R^2's, if the approach is successful in giving coefficients with an economically meaningful sign, a reasonable degree of significance and good predictive power.

Features of Time Series Data

A major part of the statistical analyses carried out in this thesis will be based on time series data. Many of the problems involved in using time series have been pointed out earlier in this chapter, and it has been explained why these problems caused us to work with first differences of time series data.

When we use time series, we make the assumption that the universe from which the observations are drawn remains stable over the selected time period. This assumption is carried over to the first differences of time series. The first differences do lead to avoidance of the problems caused by first order trends over time, but we do assume the relationship between the variables to remain constant over the selected time period. With the changes which have taken place in agriculture during the last forty years, it is doubtful that this assumption is realistic. The total output of land has increased rapidly. Many substitutes for land have been developed. The productivity of complementary factors, such as labor, has increased. Is it reasonable to assume that the relationship betwee

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ship between, for instance, land values and agricultural product price expectations has remained constant over this time period? Obviously, changes in price expectations have not been nearly as closely related to changes in land values during the last decade as they were in the thirties. However, this is because other factors have become more prominent in the determination of land values, and it does not mean that the relationship between land values and price expectations have changed. No firm answer can be given to the question about the assumption concerning stability through time, but it is believed that the results will indicate that the assumption is not too unreasonable.

Selection of Time Period

It has been mentioned earlier that the estimates are obtained from data covering the period 1925-1962. The number of observations in a given time period depends on the choice of time unit. In this study annual data are considered to be satisfactory. However, as discussed in the next section, the influence of using biennial observations is tested in the combined analyses.

Statistical considerations are conflicting with respect to choice of time period. In order to obtain a "good statistical fit", it is desirable to have a large number of observations. The assumption of a stable structural relationship during the time period and the problem of getting reliable and consistent observations call for a short time period.

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The time period of this study is related to the time period of the parent project, namely 1917-62.[17] Some initial analyses were carried out for this period, but the observations for a few of the earliest years did not give a good fit. There could be several reasons for this, but a major one is probably that, for the earlier years, several of the independent variables had to be obtained by interpolation. Other evidence suggests that the data of earlier time periods are less reliable. Since we are more interested in explaining the more recent development in the land market, and since other stated considerations call for a shorter span of years, the period 1925-62 was decided upon.

The selected period includes a variety of general economic conditions such as the depression period, World War II, the Korean War and various business cycles. The different economic conditions might have affected the structural relationships. Indeed, many econometricians have omitted war years on the ground that the structural relationship was changed for these years. However, if war years are omitted, we must ask if the structural changes during wars are larger than those occurring from the business cycles? There is no simple argument by which we can decide to omit certain time periods whether these are well defined or not. It is probably no more heroic to assume that the structure remained

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[17]See Chapter I, p. 2. Rossmiller's study uses the time period 1930-1962.

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The question of whether or not to include war years is finally up to the researcher's discretion. The information obtainable from war years is, in this study, considered important enough to be included.

Aggregation Problems

Some degree of aggregation is used in any model attempting a simplified representation of the real world. Aggregate economic data generally involve an averaging of heterogeneous data. This means that the simplification sought in a model involves an averaging of non-identical relationships.

One dimension of aggregation is space. The use of data at the state level means that the space aggregation in this study is less than that of other studies using national data. However, data on a state level represents a large degree of space aggregation. The aggregation is justified since we are interested in the micro economic effects. We are interested in the differential effects between regions, but we are little concerned with effects on individual farms.

The use of one year as the time unit means that the observations are aggregated in time. It also means that seasonal variation cannot be accounted for.

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The price expectation indices used in this study are aggregated over commodities. The enterprise combination within a state, for which the weights are obtained for construction of an aggregate state index, changes little from year to year. Thus, commodity aggregation should not give serious problems in state analyses. However, among states the aggregate indices could be based on quite different commodity mixes and the coefficients of price expectations as related to land values could vary substantially.

Extensive attention to the problem of aggregation of data used in estimation of economic relationships was given by Theil in a work published in 1954.[18] In his comparisons of micro and macro economic relationships, he assumed the micro equations to be perfectly specified and showed the errors which could occur from linear aggregation. The assumption of perfectly specified micro equations is hardly applicable "in practice".

Grundfeld and Griliches argued that in general it is not possible to specify micro equations perfectly because of lack of knowledge.[19] Empirically they proved that aggregation would not necessarily produce an error, but there might be an aggregation gain. They concluded that:

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[18] H. Theil, Linear Aggregation of Economic Relationships, (Amsterdam: North Holland Publishing Company, 1954).

[19] Yeheda Grundfeld and Zvi Griliches, "Is Aggregation Necessarily Bad?", The Review of Economics and Statistics, 42 (February, 1960), p. 1.

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1. It is quite likely that a macro equation will have a higher R^2 than a micro equation, but this is not very relevant in judging the performance of either equation.

2. Considering the more relevant comparison, the aggregate equation may explain the aggregate data better than all micro equations combined if the micro equations are not "perfect". Since perfection is unlikely, aggregation may result in a "net gain".[20]

They did not, except by implication, investigate the impact of measurement errors in the independent variables. However, since specification errors and errors in the dependent variable are formally equivalent,[21] we can expect aggregation to alleviate some of the problems due to errors in the dependent variable.

The question of errors in the estimated dependent variable is of some concern. The highly aggregated national data are based on a very large number of estimates, and the aggregation will alleviate most of the spurious variations.[22] Thus, if the disaggregation to the state level would give any problems, these should show up in smaller states where the data are based on relatively few estimates. The model has not performed as well in some northeastern and mountain states as it has in general. This could very well be due to spurious variation in the dependent variable.[23] This indicates

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[20] Ibid, pp. 9-10.

[21] Johnston, pp. 6-7.

[22] Spurious variation being random variations as opposed to the earlier mentioned cyclical variation, p. 34.

[23] As it will be discussed in Chapter IV, some of this spurious variation has been eliminated by changing the definition of the dependent variable.

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too much disaggregation, which "should be determined by the level of spurious variation. When this 'noise' begins to obscure results, disaggregation ceases to be useful."[24]

This doubt as to whether or not disaggregation has gone too far for some of the smaller states led us to test how some higher degree of aggregation would influence the results. As already mentioned, there are many dimensions in which aggregation can take place. One way would be to aggregate the data over different states. This approach is not used here because the variables for different states cannot be added directly, and it would involve rather elaborate calculations to obtain data which would be consistent for a combination of states. Another approach to aggregation is that of time aggregation. Increased time aggregation is when we use, for instance, weekly data instead of daily data or, as the approach used here, instead of using annual data we can use biennial data. The changes in the variables are likely to be greater the longer period we consider. Since the errors are assumed to fluctuate from year to year with zero as the expected mean, we would expect the error to be a smaller part of the total change for a longer than for a shorter time period.[25]

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[24] Lester B. Lave, "Technical Change in U.S. Agriculture: The Aggregation Problem," Journal of Farm Economics, 46 (February, 1964), p. 207.

[25] Time aggregation is used very frequently in economic analysis. For instance, when we want to judge yield increases on a unit of land we seldom look at the change from year to year, but we look at the average increase between two more distant points in time.

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Generally the availability of data determines the time aggregation which is used in a study, and we usually want more disaggregate data than those obtainable. However, there could very well be cases in which more time aggregation would be useful than that necessitated by the data. It does mean that we throw away some information, but so would we if space aggregation were applied. In space aggregation we throw away cross-sectional variation, while in time aggregation we eliminate some intermediate time variation. Time aggregation is particularly useful in a study of first differences since the errors of two years enter each observation.

Time aggregation is applied to combined cross-sectional and time series analyses only. Since time aggregation is mainly a matter of a little extra computer cost, it is carried out for all regional estimates so as to observe the differential impacts.

Summary

With an almost constant supply of land, the changes in land values are assumed to be caused by shifts in the demand for land. A difference model of first order is employed in the analysis of land values and related factors. The relationship is assumed to be linear. The factors believed to cause land value changes are discussed in Chapter IV. Time series analyses are carried out for each of the 48 states in the conterminous U.S. Combined time series and cro

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series and cross-sectional analyses are carried out for selected regions. The time period is 1925-62. In the combined analyses the effects of increased time aggregation (aggregating over two year periods) are investigated.

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CHAPTER IV

THE VARIABLES

This chapter is devoted to a discussion of the variables used in the analysis. The relation between the dependent and the independent variables is discussed and the problem involved in using the available data and the limitations of these data are considered. While most of the required mechanics involved in the derivation of variables is deferred to the appendices, some important aspects are handled here.

Value of Land

The dependent variable is value of land per pasture acre equivalent. Value of land is the difference between value of farm real estate and value of farm buildings. Thus, the dependent variable is derived from (1) value of farm real estate, (2) value of farm buildings, and (3) number of pasture acre equivalents. These components are discussed in turn.

Value of farm real estate--Characteristics of the farm real estate market are such that it is necessary to rely mainly on subjective estimates of market values rather than on actual sales values. The low annual incidence of transfers, and the lack of quality standards provide the reasons for using estimates of real estate values.

The estimated value of farm real estate in current dollars on March first of each year is available by states. The estimates are derived from two sources--annual information and census information.

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The annual information is obtained from two sources: (1) the regular crop reporters of the U.S. Department of Agriculture, and (2) a group of farm real estate dealers, lawyers, local bankers, county officials, and others in contact with local farm real estate markets. The values obtained are supposed to reflect the market value of farm land and farm buildings used primarily for farming purposes, but the estimates are probably biased upwards by the sale of some farm land for nonfarm purposes.[1]

The farm real estate values obtained by the Census of Agriculture are based on much larger samples than those obtained by the yearly estimates.[2] Census estimates are used as benchmarks, and the yearly estimates provide the intercensal variation. If between two cenuses the sum of changes in the yearly estimates does not conform to the change in the census data, the difference is distributed equally over the years in the intercensal period. The trend between census years is determined by the year to year information, but when adjusted by census data, the absolute yearly change may deviate from that obtained by the yearly estimates.[3]

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[1] U.S. Department of Agriculture, "Land Values and Farm Finance," Major Statistical Series of the USDA, 2, Agricultural Handbook No. 118 (Washington: U.S. Government Printing Office, 1957), pp. 3-4.

[2] In recent censuses, information about farm real estate values have been obtained from about 20% of all farms. The yearly estimates are based on 6-7,000 questionnaries; however, each questionnaire give information about more than one farm.

[3] U.S. Department of Agriculture, "Land Values ....," pp. 9-10.

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There is a question regarding possible errors in the estimates of farm real estate values. The problem is likely to be greater in states where the yearly values are based on few estimates as, for instance, in many New England and Mountain states. The change in R^2 due to time aggregation might give some indication of the magnitude of the errors.

Value of farm buildings--Estimates of the value of farm buildings are available annually from 1940 to date. The annual estimates are based on crop reporter data, which report value of buildings as a percentage of total farm estate value.

Prior to and including 1940 estimates of the value of farm buildings were obtained in the censuses of agriculture. Between censuses, a linear interpolation of the percentages which buildings were of land and buildings (in value terms) was applied to the intercensal total farm real estate values. Thus, before 1940 the ratio of value of farm buildings to value of farm real estate showed uniform direction of change between censuses, and indicated the long-run changes in farm building investments.

About the reliability of the annual series, the following view was expressed:

> Although random variations in the proportion of all farm real estate represented by buildings can be detected in the annual series for certain states, the series is believed to be generally adequate over an extended period."[4] (italics mine.)

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[4] Ibid, p. 10.

Thus, there is reason to believe that while the annual series would be adequate to reflect changes over an extended period, there could be substantial errors involved in using each single estimate of the series. This view is affirmed by the fact that new series of building values are presently being worked out in the USDA. The new series differ considerably from the presently available series.[5]

The anticipation of random fluctuation in the annual building value estimates led us to compare them with estimates obtained in a manner similar to the pre-1940 building value estimates.

The two building value series to be compared were the same for the period 1925-39, but differed as follows for the 1940-62 period:

> Series A is derived using an estimate of the building to real estate value ratio for every fifth year with interpolation for intervening years. The estimate for every fifth year was computed as an average of the annually estimated ratios for three years: the estimation year, the previous year, and the following year. Annual estimates of the ratio derived in this way were then applied to estimates of farm real estate value to get the annual building value series.
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> Series B simply used the annual estimates of the building-real estate value ratio as prepared by the USDA.

Due to their interdependence, the two series assume similar long-run changes. However, the ratio of building values to farm real estate values exhibited more year to year fluctuation in series B. The estimates based on census data and the estimates in series A assume that, in the short run, the value of farm buildings fluctuates by about

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[5] According to correspondence with W. H. Scofield, Leader, Farm Real Estate Group, Farm Production Economics Division, U.S. Department of Agriculture, July 27, 1965.

the same percentage as does land value. However, the change in the ratio of building values to farm real estate values, which is substantial over the longer run, is adjusted for. The assumption seems justified since, in the short run, buildings are about as fixed as land.

Farm real estate values together with building value series A and B gave two series of land values to be comparatively tested. The land value series derived with series B gave generally lower multiple correlation coefficients, in some cases (for smaller states) decreasing the multiple correlation coefficient as much as .15 to .20. This seemed to confirm the suspicion of much random variation in the annually estimated building values. Therefore, land values derived using building value series A were used in this study.

Pasture acre equivalents--For our analysis it is necessary to express the dependent variable as value per unit of land. This is necessary since there are, in spite of little change from year to year, considerable long-run differences in the quantities of land measured by the value series. Also, since some of the explanatory variables are entered in index form, the cross-sectional analyses will require comparable units. Acres of farm land give one measure of quantity of farm land. However, in order to incorporate some of the major reproducible capital investments in land the quantity of land is expressed in pasture acre equivalents. The derivation of pasture acre equivalents is explained in Appendix A.

Pasture acre equivalents as a measure of the quantity of farm land were used by Boyne. He points out that investments in land such as irrigation and land clearance would affect the quantity of land measured in this way. However, he further states ".... a sizeable portion of investments via redredging of ditches and the tiling of land already classified as cropland not irrigated would not be included."[6] Hence, many of the conservation practices carried out with government aid will not affect available estimates of the quantity of land.

The dependent variable used in the analyses is the estimated value of a pasture acre equivalent. The time series by states are given in Appendix B. Data on farm real estate values and farm building values are obtained directly from U.S. Department of Agriculture or from its publications.[7]

Expected Prices

Expectations about future prices of agricultural products influence the expected returns to land, and thereby the prices which land-users will be willing to pay for land.

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[6]Boyne, p. 46.

[7]Data from 1925 to 1949 are obtained by state from photostats of USDA worksheets on farm real estate. Value of buildings for years 1950-62 are obtained from photostats of USDA worksheets on value of farm buildings. The photostats were made available by W. H. Scofield, Leader, Farm Real Estate Group, Farm Production Economics Division, USDA. Farm real estate values for the year 1950-62 are available in: Farm Real Estate Market Developments, USDA, August 1963.

Previous year's prices have in many studies been assumed to approximate the expectations about future prices. Other studies have utilized some weighted average of previous year's prices. The approach used by Nerlove[8] was more sophisticated in the sense that the weights attached to previous year's prices were estimated rather than assumed. The estimation procedure was based on a simple expectation model. Referring to the results of the Interstate Managerial Survey,[9] Johnson points out that farmers use much more complicated expectation models for prices than those suggested by Nerlove.[10]

Price expectations series utilizing more information than what is obtainable from mechanical estimates of past prices have been developed by M. L. Lerohl.[11] These price expections series will be applied in our analysis. The series are assumed to reflect expectations of prices held by "resonably" well-informed farmers. Essentially, the series are based on the various situation reports available at the point in time when the expectations are formulated. The sources used

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[8]Marc Nerlove, The Dynamics of Supply: Estimation of Farmer's Response to Price, (Baltimore: The John Hopkins Press, 1958).

[9]G. L. Johnson et al. (edit.), A Study of Managerial Processes of Midwestern Farms, (The Iowa State University Press, Ames, Iowa, 1961), Ch. 5.

[10]G.L. Johnson, book review of Marc Nerlove, "The Dynamics of Supply: Estimation of Farmer's Response to Price," Agricultural Economics Research, 12 (January 1960), pp. 25-28.

[11]Lerohl, Appendix A.

in the formulation of expectations might not be the same sources as those used directly by the majority of farmers, but most outlook information reaching farmers is based on the USDA situation reports.

Lerohl developed indices of yearly expected prices for thirteen agricultural commodities[12] in the period 1917-1962. Expectations were developed for 1, 5, and 10 years, i.e. a one-year price expectation gives the average expected price for the following year, a five-year price expectation gives the average expected prices for the following five years, etc. In relating price expectations to land values, the 10-year expectations are considered most suitable. For farmers investing in land, the longer-run considerations are probably most relevant.

These series are constructed to reflect the price expectations held at the beginning of the year. This means that the series should reflect rather closely the expectations held on March 1st, the date at which land values are estimated.

Lerohl's indices were for single commodities, except the three aggregate indices for the U. S. No weights are readily available for aggregation to the state level. The methods used to find weights and aggregate state indices as well as the indices themselves are presented in Appendix C.

Some tests of the price expectations have been carried out. Of specific interest to this study is that Lerohl found a good relationship

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[12] The thirteen agricultural products are: Beef, Hogs, Dairy, Chickens, Eggs, Corn, Wheat, Potatoes, Oranges, Apples, Cotton, Tobacco and Soybeans.

between changes in farm real estate values and changes in aggregate price expectation indices. The positive correlation was considerably higher for the period 1917-54 than for the entire period 1917-62.[13] This is in agreement with the suggestions that in the last decade other factors have been more prominent in the determination of land values (see Chapter II).

In a study dealing with the feed-grain, beef and hog economies, Petit found that Lerohl's "price expectations have never been inferior to any other price variable used .... in many equations it appears as a key explanatory variable."[14]

In view of the above discussion, Lerohl's series seem to be reasonable approximations for price expectations.

Conservation

As mentioned in Chapter II, many of the practices carried out under the name of land conservation not only conserve land for future use, but will immediately increase land productivity. In the following, the word "conservation" will be used for the practices carried out under this name whether they conserve land resources, affect the productivity of the land resources, or both. Conservation practices in which we are interested are those which increase the productive capacity. New

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[13] Lerohl, p. 57.

[14] Michel J. Petit, "Econometric Analysis of the Feed-Grain Livestock Economy," (unpublished Ph. D. thesis, Michigan State University, 1964), p. 214.

investments in land minus depreciation and erosion losses would be a proxy for net additions to productive capacity of lands. The problems of obtaining estimates of depreciation and erosion losses as well as conservation investments will be discussed in turn.

Depreciation and erosion losses--Ibach[15] discussed the role of soil depletion and argued that this was an annual cost which seldom was considered in estimations of net rental income to land. For the Corn Belt, Ibach used nitrogen content as a measure of "Soil Capital" and the influence of depletion on land valuation (through the capitalization formula) was shown. Depletion (depreciation) losses would depend on initial productivity of land. Increases in productivity would, at a given rate of depletion, increase the total annual depletion loss.

Estimates of erosion losses are provided by Hoover.[16] These estimates are based on the assumption that .5 percent of the 1910 land stock was lost each year. Estimates of private expenditures on irrigation and on investments in drainage and clearing are also given. The estimates of clearing and drainage are based on the assumption that changes in total farm land in crops and pasture were caused by clearing and/or drainage. Such changes in quantity of irrigated land, crop land, and pasture are taken care of in the estimate of pasture acre equivalents.

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[15] D. B. Ibach, "Role of Soil Depletion in Land Valuation," Journal of Farm Economics, 22 (1940), pp. 460-72.

[16] Hoover, Appendix A, Table 2.

It is reasonable to believe that losses due to erosion have been falling because of appropriate conservation practices. Since the increase in land productivity increases the total amount of depreciation, the sum of depreciation and erosion losses might have stayed fairly constant. In any case, since only linear estimates could be provided they cannot be included specifically in an analysis of first differences. The effect of linear erosion and depreciation losses would be included in the constant term.

Conservation investments--Information on investments in conservation prior to 1936 is scanty. Censuses of agriculture give information about some of the irrigation and drainage projects. Some estimates of investments in agricultural conservation are possible, but no yearly variation is obtainable prior to 1936. Since 1936 large public investments have been made in conservation, and yearly data on these as well as on a large part of the private investments in conservation are available.

Of the total investments carried out with federal aid, public investments has constituted about 50 percent.[17] Since we are interested in the impact of government programs, it seems natural to use the federal expenditures on agricultural conservation as a

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[17] See W. K. Easter, (Ph. D. thesis currently in progress at Michigan State University).

variable in our analysis.[18] This variable would estimate the impact on land values of conservation practices carried out with federal aid. Since part of the costs are paid for privately, the obtained coefficient would overestimate the impact of federal expenditures.

Conservation carried out with federal aid is supposedly conservation which would not be carried out otherwise. Few would believe this to be generally true in practice. On the other hand, there is little doubt that a considerable part of the conservation practices would not be carried out without the cost reductions provided by government aid. Therefore, the total amount of conservation practices carried out is probably correlated with the level of federal expenditures on conservation. This would provide another reason for overestimating the influence of federal conservation expenditures. The cost involved in planning the different conservation undertakings are almost entirely paid from public funds, which are not always included in conservation expenditures. This feature would also tend to increase the estimated coefficients.

Most of the conservation receiving federal aid is of enduring nature, such as drainage, terracing, liming, fixtures for livestock watering, etc. The enduring nature of the practices suggests that

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[18] The conservation variable is available in: Agricultural Conservation Program: 25 Years Summary, 1936 through 1960, USDA Agr. Stabilization and Conservation Service, Washington, D.C., pp. 174-175. Years later than 1960 are available in the yearly publication: Agricultural Conservation Program: Summary by States, USDA, Agr. Stabilization and Conservation Service, Washington, D.C.

the yearly investments are additions to a capital stock of investment and should therefore be treated as a first difference itself. There is depreciation on all of these investments, but the rate of depreciation would vary greatly for the different practices. As mentioned earlier, some effects of depreciation will be included in the constant term.

Government expenditures on conservation are determined by a yearly appropriation and as such would be believed to be rather independent of the other variables in the equation. However, intercorrelation between conservation expenditures and other variables did occur. According to the degree of intercorrelation, alternative variables which to some degree express technological changes were used with the conservation variable.

Influence of Technological Changes

Technological changes, are changes which come about when new inputs are invented, or when reorganization of conventional inputs takes place. Reorganization of conventional inputs most often takes place when a change in relative prices of inputs occurs. The change in relative prices can be due to new inventions, which decreases the prices of some of the used inputs or to new knowledge about input combinations.

In many economic analyses a time variable has been included to take care of technological changes. Use of a first order time variable can be a reasonable expression for the state of technology only if technology is improved at an almost constant rate. For the time period 1925-62, technological changes have not occurred at a constant rate. Different indicators of the state of technology, such as output per acre, use of fertilizer, and output per man-hour, show a much larger rate of change toward the end of the period. If time was to be used, a squared time variable would seem more appropriate than the linear one. As already discussed, the constant included in a first difference analysis represent a linear time trend.

Since no variable which quantifies all the relevant technological advances is available, three variables which are believed to reflect technological changes to some degree have been included in the analysis. The choice of which variable to use in a particular analysis is made partly according to the variable's significance in the analysis and mainly according to multicorrelation problems.[19] The three variables will be discussed in turn. A discussion of the consolidation hypothesis is given at the end of this section.

<u>Output per man-hour in agriculture</u>--An index of output per man-hour takes into consideration a variety of technological changes. Changes in output per acre and use of labor-saving technology would be reflected by the index. Most of the increases in output per acre such as those brought about by using insecticides, fertilizer, new varieties, etc., would not require much increase in labor use, and changes in output per acre would therefore be reflected in the index

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[19]There is no general rule stating which level of multicorrelation is too high, but as a "rule of thumb" we have regarded a simple correlation of .6 as the upper limit.

of output per man-hour. Also, since there is a high degree of substitution between machinery and labor this means that indices of output per man-hour are heavily influenced by changes in farm machinery.

Indices of output per man-hour are not available on a state basis, but they are available on a commodity basis.[20] By calculating weights for the twelve commodity groups on a state basis, it was possible to compute state indices.[21]

In terms of simple correlation with land value changes, the changes in the indices of output per man-hour performed very well. However, in regions where the correlation between output per man-hour and another independent variable exceeded .6, the output per man-hour variable was replaced with either output per acre or use of fertilizer.

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[20] Changes in Farm Production and Efficiency: A Summary Report, 1964, U. S. Department of Agriculture, Statistical Bulletin No. 233 (Washington, D. C.), pp. 36-37.

[21] The following twelve commodity groups were used: (1) Meat animals: cattle and calves, sheep and lambs, and hogs, (2) Dairy products, (3) Feed grains: corn for grain, oats, barley, and sorghum grain, (4) Poultry and eggs: chicken and eggs, commercial broilers, and turkeys, (5) All hay, (6) Food grains: All wheat, rye, and rice, (7) Vegetables: potatoes and truck crops, (8) Fruits: oranges, apples, grapes, grapefruit and peaches, (9) Sugar crops: sugarbeets and sugar-cane, (10) Cotton, (11) Tobacco, (12) Oil Crops: soybeans, cottonseed, flaxseed and peanuts. The weights and indices were found in a similar manner as those for price expectations described in Appendix C.

Quantity of fertilizer per pasture acre equivalent--Use of fertilizer is closely connected with the increase in land productivity. Fertilizer is a substitute for land in the sense that we can increase output either by using more fertilizer or more land. Since use of more fertilizer does not change the measured quantity of land, the output per unit of land increases and the returns to land increase given constant product prices. Even with substantial decreases in product prices it would be possible to have increasing returns to land and therefore also increasing land values.[22] The same argument is applicable to the other measures of technological change.

Annual data on total amounts of commercial fertilizer are available by states.[23] Since most of the fertilizer is used in the first six months of the calendar year, the expectations of output on March 1st in year t due to fertilizer use is approximated by the quantity of fertilizers used in year t.

Crop production per acre--The best available measure of land productivity is crop production per acre. The increase in output

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[22] For more elaborate discussion of this point see: Rossmiller, pp. 92-94.

[23] For the years 1925-53 data are available in "Statistics on Fertilizers and Liming Materials in the United States," Statistical Bulletin No. 191, U.S. Department of Agriculture (Washington: U.S. Government Printing Office), pp. 108-110. Other years can be found in the yearly publication: "Consumption of Commercial Fertilizers and Primary Plant Nutrients in the United States," ARS 41-19-6, U.S. Department of Agriculture.

per land unit brought about by using land saving technologies, such as new varieties, insecticides, fertilizer, etc., is expected to have an impact on land values. The argument is similar to that for the fertilizer variable.

Unfortunately, data on crop production per acre by states are not available, but indices on regional levels are published by the USDA.[24] The same index is used for all states in a region. This would suggest that the variable would work best in small regions with relatively homogeneous conditions among states. For large regions with wide differences among states the index of crop production would be likely to do less well. The indices of crop production per acre are influenced by weather and thus exhibits large year to year changes. The weather influence is alleviated somewhat by using a three year (t-3, t-2, t-1) moving averages of the crop production per acre indices. A major limitation of the indices is that they do not take pasture and other land into account. This feature suggests that the variable will perform best in areas where cropland is a relatively large and constant part of total farm land.

<ins>The consolidation hypothesis</ins>--Farm consolidation is suggested as being partly responsible for the increases in land values. By farm consolidation is meant the addition of land to some farms by splitting

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[24] <ins>Changes in Farm Production and Efficiency</ins>. For years 1923-1939 see 1956, p. 19, and for years 1940-1962 see 1964, p. 19.

up, or adding whole, other farms. The suggestion that this process would increase land values is based on the assumption that certain fixed inputs can be used on a larger land base without appreciable change in costs.

The consolidation hypothesis suggests that for a given farm, addition to its present land base has a higher return per unit than the average return per unit of presently farmed land. The returns on additional land are higher because certain of the inputs which enter production have a very low opportunity cost. Such inputs are machinery, buildings, and in many instances labor. Thus, the consolidation hypothesis is based on the theory of fixed assets.[25]

The importance of farm consolidation (expansion) as related to land values has often been pointed out during the last few years and evidence of increase in the quantities of land bought for expansion has been given regularly in Farm Real Estate Market Developments.[26]

In order to test the influence of purchases for farm enlargement on land values, an attempt was made to obtain series expressing the proportion of farm land purchases which were made for farm enlargement. However, statistics on purchases for farm enlargement were not included in USDA surveys until the late 1940's, and have not been consistently tabulated by states.[27] An attempt to use average

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[25]See Rossmiller, pp. 107-108.

[26]U.S. Department of Agriculture, Farm Real Estate Developments. See, for instance, the March 1962 issue, p. 6.

[27]According to correspondence with W. H. Scofield, Leader, Farm Real Estate Group, USDA, August 11, 1965.

farm size as a measure of the consolidation hypothesis failed because no yearly data are available.

The basis for the consolidation hypothesis is closely related to technological changes. Use of new technology can bring about changes which make capital and labor inputs plentiful as compared with land and this would increase the quantity of land demanded for farm enlargement. Therefore, some of the effects of farm consolidation may be included in the estimates related to technological changes. No specific test of the consolidation hypothesis was made in the study.

The Soil Bank

The Soil Bank is a program intended to decrease supply of agricultural products by decreasing the available quantity of land input. Simultaneously, it brings about increased on-the-farm conservation and it "will promote a whole new pattern of conservation work leading to better farms, better use of natural resources, and the building up of seriously eroded land."[28] This is not the place to discuss whether these somewhat contradictory objectives have been partly carried out or not, but we are interested in the influence of the Soil Bank program on land values. Demand for land stimulated by the Soil Bank represents an increase in the overall demand for land.

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[28] U. S. Department of Agriculture, The Soil Bank Program: How it Operates, How it Will Help Farmers, (U. S. Government Printing Office, September 1956), p. 2.

Activation of the Soil Bank program has at least three different effects on land values: (1) The land which will be contracted for the soil bank is valued higher than or at least equal to its alternative value, (2) Farms with part of their land in the Soil Bank will have less land available for production of agricultural products and increased intensivity of land use is expected, (3) the decreased use of an essential input in agricultural production will increase the expected prices of agricultural output, except where output prices are given by the price support level.

The last reason mentioned for changed land values, that of changed price expectations, should be taken care of by the index of expected prices. The effects of (2) might be partly reflected by the output per man-hour or the output per acre variables. The influence of the soil bank on land values is to be tested by relating the government expenses on land contracted for the soil bank to land values.

The Soil Bank program consists of two parts: (1) the acreage reserve program, and (2) the conservation reserve program. Since the two parts are expected to have different impacts on land values, they are treated as separate variables.

The acreage reserve program--The purpose of this part of the Soil Bank program was to reduce the utilization of acreage allotments for wheat, corn, cotton, rice, most kinds of tobacco and peanuts.[29]

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[29] *Ibid.*, p. 4.

Farmers with acreage allotments could place part or all of their allotments in the acreage reserve. The farmers would receive payments as compensation for lost income. These would be "payments at least equal to net income farmers would have earned from production on acres put in reserve."[30] Land in the acreage reserve could not be utilized for production, except for grazing in case of natural disaster. Land was contracted for a one year period and would therefore not yield a certain continuous return. This feature of the acreage reserve program has in some cases led to the opinion that land values would be relatively little affected.[31] This we shall test.

The acreage reserve program was in effect during 1956-1958 and from this period the annual payments, by states, made under the program are obtained.[32]

The conservation reserve program--In contrast to the acreage reserve program, land in the conservation reserve program is contracted not for one year but for a period ranging from three to fifteen years. Both cropland and pasture land can be placed in the conservation reserve. A protective cover has to be kept on the land

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[30] Ibid., p. 2.

[31] See, for instance, USDA, The Farm Real Estate Market, May 1957, pp. 7-9.

[32] The data were made available by the Conservation and Land Use Division, Agricultural Stabilization and Conservation Service, U.S. Department of Agriculture.

in conservation reserve, but as in the acreage reserve no production may be utilized except by special authorization. Since the conservation reserve program guarantees a certain income to contracted land for several years, it is believed to have had considerable impact on land values in some regions of the country. Also since the payments which attract land to the program would vary according to land productivity, the average payment rates used for large areas attract the poorer land into the conservation reserve in the respective areas. The geographical distribution of contracts indicates a wide difference in the attractiveness of the offered rates. This will most likely affect the estimated coefficients related to the Soil Bank. The conservation reserve program was started in 1956 and a considerable acreage is still under contracts. The yearly cost of the program, by states, are published.[33]

Population Density

There are two dimensions of the impact of population on land values. In spite of the alleviation brought about by output increasing technological changes, increases in population do make land an increasingly scarce resource. Demand for recreational areas increases, and the average value of agricultural land is likely to be affected.

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[33] Conservation Reserve Programs and Land Use Adjustment Program, U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Washington, D.C., pp. 8-9.

Another aspect of population is its continuous redistribution among regions. Differences in pace of regional development leads to contraction in some areas and expansion in other areas. As stated at the outset of this thesis, the increases in land values were largest in the Southeast and in the Pacific area. Between 1920 and 1960, population density in Florida and California increased 5.2 and 4.6 times, respectively. The influx of people to these two states could be a reason for some of the land value changes.

There is little doubt that the impact of population density changes would be more pronounced if we were using cross-sectional analysis on data which were highly disaggregated in space.[34] In such a study some data would originate in pure farming areas, while other data would originate in areas with much urban development. When we use state data, the differences between such communities tend to be averaged out. However, we believe that at least for some states the population changes have been so large and so varying that the inclusion of the population density variable is important.

Population density is defined as inhabitants per square mile of total land surface. The population data, as well as area data, are available in Statistical Abstracts of the United States.[35]

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[34]See Scharlach and Schuh, supra., p.19.

[35]Department of Commerce, Statistical Abstract of the United States, Washington, D.C. Population by States were obtained from the following volumes: 1933, p. 9; 1942, p. 10; 1943, p. 17; 1951, p. 28; 1953, p. 14; 1954, p. 14; 1955, p. 14; 1957, p. 10; 1961, p. 6; 1963, p. 9. Areas were obtained from the 1963 volume, p. 173.

Personal Income

Just as an increasing population density would be expected to increase land values through increased demand for recreational land and for suburban developments, so would increasing income be expected to increase demand for these facilities. There is no doubt that the demand for recreational facilities has a rather high income elasticity.[36] There is also some reason to believe that the demand for land for investment purposes may be positively correlated with the level of income. Investments in land as a hedge against inflation might also be closely related to the rate of change in money income. Also investment in land as a means to avoid high income taxation[37] might be quite highly correlated with income which is an indicator of the business cycle.

The relations between land value and the above named income effects are expected to be positive. However, there are aspects of income changes which might be negatively correlated with land values. The outmigration from farms which occurs when job opportunities arise in the nonfarm economy during expansions would probably tend to decrease the demand for land. Thus, some aspects of increased income might lead to increased demand for land, while other aspects lead to decreased demand for land. The sign of the estimated income

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[36]For a discussion of the influence of increasing population and income, see: The Farm Real Estate Market, October 1959, pp. 6-7.

[37]See Rossmiller, pp. 81-82.

coefficient will indicate which effects are the strongest ones. In states with a high degree of industrialization and many areas conveniently located and usable for recreation, a positive sign would be expected. The high degree of industrialization would give good opportunities for off-farm work, but with a small percentage of people in agriculture the impact would be small. In states with a high proportion of the people in agriculture, the sign of the income coefficient might turn out to be negative.

Since the factors of demand named above do not originate in the nonfarm economy only, a business cycle indicator including the farm economy was chosen. Personal per capita income was chosen as an indicator of the general level of economic activity. Data are available by states since 1929.[38] Observations for 1925-1928 were estimated by applying the variation in national per capita income to the specific state income levels in 1929.[39]

The variables are summarized in Table 1, p. 73.

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[38]U. S. Department of Commerce, Personal Income by States, Office of Business Economics (Washington: U. S. Government Printing Office), pp. 142-143 gives data from 1929-53. The data from 1954 on are published in: Survey of Current Business, U. S. Department of Commerce, 44 (August 1964), p. 16.

[39]U. S. Department of Commerce, Historical Statistics of the U.S., Colonial Times to 1957, Table F-4.

CHAPTER V

ANALYSIS OF LAND VALUES BY STATES AND REGIONS

The previous chapters have outlined the reasons for this research, examined the methods to be used, and discussed the factors which are believed to have an influence on the value of land. Now we come to the essence of the thesis, namely the delineation of the most important factors related to land value changes, and the quantification of these factors' influence on land values in states and regions.

A few technical notes are appropriate at the outset of the chapter. The general features of the variables were given in the previous chapter. Table 1 contains the names of the variables as they will be used in the regression tables, a specification of the variables, and the units of measurement. All data are obtained by states with the exception of the output per acre variable. The regional output per acre indices are applied to the states contained in the respective regions. There are 38 (1925-62) observations of the variables for each state. Using first differences, this gives 37 observations for each of the state time series analyses. In the combined cross-sectional and time series analyses the total number of degrees of freedom increases proportionately with the number of states. When we aggregate the first differences over two year periods there are 18 first differences for each state.

Table 1. Variables Used in the Regression Analyses

Name	Specification	Unit
Dependent variable: Value of Land	Change in value of land[1]	$/p. a. e.[2]
Independent variables: Price Expectations	Change in the index of expected prices (1947-49=100)[3]	
Conservation Expenditures	Government expenditures on agricultural conservation in year t-1	$.1/p. a. e.
Conservation Reserve	Change in conservation reserve payments	$.1/p. a. e.
Acreage Reserve	Change in acreage reserve payments	$.1/p. a. e.
Output per Man-hour	Change in the index of output per man-hour in year t-1 (1957-59=100)	
Output per Acre	Change in index of a 3 years' moving average of output per acre in year t-1 (1957-59=100)	
Fertilizer	Change in the use of fertilizer	tons/1000 p. a. e.
Population Density	Change in population density	inhabitants/ sq.mile
Personal Income	Change in personal income	$1000

[1] The indices of value of land are given in Appendix B.

[2] Pasture acre equivalent.

[3] The indices of expected prices are given in Appendix C.

The Durbin-Watson (D. W.) statistics are given for the time series. The limits for a one sided test of positive serial correlation are given by Theil and Nagar.[1] For 37 observations and 6 adjusted coefficients[2] the 1 percent and 5 percent levels are 1.58 and 1.79, respectively. If the D. W. statistics is below the chosen limit, the assumption of serially independent disturbances should be rejected. The limits for a two sided test at the 5 percent level of serially correlated disturbances are given by Durbin and Watson.[3] If for 37 observations and 6 adjusted coefficients, the D. W. statistic is above 1.70, we would conclude that the disturbances are not serially correlated. If the D. W. statistic falls between 1.10 and 1.70, the test is indeterminate. A D. W. statistic below 1.10 indicates serially correlated disturbances. There is obviously a large difference between the two tables in the size of the D. W. statistic which would suggest autocorrelated disturbances. Since the problem of which table to use is an unsolved theoretical question, we chose to refer to the Theil-Nagar table whenever the question of positive serial correlation is discussed.

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[1] H. Theil and A. L. Nagar, "Testing the Independence of Regression Disturbances," Journal of the American Statistical Association, 56 (December 1961), p. 802.

[2] The limits were not given for more than 6 adjusted coefficients.

[3] J. Durbin and G. S. Watson, "Testing for Serial Correlation in Least Squares Regression, Part II," Biometrica, 38, 1951, pp. 159-177.

In this study pasture acre equivalents are used as a measure of quantity of land. For each state a series of pasture acre equivalents was constructed in order to quantify the larger changes in land quality brought about by reproducible capital investments (see Appendix A). For each state the series of pasture acre equivalents is based on the value of an acre of pasture in that particular state.

When the states are combined cross-sectionally it becomes necessary to adjust for the interstate differences in value of pasture acre equivalents. This is necessary since not all of the variables are measured on the basis of a pasture acre equivalent. The coefficients for estimates obtained on the index measures would vary according to land productivity, e.g., the coefficient for price expectation indices would be expected to be different for two wheat states if the land in one of the states gives twice the yield of that in the other state. The adjustments of productivity differences in pasture acre equivalents among states are based on the 1940 values of pasture acre equivalents.[4, 5] The weights used for adjustments in the combined analyses are given in connection with the regional regression tables.

In the combined analyses only one constant (time) is included.

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[4]If the value of a pasture acre equivalent in state x is twice that in state y, the combined analysis is expressed in terms of y pasture equivalents by multiplying by two the number of pasture equivalents in x.

[5]The 1939-41 values of different kinds of land were used in deriving the weights by which the number of pasture acre equivalents were found. See Appendix A.

Thus, the effect on land values of factors measured by the time variable are assumed to be similar, when producitivty differences are adjusted for, among states within regions.

It was earlier argued (p. 49) that increased time aggregation would lead to an increased multiple correlation coefficient if there were random errors in the variables. The random errors are likely to originate mainly in the dependent variable. Even if all the variables had random errors of equal magnitude, the yearly weighted sum of random errors in the independent variables would tend to be low due to offsetting effects associated with the number of variables. Therefore, most of the random errors revealed by the multiple correlation coefficient with increased time aggregation are likely to originate in the dependent variable.

When time aggregation is carried out in the combined analyses, by aggregating over two year periods, the coefficient of the constant will be expected to double. The constant measures a time trend, and the coefficient is proportionate to the amount of time having passed between observations.

The following discussion is based mainly on the regression results which are presented by regions in Tables 2 to 14. However, in order to give some indication of the reasons for increased land values and for the different increases among states, part of the discussion is related to the changes which have occurred in the most important explanatory variables over time. Appendix D summarizes, by state, the increases in land values, price expectations, output per man-hour, and population density. Also, the relative levels of government conservation expenditures and payments made for the conservation reserve program are given.

Chapter VI contains a more rigorous analysis of the regional differences in land value increases.

Southeast

The results from the statistical analyses of the Southeast are presented in Table 2. The first difference model yielded a good fit, and most of the variables show significant influence on land values. The D. W. statistics indicate that the assumption of independence among disturbance terms cannot be rejected, at least not at the .01 level.

The results from the South Carolina time series given in Table 2 are, using the variable definitions given in Table 1, interpreted as follows. The constant term implies that the value of a pasture acre equivalent decreases by \$.90 per year if no change occurs in the independent variables. An increase in the index of price expectations of one index point will cause an increase in the value of a pasture acre equivalent of \$.17. A \$.10 increase in annual government conservation payments, in conservation reserve payments, or in acreage reserve payments will bring about increases in the value of a pasture acre equivalent amounting to \$1.39, \$1.90 or \$.08, respectively. A one point increase in the output per acre index changes the value of a pasture acre equivalent by \$.21. An increase in population density of one person per square mile decreases the

Table 2. Southeast: Results of Land Value Regressions, 1925-62

Variable	Individual States				Combined Analyses[1,2]	
	South Carolina	Georgia	Alabama	Florida[3]	All Years	Even Years Only
Constant	-.90 (.50)[4]	-.97 (.56)	-.66 (.46)	-5.09 (1.52)	-.87 (.32)	-1.92 (.63)
Price Expectations	.17 (.07)	.16 (.08)	.23 (.06)	.07 (.12)	.20 (.04)	.18 (.05)
Conservation Expenditures	1.39 (.33)	1.30 (.30)	.75 (.17)	2.07 (1.23)	1.04 (.13)	.98 (.15)
Conservation Reserve	1.90 (.59)	1.81 (.77)	2.71 (.98)	19.94 (7.22)	2.15 (.39)	2.14 (.38)
Acreage Reserve	.08 (.08)	.08 (.11)	.01 (.07)	- -	.06 (.05)	.02 (.06)
Output per Acre	.21 (.10)	.20 (.12)	.13 (.08)	.68 (.25)	.21 (.06)	.29 (.09)
Population Density	-.49 (.41)	-.26 (.55)	.70 (.46)	2.17 (.61)	.02 (.29)	.19 (.36)
R^2	.78	.75	.78	.76	.73	.87
Durbin-Watson Statistics	1.92	1.75	2.31	1.68		

[1]Florida is excluded.

[2]In the combined analyses the pasture acre equivalents are standardized using the following weights which are based on relative prices--South Carolina: 1.00, Georgia: .82, Alabama: 1.05.

[3]For Florida the time period was 1927-62. A large increase in land values which took place in 1926 followed by a subsequent fall in 1927 could not be explained by the model. The 1926 increase in land values is mainly due to estimation errors. Therefore, the years 1925 and 1926 were omitted.

[4]Standard deviations are given in parentheses.

value of a pasture acre equivalent by \$.49. The coefficients obtained in the other analyses of the Southeast and in all other regions are interpreted in a similar manner. However, in the analyses using biennial observations, the constant term measures not the annual, but the biennial change in the pasture acre equivalent value.

The structural relationship based on Florida data differs from that in the rest of the area. Florida was, therefore, not included in the combined cross-sectional and time series analysis for the region. When all years were included in the regional analysis, the coefficient of multiple determination fell below the level for individual states. This indicates some structural differences between the states.

Aggregation of the first differences over two year periods raised the multiple determination coefficient by .14 indicating considerable random variation in the variables. As pointed out earlier, most of the decrease in random variation is probably related to random variation in the dependent variable.

Value and quantity of land--At the outset of this thesis it was noted that some of the largest increases in land values had occurred in the Southeastern region of the U.S. This also holds when we express the quantity of land in terms of pasture acre equivalents. Florida had a much larger absolute change in land values over the period 1925-62 than did the other states in the region. Georgia had the largest percentage increase due to a low initial unit value. In Georgia the area of cropland has decreased rapidly and brought about a decrease in the quantitative measure of land, while in Florida the quantity of land has more than doubled from 1925 to 1962. South Carolina and

Alabama had, like Georgia, decreases in the number of pasture acre equivalents (30-40% between the endpoints of the period).

Constant term--The constant was negative and significant at the .05 level in all the analyses except for Alabama.

Price expectations--The indices of price expectations for the Southeast (excluding Florida) increased somewhat more than in most other regions. Cotton production is of considerable importance for South Carolina, Georgia, and Alabama, but cotton price expectations increased by about the same amount as the aggregate national index. The tobacco price expectation index, which increased about three times as fast as the aggregate national index, has influenced the indices for South Carolina and Georgia substantially (see Appendix D). In South Carolina, where the price expectation index increased most, tobacco accounts for about twenty percent of total farm sales. For Florida, where oranges account for about forty percent of farm income, the long run changes in the state index of price expectations were much smaller than in the other states. The sizes of the coefficients indicate that cotton prices have more influence on land values than do tobacco prices. Other regions will provide further evidence on this point. Except for Florida the coefficients were significant at the .05 level or better.

Conservation expenditures--With about six to seven percent of farm land in the U.S., the Southeast received eight to nine percent of the conservation payments over the 1936-61 period.

The intercorrelation between output per man-hour and conservation payments was high (about .8) in the Southeast, and the high coefficients for conservation expenditures are likely to be measuring some influence of technological changes as well as the impact of conservation expenditures. The index of output per man-hour in the cotton industry has increased more than most of the other eleven enterprise groups from which the aggregate indices of output per man-hour were computed, and the impact of mechanization in the cotton industry would to some extent be measured by the coefficients estimated for conservation expenditures. The conservation expenditures explained more of the land value variations than did the output per man-hour indices, which were not retained in the analyses.

The differences in size of the estimated conservation expenditures coefficients could be due to differences in the kind of conservation carried out. The conservation data suggests that the practices carried out in South Carolina and to a lesser extent in Georgia are of a more enduring kind than those carried out in Alabama. In all three states a major part of the conservation payments are spent on measures to establish permanent cover. In addition, in South Carolina substantial amounts are spent on drainage and in Alabama a substantial part of the conservation measures are for temporary protective cover.

<u>Conservation reserve</u>--The Southeast has received a substantial part of the payments made for contracted acreages under the conservation reserve program (in 1960 it received 8.2% of U.S. total). Georgia and South Carolina received most while Florida received relatively little.

Compared with the national average rental rates per acre under contract, the rates for the Southeast (with the exception of Florida rates) have increased faster over time.[6] This has led to a relative increase in the acreage contracted for the conservation reserve program in the Southeast. In 1960, the year with the highest national expenditures on the conservation reserve program, the payments to the Southeast amounted to 26.7 million dollars. The coefficients show that the conservation reserve program has a large influence on land values. For example, using the estimated coefficient (2.2) for the combined analysis would indicate that from 1955 to 1960 the conservation reserve program has caused an increase in land values in the Southeast amounting to 583 million dollars, or about 25 percent of the total increase in that period. The Florida coefficient is out of line with other estimated coefficients. This could be due to spurious correlation associated with the relatively small area in the conservation reserve.

Acreage reserve--The acreage reserve programs had little influence on land values in the Southeast. This is not because of small participation in this program. In the last year of the program 101 million dollars, or 15% ot total expenditures under this program, were spent in the Southeast. Most of these payments (85%) were spent on decreasing the active cotton allotments. The insignificant coefficients

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[6] U. S. Dept. of Agriculture, Conservation Reserve Program and Land Use Adjustment Programs, Statistical Summary 1963, Agricultural Stabilization and Conservation Service, Washington, D. C., p. 14.

could indicate that the acreage reserve payments on cotton allotments did not increase returns to land, at least not in the Southeast.

Output per acre--The output per acre variable was significant at the .05 level or better, indicating rather homogeneous crop production conditions among the states in the region. As discussed in the previous chapter,[7] it also suggests little change in the ratio of cropland to other land.

Population density--The population density coefficient for Florida suggests that a large part of the extremely large increase in land value is due to increased population. The population density in Florida increased from 23 persons per square mile in 1925 to 101 in 1962, indicating an increase of more than 150 dollars in value per pasture acre equivalent due to population increases. This is probably an over estimation of the impact of population density, since the variable most likely measures some of the impact due to technological advance. The intercorrelation between population density and output per man-hour was .5. Also, the very high negative constant could be associated with overestimation of other rather constant variables. Nevertheless, there is little doubt that influx of people to Florida has had a large impact on land values.

Appalachians

The statistical results for the Appalachians are given in Table 3. A good fit is indicated, and the D. W. statistics give no indication of

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[7]Supra, p. 63.

Table 3. Appalachians: Results of Land Value Regressions, 1925-62

Variable	Individual States					Combined Analyses[1]	
	Virginia	West Virginia	North Carolina	Kentucky	Tennesee	All Years	Even Years Only
Constant (time)	-1.97 (.71)[2]	-1.08 (.42)	-1.69 (.86)	-1.45 (.78)	-1.10 (.61)	-1.59 (.31)	-3.36 (.76)
Price Expectations	.11 (.10)	.25 (.06)	.05 (.11)	.27 (.10)	.24 (.08)	.23 (.04)	.17 (.06)
Conservation Expenditures	.89 (.24)	.75 (.19)	1.59 (.26)	.67 (.23)	.80 (.21)	.95 (.10)	.98 (.13)
Conservation Reserve	1.75 (2.98)	-.46 (1.60)	3.72 (2.28)	3.70 (1.47)	2.64 (.88)	2.46 (.55)	2.25 (.68)
Acreage Reserve	.53 (.75)	-2.29 (2.93)	.33 (.18)	.72 (.40)	.26 (.20)	.28 (.10)	.25 (.15)
Output per Acre	.35 (.15)	.13 (.09)	.43 (.16)	.22 (.13)	.15 (.11)	.22 (.06)	.24 (.10)
Fertilizer	.43 (.14)	.14 (.25)	.15 (.08)	.23 (.20)	.29 (.22)	.17 (.05)	.28 (.08)
Population Density	.43 (.34)	.02 (.20)	-.31 (.52)	.39 (.43)	.18 (.35)	.31 (.14)	.32 (.20)
R^2	.71	.71	.77	.67	.74	.65	.74
Durbin-Watson Statistics	1.99	2.31	1.84	2.16	1.89		

[1] In the combined analyses, the pasture acre equivalents are standardized using the following weights which are based on relative prices--Virginia: 1.21, West Virginia: .73, North Carolina: 1.00, Kentucky: 1.07, and Tennessee:.98.

[2] Standard deviations are given in parentheses.

serially correlated disturbances. The estimated coefficients suggest some heterogeneity among the states and this is in agreement with the fall in the coefficient of multiple determination when all years are included in the combined analyses. The significance of the estimated coefficients increased considerably in the combined analyses. Time aggregation increased the coefficient of multiple determination and generally decreased the significance of the coefficients. Time aggregation is likely to increase multicollinearity, and the rather large changes in the price expectations and the fertilizer coefficients indicate intercorrelation.

Value and quantity of land--The percentage increase in land values in the Appalachians during the 1925-62 period was much lower than the increase in the Southeast, but it was still somewhat above the U.S. average. The Virginias had small relative increases, especially West Virginia which was far below the U.S. average. North Carolina had the largest increases relatively as well as absolute.

The quantity of land, as measured in pasture acre equivalents, declined in all states. The decline in West Virginia was almost 50 percent, while other states showed 19-30 percent decreases.

Constant term--The constant terms were negative and significant at the .05 level throughout. The absolute value of the terms tend to vary among states in agreement with the variation in the value of pasture acre equivalents. Thus, it would appear that as expected, the total annual depreciation of land is related to the value of land.

Price expectations--Increases in the indices of price expectations during the 1925-62 period have been considerably higher in the Appalachians than in the country as a whole. The largest increase occurred in North Carolina where the average percentage increase has been twice that of the entire country. The rapid increase in North Carolina was due to the large influence of tobacco prices. West Virginia, where dairy is the most important enterprise, had the lowest increase in the index of price expectations for the region, but it was still appreciably above the U.S. average. While the coefficients for West Virginia, Kentucky, Tennessee and the combined analyses are significant at the .01 level, the coefficients for Virginia and North Carolina are not significant and are considerably lower than those for the rest of the region. In both North Carolina and Kentucky tobacco is the main enterprise, but Kentucky produces burley tobacco while North Carolina produces flue-cured tobacco.[8]

Conservation expenditures--The Appalachians receive a relatively high proportion of the total government conservation subsidies. In the period 1936-61 the Appalachian payments amounted to about 13.0 percent of all payments made in this period.[9] The conservation investments were primarily spent on establishing cover and cover protection measures which includes fertilizing and and liming. In North Carolina a large part of the subsidies were

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[8]Virginia also produces flue-cured tobacco, but the impact of tobacco is much less than in North Carolina.

[9]Farm land in the Appalachians constitute about 6.5% of total U.S. farm land.

spent on drainage. The coefficients were significant at the .01 level.

Conservation reserve--The soil-bank variables were not significant in the Virginias, but they were important in other states of the region. Participation in the conservation reserve program is relatively low in the Virginias and North Carolina, but above average in Kentucky and Tennessee. Participation was low for the entire region until 1959 when the rates increased for some states up to almost 100 percent while the national average rate increased 30 percent only.

Acreage reserve--The acreage reserve program had much participation in North Carolina and little in the Virginias. In North Carolina it mainly decreased the utilization of cotton and tobacco allotments, while in Kentucky it mainly influenced corn production.

Fertilizer and output per acre--In the Appalacians both output per acre and fertilizer were included in the analyses since, for some states, they both had significant influence. Generally the two variables did not show high intercorrelation, indicating that the output per acre is influenced by many other factors than those approximated by the fertilizer variable. Weed and insect killing chemicals would be important factors in increasing output per acre.

Population and income--Population density did not have any significant influence on a single state basis, but was significant when cross-sectional variation was introduced. Income was not retained in the analysis due to its high intercorrelation with price expectations.

The relatively low increases in land values in West Virginia are related to generally lower price increases on farm products, below average conservation expenditures, little participation in the conservation reserve program, and small effects of variables related to technological changes.

Northeast

Due to much heterogeneity among states, the Northeastern region was split up in three sub-regions[10] according to statistical similarities such as multicollinearity and significance of coefficients. The split turned out to be reasonable also from a geographical point of view.

Tables 4, 5, and 6 give the statistical analyses of the three Northeastern sub-regions. The picture given from these tables is not too encouraging. As anticipated earlier, the first differences model did not perform well in the small northeastern states. The larger states and Delaware in Northeast 1 gave a good fit and reasonable significance of the variables. The results for the small states in Northeast 2 and 3 show a poor fit and little significance of the variables. The D. W. statistics for the small states give in some cases reason to assume positively autocorrelated disturbances, and

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[10] The three sub-regions are:
Northeast 1--New York, Pennsylvania, Delaware and Maryland.
Northeast 2--Massachusetts, Rhode Island, Connecticut, and New Jersey.
Northeast 3--Maine, New Hampshire, and Vermont.

Table 4. Northeast 1: Results of Land Value Regressions, 1925-62

Variable	Individual States: New York	Individual States: Pennsylvania	Individual States: Delaware	Individual States: Maryland	Combined Analyses[1]: All Years	Combined Analyses[1]: Even Years Only
Constant (time)	-.57	-.71	-1.09	-1.04	-.72	-1.82
	(.29)[2]	(.43)	(.77)	(.60)	(.26)	(.62)
Price Expectations	.10	.20	.24	.16	.16	.21
	(.04)	(.06)	(.10)	(.08)	(.03)	(.05)
Conservation Expenditures	.32	.65	.59	.94	.42	.31
	(.24)	(.24)	(.19)	(.31)	(.13)	(.16)
Conservation Reserve	1.51	.88	4.75	4.51	.72	.33
	(.69)	(.85)	(1.76)	(1.87)	(.54)	(.62)
Acreage Reserve	.68	.65	.60	1.35	.29	.10
	(.54)	(.48)	(.22)	(.39)	(.13)	(.17)
Output per Man-hour	.21	.34	.82	.82	.58	.69
	(.10)	(.15)	(.22)	(.18)	(.08)	(.10)
Population Density	.04	-.08	-.11	-.02	.05	.14
	(.04)	(.09)	(.24)	(.10)	(.04)	(.06)
Personal Income	1.96	-2.82	3.50	-1.20	-.21	-3.52
	(2.87)	(4.93)	(4.72)	(5.26)	(2.07)	(3.05)
R^2	.72	.71	.77	.81	.63	.76
Durbin-Watson Statistics	2.09	2.07	1.97	2.08		

[1] In the combined analyses the pasture acre equivalents are standardized using the following weights which are based on relative prices--New York: .72, Pennsylvania: 1.00, Delaware: 1.60, and Maryland: 1.08.

[2] Standard deviations are given in parentheses.

Table 5. Northeast 2: Results of Land Value Regressions, 1925-62

Variable	Individual States				Combined Analyses[1]	
	Massa-chusetts	Rhode Island	Connec-ticut	New Jersey	All Years	Even Years Only
Constant (time)	-.50	.24	-.74	-.85	-.42	-2.02
	(.71)[2]	(1.40)	(1.62)	(1.27)	(.65)	(1.62)
Price Expectations	.23	.40	.17	.19	.22	.14
	(.10)	(.23)	(.24)	(.16)	(.09)	(.15)
Conservation Expenditures	1.81	1.11	2.82	.79	1.39	1.59
	(.47)	(.43)	(.79)	(.44)	(.25)	(.34)
Conservation Reserve	13.38	-43.48	18.69	-.46	.85	.65
	(15.96)	(76.31)	(9.52)	(1.53)	(1.56)	(1.95)
Output per Acre	-.13	.35	-.15	.10	.16	.03
	(.22)	(.44)	(.51)	(.33)	(.19)	(.30)
Population Density	-.06	-.06	.08	.20	.08	.11
	(.06)	(.10)	(.19)	(.08)	(.05)	(.07)
Personal Income	-7.57	4.80	-6.61	14.83	3.29	4.57
	(8.46)	(14.19)	(11.62)	(10.15)	(5.59)	(8.97)
R^2	.53	.38	.56	.49	.37	.50
Durbin-Watson Statistics	1.83	1.86	.97	2.60		

[1] In the combined analyses the pasture acre equivalents are standardized using the following weights which are based on relative prices--Massachusetts: .68, Rhode Island: 1.07, Connecticut: 1.10, and New Jersey: 1.00.

[2] Standard deviations are given in parentheses.

Table 6. Northeast 3: Results of Land Value Regressions, 1925-62

Variable	Individual States			Combined Analyses[1]	
	Maine	New Hampshire	Vermont	All Years	Even Years Only
Constant (time)	-.49 (.42)[2]	-.47 (.37)	-.26 (.17)	-.37 (.15)	-.80 (.37)
Price Expectations	.17 (.07)	.08 (.05)	.09 (.02)	.08 (.02)	.08 (.04)
Conservation Expenditures	.62 (.26)	.78 (.26)	.34 (.13)	.57 (.11)	.45 (.17)
Conservation Reserve	.63 (.62)	-.02 (2.12)	1.27 (.93)	.71 (.55)	1.01 (.67)
Output per Acre	.17 (.13)	.09 (.12)	.03 (.06)	.09 (.05)	.12 (.08)
Population Density	.62 (.85)	.03 (.28)	.12 (.15)	.17 (.14)	.33 (.20)
Personal Income	-5.13 (6.67)	.20 (6.01)	.11 (2.66)	-.64 (2.34)	1.77 (4.33)
R^2	.50	.48	.61	.46	.58
Durbin-Watson Statistics	1.64	.86	1.61		

[1] In the combined analyses the pasture acre equivalents are standardized using the following weights which are based on relative prices--Maine: 1.57, New Hampshire: 1.00, and Vermont: .96.

[2] Standard deviations are given in parentheses.

in a single case (New Jersey) there is indication of negatively correlated disturbances. The high D. W. statistics for New Jersey is due to two consecutive large errors with opposite signs. Increased time aggregation alleviates such errors.

The combined analyses indicate that there is no more homogeneity among states in the small northeastern regions than there is in other regions. The use of cross-sectional analysis did increase the significance of the variables, but time aggregation did not increase the multiple correlation coefficient more in the Northeast than it did in regions with a better statistical fit. Therefore, the random variation in the dependent variable in the Northeastern states does not seem to be much different from that in many other states. The poor statistical fit could be caused by cyclical variation in estimates of land value or it could be due to exclusion of important variables.

Value and quantity of land--The larger Northeastern states generally showed a little less than average relative increase in land values during the 1925-62 period. The northeastern part of the Northeast Region had the lowest land value increase in the region, while the smaller states around New York City had relative increases which were somewhat above the U. S. average. New York state was substantially below the national average.

The decrease in number of pasture acre equivalents ranged from 12 percent in Delaware to 62 percent in New Hampshire. Compared with other regions, the decreases were large. Among the sub-regions, Northeast 1 had the smallest decrease in quantity of land input. The rate of decrease has increased toward the end of the period.

The USDA indices of average value per acre for the Northeast give substantially lower relative increases in land value than do the series of land value per pasture acre equivalent which are used in this study. This indicates that the pasture acre equivalent series have been more sensitive to the decrease in farm land than have other indices.

Constant term--With the exception of Rhode Island, all the constant terms were negative. The Rhode Island coefficient is not significant and the positive sign could be due to intercorrelation with conservation. Reasonable significance was obtained in Northeast 1 states and in the combined analyses for Northeast 3.

Price expectations--The price expectations were generally quite significant in the analyses. Increases in the indices of price expectations in the Northeast over the 1925-62 period have generally been much below increases in other regions. Connecticut and Maryland have above average increases in indices of price expectations due to the importance of tobacco in these states. The dairy industry is an important enterprise in all the states, but it is the reliance on poultry which has kept the price expectation indices down. The importance of potatoes in Maine (more than 50% of total farm sales) has kept its index on a particularly low level.

Conservation expenditures--Compared with farm land area in the region, the conservation payments are relatively large. However, compared to the level of land values the conservation payments to Northeast 2 were relatively small. The estimated coefficients are, except for Northeast 2, lower than the coefficients for other regions.

A very large part of the conservation expenditures were spent on measure to establish permanent cover such as the use of lime, fertilizer, etc. Except for New York, the coefficients were significant at the .05 level or better.

Conservation reserve--The participation in the conservation reserve program is relatively low in Northeast 2, but rather high in Northeast 1 and 3. The many insignificant coefficients of the variable seem to be due to little participation in the programs.

Acreage reserve--Maine and Rhode Island did not participate in the acreage reserve program at all, and for the entire region the participation was low. Coefficients are estimated for Northeast 1 only.

Output per man-hour and output per acre--The output per man-hour variable was significant at the .05 level or better in Northeast 1 but was not included in the other sub-regions due to intercorrelation with other variables. The output per acre variable did not show any significance in the state analyses of Northeast 2 and 3. However, output per acre was significant at the .05 level in the combined analysis of all years for Northeast 3.

Population and income--Population density showed some significance in the combined analyses, but was generally insignificant in the time series analyses. Personal income was not significant.

Lake States

Table 7 gives the statistical results for the Lake States. A good fit and no serial correlation problems are indicated. Heteroge-

Table 7. Lake States: Results of Land Value Regressions, 1925-62

Variable	Individual States			Combined Analyses[1]	
	Michigan	Wisconsin	Minnesota	All Years	Even Years Only
Constant (time)	-1.50 (.51)[2]	-2.05 (.30)	-2.54 (.59)	-1.71 (.27)	-3.42 (.64)
Price Expectations	.14 (.07)	.17 (.04)	.19 (.09)	.17 (.04)	.13 (.07)
Conservation Expenditures	.96 (.27)	.76 (.18)	1.48 (.63)	.84 (.18)	.68 (.23)
Conservation Reserve	2.24 (.80)	.82 (.67)	2.64 (.83)	2.09 (.48)	2.35 (.58)
Acreage Reserve	.43 (.22)	.46 (.30)	1.05 (.35)	.63 (.17)	.95 (.25)
Output per Man-Hour	.23 (.15)	.23 (.09)	.35 (.18)	.29 (.08)	.29 (.11)
Population Density	.26 (.21)	.16 (.25)	.43 (.70)	.21 (.15)	.33 (.21)
Personal Income	3.45 (3.13)	8.36 (3.14)	14.34 (8.31)	7.07 (2.38)	11.32 (4.31)
R^2	.77	.85	.78	.72	.81
Durbin-Watson Statistics	1.83	2.00	1.90		

[1] In the combined analyses, the pasture acre equivalents are standardized using the following weights, based on relative prices--Michigan: 1.00, Wisconsin: .98, Minnesota: 1.16.

[2] Standard deviations are given in parentheses.

neity among the states is indicated by the fall in the multiple correlation coefficient when the states are combined. Some random errors in the data, mainly in the dependent variable, are indicated by the increase in the multiple correlation coefficient when every other year is omitted. With the exception of population density, the variables were generally significant in the analyses.

Value and quantity of land--The percentage increase in land values in the Lake States region during the period 1925-62 was substantially below national average. However, Michigan showed an increase which was only a little below the national average.

The number of pasture acre equivalents was very stable over the period. Michigan showed the largest change with an 18 percent decrease. Minnesota and Wisconsin had small percentage changes between the first and last year in the period. However, there were first increases and later decreases in the quantity of land, and the difference between the lowest and highest year in the entire period was about 10 percent.

Constant term--The constants were negative and significant at the .01 level in all the analyses. When every other year was omitted in the combined analysis, the constant did double as would be expected.

Price expectations--The price expectations variable was significant at the .01 level. The indices of price expectations, which were highly influenced by the sale of dairy products,[11] beef,and hogs,

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[11] In Wisconsin dairy products constitutes about 50% of total farm product sale.

increased over time with about the national average. In the analysis utilizing every other year only, the price expectations became quite intercorrelated with income (.72), and its significance decreased somewhat.

Conservation expenditures--Compared with farm land area, the Lake States received a relatively large part of total government conservation expenditures. In Michigan and Minnesota a large part of the conservation aid was spent on drainage, while in Wisconsin the major part was spent on establishing permanent vegetative covers. Michigan and Wisconsin received, relatively, the largest amounts (see Appendix D). The coefficients were significant at the .01 level.

Conservation reserve--The conservation reserve program has had much influence on land values in the Lake States. In 1960 the payments to the Lake States for areas in conservation reserve amounted to almost 42 million dollars, which is more than 12 percent of the total payments made that year. Next to Texas and North Dakota, Minnesota has been and is the state receiving the highest conservation reserve payments. The estimate suggests that 36 percent of the increase in Minnesota land values during 1955-62 is caused by the conservation reserve program. The relatively low coefficient and low significance level of the Wisconsin estimate indicates that the opportunity costs there are closer to the conservation reserve rates offered than they are in Michigan and Minnesota.

Acreage reserve--There was considerable participation by the Lake States in the acreage reserve program. While a considerable part of Michigan's participation consisted in reducing wheat allotments, the major crop reductions for the region occurred by decreasing the corn allotments. The only explanation for the higher Minnesota coefficient is that the rates offered there were relatively more attractive to farmers. Except for Wisconsin, the coefficients were significant at the .05 level or better.

Output per man-hour--The output per man-hour variable worked well as it gave significant results in most analyses without giving inter-correlation problems.

Income and population--The general level of economic activity as measured by personal income has considerable influence on land values. This is especially true in Wisconsin where the income variable was one of the most important. All the states have land which is very usable for recreation and the proximity of large industrial towns is also a factor of importance. Except for Michigan, the income coefficients were significant at the .05 level or better. The high level of significance for the Wisconsin variable is most likely connected with the proximity of Chicago. Population density was not significant in the analyses.

Corn Belt

The statistical results for the Corn Belt, which are presented in Table 8, do not show as much uniformity among states as expected *a priori*. The low multiple coefficient of determination for Ohio is mainly due to four observations, namely a low negative residual in 1950, followed by a high residual in 1951. The same thing happened, with opposite signs, in 1957-58. This also explains the high D. W.

Table 8. Corn Belt: Results of Land Value Regressions, 1925-62.

Variable	Individual States					Combined Analyses[1]	
	Ohio	Indiana	Illinois	Iowa	Missouri	All Years	Even Years Only
Constant (time)	-1.07 (1.06)[2]	-2.09 (1.03)	-3.67 (1.70)	-4.42 (1.29)	-1.87 (.54)	.14 (.44)	-.84 (1.04)
Price Expectations	.22 (.16)	.24 (.14)	.54 (.23)	.47 (.16)	.19 (.07)	.43 (.07)	.31 (.10)
Conservation Expenditures	1.70 (.61)	1.37 (.63)	3.40 (.90)	4.69 (.92)	1.51 (.28)	.37 (.10)	.27 (.11)
Conservation Reserve	4.22 (2.14)	5.83 (2.23)	12.95 (5.39)	4.97 (2.82)	3.55 (1.28)	6.06 (1.00)	7.43 (1.18)
Acreage Reserve	.97 (.43)	.95 (.45)	.78 (.75)	-.17 (.36)	.45 (.19)	.80 (.16)	1.39 (.24)
Fertilizer	.46 (.31)	.48 (.30)	.08 (.33)	-1.62 (.81)	.44 (.20)	.63 (.15)	1.14 (.23)
Population Density	-.16 (.23)	1.04 (.47)	.30 (.52)	-.56 (1.27)	-.24 (.37)	.002 (.000)	.33 (.23)
R^2	.53	.66	.63	.67	.76	.43	.60
Durbin-Watson Statistics	2.51	1.78	1.45	1.76	2.38		

[1] In the combined analyses the pasture acre equivalents are standardized using the following weights which are based on relative prices--Ohio: .84, Indiana: 1.00, Illinois: 1.50, Iowa: 1.26, and Missouri: .58.

[2] Standard deviations are given in parentheses.

statistic which implies negative autocorrelation.

The modest coefficients of multiple determination were mainly due to a few big errors. The model apparently did not catch the 1951 land market boom, and especially for Illinois, a stronger business cycle indicator might be useful.

The combined analysis brought about a large decrease in the multiple correlation coefficient, but the significance level of the coefficients increased substantially for all variables except the constant.

Value and quantity of land--The increase in relative value of land in the Corn Belt was somewhat below the national average. However, there were wide differences between the states--from a less than 80 percent increase in Iowa (using the endpoints in the period 1925-62) to more than 180 percent increase in Indiana. Due to the high absolute level of land values in the Corn Belt, the absolute increases were very large.

The number of pasture acre equivalents for the Corn Belt was as stable as in the Lake States. The largest decrease (19 percent) occurred in Ohio.

Constant term--The constants were negative and significant at the .05 level for the individual states except for Ohio. However, the combined analyses yielded constant terms that were not significant.

In the combined analyses large declines in the conservation expenditure coefficients occurred simultaneously with an increase in the constants. This suggests some interaction between these two variables. Also the individual state estimates suggest some relation between increasing negative constants and increasing conservation coefficients. Compared with other regions the constant and the conservation coefficient in the combined analyses of the Corn Belt would appear to be too high and too low, respectively.

Price expectations--The price expectation indices increased over the 1925-62 period with about the same as the U.S. index of agricultural price expectations. The coefficients were significant at the .05 level or better except for Ohio. The main enterprise in the region is corn, but it is for the most part converted into beef, hog, and dairy products from which a main part of gross farm receipts are obtained. The estimated coefficients vary, as would be expected, according to the value of a pasture acre equivalent in the respective states.

Conservation expenditures--The government conservation payments from 1936 to 1961 to the Corn Belt constituted about 18 percent of total U.S. payments. The conservation measures consisted mainly of lime and phosphate treatments and drainage. The coefficients were significant at the .05 level or better.

Conservation reserve--Acreage participation in the conservation reserve program is close to the U.S. average when compared to total number of acres of farm land. However, due to the higher payments per acre, the region received 14-15 percent of total U.S. payments in 1960. All coefficients were significant at the .05 level or better and were larger than in other regions.

Acreage reserve--The participation in the acreage reserve program was very high in the region. In 1958 more than one fourth of total acreage reserve payments went into the Corn Belt. Iowa alone received more than 7 percent of the total payments. The program mainly affected corn allotments. Also the wheat acreage was reduced, and in Missouri substantial payments were made to reduce cotton acreages. The coefficients were significant at the .05 level except for Illinois and Iowa.

Fertilizer--Fertilizer use was significant in the combined analyses at the .01 level and some of the single state coefficients were significant at the .10 level. However, the Iowa coefficient had a negative sign. This might be due to intercorrelation problems. For example, the simple correlation between fertilizer and conservation expenditures was .49.

Population and income--Population density was significant in the combined analyses, but the coefficient was very low. Due to intercorrelation problems with price expectations, personal income was not retained in the analyses.

Delta States

The statistical results for the Delta States are given in Table 9. The goodness of the statistical fit varies among states, and the usual decline in the multiple correlation coefficient for the combined analyses is observed. For the combined analysis including even years only, the multiple determination increased more than in all other regions, except for the Southern Plains.

Value and quantity of land--The Delta States are among the states in the nation with largest increases in land values. Among

Table 9. Delta States: Results of Land Value Regressions, 1925-62

Variable	Individual States: Mississippi	Individual States: Arkansas	Individual States: Louisiana	Combined Analyses[1]: All Years	Combined Analyses[1]: Even Years Only
Constant (time)	-.55 (.58)[2]	-.95 (.81)	-.21 (.78)	-.67 (.45)	-2.24 (.97)
Price Expectations	.16 (.08)	.27 (.12)	.24 (.11)	.23 (.07)	.04 (.09)
Conservation Expenditures	1.33 (.28)	1.24 (.43)	1.06 (.31)	1.28 (.18)	1.32 (.20)
Conservation Reserve	1.24 (2.06)	3.21 (1.50)	10.18 (2.39)	2.85 (.98)	2.61 (1.05)
Acreage Reserve	.02 (.12)	.49 (.23)	.34 (.19)	.12 (.09)	.13 (.10)
Output per Acre	-.01 (.10)	.10 (.10)	.09 (.09)	.06 (.06)	-.03 (.08)
Population Density	.36 (.45)	.43 (1.00)	.46 (.54)	.76 (.34)	.81 (.43)
Personal Income	-11.56 (8.47)	2.05 (12.23)	-.41 (9.83)	-5.04 (6.08)	14.43 (8.36)
R^2	.59	.60	.73	.56	.75
Durbin-Watson Statistics	1.77	2.03	1.97		

[1] In the combined analyses, the pasture acre equivalents are standardized using the following weights which are based on relative prices--Mississippi: .71, Arkansas: 1.00, and Louisiana: 1.05.

[2] Standard deviations are given in parentheses.

individual states, Louisiana is second only to Georgia with respect to relative increase during the 1925-62 period. Arkansas had the lowest relative increase in land values in the region, which was, nevertheless, substantially above the national average.

The number of pasture acre equivalents had an increasing trend in the first part of the period and a decreasing trend in the latter years. However, the differences between 1925 and 1962 were within ten percent. Taking the lowest and highest years of the period gave differences up to 25 percent.

Constant term--Constant terms were negative but not significant in the analyses except in the combined analysis of even years only.

Price expectations--The price expectations were significant in the analyses at the .05 level or better except in the combined analysis utilizing time aggregation. The increase in price expectation indices, mainly reflecting cotton and oil prices, was less than that for most other regions.

Conservation expenditures--Conservation payments to the region over the period 1936-61 were, relative to farm land area, greater than to most other regions. Most of the conservation practices pertained to establishment or improvement of permanent covers. A substantial amount was also spent on drainage. The coefficients were significant at the .01 level.

Conservation reserve--The conservation reserve payments made to the region are about average in the sense that the percentage of total payments under this program received by the region is close to the region's share of total farm land. However, within the region

Arkansas receives relatively most of the conservation reserve payments. While the Mississippi coefficient is not significant, other conservation reserve coefficients are significant at the .05 level or better.

Acreage reserve--The Delta States participate heavily in the acreage reserve program. In 1958 alone they received more than 11 percent of all payments made under the program. Mainly the production of cotton and rice was affected by the program. The Arkansas and Louisiana coefficients are significant at the .05 level. Other coefficients are not significant.

Output per acre--The output per acre variable was not significant in the analyses. Output per man-hour was highly correlated with land values, but was not retained in the analyses because of inter-correlation with other explanatory variables.

Population and income--Population density was significant in the combined analyses, but not in the individual state analyses. Income was significant only in the combined analysis with time aggregation. However, in this analyses correlation between income and price expectations was high (.66).

Southern Plains

Table 10 gives the statistical results for the Southern Plains, and a reasonably good fit is indicated. The D. W. statistics for Oklahoma is so large that there is reason to suspect some negative autocorrelation. The combined analysis gave a modest decrease in the multiple correlation coefficient, but where every other year was

Table 10. Southern Plains: Results of Land Value Regressions, 1925-62

Variations	Individual States		Combined Analyses[1]	
	Texas	Oklahoma	All Year	Even Years Only
Constant (time)	-.86 (.44)[2]	-.15 (.30)	-.29 (.25)	-.89 (.52)
Price Expectations	.11 (.05)	.16 (.04)	.16 (.03)	.18 (.04)
Conservation Expenditures	1.93 (.59)	.90 (.37)	1.35 (.32)	1.43 (.36)
Conservation Reserve	1.72 (1.74)	2.65 (.99)	2.18 (.89)	1.82 (.94)
Acreage Reserve	-.23 (.37)	.09 (.29)	-.07 (.23)	-.61 (.30)
Fertilizer	.48 (1.02)	1.28 (.72)	.84 (.59)	.03 (.73)
Population Density	1.19 (.67)	.09 (.20)	.28 (.20)	1.00 (.33)
R^2	.62	.67	.60	.80
Durbin-Watson Statistics	1.96	2.54		

[1] In the combined analyses, the pasture acre equivalents were standardized using the following weights which are based on relative prices--Oklahoma: 1.00, and Texas: .98.

[2] Standard deviations are given in parentheses.

omitted the coefficient increased more than in any other region.

Value and quantity of land--In the Southern Plains, land values increased during the 1925-62 period by a percentage which was above the national average. The absolute level of land values as well as the relative increase in land values is uniform for the two states.

The quantity of land was fairly stable in Oklahoma with the maximum reached in 1934. Texas had an almost continuous increase in number of pasture acre equivalents throughout the period, and the total increase amounted to 32 percent.

Constant term--The constant term for Texas was negative and significant at the .05 level and for Oklahoma it was negative, small and insignificant.

Price expectations--In the examined period, price expectation indices increased about the same as the national average index. The main enterprises influencing the indices are cotton for Texas and wheat for Oklahoma. Beef production is very important for both states. The higher coefficient for Oklahoma could indicate that wheat price expectations influence land values more than do cotton price expectations. More evidence on this proposition will be presented in the next chapter. The coefficients were significant at the .05 level.

Conservation expenditures--The government conservation payments to the Southern Plain states in the period 1936-61 were compared with the land area in farms below national average. A large part of the conservation expenditures in Texas were for "control of competitive shrubs on range and pasture land." In Oklahoma there was much

emphasis on measures to establish permanent cover and large amounts were spent on fixtures for watering of livestock. Water conservation was quite important in both states. The coefficients, which were all significant at the .01 level, indicate that the conservation practices carried out in Texas had a large impact on land values.

Conservation reserve--Although the conservation reserve payments made to Texas are the largest for a single state (39 million dollars in 1960) the payments are less than average when compared with land in farms. The payments to Oklahoma are relatively larger. The rates paid per acre are fairly similar in the two states, but Oklahoma has a larger percentage of farm land participating. The estimated coefficients and their significance indicate that the conservation reserve program has a considerably larger influence in Oklahoma than in Texas.

Acreage reserve--The acreage reserve program did not yield significant results. The participation was below average. Cotton was the main crop affected by the acreage reserve programs, but in Oklahoma considerable participation came from wheat areas.

Fertilizer--The fertilizer variable was significant at the .05 level for Oklahoma, but was not significant for Texas. The high conservation coefficient in Texas might include some effects of technological changes.

Population and income--A relatively large increase in the population in Texas was reflected in a significant population density coefficient. Income was not retained in the analysis as it was intercorrelated with price expectations.

Northern Plains

Table 11 gives the statistical results of the Northern Plains, and a good fit is indicated. At the .01 level, the assumption of independent disturbances cannot be rejected for any of the time series analyses.

In the combined analysis, utilizing every other year only, multicorrelation became more of a problem than in most other regions. Many of the coefficients changed substantially, and the income coefficient changed sign. Thus, the increase in the multiple correlation coefficient brought about by time aggregation was accompanied by less desirable features related to this procedure.

Value and quantity of land--The Northern Plains region had a small increase in land values both in percentage terms and in absolute terms during the 1925-62 period. In percentage terms, South Dakota had the lowest increases in land values for the entire country (41%). Kansas and North Dakota, even though they were far below the U.S. average increase, had increases of more than 100%.

The number of pasture acre equivalents increased for all the states. For Kansas and Nebraska the increases have been continuous through the time period, while some small decreases occurred for South Dakota and North Dakota in the latter years. The increases for the entire period were from 19 to 32 percent.

Constant term--The constants were negative and significant at the .01 level for all analyses.

Table 11. Northern Plains: Results of Land Value Regressions, 1925-62

Variation	Individual States				Combined Analyses[1]	
	North Dakota	South Dakota	Nebraska	Kansas	All Years	Even Years Only
Constant (time)	-.55 (.19)[2]	-1.52 (.31)	-1.60 (.43)	-.92 (.34)	-1.32 (.23)	-2.82 (.47)
Price Expectations	.07 (.02)	.16 (.04)	.30 (.06)	.18 (.05)	.24 (.03)	.19 (.04)
Conservation Expenditures	1.48 (.38)	2.47 (.46)	3.23 (.65)	2.47 (.48)	1.86 (.21)	1.57 (.23)
Conservation Reserve	.81 (.38)	1.70 (.60)	3.29 (1.54)	1.33 (1.06)	1.34 (.27)	1.40 (.27)
Fertilizer	3.43 (1.30)	2.52 (2.07)	.08 (.54)	.01 (.61)	.84 (.41)	.37 (.52)
Population Density	.30 (.66)	.75 (1.31)	-.30 (1.20)	.45 (.66)	1.00 (.61)	3.24 (.79)
Personal Income	-1.41 (.78)	-2.89 (1.63)	-7.85 (3.64)	.43 (2.87)	-3.04 (1.38)	5.28 (2.93)
R^2	.74	.73	.72	.73	.64	.80
Durbin-Watson Statistics	1.78	1.58	2.03	2.08		

[1] In the combined analyses the pasture acre equivalents are standardized using the following weights which are based on relative prices--North Dakota: .39, South Dakota: .53, Nebraska: 1.00, and Kansas: 1.12.

[2] Standard deviations are given in parentheses.

Price expectations--The estimated price expectation coefficients are significant at the .01 level. The indices of price expectations increased during the entire period, a little more than the national average except in North Dakota where the increase was less. Wheat is the dominant enterprise in North Dakota and Kansas. Beef production is important in all four states, but more so in South Dakota and Nebraska where corn and hog production is also rather large. Even though the pasture acre equivalent prices in this region vary from state to state and the coefficients therefore cannot be directly compared, the coefficients seem to indicate that in states where wheat is the predominant enterprise the price expectations have had less influence on land values than in states with mixed agriculture.

Conservation expenditures--From 1936 to 1961 the government subsidies to conservation in the Northern Plains as compared with the area of farm land, were much below average. Even when we consider the relatively low land values in the Northern Plains, the conservation subsidy per dollar value of land is below that paid in the southeastern part of the country. The conservation expenditures appear to be the single most important explanatory variable in the analyses of the Northern Plains. In North Dakota a large part of the conservation aid is used on temporary protection from erosion, and we would expect a lower coefficient. In South Dakota a large part of the conservation consists of measures to provide water for livestock. In Kansas and Nebraska the major emphasis is on measures to conserve or dispose of water; terraces and sod waterways are the most important single measures.

<u>Conservation reserve</u>--Participation of the Northern Plains in the conservation reserve program was high with North Dakota having particularly high participation. However, the estimated coefficient for North Dakota is rather low. This indicates a small absolute effect of the conservation reserve on the income stream to a pasture acre equivalent. However, considering the low value of land in North Dakota, the relative increase is large. The estimate suggests that about 25 percent of the land value increase in North Dakota during the 1955-62 period was due to the conservation reserve program.

<u>Acreage reserve</u>--Participation in the acreage reserve program was very large in 1957 but declined rapidly in 1958. Wheat was the main product affected, and Kansas received larger total payments in 1957 than any other single state. The variable was not retained in the final analyses since it was not significant but did give inter-correlation problems.

<u>Fertilizer</u>--The fertilizer variable was significant at the .05 level only for North Dakota and the combined analysis for all years.

<u>Population and income</u>--Population density was significant at the .10 level in the combined analyses. Personal income was significant at the .05 level with negative signs for three of the states. This indicates a decline in demand for land associated with increased personal income. The relatively high coefficient for Nebraska might suggest that off-farm employment is easier to obtain there than in North and South Dakota.

Mountain States

The large Mountain region was divided into two sub-regions[12] according to geographical and statistical differences. Tables 12 and 13 give the statistical results. The Mountain 2 region and Idaho show signs of positively autocorrelated disturbances and the dependent variables indicate some cyclical expectations not accounted for by the model. A strong business cycle indicator might be of value to explain some of this variation. However, the land values indicate low expectations during W. W. II and subsequent high expectations of the post war years. This cannot be explained by any of the usual business indicators.

In the combined analyses personal income and population density became significant where they were retained in the final analyses.

Value and quantity of land--The percentage increase in land values during the 1925-62 period were generally above the national averages. The absolute increases were low since the money value of a pasture acre equivalent is very low. Arizona and New Mexico had the largest relative increases, while Idaho and Nevada were somewhat below the national average.

All the Mountain states had increases in the quantity of land. The increases were continuous throughout most of the time period, but

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[12] The two regions are:
Mountain 1--Montana, Idaho, Wyoming, Colorado, and Utah
Mountain 2--New Mexico, Arizona, and Nevada

Table 12. Mountain 1: Results of Land Value Regressions, 1925-62

Variation	Individual States					Combined Analyses[1]	
	Montana	Idaho	Wyoming	Colorado	Utah	All Years	Even Years Only
Constant (time)	-.118 (.125)[2]	-.588 (.231)	-.198 (.096)	-.250 (.105)	-.222 (.159)	-.148 (.041)	-.318 (.102)
Price Expectations	.036 (.016)	.055 (.034)	.037 (.012)	.053 (.016)	.076 (.022)	.037 (.006)	.032 (.010)
Conservation Expenditures	1.549 (.503)	2.521 (.644)	1.446 (.357)	1.825 (.411)	1.752 (.430)	1.616 (.176)	1.472 (.224)
Conservation Reserve	4.536 (1.670)	2.131 (1.860)	4.910 (2.965)	1.448 (.725)	1.995 (1.329)	2.557 (.528)	3.101 (.872)
Acreage Reserve	-.222 (.684)	-.346 (.718)	-1.762 (2.449)	-.166 (.147)	-.187 (.661)	-.218 (.131)	.097 (.777)
Fertilizer	2.039 (2.830)	.176 (.498)	.805 (1.901)	1.623 (.968)	.829 (.620)	.793 (.347)	1.416 (.631)
Personal Income	.276 (.941)	4.357 (2.221)	.503 (1.016)	.831 (1.185)	.676 (1.514)	.649 (.394)	1.317 (.746)
R^2	.59	.63	.70	.77	.66	.64	.73
Durbin-Watson Statistics	1.68	1.45	1.65	2.21	1.99		

[1] In the combined analyses the pasture acre equivalents are standardized using the following weights which are based on relative prices--Montana: 1.00, Idaho: 2.53, Wyoming: .96, Colorado: 1.17, and Utah: 1.98.

[2] Standard deviations are given in parentheses.

Table 13. Mountain 2: Results of Land Value Regressions, 1925-62

Variation	Individual States			Combined Analyses[1]	
	New Mexico	Arizona	Nevada	All Years	Even Years Only
Constant (time)	-.118	-.218	-.381	-.193	-.469
	(.139)	(.162)	(.202)	(.076)	(.206)
Price Expectations	.034	.003	-.009	.008	.011
	(.014)	(.022)	(.019)	(.009)	(.013)
Conservation Expenditures	1.656	2.348	3.586	1.942	1.800
	(.516)	(1.485)	(1.012)	(.429)	(.593)
Conservation Reserve	-2.720	63.267	--	-3.345	-3.682
	(.865)	(40.008)		(.876)	(1.413)
Acreage Reserve	1.172	1.317	--	1.033	.839
	(.950)	(1.750)		(.815)	(1.458)
Output per Man-Hour	.093	.246	.005	.095	.065
	(.052)	(.076)	(.079)	(.031)	(.050)
Population Density	-.012	.090	1.389	1.027	1.748
	(.814)	(.445)	(2.225)	(.270)	(.481)
R^2	.61	.67	.40	.54	.63
Durbin-Watson Statistics	1.57	1.09	1.32		

[1] In the combined analyses the pasture acre equivalents were standardized using the following weights which are based on relative prices--New Mexico: 1.00, Arizona: .93, and Nevada: 2.04.

[2] Standard deviations are given in parentheses.

in the latter years increases were smaller and in some instances decreases actually took place. While Colorado had only a 17 percent increase for the period as a whole, other states had substantially higher increases. Idaho, Arizona and Nevada had increases between two and three hundred percent.

Constant term--The constants were negative in all the analyses and except for Montana and New Mexico, the coefficients were significant at the .10 level.

Price expectations--The price expectation indices were significant at the .05 level in the Mountain 1 analyses, except for Idaho. In Mountain 2 only New Mexico had a significant coefficient. Beef is a main enterprise in all the Mountain states. In Mountain 1, wheat is an important enterprise, and cotton is very important in New Mexico and Arizona.

The increases in price expectation indices over the time period were generally substantially larger than the increases in the U.S. agricultural price expectation index.

Conservation expenditures--Conservation subsidies for the region during the period 1936-61, considering the quantity of farm land, where relatively small. The main part of the conservation aid was spent on water conservation and a substantial amount was spent on measures to provide water for livestock. Some of the effects on land values brought about by irrigation measures would be accounted for in the measure of pasture acre equivalents, but such measures as terracing and leveling of land for efficient use of irrigation water would not be accounted for. The coefficients obtained show a strong correlation between land values and conservation subsidies.

Conservation reserve--Participation in the conservation reserve program is generally low in the Mountain region, and practically zero in Nevada. The highest participation is in eastern Colorado. The estimated coefficients are significant at the .10 level in Mountain 1 except for Idaho. The unreasonable results obtained for Mountain 2 states must be attributed to spurious correlation in connection with the small magnitude of the variable.

Acreage reserve--The acreage reserve variable was not significant in the analyses (except a negative significance in the combined analyses for Mountain 1). The participation in the program was low, both in acres and especially in money terms. The low acreage participation indicates that the rates which were offered in the Mountain states were not too attractive. In the Mountain 1 region, wheat was the only crop affected, while in the southern states mainly cotton acreages were reduced.

Fertilizer and output per man-hour--The fertilizer variable included in Mountain 1 was significant at the .05 level in Colorado and in the combined analyses. The output per man-hour which was included in Mountain 2, was significant at the .05 level in the combined analysis of all years and in the time series for New Mexico and Arizona.

Population and income--As mentioned earlier, the personal income and population density variables were significant only in the combined analyses. Due to intercorrelation problems, population density was not retained in the analyses of Mountain 1 and income was not retained in Mountain 2.

Pacific States

The statistical analyses of the Pacific States were presented in Table 14 and a reasonably good fit is indicated. However, the D.W. statistics for California indicates serially correlated disturbances at the .01 level of significance. Like some of the Mountain and Northeastern states, California land values seem to be influenced by expectations generated outside the state itself. For California this is further underlined by the fact that the population density is the most important single variable.[13] The behavior of land values during the years of and immediately following World War II makes the business cycle indicators insufficient as explanations of the cyclical variation.

Neither of the combined analyses showed a higher degree of multiple determination than the lowest single state analysis. The modest increase in the multiple correlation coefficient due to time aggregation suggests small random errors in the variables.

Value and quantity of land--In the Pacific region, the percentage increase in land values was about equal to the U.S. average increase. However, on a state basis the increase in California was substantially above the increases in Oregon and Washington. If we consider the period 1940-62 only, the differences between California and other states would become even more pronounced, indicating larger falls in the California land values during the depression of the thirties.

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[13] When population density was deleted from the California analysis, R^2 fell to .53.

Table 14. Pacific States: Results of Land Value Regressions, 1925-62

Variation	Individual States			Combined Analyses[1]	
	Washington	Oregon	California	All Years	Even Years Only
Constant (time)	-.53 (.28)[2]	-.33 (.20)	-3.76 (.91)	-.99 (.21)	-2.00 (.58)
Price Expectations	.14 (.04)	.09 (.02)	.11 (.09)	.12 (.02)	.12 (.04)
Conservation Expenditures	2.57 (.61)	2.37 (.52)	2.58 (2.09)	2.52 (.41)	2.40 (.58)
Conservation Reserve	.19 (1.60)	-1.28 (1.71)	3.44 (19.02)	.57 (1.42)	.82 (2.26)
Acreage Reserve	-.47 (.54)	-2.63 (1.08)	.05 (1.68)	-.26 (.52)	.85 (3.04)
Fertilizer	-.52 (.29)	1.81 (.50)	.91 (.37)	.44 (.20)	.65 (.36)
Population Density	.30 (.30)	-.73 (.56)	2.11 (.47)	.77 (.11)	.77 (.16)
R^2	.68	.72	.72	.61	.67
Durbin-Watson Statistics	1.84	1.59	1.21		

[1] In the combined analyses, the pasture acre equivalents were standardized using the following weights which are based on relative prices--Washington: 1.00, Oregon: .68, and California: 1.84.

[2] Standard deviations are given in parentheses.

The number of pasture acre equivalents in California and Washington increased over the entire period about 50 percent, while the increase in Oregon was 26 percent. These increases were continuous.

The USDA average value per acre indices for the Pacific states showed increases in land values which were substantially above the U. S. average increase. The disagreement between these indices and the value per pasture acre equivalent series used here is mainly due to the large increase in irrigation. Increased acreage of irrigated land increases the number of pasture acre equivalents and subsequently affects the change in their average value.

Constant term--The constants were negative and significant at the .05 level. For California the negative constant takes a relatively large value. This might inflate the estimated population density coefficient, because the population density has been continually increasing, though not at a constant rate.

Price expectations--The price expectation indices increased over the 1925-62 period a little less than the U.S. index of expected agricultural prices. Beef and dairy are important enterprises in all three states. Wheat gives a large part of total farm revenue in Washington and Oregon, while fruits, vegetables and cotton are important for California agriculture. The coefficients were significant at the .01 level except for California.

Conservation expenditures--Conservation payments during the 1925-61 period when compared with farm land area, were somewhat below average for the U.S. The main part of the conservation aid was used for measures to conserve or dispose of water. As for the Mountain states, the quantity measure of land does not take into account all the different conservation measures related to irrigation, and there is generally a high correlation between land values and conservation expenditures. However, the California coefficient is not significant.

Soil bank--The soil-bank variables were not significant in the analyses of the Pacific region. The participation in the program was relatively small for the region.

Fertilizer--The fertilizer variable is significant at the .05 level in all the analyses. The Washington coefficient deviates by having a negative sign, but it contributes little to the analysis.

Population and income--Population density, which was highly important in the California analysis, was also highly significant in the combined analysis. Due to intercorrelation problems, income was not retained in the analysis.

Conclusions

The selected variables used in the statistical model generally explained a major part of the variation in land value changes. The first difference model gave, for the significant coefficients, the signs which generally would be expected from an economic point of view. The assumption of independent disturbances could be accepted in most of the analyses. Positive autocorrelation was indicated for a few states, of which most had a low multiple correlation coefficient. A low Durbin-Watson statistic, indicating positive serial correlation of disturbances, was in many cases caused by the World War II and postwar years. The pessimistic expectations, indicated by the small increases in land values, during the war years were followed by high expectations in the postwar years.

The combined time series and cross-sectional analyses gave a decrease in the coefficient of multiple determination. This implies some heterogeneity in the variables among states. The significance of the coefficients increased substantially in the combined cross-sectional and time series analyses as compared with time series alone. A large increase in the coefficient of multiple determination was brought about by aggregating the first differences over two year periods. This indicates some random variation in the variables. At the outset of this chapter it was argued that random variation in the independent variables would be alleviated by the number of variables. The random variation eliminated by time aggregation must therefore originate mainly in the dependent variable. The time aggregation gave in some cases multicorrelation problems and subsequently less significance of the coefficients.

All the independent variables listed in Table 1 were significant at one point or another in the explanation of land value changes. Price expectations and conservation expenditures were significant in almost all the analyses, and they explained a major part of the changes in land values. The conservation reserve variable was generally significant in the areas where substantial payments were made through the program, while the acreage reserve variable had less impact on land values and did not show any significant impact in some areas where large payments were made under the program. The output per man-hour variable was highly significant where it was retained. Fertilizer and output per acre gave best results in the combined analyses. Population density and personal income also gave the best results in combined analyses, but personal income was generally of little importance.

The regional discussions suggested that among regions there is a rather close relationship between the relative increase in land values and the relative change in or the size of the explanatory variables. This will be analyzed and discussed in the next chapter. The regional difference in the estimated coefficients will also be discussed in the following chapter.

CHAPTER VI

COMPARISON AMONG REGIONS

The analyses presented in the previous chapter focussed on the significance of several variables as related to the variation in value of land. Differences among states within the defined regions were discussed. In this chapter the major emphasis is on inter-regional differences. The chapter consists of three parts; one in which the estimated coefficients are compared among regions, another in which the magnitude of change in the variables is compared among regions, and a third part which combines the effects of coefficient size with magnitude of change.

Regional Differences in the Estimated Coefficients

Coefficients would be expected to differ among regions for the same reasons as they differed among states within a region. The aggregate variables are built from dissimilar components, and these components do not enter into the aggregate variable in constant proportions among states or regions. For example, the most important influence on agricultural price expectations in one state might be tobacco prices while cotton prices would have a major influence in a neighboring state. Similarly, the kind of conservation practices carried out differ among areas. Interregional differences which will be discussed in the following pages are generally larger than the intraregional differences.

Price Expectations

The price expectation indices are obtained by aggregating the individual commodity indices. The weight of a given commodity index varies with the commodity's importance, in relation to gross farm sales, in the different areas.[1] For areas close to each other the vectors of weights will generally be much alike. More distant areas have, in general, substantial different weight vectors.[2] This heterogeneity among regions is likely to result in different coefficients for price expectations. For instance, we would expect a more direct relationship between wheat prices and land values than between dairy prices and land values.

The coefficients for price expectations are given in Table 15. The coefficients are given for 13 regions and 11 selected states. In each of the selected states, a single commodity price index plays a major role in calculating the aggregate price expectation index for the state. The importance of a single commodity price expection index is given in parantheses behind the commodity (Column 4). For example, in Maine the revenue from potato sales constitutes 54 percent of the total revenue from the 13 commodities for which price expectations are available. In computing the aggregate index for Maine the potato

[1]See Appendix C.

[2]The heterogeneity is not a function of distance alone. For instance, due to climatic changes a distance along longitudes will be likely to give more heterogeneous vectors than would the same distance along latitudes.

Table 15. Regional Coefficients for the Price Expectations

Region	Estimated coefficient (1)	1940 value of a pasture acre equiv. $ (2)	Adjusted coefficients col.1x100 / col. 2 (3)	Products yielding a major part of farm income (4)
Southeast (excl. Fla.)	.205***	15.53	1.32	cotton, hogs, tobacco
Appalachia	.231***	28.59	.81	tobacco, dairy
Northeast 1	.160***	21.80	.73	dairy, eggs
Northeast 2	.217***	49.54	.44	dairy, eggs
Northeast 3	.080***	8.24	.97	dairy, potatoes
Lake States	.170***	22.03	.77	beef, dairy, hogs
Corn Belt	.425***	39.35	1.08	corn, beef, hogs, dairy
Delta States	.225***	21.64	1.04	cotton
Southern Plains	.161***	11.96	1.34	wheat, cotton, beef
Northern Plains	.237***	15.11	1.57	wheat, beef
Mountain 1	.037***	3.24	1.14	beef, wheat, dairy
Mountain 2	.008	3.00	.27	beef, cotton
Pacific	.123***	12.19	1.01	all commodities
Selected States:				
Maine	.170***	12.97	1.31	potatoes (54%)
North Dakota	.074***	5.87	1.24	wheat (47%)
Arkansas	.267**	21.64	1.23	cotton (45%)
Wyoming	.037***	3.12	1.19	beef (63%)
Vermont	.086***	7.94	1.08	dairy (72%)
Mississippi	.156**	15.38	1.01	cotton (53%)
Iowa	.471***	49.40	.95	hogs (42%)
New Hampshire	.075*	8.24	.91	eggs (36%)
Kentucky	.269***	30.65	.88	tobacco (32%)
Florida	.070	23.19	.30	oranges (40%)
North Carolina	.052	28.59	.18	tobacco (50%)

*** Significantly different from zero at the one percent level.

** Significantly different from zero at the five percent level.

* Significantly different from zero at the ten percent level.

price expectation index has a weight of .54 (out of 1.00). The regional coefficients in column 1 are those estimated in combined cross-sectional and time series analyses including all years.[3] The state coefficients in column 1 are those estimated from time series as presented in Chapter V. The coefficients are not directly comparable since they are obtained by regressing series of land values at very different levels in terms of price per pasture acre equivalent on price expectation indices at the same level. The 1940 land values, given in column 2, are used to adjust the estimated coefficients.[4] The adjusted coefficients given in column 3, express the impact of a one point change in price expectations on a unit of land worth $100 (1940 values).

The adjusted regional coefficients show that changes in price indices of wheat, cotton, and beef tend to have a larger influence on land values than do changes in egg and dairy prices. This would be expected, since the latter group requires relatively larger amounts of rather fixed non-land inputs. Changes in returns, which would affect the MVP's of fixed inputs, would be distributed over all such inputs. Thus the change in returns to one such input would tend to be

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[3] The analyses including all years were chosen in favor of those with increased time aggregation, because in the latter, multicorrelation problems were encountered in some cases.

[4] The method is essentially the same as that used in order to combine states in regional analyses. In the combined analyses the numbers of pasture acre equivalents were adjusted according to relative land prices, thus changing the value of land series before the regression. Here the coefficients are adjusted after the regression.

smaller with an increasing ratio of fixed inputs to total inputs.

The adjusted coefficients from the selected state analyses give essentially the same picture as do the regional analyses, namely that wheat, cotton, and beef coefficients are larger than egg and dairy coefficients. However, potato prices, which do not have a large influence on any single region, have the highest coefficient in the comparison among states. Tobacco and cotton were represented by two states each because the coefficients estimated for North Carolina and Mississippi, respectively, deviated from the general level of the coefficients estimated for other states where these enterprises were prominent. Nevertheless, the results would seem to suggest that tobacco prices have a smaller influence on land values than do other crop prices.

Conservation Expenditures

The conservation expenditure variable consists of the government subsidy payments for agricultural conservation. The conservation measures vary among regions, and to the extent that the varying practices result in different returns to land, the estimated coefficients would be expected to vary among regions.

The estimated coefficients are given in Table 16. Assuming that a dollar spent on conservation of low value land adds as much to land value as does a dollar spent on high value land,[5] the coefficients

[5] This is implicitly assumed in the linear relationship over time. However, the variation in land values over time is much less than the variation among areas. For price expectations the linear relationship could hardly be extended over regions with widely varying land productivity, but the conservation payments are expressed as dollars per land unit and an extension of the linear relationship seems reasonable.

Table 16. Regional Coefficients for Conservation Expenditures

Region	Estimated Coefficient	The main conservation practices carried out
Southeast (excl. Fla.)	1.04[1]	establishing permanent cover
Appalachia	.95	establishment and improvement of cover; drainage
Northeast 1	.42	establishment and improvement of permanent cover; drainage
Northeast 2	1.39	establishment and improvement of permanent cover; drainage
Northeast 3	.57	establishment and improvement of permanent cover; drainage
Lake States	.84	establishment of permanent cover; drainage
Corn Belt	.37	lime, phosphate, drainage
Delta States	1.28	establishment and improvement of permanent cover; drainage
Southern Plains	1.35	controlling shrubs; permanent cover
Northern Plains	1.86	water conservation and disposal; temporary cover
Mountain 1	1.62	water conservation and disposal
Mountain 2	1.94	water conservation and disposal
Pacific	2.52	water conservation and disposal

[1] All the coefficients are significantly different from zero at the one percent level.

are directly comparable. The coefficients indicate that a dollar spent on water conservation in the Pacific, Mountain or Northern Plains region increased land values more than if spent on the typical conservation practices in the eastern and southern states. For example, 10 cents spent on conservation increases land values in the Northern Plains by $1.86, while in the Southeast it increases land values by $1.04. Apart from the suggestion that water conservation increases land values more than other conservation practices, no general conclusions about the conglomerate of conservation practices can be derived from Table 16. The high coefficient in Northeast 2, as compared with other northeastern regions, does not seem to have any apparent explanation.

Most of the coefficients are much higher than what can reasonably be expected to be the influence of government subsidized conservation practices on land values. If land values increased with the full amount of the conservation investments and the government subsidy amounts to 50%, we would expect the coefficient to be .2.[6] Since most of the estimated coefficients are much above .2, some other explanation is necessary.

It is likely that the MVP of expenditures for conservation practices is somewhat above the cost of conservation, and thereby

[6] The conservation variable is entered as $.1/pasture acre equivalent. If the value of land increases with the amount of government expenditures on conservation, the coefficient should be .1.

increases the estimated coefficients. Another, and probably more important reason for the high coefficient, is that the amount of conservation carried out with government funds is highly correlated with the total investment in agricultural conservation practices. Also, as has been mentioned previously, there was generally a high correlation between the conservation variable and the output per man-hour variable. Since, for this reason, the output per man-hour variable was in most cases omitted from the final analyses, the estimated coefficient for conservation has most likely measured some of the impact of technological change.

Also in some analyses, intercorrelation between conservation expenditures and the constant term could lead to overestimated conservation coefficients. In the Corn Belt high negative constant terms were generally associated with high coefficients for the conservation variable. However, in the regional comparisons there was little correlation between coefficients for conservation expenditures and constant terms. The effects of eliminating the constant term were tested, and most of the coefficients, including the conservation coefficients were depressed somewhat. However, simultaneously the coefficients of multiple correlation fell, the significance of the coefficients fell, and the sum of the residuals was negative.

In summary, there is no doubt about the strong relationship between conservation payments and land values. However, the conservation coefficients might be biased upward because they estimate effects of conservation expenditures not measured directly by the variable, and because they might to some degree estimate effects of technological change.

Soil Bank Variables

The conservation reserve part of the soil-bank program has, as indicated by the estimated coefficients, had the major impact on land values. The coefficients for the conservation reserve part of the program were generally much larger than those for the acreage reserve payments. This could be due partly to the longer term contracts for the conservation reserve program, the different nature of the programs, or it could be because conservation reserve program payments, relative to opportunity costs, were greater than acreage reserve program payments.

Some of the difference in performance of the soil bank variables might be associated with specification problems. The specification of both soil bank variables is based on the assumption that the rates paid per acre and the number of acres contracted for the soil bank influence land values.

An alternative specification would be to let land values be a function of the level of average rates paid. The underlying assumption would be that the MVP of all land changes proportionately with the change in average rates paid.

A third way to enter the soil bank variables would be to specify the variables as being the contracted acreages. This specification, which was tried in some initial analyses, explained less of the land value variation than did the specification used throughout the study.

The chosen specification is a combination of contracted acreages and rates paid per acre. This specification seems superior to using

the contracted acreage alone, but has not been comparatively tested with rates paid per acre.

Conservation Reserve--The regional estimates of the soil bank variables are compared in Table 17. The conservation reserve coefficient for the Corn Belt is more than double those for other regions. The data show that the Corn Belt had a large participation in the program and the rates paid per acre were substantially above the national average rates.[7] High rates per acre would be expected in the Corn Belt to attract high value land into the program. However, an understanding of the high coefficient would seem to require that the difference between rates paid and opportunity costs must have been higher in the Corn Belt than in other regions.

The Northern Plains also had relatively high participation in the program, but the estimated coefficient is low, apparently indicating a much smaller difference between conservation reserve payments and opportunity costs for the land input.

Low, but less significant, coefficients were also obtained in the Northeast and the Pacific regions. The negative coefficient for Mountain 2 must be attributed to spurious correlation in connection with the very low participation in the program. Except for the Corn Belt and the Northern Plains the positive coefficients significant at the .01 level, were in the range 2.0 to 3.0 indicating a rather stable change

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[7]In 1960 the average rates paid in the Corn Belt were 17-18 dollars per acre. The U.S. average was 11.85 per acre.

Table 17. Regional Coefficients for Soil Bank Variables

Region	Estimated Coefficients: Conservation Reserve	Estimated Coefficients: Acreage Reserve	Main crop allotments reduced by the acreage reserve program
Southeast (excl. Fla.)	2.15***	.06*	cotton
Appalachia	2.46***	.28***	tobacco, corn
Northeast 1	.72*	.29**	tobacco, corn wheat
Northeast 2	.85	--	tobacco, corn
Northeast 3	.71*	--	tobacco
Lake States	2.10***	.63***	corn, wheat
Corn Belt	6.06***	.80***	corn
Delta States	2.85***	.12*	cotton, rice
Southern Plains	2.18***	-.07	cotton, wheat
Northern Plains	1.34***	--	wheat
Mountain 1	2.56***	-.22**	wheat
Mountain 2	-3.35***	1.03	cotton
Pacific	.57	-.26	cotton, rice, wheat

***Significantly different from zero at the one percent level.

** Significantly different from zero at the five percent level.

* Significantly different from zero at the ten percent level.

in land values (among regions) for a dollar spent in the conservation reserve program. For example, a coefficient on 2. 5 would mean that land values increased 25 dollars per dollar change in conservation reserve payments. The stability implies that land value increases due to the conservation reserve program are almost proportionate to the payments received by states or regions.[8]

Acreage Reserve--The payments of the one year contracts for land in the acreage reserve have had less impact on land values. Since the program was in effect three years only, it turned out to be wise not to capitalize much of its benefits into land values. The coefficients do suggest that the payments made for reduction of corn allotments were high relative to alternative opportunities for land, since they had the largest significant influence on land values.

Efficiency and Input Variables

Output per man-hour--The output per man-hour variable was included in the analyses because it was expected to provide a better measure of technological advances in agriculture than would the usual forms of a time variable. As pointed out earlier, the variable measures changes in efficiency associated with increased output per acre and with the use of labor-saving machinery.

The output per man-hour variable was generally highly correlated with land values, but the variable was in several instances deleted from the final analyses because of intercorrelation problems with conservation expenditures. Where the output per man-hour

[8]Some losses have also occurred due to decline in payments during the latter years.

variable was deleted, either fertilizer use or output per acre was included. The variable which caused least multicorrelation problems and was most significant was retained. Generally, the substitute variables had a lower simple correlation with land values than did output per man-hour.

Table 18, column 1, gives the output per man-hour coefficients for the regions in which the variable was retained. For comparison among regions, the coefficients are adjusted (column 2) in a manner similar to that for the price expectations variable. The adjusted coefficients suggests that a change in the index of output per man-hour of one index point would have relative more effect on land values in the Mountain 2 states and less in the Lake States. The enterprises with heaviest weights in the index for Mountain 2 are beef and cotton, while in the Lake States index dairy and feed grains weight heaviest. This could imply that efficiency changes in the beef and cotton production have relatively larger effects on land values than do efficiency changes in dairy and feed grain production.

Output per acre--The estimated and adjusted coefficients for the output per acre variable are given in Table 18, columns 3 and 4. The variable was retained in five regions and was significant at the .05 level for the Southeast, Appalachia, and Northeast 3. The variable fluctuated less violently in the eastern regions than in other parts of the country. Some of the fluctuation in the indices of output per acre was alleviated by using a three year moving average.

The significant coefficients suggest that changes in output per acre have a relatively small effect on land values in Appalachia. The

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Table 18. Regional Coefficients for Efficiency and Input Variables

Region	Output per man-hour coefficient		Output per acre coefficient		Fertilizer use coefficient
	Estimated (1)	Adjusted[1] (2)	Estimated (3)	Adjusted[1] (4)	
Southeast (excl. Fla.)			.21***	1.35	
Appalachia			.22***	.77	.17***
Northeast 1	.58***	2.66			
Northeast 2			.16	.32	
Northeast 3			.09**	1.09	
Lake States	.29***	1.32			
Corn Belt					.63***
Delta States			.06	..28	
Southern Plains					.84***
Northern Plains					.84**
Mountain 1					.79**
Mountain 2	.10***	3.33			
Pacific					.44**

[1] The adjusted coefficients give the change per $100 land value (1940 values) brought about by a one index point change in the independent variables. The adjustments are similar to those used for price expectations in Table 15.

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fertilizer use variable was also included in the Appalachian analysis, but this has probably not affected the output per acre coefficient as the two variables had a low intercorrelation (-.07).

Fertilizer use--Table 18, column 5, gives the regional coefficients for the fertilizer use variable. Since the variable was entered in the analyses as tons of commercial fertilizer per thousand pasture acre equivalents no adjustment among regions was required. The variable was significant at the .01 level in the Appalachian, the Corn Belt, and the Southern Plains. It was significant at the .05 level in the Northern Plains, Mountain 1, and the Pacific.

The coefficients indicate that fertilizer use has had the largest impact on land values in the Southern Plains, Northern Plains and Mountain 1 regions.

Population Density and Income

The coefficients for population density and personal income varied greatly between regions (Table 19).

Population density--A unit change in population density has had least influence in heavily populated states such as those in Northeast 1 and 2, and in the Corn Belt. The coefficients for less densely populated areas are higher. The highest coefficients were obtained for Florida and California, both states with large absolute and relative increases in population. The varying sizes of the coefficients might suggest that the relationship between land values and population density is nonlinear. However, since the differences in population density among regions are generally much larger than the differences occurring within regions during

Table 19. Regional Coefficients for Population Density and Income

Region	Estimated coefficients: Population Density	Personal Income[1]
Southeast (excl. Fla.)	.02	--
Appalachia	.31**	--
Northeast 1	.05	-.21
Northeast 2	.08**	3.29
Northeast 3	.17	-.64
Lake States	.21*	7.07***
Corn Belt	.002***	--
Delta States	.76**	-5.04
Southern Plains	.28*	--
Northern Plains	1.00*	-3.04**
Mountain 1	--	.65**
Mountain 2	1.03***	--
Pacific	.77***	--
Florida	2.17***	--
California	2.11***	--

[1] A two sided significance test is used for personal income.

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the investigated time period, the assumption of linearity within regions does not seem unreasonable.

Personal income--In general, the personal income variable was not important in the analyses. However, as discussed under the respective regions in Chapter V, it was a rather important variable in the Northern Plains and in the Lake States.

The income variable was in several instances deleted from the final analyses because of its intercorrelation with the price expectations variable. In such cases, the price expectation coefficients might include some of the effects due to changing income.

As discussed earlier, income would probably have a positive effect on land values in areas with large urban communities. In other areas income increases in the non-farm economy might be associated with increased migration away from rural areas and, thus, have a negative effect on land values. It is possible that in some areas, the two opposite effects have offset each other and resulted in an insignificant income coefficient.

Constant Terms

The constant term in an analysis of first differences estimates the changes in land values over time given no change in the other independent variables. The regional constant terms and adjusted constant terms are given in Table 20. The adjusted coefficients show the yearly change in land values per $100 of land value measured in 1940 dollars. All the significant coefficients are negative and range, when adjusted, from -3.00 in the Delta States to -8.75 in the Northern Plains. The reason for a

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Table 20. Regional Constant Terms (time)

Region	Constant term	Adjusted Coefficient[1]
Southeast (excl. Fla.)	-.87***	-5.62
Appalachia	-1.59***	-5.58
Northeast 1	-.72***	-3.30
Northeast 2	-.42	-.84
Northeast 3	-.37***	-4.55
Lake States	-1.71***	-7.92
Corn Belt	.14	.35
Delta States	-.67*	-3.00
Southern Plains	-.29	-2.44
Northern Plains	-1.32***	-8.75
Mountain 1	-.15***	-4.50
Mountain 2	-.19***	-6.07
Pacific	-.99***	-8.05

[1] The adjusted coefficients give the yearly change per $100 land value (1940 values) with no change in other independent variables.

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positive and non-significant coefficient for the Corn Belt seems to be due to intercorrelation problems in the combined analyses of the Corn Belt. The constant terms in the individual state analyses of the Corn Belt were negative and generally significant.

The constant terms measure the effect of variables which individually or combined have a constant effect on land values. The constant terms would probably estimate some of the effects on land values of erosion and soil depletion.

Magnitude of Change in Variables

In the introductory chapter some attention was given to the differences in relative land value increases among regions and states. That discussion was based on indices of average farm real estate value per acre as published in Farm Real Estate Market Developments. The series of land value per pasture acre equivalent used in this study show generally the same trends as those indices. However, the series for the Pacific and the Northeastern regions give, respectively, much less and much more increase in land values than do the indices of average value per acre. This is due to the quantity measure of farm land used in this study, namely pasture acre equivalents. The large increases in irrigation of previously unirrigated land in the Pacific region increased the number of pasture acre equivalents rapidly toward the end of the time period and subsequently reduced the relative land value increase. In the Northeast, the decrease in acreage of the land component with the lowest per acre value (other land) was relatively smaller than the decreases in acreages of other land components.[9]

[9] See Appendix A.

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This caused the series of pasture acre equivalents to decrease relatively faster than the acres of farm land. Subsequently, the relative increase in land value, as portrayed by the series of value per pasture acre equivalent, is larger than the relative increase in the indices of average value per acre.

The relative increase in the value of a pasture acre equivalent 1925-62, is given by region in Table 21, column 1. Relative changes in and relative importance of related variables are also given in the table.[10] The relationship between land values and the included variables was discussed in Chapter V. The estimated coefficients varied for different parts of the country, indicating that even equal long run changes in the independent variables would lead to differences in land value increases. However, Table 20 shows that there are rather large quantitative variations among regions in the changes in or the size of a given variable. The regions are arranged in two groups according to relative land value increases. Generally the largest numerical values of column 2 through 6 are found in the upper five rows which contain the regions with largest land value increases. A crude test of this proposition is supplied by the sum of ranks. The average sum of ranks for the upper five rows is considerably lower

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[10]The output per man-hour variable is, as the most successful, taken to represent the three efficiency and input variables. The acreage reserve payments are not included since the program is terminated and its total effect in the analysis therefore is neutral. Personal income was excluded because it was not found to be important in this study.

Table 21. Relative Changes in and Average Size of Selected Variables by Region, 1925-1962

	Ratios 1962/1925:	Average Amount ($)	Sum of Ranks:

Table 21. Relative Changes in and Average Size of Selected Variables by Region, 1925-1962

Region	Ratios 1962/1925:				Average Amount ($)		Sum of Ranks:	
	Land Value (1)	Price Expect. (2)	Output per man-hour (3)	Population (4)	Conservation Expenditures (5)	Change in Conserv. Reserve (6)	By Region (7)	Group Average (8)
Southeast (excl. Fla.)	5.40	1.67	3.28	1.39	1.38	.133	19.0	
Delta States	4.75	1.52	3.61	1.30	1.02	.044	37.0	
Southern Plains	3.59	1.66	3.12	1.67	.59	.049	31.5	31.9
Mountain	3.49	1.84	2.69	2.13	.56	.034	39.5	
Appalachian	3.31	1.90	2.72	1.46	.93	.034	32.5	
Pacific States	3.02	1.60	2.93	3.13	.28	.013	54.0	
Northeast	2.78	1.49	3.12	1.47	.96	.035	41.5	
Corn Belt	2.24	1.65	2.88	1.43	.54	.027	53.0	45.1
Lake States	1.86	1.64	3.09	1.62	.64	.058	37.0	
Northern Plains	1.79	1.65	3.16	1.12	.58	.087	40.0	

Notes:

Column 5 and 6 - Average amount of conservation expenditures and conservation reserve payments, respectively, per $100 of land value (1940 value).

Column 7- Sum of the ranks of column 2 through 6. Each column was ranked from 1 to 10 giving rank 1 to the largest and rank 10 to the lowest figure. Due to the larger importance of price expectations and conservation payments, as established in the regression analyses, their ranks are counted twice.

Column 8 - Average sum of ranks for two groups of regions, one with large land value increases, and the other with smaller land value increases.

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than the average sum for the group with lower relative land value increases. This implies that the relative changes in the variables have been largest for the group with large land value changes.

For individual regions, the very low sum of ranks for the South East indicates that this region has had rather large relative increases in all the variables. Some of the variation in the sum of ranks is due to the inability of the ranking method to distinguish between large and small changes. Thus, the high rank sum for the Delta region is much influenced by its high rank for price expectations. However, the increase in its price expectations is not much below the U. S. average.

The two regions with the largest relative changes in land values also had the largest relative changes in the output per man-hour variable and received the largest government conservation subsidies. Both regions also have high participation in the conservation reserve program. The largest changes in price expectations occurred in the Appalachian and the Mountain regions. With the exception of Florida, relative population changes were largest in the Pacific region, but other variables had high ranks in this region.

The relatively low sums of ranks for the Lake States and the Northern Plains need some explanation. In the Lake States the land values have not increased as much as in other regions, with a similar sum of ranks, because the price expectation and conservation variables had relatively low coefficients (as statistically related to land values). In the Northern Plains the stagnating population density and the

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and the negative relationship between land values and income have had dampening effects on land value increases.

Sources of Increased Land Values

Table 22 lists the estimated sources of land value increases by region. The estimated changes in land values due to trend factor and specified factors are obtained by applying the regional coefficients to the changes in the variables. For example, in the Southeast, the price expectation coefficient was .205 and the increase in the price expectation index was 41.7 index points resulting in a $8.6 increase in the value of a pasture acre equivalent due to price expectations.

In the Southeast, the actual increase in value per pasture acre equivalent amounted to $91.5. The estimated change due to the trend factor and the specified factors amounted to $-32.2 and $123.6, respectively. Due to errors in the estimates, the sum of the estimated changes deviates slightly from the actual change. The increase due to specified factors is distributed as follows--Price Expectations: $8.6 or 7.0% of total change due to specified factors, Conservation Expenditures: $82.4 or 66.6%, Conservation Reserve: $16.4 or 13.3%, Population Density: $.4 or .3%, and Output per Acre: $15.9 or 12.9%. Data for other regions are interpreted similarly.

The actual land value increases per pasture acre equivalent were largest in Northeast 2, the Corn Belt, and the Delta States. The Mountain States and Northeast 3 had the smallest land value increases.

Table 22. Estimated Sources of Land Value Increases by Region, 1925-1962

Region	Actual change $/pae[1]	Estimated Change		Change ($ figure on	
		Trend Factor $/pae	Specified Factors $/pae[2]	Price Expect.	Conserv. Expend.
Southeast (Excl. Fla.)	91.5	-32.2	123.6	8.6	82.4
				7.0	66.6
Appalachia	82.1	-58.5	140.8	11.6	94.3
				8.2	67.0
Northeast 1	66.6	-26.8	93.6	5.5	30.5
				5.8	32.6
Northeast 2	145.1	-15.4[a]	160.6	6.8	120.5
				4.2	75.0
Northeast 3	23.2	-13.3	36.8	2.3	28.5
				6.3	77.4
Lake States	40.5	-63.3	103.6	6.5	43.5
				6.3	42.0
Corn Belt	123.9	5.1[a]	116.1	19.7	36.1
				17.0	31.1
Delta States	103.7	-25.1[a]	128.4	8.0	104.4
				6.2	81.3
Southern Plains	43.3	-10.7[a]	53.9	6.7	35.4
				12.4	65.7
Northern Plains	29.7	-48.5	78.2	9.5	61.2
				12.1	78.3
Mountain 1	11.1	- 5.5	16.5	1.7	11.9
				10.3	72.1
Mountain 2	15.3	- 7.0	22.4	.4[a]	10.7
				1.8	47.8
Pacific	33.0	-36.7	69.5	4.8	31.9
				6.9	45.9

[1] pae = pasture acre equivalent.

[2] Estimated change from specified factors = actual change - trend factor - residual.

[a] The coefficient used to estimate this figure was not significant at the .05 level.

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top, % of total change due to specified factors on bottom)

Conserv. Reserve	Population Density	Personal Income	Output per Man-Hour	Output per Acre	Fertilizer Use
16.4	.4[a]			15.9	
13.3	.3			12.9	
8.7	8.1			11.6	6.6
6.2	5.8			8.2	4.7
2.5[a]	5.6[a]	- .4[a]	49.8		
2.7	6.0	- .4	53.2		
1.3[a]	18.4	6.2[a]		7.4[a]	
.8	11.5	3.9		4.6	
1.3[a]	1.7[a]	-1.0		4.0	
3.5	4.6	-2.7		10.8	
9.9	7.2[a]	11.9	24.7		
9.6	6.9	11.5	23.8		
29.8	.1				30.4
25.7	.1				26.2
10.1	9.5	-6.2[a]		2.5[a]	
7.9	7.4	-4.8		1.9	
4.8	3.1[a]			4.0[a]	
8.9	5.8			7.4	
6.4	1.8[a]	-5.4			4.7
8.2	2.3	-6.9			6.0
1.1		1.1			.7
6.6		6.6			4.2
-1.2	5.9		6.6		
-5.4	26.3		29.5		
.3[a]	28.7				3.8
.4	41.3				5.5

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Among regions the price expectations had the largest absolute and percentage influence on land value increases in the Corn Belt. This is mainly due to the high coefficient which seems related to high land productivity. The relatively large influences of price expectations on land values in the Southern and Northern Plains is mainly due to the high price expectation coefficients for these regions.

Generally, the major source of land value increases is associated with the conservation variable. Only in Northeast 1 did the increase in land values due to the output per man-hour variable exceed the increase due to conservation. Some intercorrelation existed between these variables and the percentage of increased land values due to conservation seems to be depressed somewhat when the output per man-hour is retained in the analyses. This substantiates the belief that the conservation coefficients measures some of the impact due to efficiency changes. As discussed earlier, it appears that the relatively small part of land value increases in the Corn Belt which are explained by the conservation expenditure variable is due to intercorrelation problems between the conservation expenditure variable and the constant term.

The conservation reserve program has, according to the estimates, had substantial impact on land value increases in most of the regions. The largest influence was in the Corn Belt and in the Southeast. The conservation reserve had little impact on land value increases in the Northeastern and Pacific regions. The negative impact estimated for Mountain 2 is probably due to spurious correlation in connection with little participation in the program.

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Increased population density had a major impact on land values in the Pacific region.[11] The Pacific region had a large coefficient for, and a large change in population density. Mountain 2 and Northeast 2 had lower coefficients for population density, but with the large population increases, population changes are estimated to have caused large increases in land values.

Personal income is estimated to have caused substantial land value increases in the Lake States and some decreases in the Northern Plains.

Output per man-hour is estimated, where it was retained, to have had a large impact on land value increases. The changes in output per acre and fertilizer use variables are also estimated to have increased land values. The fertilizer use variable had a large impact in the Corn Belt.

In summary then, the analysis of sources of increased land values suggests that a large part of the increase which occurred was caused by conservation expenditures or factors strongly correlated with the conglomerate of expenditures defined as being related to conservation. The change in land values associated with the efficiency and input variables was substantial. Price expectations also appeared to cause land value increases in all regions. The conservation reserve program, population density and personal income were other variables which had a definite impact on land values in particular regions.

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[11] The impact of population density on land values in Florida has been pointed out earlier. Florida was excluded from the combined analysis of the Southeast.

CHAPTER VII

CONCLUSIONS AND IMPLICATIONS

There were two major objectives of this thesis. One was to delineate factors, including government programs, which have caused a major part of the variation of and relative increase in land values. Another objective was to investigate the causes of regional variation in land value increases.

The difference model of first order employed in the analyses generally yielded coefficient signs consistent with the usual economic expectations. Also, multicollinearity and serial correlation problems were reduced by using first differences. With respect to the use of original data, initial analyses indicated that the strong trends in these data would produce many "wrong" signs.

Combined time series and cross-sectional analyses for regions increased the significance of the estimated coefficients as compared with individual state time series analyses. However, inclusion of cross-sectional variation generally decreased the coefficient of multiple determination indicating some heterogeneity among the cross-sectionally combined states. Time aggregation of first differences over two year periods gave large increases in the coefficients of multiple determination, indicating considerable year to year random variation in the data. It is argued that the random variation is likely to originate mainly in the dependent variable. Time aggregation produced increased intercorrelation among the independent variables.

Even though the combined analyses of data with time aggregation yielded higher multiple correlation coefficients than the analyses of data based on yearly observations, the results of the latter analyses are believed to be more reliable on the regional level. In several instances, time aggregation caused increased multicollinearity which led to less significant coefficients. In analyses where intercorrelation did not increase appreciably with increased time aggregation, as in the Southeast, the estimated coefficients did not show much change from those based on yearly observations.

The indices of expected prices were among the most important variables in the land value analyses. The commodity price expectation indices, from which the aggregate state indices were derived, were estimated in another part[1] of the Resources for the Future, Inc. project. The price expectation indices were mainly important in explaining the yearly variation, while they had relatively little to do with the increase in land values. Very large increases in land values have occurred since the early 1950's, a period in which the price expectations have shown slight downward changes. The largest estimated impact of price expectations on land values was found in the Corn Belt.

Government expenditures on conservation were highly correlated with land value changes. Conservation expenditures

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[1] M. Lerohl, op cit.

were found to be associated with a substantial part of the increase in land values. The variable also seems to be of some importance in explaining the short-run variations in land values. Conservation expenditures were cut substantially in 1948 and in 1953-54; the following years gave decreases or small increases in land values. Part of the estimated effects attributed to conservation expenditures were undoubtedly due to technological changes. This is implied by rather high correlations between conservation expenditures and output per man-hour.

The estimated impact of conservation expenditures on increased land values was largest, in absolute terms in Northeast 2 and Delta regions. However, in the Northern Plains and Northeast 3, about 78 percent of the increase in land values due to specified sources, was associated with the conservation variable. Thus, also in regions with comparatively low land value increases a large part of the increases were associated with conservation expenditures.

Of the soil bank variables, the conservation reserve part was the most important in the land value analyses. Coefficients for the conservation reserve variable were larger and generally more significant than those for the acreage reserve variable. Since the acreage reserve program was terminated in 1958, its impact on land value increases over the examined period was zero. Large payments are still being made through the conservation reserve program, and the estimates suggest that these payments have been a substantial source of increased land values. The largest increases in land values associated with the conservation reserve variable occurred in the Corn Belt, the Southeast and the Lake States.

The output per man-hour variable had a high simple correlation with land values. Due to intercorrelation problems, this variable was deleted in many cases and fertilizer use or output per acre substituted. There is little doubt that large efficiency changes (technology) have caused some of the relative increases in land values.

Population density was significant in many of the combined cross-sectional and time series analyses. The largest coefficients of the population density variable were in areas with large relative increases in population, such as Florida and California. A considerable part of land value increases in Mountain 2 and Northeast 2 were also explained by population increases.

Personal income has had increasing effects on land values in the Lake States and in Mountain 1, but led to decreased land values in the Northern Plains.

The large differences in relative land value increases among regions appear to be caused in large part by the distribution of government program payments. Agricultural conservation payments have been shown to be strongly correlated with land values, and the distribution of these payments as well as the conservation reserve payments have had substantial impact on regional differences in land value increases. Relative changes in price expectations and indices of output per man-hour were also important in explaining the regional differences in land value increases. The price expectation series are greatly influenced by government regulations and subsidies, and government prog

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ment programs have caused some of the large regional differences in price expectation increases. For example, the largest relative increases in price expectations occurred in the Appalachians due to influence of tobacco price expectations.

Although some of the impact on land values measured by the government conservation payments might be due to other technological changes, there is little doubt about the importance of conservation payments, soil-bank payments, and price subsidies as causes of varying real estate capital gains among regions. Similarly, the capital losses which occurred when the acreage reserve program was terminated and the losses occurring through liquidation of the conservation reserve program differ widely among regions.

The importance of conservation practices as related to land values implies that large increases in productivity are gained through practices defined as conservation. Therefore, we must once more repeat the argument that a main part of the government conservation subsidy program is in direct conflict with other government programs which are aimed at a stabilized or reduced supply of agricultural products.

In decisions concerning government agricultural programs affecting the value of real estate, policy makers should be aware of the differential capital gains among regions due to the distribution of program benefits. Of at least as much importance are the differential regional impacts of capital losses occurring with the termination of agricultural programs.

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APPENDIX A

PASTURE ACRE EQUIVALENT UNITS

In order to obtain the value per unit of farm land, series of pasture acre equivalents are established. The pasture acre equivalent series quantify the larger changes in land quality. The quality changes are brough about by reproducible capital investments in land. Five categories of land are defined:

z_1 = Acres of pasture land not irrigated.

z_2 = Acres of cropland irrigated.

z_3 = Acres of pasture irrigated.

z_4 = Acres of cropland not irrigated.

z_5 = Acres of other land.

Pasture acre equivalents for year t in state s (pae_{ts}), is then:

$$pae_{ts} = \sum_{i=1}^{5} r_{is} z_{ist}$$

where r_{is} = For state s: Price per acre of land in category z_i/Price per acre of pasture land.

The method was suggested by Hoover, who worked out the r_{is} coefficients using price data supplied by the USDA.[1] Hoover considered three time periods, 1929-31, 1939-41, and 1949-51, but found little variance between the periods. The period 1939-41 was used to compute

[1] D. Hoover, Appendix A.

the r_{is}'s. Since 1939-41 is close to the center of the period studied here, these coefficients are considered suitable for the entire period. The five categories of land are obtained from census data. However, in earlier censuses, agricultural land was not listed in the given five categories. A guide for reconcilliation of census data was given by Hoover[2] and has been used in this study. Data on categories of agricultural land are available for census years only. For years between censuses, linear interpolation has been used to get yearly numbers of pasture acre equivalents.

[2] *Ibid.*, Table 4.

APPENDIX B

SERIES OF LAND VALUES BE STATES

The land value of a pasture acre equivalent in state s is found by, for each year, dividing the number of pasture acre equivalents for state s into total value of farm land in state s. The series of pasture acre equivalents were derived as explained in Appendix A. Value of farm land is found by subtracting value of farm buildings from value of farm real estate. Details about the value of farm real estate and farm building series were given previously.[1] Table 23 gives the state series of land value per pasture acre equivalent, 1925-1962.

[1] Supra, pp. 47-51.

Table 23. Value per Pasture Acre Equivalent by States 1925-62

Year	Maine	New Hampshire	Vermont	Massa-chusetts	Rhode Island	Con-necticut
1925	19.28	11.51	11.16	40.40	50.45	45.95
1926	20.08	11.86	11.29	42.00	53.92	50.66
1927	20.19	11.91	11.21	42.04	58.43	55.86
1928	20.68	12.04	10.77	43.20	61.53	61.19
1929	20.85	12.09	11.20	44.31	64.20	66.12
1930	21.03	11.60	11.21	43.20	64.32	64.88
1931	20.84	11.46	11.02	43.11	63.95	66.37
1932	18.87	10.55	10.25	40.17	64.03	64.08
1933	16.21	9.10	9.28	37.87	56.11	60.99
1934	15.99	9.36	9.15	37.76	55.83	60.98
1935	16.20	9.52	9.27	38.35	59.51	66.73
1936	15.55	9.31	9.01	37.31	59.93	65.75
1937	15.24	9.16	8.85	36.60	60.59	64.65
1938	14.39	8.74	8.43	36.05	59.33	61.55
1939	13.51	8.44	8.16	34.85	58.31	59.18
1940	12.97	8.24	7.94	33.90	53.20	54.79
1941	13.38	9.23	8.18	36.15	56.25	58.51
1942	14.89	10.45	8.46	38.62	61.10	63.06
1943	16.43	11.91	9.48	42.01	64.05	65.75
1944	20.18	14.09	10.55	49.07	72.86	73.08
1945	22.89	17.89	12.40	57.59	84.48	81.67
1946	25.96	19.34	13.78	61.58	94.22	91.62
1947	29.04	22.16	15.84	63.01	104.66	104.57
1948	30.74	23.61	16.28	67.11	110.13	108.71
1949	33.78	24.53	17.53	69.30	114.04	111.01
1950	32.15	23.00	16.00	64.20	107.25	105.94
1951	37.66	23.71	17.11	68.55	122.90	114.04
1952	37.74	24.43	18.47	77.50	131.80	118.12
1953	35.34	24.60	18.67	80.25	135.21	120.56
1954	34.92	23.68	17.98	79.16	136.14	118.70
1955	33.09	23.27	17.81	82.02	145.60	123.27
1956	33.97	23.88	18.22	81.23	138.09	133.48
1957	35.55	24.54	19.04	85.94	139.05	152.83
1958	38.20	25.56	20.25	89.29	142.96	173.69
1959	41.49	27.68	21.57	94.11	148.47	195.04
1960	44.57	32.47	24.02	102.18	160.12	216.37
1961	48.45	36.61	25.38	109.24	172.90	232.95
1962	51.28	44.24	27.60	116.63	187.00	258.63

Table 23. Continued

Year	New York	New Jersey	Pennsylvania	Ohio	Indiana	Illinois
1925	22.03	54.40	29.99	52.14	60.29	108.69
1926	21.99	59.98	30.56	50.00	56.12	102.20
1927	22.13	63.02	30.44	47.10	50.61	91.54
1928	22.08	65.42	30.52	45.37	48.44	87.53
1929	22.36	68.99	30.67	44.80	47.62	85.21
1930	21.85	68.63	29.97	42.12	45.59	80.85
1931	20.47	65.26	28.14	37.98	40.86	71.08
1932	19.35	60.94	26.27	32.09	33.95	58.18
1933	17.30	55.35	21.49	26.44	30.00	47.47
1934	17.28	53.07	21.02	27.82	31.54	50.37
1935	17.65	52.36	21.82	28.82	31.43	51.65
1936	17.57	52.86	22.52	31.23	36.57	53.85
1937	17.34	52.65	22.44	32.69	38.36	57.29
1938	17.00	52.09	22.58	32.21	39.48	58.78
1939	16.43	51.65	22.06	32.92	39.10	57.65
1940	15.61	49.54	21.80	32.97	39.35	50.07
1941	15.63	54.47	22.04	34.44	40.26	60.17
1942	15.88	59.95	23.46	38.02	45.37	68.42
1943	17.59	65.75	25.81	41.87	49.43	72.43
1944	18.03	68.98	27.97	47.90	56.29	83.83
1945	19.87	76.61	31.85	52.94	63.11	90.66
1946	21.70	86.61	33.97	60.89	73.50	101.34
1947	25.05	101.14	37.99	68.43	80.32	116.74
1948	25.78	105.05	41.27	72.24	87.42	125.12
1949	27.81	112.54	44.60	75.50	89.70	132.28
1950	27.17	111.38	42.71	71.50	88.49	135.51
1951	28.91	118.53	48.40	84.71	106.35	159.12
1952	31.93	134.16	53.13	93.96	116.95	172.58
1953	32.05	145.31	52.49	93.11	120.25	176.14
1954	30.49	146.42	52.28	94.32	119.19	179.42
1955	32.47	163.14	53.88	100.79	127.90	183.46
1956	34.62	163.14	58.00	109.89	136.02	197.51
1957	38.88	173.07	62.17	129.11	149.47	220.90
1958	41.47	179.92	66.25	127.95	158.10	230.70
1959	46.43	187.13	70.22	135.20	168.65	256.16
1960	48.59	192.40	76.40	139.03	175.07	259.35
1961	49.84	199.54	80.85	138.69	169.12	250.37
1962	53.57	202.99	87.33	145.76	173.62	257.42

Table 23. Continued

Year	Michigan	Wisconsin	Minnesota	Iowa	Missouri	North Dakota
1925	37.04	48.25	57.52	105.21	48.01	14.65
1926	35.54	45.55	55.40	99.40	44.25	13.84
1927	34.73	43.44	51.01	91.24	41.98	12.87
1928	33.99	41.76	48.53	87.67	40.83	12.55
1929	33.36	40.43	47.20	85.66	40.30	12.09
1930	31.63	38.52	44.45	82.90	39.11	11.79
1931	29.95	33.93	38.17	71.50	34.19	10.56
1932	25.00	29.57	31.69	57.68	29.07	9.02
1933	20.66	25.83	24.94	41.58	24.19	8.12
1934	20.99	25.27	25.64	44.22	25.20	8.32
1935	21.15	25.36	25.13	45.10	25.28	8.22
1936	21.23	24.98	25.46	48.85	25.14	8.28
1937	22.63	25.37	25.82	49.32	24.78	8.03
1938	22.33	24.14	25.95	49.39	23.62	7.57
1939	22.00	22.56	25.13	48.98	22.19	6.70
1940	22.03	21.63	25.45	49.40	22.67	5.87
1941	22.54	21.33	25.92	50.20	23.30	5.99
1942	25.14	23.13	27.38	53.68	23.66	6.49
1943	27.63	24.60	30.47	58.90	28.93	7.00
1944	32.08	27.62	33.90	68.82	32.30	8.62
1945	35.32	30.21	35.70	73.83	36.60	9.61
1946	40.32	32.90	39.90	83.19	41.06	10.60
1947	46.26	37.03	44.02	92.65	45.74	11.70
1948	46.72	39.68	48.32	104.07	46.67	14.10
1949	47.41	41.33	50.09	107.69	49.98	15.07
1950	45.82	39.18	51.26	109.90	49.92	14.72
1951	52.86	43.56	60.02	129.08	58.65	16.03
1952	56.55	46.07	65.77	138.08	66.05	18.45
1953	58.78	46.83	67.45	135.08	66.87	19.32
1954	59.68	44.07	64.63	132.72	63.23	18.99
1955	62.38	43.99	68.24	143.33	66.48	19.18
1956	67.67	46.25	75.67	148.51	70.80	20.39
1957	74.23	49.60	82.96	158.26	77.11	22.69
1958	78.32	51.79	93.01	166.38	84.22	25.32
1959	86.80	55.13	100.45	180.42	91.68	28.43
1960	91.52	57.30	103.86	187.02	95.76	29.63
1961	94.01	58.65	103.19	180.12	98.86	30.58
1962	98.59	63.31	109.73	188.64	103.75	31.61

Table 23. Continued

Year	South Dakota	Nebraska	Kansas	Delaware	Maryland	Virginia
1925	30.81	40.06	29.49	43.28	31.10	46.38
1926	28.43	39.75	28.74	44.43	31.32	44.56
1927	25.46	38.30	28.74	43.58	30.46	41.98
1928	24.71	37.65	28.36	43.95	30.31	42.25
1929	24.03	37.23	28.20	44.29	30.42	42.58
1930	23.79	36.31	28.33	44.43	30.67	42.07
1931	21.10	33.50	25.76	42.56	29.70	36.74
1932	17.20	28.43	22.07	37.05	25.99	31.16
1933	14.29	22.36	17.38	30.79	21.73	27.61
1934	13.80	22.24	17.55	30.45	21.39	28.33
1935	13.09	21.58	17.67	30.96	21.59	30.14
1936	12.70	21.39	18.09	32.21	22.46	31.32
1937	12.14	20.32	18.78	33.42	23.52	33.01
1938	10.99	18.96	18.60	34.85	24.30	32.75
1939	9.14	17.38	18.09	35.03	24.11	31.96
1940	8.02	15.11	16.95	34.89	23.61	31.77
1941	7.94	14.16	17.12	36.77	24.55	32.22
1942	8.43	15.51	17.86	38.46	25.82	33.09
1943	9.63	17.28	20.12	43.61	28.73	36.44
1944	11.98	21.38	22.95	45.02	31.72	40.55
1945	13.02	23.97	26.50	51.60	34.23	47.79
1946	14.39	27.21	28.53	58.40	38.54	55.89
1947	16.44	30.95	32.99	69.50	46.23	62.92
1948	19.81	36.47	38.38	71.69	47.69	63.91
1949	21.36	40.46	39.78	73.39	49.54	69.85
1950	21.80	37.79	38.67	71.36	47.79	66.98
1951	24.04	43.14	43.15	74.13	54.48	75.46
1952	27.44	46.96	47.12	75.37	61.53	83.63
1953	27.81	48.62	47.98	82.22	63.55	85.22
1954	27.44	45.50	46.74	85.95	68.31	81.37
1955	28.81	47.10	48.19	88.57	68.49	85.64
1956	29.73	47.34	49.87	93.00	77.33	90.18
1957	31.64	47.29	51.39	100.94	84.95	95.35
1958	34.69	52.12	54.29	114.91	95.86	99.39
1959	38.88	56.37	56.74	127.31	103.99	106.83
1960	40.00	58.55	59.16	140.90	114.11	110.91
1961	40.54	58.56	60.18	148.82	121.93	117.34
1962	43.40	61.55	63.62	159.94	131.36	128.37

Table 23. Continued

Year	West Virginia	North Carolina	South Carolina	Georgia	Florida	Kentucky
1925	32.55	41.90	23.96	17.20	60.01	37.32
1926	31.55	41.32	21.96	16.90	76.89	37.41
1927	30.12	39.52	19.33	15.71	61.56	36.31
1928	29.85	38.14	18.94	15.78	57.91	35.54
1929	29.67	36.46	18.84	15.85	56.14	35.46
1930	28.75	34.42	17.66	15.64	51.50	35.54
1931	26.67	29.49	15.78	14.41	48.39	32.27
1932	22.01	25.01	13.00	11.58	41.64	28.06
1933	19.70	19.03	10.42	9.66	36.08	22.41
1934	20.59	22.15	12.27	10.96	34.82	22.85
1935	20.49	24.40	14.38	12.34	31.52	24.55
1936	21.11	24.91	14.57	12.27	29.83	24.66
1937	20.94	26.42	15.28	13.12	28.92	26.87
1938	21.18	29.21	15.75	12.87	26.64	28.05
1939	21.15	28.77	15.61	12.71	24.42	28.80
1940	20.75	28.59	15.53	12.75	23.19	30.65
1941	22.36	28.17	16.72	13.66	24.67	30.42
1942	23.29	31.31	18.07	14.58	28.32	33.45
1943	26.39	33.49	19.81	16.18	32.70	37.25
1944	28.84	40.65	24.15	19.15	37.48	40.83
1945	29.98	47.18	29.02	21.40	46.56	45.89
1946	35.21	56.16	31.18	23.94	56.29	53.15
1947	40.70	65.32	35.92	28.80	54.25	63.12
1948	44.77	68.71	38.83	30.47	49.26	63.02
1949	47.58	72.97	42.30	33.70	48.46	67.55
1950	43.76	74.35	39.79	32.22	49.77	65.64
1951	47.56	81.47	43.93	36.32	60.04	73.97
1952	49.72	92.27	47.45	43.71	69.74	81.05
1953	48.30	97.22	49.09	47.62	75.08	77.46
1954	48.24	95.24	50.17	47.91	84.73	74.21
1955	47.52	99.81	51.50	50.12	90.08	75.74
1956	48.54	105.34	57.23	54.38	103.96	78.90
1957	49.45	114.62	62.70	61.01	124.36	87.27
1958	51.24	122.32	67.36	67.63	146.63	94.44
1959	53.47	129.79	75.36	75.96	169.92	103.30
1960	55.60	140.69	85.94	86.43	181.46	109.63
1961	57.95	149.59	91.91	92.52	196.18	114.53
1962	65.66	166.48	104.50	109.26	217.83	122.26

Table 23. Continued

Year	Tennessee	Alabama	Mis-sissippi	Arkansas	Louisiana	Oklahoma
1925	34.32	18.79	18.93	31.11	24.02	16.00
1926	33.61	19.36	19.33	29.72	25.56	16.17
1927	32.65	18.68	18.73	29.30	24.85	16.31
1928	32.01	19.24	18.99	28.79	25.26	16.56
1929	31.47	19.60	19.55	28.55	26.24	16.79
1930	31.09	20.26	20.41	28.07	27.58	17.40
1931	29.03	18.78	18.85	23.70	25.70	16.00
1932	24.62	15.35	15.78	21.06	22.17	13.15
1933	20.31	13.52	12.71	16.17	19.53	10.74
1934	21.99	15.18	13.96	18.07	20.69	11.48
1935	23.93	16.70	15.03	19.13	22.00	11.79
1936	25.24	16.70	14.78	20.27	21.66	12.32
1937	25.48	16.51	15.19	20.48	21.91	12.12
1938	25.59	16.84	16.15	21.58	23.03	12.41
1939	25.56	16.17	15.72	21.24	22.39	12.17
1940	26.71	16.24	15.38	21.64	22.80	11.96
1941	27.89	16.95	16.39	22.62	23.57	12.37
1942	30.15	18.04	18.27	24.82	25.87	13.10
1943	33.52	19.70	20.18	27.31	30.61	14.52
1944	38.12	23.29	22.42	31.31	33.34	15.82
1945	41.39	26.41	25.70	36.60	36.52	17.42
1946	48.97	31.13	30.58	38.81	40.81	20.90
1947	55.58	38.31	33.67	46.02	48.86	23.54
1948	58.57	39.64	37.36	50.90	49.06	25.59
1949	61.22	44.35	39.26	55.83	57.44	29.56
1950	60.57	43.54	39.56	53.26	56.24	28.90
1951	67.74	48.12	46.35	62.92	59.85	34.00
1952	74.06	52.93	51.61	67.60	66.53	36.60
1953	74.64	55.88	53.86	68.04	73.23	35.05
1954	69.81	52.45	52.81	64.74	78.57	34.41
1955	73.35	55.60	54.15	67.48	82.91	37.67
1956	78.27	61.87	63.91	73.93	87.44	39.03
1957	83.41	66.50	71.31	79.50	97.17	40.87
1958	88.49	71.67	73.92	85.83	107.61	43.56
1959	99.07	80.86	80.59	89.03	122.59	48.14
1960	106.01	87.55	82.69	101.19	133.61	51.80
1961	110.75	94.15	84.51	106.43	137.57	52.02
1962	119.59	101.24	92.36	118.04	150.68	55.89

Table 23. Continued

Year	Texas	Montana	Idaho	Wyoming	Colorado	New Mexico
1925	16.97	5.45	16.48	4.68	6.35	3.84
1926	17.30	5.12	15.72	4.38	6.09	3.80
1927	16.84	5.15	16.34	4.30	6.14	3.86
1928	16.90	5.33	16.90	4.54	6.13	3.88
1929	17.02	5.28	16.86	4.69	6.10	3.95
1930	17.46	5.14	16.60	4.78	6.17	4.17
1931	15.52	4.51	14.52	4.53	5.65	3.93
1932	12.40	3.60	11.89	3.56	4.32	3.17
1933	10.66	2.94	9.18	2.73	3.44	2.68
1934	11.16	2.99	9.46	2.76	3.39	2.75
1935	11.53	3.09	9.24	2.84	3.35	2.78
1936	11.72	3.24	9.11	3.01	3.54	2.86
1937	11.88	3.35	9.47	3.17	3.80	2.90
1938	12.04	3.25	8.68	3.15	3.81	2.98
1939	11.67	3.29	8.11	3.14	3.83	2.98
1940	11.71	3.24	8.20	3.12	3.78	3.00
1941	12.03	3.41	8.52	3.30	3.97	3.22
1942	13.50	3.78	9.34	3.66	4.41	3.63
1943	14.63	4.33	10.93	4.20	5.04	4.36
1944	17.29	4.97	13.16	4.87	6.06	5.56
1945	19.69	5.67	15.25	5.52	6.97	6.67
1946	22.04	6.46	16.55	6.55	8.23	7.82
1947	24.51	7.43	18.05	7.35	9.66	8.59
1948	28.20	7.97	19.23	8.49	10.60	9.89
1949	28.53	8.39	19.77	8.30	10.98	10.42
1950	28.15	7.95	19.70	8.02	10.69	10.16
1951	33.77	9.79	23.21	9.37	12.61	12.14
1952	37.27	10.98	25.05	10.21	13.98	13.99
1953	37.54	11.29	26.00	10.12	13.80	14.24
1954	37.56	11.26	25.68	9.64	13.76	14.58
1955	38.95	11.72	26.77	9.58	13.92	14.92
1956	39.49	12.76	27.93	10.16	14.47	14.90
1957	43.44	13.66	28.58	10.87	15.44	14.57
1958	43.09	14.80	29.90	12.01	16.81	14.98
1959	46.69	16.40	31.80	13.50	18.23	15.38
1960	53.44	17.53	32.48	13.95	19.62	16.29
1961	56.47	17.81	32.37	14.72	20.09	17.66
1962	60.79	19.08	33.37	15.44	21.84	18.82

Table 23. Continued

Year	Arizona	Utah	Nevada	Washington	Oregon	California
1925	4.76	8.84	10.63	17.80	12.15	38.18
1926	4.99	8.94	10.18	17.69	11.79	37.91
1927	5.07	9.20	10.24	18.03	12.12	38.51
1928	5.51	9.48	9.96	17.93	11.92	38.15
1929	5.69	9.66	9.84	17.23	11.91	38.11
1930	5.72	9.66	10.00	17.85	11.70	38.62
1931	5.55	8.74	9.41	15.38	10.51	35.39
1932	5.37	7.86	8.36	12.50	8.46	29.38
1933	5.12	6.65	6.72	10.13	6.61	21.92
1934	4.86	6.88	6.80	10.88	6.48	21.80
1935	4.28	6.75	6.34	11.58	6.76	22.70
1936	4.17	6.71	6.54	11.89	7.26	24.39
1937	3.96	6.80	6.64	12.96	7.65	26.42
1938	3.67	6.71	6.48	12.71	8.22	26.05
1939	3.32	6.53	6.43	12.37	8.16	23.46
1940	2.85	6.41	6.12	12.19	8.30	22.42
1941	3.26	7.11	6.47	12.50	8.96	22.88
1942	3.65	7.84	7.08	14.15	9.80	25.43
1943	4.39	8.64	8.13	15.81	10.95	30.01
1944	5.30	9.92	9.59	19.57	13.35	37.23
1945	6.25	11.39	11.33	21.34	15.39	44.75
1946	7.14	12.92	12.62	24.95	18.09	51.71
1947	7.85	14.58	13.17	26.98	19.81	55.23
1948	8.09	15.74	13.36	29.21	20.88	53.89
1949	8.09	16.21	12.60	28.88	20.41	50.62
1950	7.71	16.48	12.33	28.42	20.12	48.59
1951	9.21	18.56	14.62	32.88	23.40	57.22
1952	10.61	20.50	17.01	35.53	25.30	66.19
1953	11.78	20.78	17.51	37.58	26.93	68.36
1954	12.06	18.79	19.13	36.92	26.66	68.12
1955	12.73	20.24	19.72	38.28	27.63	71.75
1956	14.83	21.17	20.86	39.46	28.15	77.88
1957	17.38	22.58	21.60	40.55	28.91	84.95
1958	19.75	23.86	22.59	41.63	29.35	92.18
1959	22.17	25.61	23.55	42.54	30.20	100.97
1960	24.55	26.94	23.58	43.34	30.17	108.45
1961	26.50	28.16	24.23	43.69	30.33	116.84
1962	28.30	29.46	24.50	43.69	31.14	121.97

APPENDIX C

INDICES OF PRICE EXPECTATIONS BY STATES

The series of ten-year expected prices developed by M. L. Lerohl[1] were for 13 separate commodities. In order to develop aggregate indices of price expectations for each state, it is necessary to assign weights to each of the 13 commodities on a state basis. The method used by Lerohl for aggregation on the national level is followed.[2] However, weights on a state basis are not readily available. The more recent censuses provide data by state on the values of products sold from farms as well as values of individual agricultural commodities sold from farms. However, these values are estimated on basis of a single year's returns, and could be quite heavily influenced by weather conditions. Also it was found that there is a big discrepancy between the data given in the censuses, and those obtained in the yearly agricultural statistics.[3] In order to avoid regional disturbances due to weather, it is preferable to use the average returns of consecutive years. It was therefore decided to use the data obtained on a yearly basis. Weights are being estimated for two time period, 1937-39 and 1947-49.

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[1] Op. cit., Appendix A, pp. 159-185.

[2] Ibid., pp. 34-37.

[3] Agricultural Statistics, U. S. Department of Agriculture, Washington D. C. (yearly publication). The discrepancy between the two sources of data is illustrated by the following example. In 1954 the gross farm income from dairy products for Maine was 38.9 million dollars according to the Agr. Statistics, while the figure was 24.3 million dollars in the census estimate.

The weight (w) for the j-th commity[4] in state s at time t, is:

$$w_{js} = \frac{\sum_t Pr._{jts} Q_{jts}}{\sum\sum Pr._{jts} Q_{jts}} , \qquad \begin{array}{l} j = 1, 2, \ldots, 13. \\ s = 1, 2, \ldots, 48. \end{array}$$

where: $Pr._{jt}$ = Price of commodity j in year t.

Q_{jt} = Quantity sold of commodity j in year t.

t = Year (47-49 or 37-39)

Given indices of expected prices and weights for the different commodities, a single regional index of expected prices can be computed. Using constant weights for the entire time period, the index of expected prices for state s (I_{Es}), is:

$$I_{Es} = A_{(i \times j)}\, z_{js} , \qquad \begin{array}{l} i = 1, 2, \ldots, 38. \\ j = 1, 2, \ldots, 13. \end{array}$$

where: A = A matrix of expected price series, where the columns are the indices of expected prices for the 13 commodities, 1925-62.

z_s = A column vector of weights attributed to the 13 commodities for state s.

There was little difference between the aggregate indices estimated by the two sets of weights, and no other weights were calculated. The linkage between the two sets of indices is made in year 1943. The expected price indices for each year 1925-43 are

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[4]Weights are derived for the 13 commodities. However, the price expectation index for wheat is used as an index for food grains and the weights for food grains comprises wheat and rice. Similarly, the index of soybeans is used as an index for oil crops, and comprises soybeans, cottonseed, and flaxseed.

modified to reflect the relationship between the two sets of indices in the linkage year. The state indices of expected prices are given in Table 24.

Table 24. Indices of Price Expectations by States, 1925-62

Year	Maine	New Hampshire	Vermont	Massachusetts	Rhode Island	Connecticut
1925	70.86	67.60	59.43	66.61	66.48	63.64
1926	79.03	79.94	61.98	69.61	69.80	66.21
1927	78.53	69.97	61.53	68.70	69.09	65.72
1928	75.73	70.45	62.46	69.40	69.54	66.37
1929	74.52	69.84	62.50	69.03	69.21	65.91
1930	76.56	68.41	60.24	67.15	67.61	64.26
1931	64.78	59.86	53.94	59.21	59.84	56.51
1932	49.40	47.47	42.35	47.84	47.72	46.15
1933	48.67	44.27	40.01	44.62	45.07	42.91
1934	51.42	45.45	40.83	45.80	46.12	44.66
1935	52.42	52.97	46.80	52.98	52.43	51.20
1936	59.61	56.65	49.42	56.38	55.85	54.69
1937	63.99	59.01	51.07	58.59	58.06	56.88
1938	61.93	60.40	53.58	60.34	59.75	58.38
1939	59.73	57.08	49.88	56.63	56.24	54.93
1940	60.16	57.46	51.04	57.07	56.91	55.42
1941	61.68	58.60	51.46	58.04	57.74	56.54
1942	74.41	66.15	59.95	66.70	66.17	67.23
1943	85.93	76.92	69.01	77.17	76.19	78.09
1944	91.21	85.34	78.46	85.41	84.35	85.67
1945	87.39	78.67	76.18	79.22	79.47	79.92
1946	88.84	85.83	79.53	85.41	84.47	84.33
1947	95.97	93.36	93.14	93.56	93.83	93.52
1948	100.32	99.70	97.72	99.94	99.15	100.14
1949	104.01	106.64	109.14	106.49	106.71	106.64
1950	97.56	99.21	99.33	100.13	98.77	102.34
1951	100.32	98.11	102.29	99.54	99.18	102.93
1952	105.16	106.55	108.38	107.02	106.35	108.71
1953	104.53	108.34	110.06	109.14	107.94	110.06
1954	96.51	103.80	101.99	105.25	102.10	106.50
1955	96.44	99.93	100.80	102.26	99.59	105.39
1956	95.03	97.00	97.53	99.53	96.77	103.70
1957	95.20	96.54	99.89	99.82	97.18	105.10
1958	93.19	94.75	99.38	98.50	95.74	104.85
1959	90.50	94.69	99.25	98.75	94.98	106.05
1960	92.63	93.15	98.98	97.59	94.52	105.33
1961	89.92	92.99	99.49	97.81	94.16	105.84
1962	90.12	92.84	100.86	97.69	94.32	105.99

Table 24. Continued

Year	New York	New Jersey	Penn-sylvania	Ohio	Indiana	Illinois
1925	61.49	68.73	62.80	58.67	57.60	59.90
1926	64.61	72.30	66.12	63.53	61.64	62.39
1927	63.68	71.27	65.36	62.65	60.93	61.78
1928	64.37	71.53	65.53	62.15	60.11	60.95
1929	64.01	70.88	65.28	62.68	61.17	61.78
1930	62.09	69.49	63.13	59.08	57.01	57.05
1931	54.84	61.05	55.60	51.92	50.01	50.84
1932	42.73	48.56	43.64	41.09	39.78	40.18
1933	40.41	45.65	40.91	38.00	36.45	37.41
1934	41.69	47.08	42.81	40.45	39.07	40.81
1935	47.70	53.96	48.97	45.92	44.40	45.89
1936	50.94	57.83	52.91	50.61	49.48	50.88
1937	52.93	60.24	55.12	53.16	52.14	53.17
1938	54.80	61.43	56.30	53.85	52.43	52.61
1939	51.29	57.96	53.08	50.27	48.90	49.97
1940	52.23	58.46	53.91	50.97	49.55	50.72
1941	52.89	59.59	54.98	52.24	51.19	53.57
1942	61.31	67.70	63.96	62.70	62.01	62.84
1943	71.09	78.31	73.65	71.05	69.60	69.88
1944	80.06	85.95	80.84	75.64	72.83	72.65
1945	77.63	79.24	76.61	73.63	71.84	72.44
1946	80.81	86.25	81.50	77.18	75.07	76.29
1947	93.43	93.65	92.48	91.35	90.79	91.20
1948	98.17	100.24	99.94	102.53	103.78	103.84
1949	108.10	106.11	106.98	106.12	105.13	104.96
1950	98.83	99.40	99.85	100.37	99.47	100.00
1951	102.26	97.73	101.32	102.53	101.75	104.43
1952	107.91	106.09	107.40	105.36	104.09	107.45
1953	109.41	107.71	107.83	104.81	102.82	104.44
1954	101.51	103.76	101.79	100.14	98.29	99.18
1955	100.50	100.01	99.99	99.18	96.91	97.85
1956	97.10	97.11	96.86	95.24	92.96	93.88
1957	99.09	96.52	97.79	96.11	93.48	94.11
1958	98.17	94.71	96.69	95.40	92.60	93.16
1959	97.71	94.09	96.50	94.31	91.17	92.17
1960	97.47	92.88	95.55	93.32	90.24	91.39
1961	97.56	92.52	95.36	9.33	90.22	91.71
1962	99.00	92.19	96.62	95.48	92.46	94.70

Table 24. Continued

Year	Michigan	Wisconsin	Minnesota	Iowa	Missouri	North Dakota
1925	60.30	57.21	59.19	53.67	57.02	66.38
1926	64.10	60.64	62.69	57.88	60.71	68.76
1927	63.25	60.20	62.11	57.36	59.80	67.36
1928	63.24	60.63	61.56	56.99	59.64	65.94
1929	63.26	61.21	62.33	58.77	60.61	64.92
1930	60.79	58.48	58.49	54.29	56.43	59.78
1931	53.28	51.83	51.88	47.52	49.57	54.19
1932	41.45	40.84	40.84	37.91	38.93	41.30
1933	39.08	37.86	37.92	34.75	35.91	39.71
1934	41.08	39.14	40.47	37.41	38.70	44.58
1935	46.32	45.37	45.70	43.03	44.30	46.85
1936	50.58	48.91	50.26	48.56	49.03	51.33
1937	52.92	50.88	52.66	50.78	51.44	53.99
1938	53.92	52.80	53.23	50.77	51.92	54.55
1939	50.87	49.06	50.10	48.11	49.20	51.70
1940	51.71	50.19	51.04	49.10	50.28	52.66
1941	52.71	50.80	52.56	51.07	51.57	53.26
1942	62.12	60.32	62.54	61.16	61.46	64.98
1943	71.27	69.02	70.23	68.15	69.19	72.68
1944	78.00	76.06	74.32	70.16	72.47	77.00
1945	75.30	73.95	73.08	69.52	71.23	75.76
1946	79.08	77.13	76.68	72.64	74.88	78.23
1947	92.05	91.74	91.01	89.20	90.02	92.16
1948	100.33	99.86	102.85	104.66	102.98	103.12
1949	107.32	108.38	105.83	106.14	106.70	105.02
1950	100.14	99.81	99.85	100.10	101.07	103.31
1951	103.47	102.16	102.75	102.90	105.20	110.94
1952	108.09	106.84	106.01	104.61	107.57	111.70
1953	108.02	107.17	104.40	101.85	104.97	109.74
1954	101.01	99.62	98.77	95.30	97.90	105.04
1955	100.38	98.63	97.29	94.40	97.64	107.65
1956	96.54	95.54	94.00	90.99	94.18	101.33
1957	98.35	97.67	94.77	92.30	95.90	103.75
1958	97.30	97.28	93.87	91.74	95.20	101.84
1959	96.82	97.09	93.24	91.30	95.66	99.72
1960	95.89	96.78	92.48	90.85	94.76	96.75
1961	95.60	96.88	92.48	90.52	94.23	95.59
1962	98.02	98.66	94.72	93.65	97.57	100.94

Table 24. Continued

Year	South Dakota	Nebraska	Kansas	Delaware	Maryland	Virginia
1925	57.87	57.18	62.40	68.23	60.81	58.70
1926	61.23	60.48	64.65	70.04	63.31	61.85
1927	60.54	59.81	63.35	69.49	62.72	61.03
1928	60.24	59.73	62.92	69.67	62.76	61.27
1929	61.11	60.76	62.62	69.20	62.61	61.35
1930	56.58	56.03	57.14	66.64	59.64	58.62
1931	50.22	49.82	51.72	57.54	52.49	50.73
1932	39.45	39.11	39.67	46.29	42.04	41.29
1933	36.69	36.71	37.81	42.69	39.12	38.35
1934	39.79	40.18	42.42	43.70	41.62	40.90
1935	44.95	45.13	46.17	51.17	47.21	46.23
1936	49.83	50.31	50.73	54.92	51.29	50.76
1937	51.98	52.21	52.76	57.65	53.53	53.23
1938	52.50	52.42	53.49	58.35	54.43	53.80
1939	50.07	50.83	51.53	56.20	51.24	50.78
1940	51.14	52.12	52.82	55.16	51.72	51.09
1941	52.54	53.69	53.59	57.57	53.18	52.68
1942	62.39	63.11	63.78	64.09	63.76	64.45
1943	69.84	70.30	71.26	74.42	73.24	74.42
1944	72.59	72.80	75.14	81.36	79.97	80.16
1945	71.57	71.37	72.92	77.32	76.42	76.64
1946	74.92	75.33	76.45	82.98	80.34	80.32
1947	89.61	89.53	90.20	93.37	92.63	92.30
1948	103.97	103.47	102.78	100.68	100.34	101.39
1949	106.72	106.70	106.72	105.94	106.74	106.01
1950	102.34	102.43	104.28	99.53	101.02	101.42
1951	108.44	108.94	112.18	101.41	103.33	103.52
1952	110.12	111.46	113.76	107.85	108.23	107.63
1953	106.15	106.77	110.29	108.12	108.54	107.81
1954	98.30	98.26	102.82	103.47	103.46	103.42
1955	99.19	99.40	105.92	100.98	102.69	102.80
1956	95.17	95.12	99.93	97.09	99.47	100.04
1957	97.49	97.44	103.40	96.88	100.91	101.62
1958	96.49	96.49	101.87	95.29	100.36	101.21
1959	96.68	96.75	101.36	94.45	100.28	101.59
1960	95.34	95.62	98.64	92.95	99.33	101.03
1961	94.50	94.72	97.17	93.03	99.59	101.35
1962	99.41	100.08	103.71	94.26	101.15	102.76

Table 24. Continued

Year	West Virginia	North Carolina	South Carolina	Georgia	Florida	Kentucky
1925	60.44	51.33	59.84	61.29	95.55	52.32
1926	64.01	52.98	61.52	63.65	101.74	54.75
1927	62.78	53.15	60.46	62.33	94.14	54.81
1928	63.57	53.35	59.76	61.65	92.74	55.08
1929	63.75	53.45	59.89	62.08	92.93	55.61
1930	61.01	50.89	56.53	58.37	88.16	52.57
1931	53.56	43.41	48.76	50.75	70.39	45.44
1932	42.33	38.11	39.99	41.22	59.08	38.24
1933	39.99	33.96	36.22	37.49	57.00	34.59
1934	41.66	38.05	39.98	40.55	68.02	37.97
1935	47.52	42.48	44.46	45.61	65.09	43.23
1936	51.46	46.76	47.93	49.12	69.44	47.94
1937	53.50	49.65	51.94	52.96	75.58	50.20
1938	54.92	49.80	51.04	52.47	68.50	50.62
1939	51.96	46.60	47.16	48.11	64.14	47.91
1940	52.81	46.83	47.73	48.75	63.56	48.43
1941	53.73	48.67	49.77	50.54	70.67	50.23
1942	62.42	67.74	64.63	63.52	85.44	65.09
1943	71.73	79.09	73.93	72.03	96.29	75.10
1944	78.31	83.50	77.05	75.47	103.02	79.37
1945	75.10	79.24	75.54	74.05	97.52	75.78
1946	79.49	81.71	79.83	78.31	99.44	78.37
1947	91.54	93.53	94.55	93.58	91.59	90.96
1948	100.78	101.72	101.03	101.52	97.47	102.58
1949	107.38	104.75	104.42	105.20	110.94	106.76
1950	99.89	105.83	103.50	102.11	110.46	104.45
1951	102.27	108.58	108.25	105.86	115.05	107.82
1952	107.26	110.67	110.80	108.77	105.52	110.09
1953	107.38	110.35	109.56	107.73	105.82	108.22
1954	100.30	109.89	108.22	104.99	103.32	103.23
1955	98.89	111.49	108.79	104.77	109.79	104.38
1956	95.68	110.50	105.36	101.09	109.65	103.10
1957	97.39	112.53	105.70	101.47	110.64	105.90
1958	96.35	113.82	105.97	101.39	115.75	106.54
1959	96.62	116.48	107.70	102.23	119.97	108.81
1960	96.00	115.94	106.63	101.27	125.11	108.37
1961	95.83	117.09	107.16	101.56	127.67	108.71
1962	97.79	117.61	108.22	102.86	128.95	111.02

Table 24. Continued

Year	Tennessee	Alabama	Mis-sissippi	Arkansas	Louisiana	Oklahoma
1925	58.33	66.01	70.19	67.30	66.14	62.75
1926	61.08	68.13	71.36	69.33	68.61	65.00
1927	60.34	66.36	68.85	67.29	66.73	63.66
1928	60.05	65.43	67.52	66.11	65.80	63.26
1929	60.58	65.68	67.59	66.36	66.29	63.16
1930	57.12	61.88	63.11	62.33	62.33	58.25
1931	49.82	54.16	55.21	54.27	54.36	52.30
1932	40.25	42.64	42.94	42.41	42.78	40.37
1933	36.77	39.19	39.41	38.93	39.39	38.11
1934	39.66	42.11	43.14	42.15	42.50	42.10
1935	45.15	47.41	47.83	47.08	47.43	46.39
1936	49.32	50.41	50.00	49.96	50.53	50.43
1937	52.23	54.59	55.27	54.70	54.90	52.92
1938	52.30	53.66	53.31	53.27	53.80	53.40
1939	48.85	49.30	48.93	49.15	49.85	50.90
1940	49.55	50.20	50.05	50.05	50.86	52.18
1941	51.29	52.17	52.30	52.10	52.72	53.14
1942	63.28	62.62	63.07	62.78	63.41	63.20
1943	72.04	70.44	70.32	70.40	71.02	70.79
1944	75.98	73.49	72.67	72.95	74.26	74.66
1945	74.22	73.36	73.42	73.33	73.63	72.87
1946	78.32	78.71	79.39	78.79	78.38	76.87
1947	92.81	94.50	95.56	94.74	93.73	90.99
1948	101.49	100.59	100.07	100.49	101.13	102.07
1949	106.00	105.21	104.68	104.47	105.44	106.95
1950	102.31	101.62	102.59	102.49	102.82	103.79
1951	106.42	107.37	110.29	109.93	109.91	111.23
1952	109.58	110.86	113.42	112.62	112.31	113.39
1953	108.09	108.88	110.72	110.17	109.92	110.12
1954	103.80	105.24	107.80	107.17	105.64	102.82
1955	103.77	104.86	107.96	107.69	106.77	105.06
1956	100.47	100.29	103.03	102.43	101.38	99.82
1957	101.51	100.03	102.40	102.29	102.12	102.64
1958	101.38	99.61	101.94	101.60	101.24	101.46
1959	102.50	100.56	103.95	102.87	101.81	101.85
1960	101.64	99.44	102.51	101.18	99.86	99.67
1961	101.81	99.45	102.55	101.04	99.30	98.51
1962	103.70	101.18	104.42	103.44	102.60	103.90

Table 24. Continued

Year	Texas	Montana	Idaho	Wyoming	Colorado	New Mexico
1925	63.74	63.22	64.18	53.18	57.41	55.12
1926	65.64	65.19	68.84	56.31	61.06	57.62
1927	63.95	63.77	67.55	55.95	60.40	56.70
1928	63.78	63.19	66.41	57.24	60.79	58.14
1929	64.22	62.42	65.80	58.58	61.52	59.53
1930	59.60	56.94	63.05	54.20	57.70	54.55
1931	52.87	51.75	55.26	48.50	51.16	48.91
1932	40.99	39.14	42.29	36.68	39.13	37.35
1933	38.30	37.65	41.18	34.86	37.51	35.54
1934	42.01	42.53	44.86	38.01	40.90	38.90
1935	47.01	45.56	47.02	43.54	45.37	44.34
1936	50.28	49.86	52.42	48.00	50.37	48.30
1937	53.50	51.95	55.37	49.13	52.12	49.76
1938	53.01	52.85	55.30	50.31	52.57	50.59
1939	50.52	50.82	52.96	50.89	52.18	50.95
1940	52.09	52.13	53.86	53.23	53.93	53.32
1941	53.74	52.60	54.65	54.02	55.04	54.32
1942	63.04	63.11	66.16	61.29	63.67	61.51
1943	70.35	70.71	75.11	68.54	71.46	68.38
1944	73.26	74.46	79.83	71.56	75.04	70.97
1945	72.87	72.70	77.56	70.41	73.36	70.84
1946	77.94	75.68	79.85	73.31	76.28	75.24
1947	92.65	89.44	92.04	86.48	89.14	89.30
1948	100.76	102.74	101.58	102.50	102.43	101.49
1949	105.99	107.52	106.37	110.42	108.14	108.92
1950	103.55	105.22	101.95	105.10	104.27	105.09
1951	111.91	115.01	108.57	115.83	113.76	116.27
1952	114.39	115.77	110.94	116.97	115.24	118.03
1953	110.71	111.20	108.65	109.37	109.94	111.29
1954	104.73	101.84	100.24	93.85	98.50	99.22
1955	106.29	106.04	102.59	97.53	102.00	102.13
1956	101.51	100.36	98.23	95.41	97.93	99.04
1957	102.98	104.84	101.13	101.16	102.36	103.06
1958	102.27	103.36	99.60	100.58	101.16	102.58
1959	104.17	103.72	98.53	104.71	102.52	107.04
1960	102.51	101.02	97.70	104.04	101.15	106.03
1961	101.88	99.17	95.87	101.94	99.22	104.70
1962	105.94	106.81	100.41	109.93	106.24	111.28

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Table 24. Continued

Year	Arizona	Utah	Nevada	Washington	Oregon	California
1925	59.87	61.10	51.40	66.34	62.07	66.76
1926	61.84	64.56	54.59	68.86	65.27	69.82
1927	60.34	63.45	54.32	65.68	64.05	68.44
1928	61.43	63.97	56.04	66.86	64.18	68.83
1929	62.67	63.96	57.74	65.59	63.97	68.94
1930	57.66	60.92	53.45	61.30	60.38	65.74
1931	51.29	53.96	47.84	54.35	53.83	58.40
1932	39.41	41.65	36.38	42.55	41.71	46.09
1933	37.23	38.99	34.33	42.23	39.89	43.43
1934	41.07	41.60	37.00	45.34	42.85	46.21
1935	46.37	48.06	43.25	48.42	47.23	52.05
1936	49.62	52.22	47.49	52.03	51.35	55.60
1937	51.99	54.12	48.39	54.09	53.45	57.98
1938	51.86	55.41	49.91	55.60	54.67	58.78
1939	51.60	52.97	50.47	52.71	52.11	56.11
1940	53.98	54.39	52.97	53.21	53.31	57.47
1941	55.47	55.13	53.69	53.68	53.89	58.63
1942	63.02	63.43	60.43	62.66	63.53	67.17
1943	69.85	72.58	67.61	72.17	72.12	76.04
1944	72.23	78.19	70.52	81.25	77.84	81.41
1945	72.80	74.60	69.50	78.71	75.53	79.02
1946	77.66	79.14	72.69	83.25	78.81	83.17
1947	71.80	90.47	85.41	94.00	91.33	91.94
1948	100.69	101.19	102.57	100.05	101.17	99.62
1949	107.51	108.04	112.02	105.64	107.20	108.13
1950	104.62	102.03	105.82	100.01	101.72	103.45
1951	115.26	106.32	117.38	105.98	107.46	109.46
1952	117.15	110.78	118.81	110.42	110.66	111.18
1953	111.38	108.57	109.82	113.97	109.09	109.04
1954	102.37	99.73	91.79	109.34	100.99	101.57
1955	104.49	99.85	95.44	109.51	102.04	102.94
1956	101.27	96.74	94.52	102.10	97.91	100.40
1957	103.55	99.31	100.97	104.92	100.73	102.24
1958	103.28	98.17	100.70	102.32	99.41	102.41
1959	107.44	99.19	106.56	100.84	99.32	104.71
1960	106.62	98.07	106.39	98.80	98.10	105.06
1961	105.84	97.02	104.23	99.12	97.12	104.88
1962	110.62	100.71	112.73	102.70	101.20	107.75

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APPENDIX D

RELATIVE CHANGE IN AND SIZE OF SELECTED VARIABLES BY STATES, 1925-1962

In the presentation of the statistical results in Chapter V several references were made to actual increases which have occurred in the explanatory variables. The actual increases in a given variable linked with its coefficient as related to land values give an estimate of how much this variable has contributed to land value increases.

In order to give some indication of the reasons for land value increases and for the different increases among states, the increases in several variables which explained a major part of land value changes are given in Table 25.

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Table 25. Relative Changes in and Size of Selected Variables by States, 1925-1962

Region	Ratios 1962/1925				Average Amount ($)[1]	
	Land Values per pae[2]	Price Expectations	Output per Man-Hour	Population	Conservation Expenditures	Change in Conservation Reserve Payments
Southeast						
South Carolina	4.36	1.81	3.08	1.42	1.06	.150
Georgia	6.35	1.68	3.23	1.41	1.56	.171
Alabama	5.39	1.53	3.54	1.33	1.46	.074
Florida	3.63	1.35	2.36	4.41	.51	.018
Appalachians						
Virginia	2.77	1.75	2.90	1.76	.82	.016
West Virginia	2.02	1.62	2.83	1.10	.96	.027
North Carolina	3.97	2.29	2.56	1.64	.91	.029
Kentucky	3.28	2.12	2.42	1.22	1.04	.040
Tennessee	3.48	1.78	2.94	1.46	.97	.056
Northeast 1						
New York	2.43	1.61	3.11	1.50	.92	.056
Pennsylvania	2.91	1.54	3.18	1.24	1.01	.055
Delaware	3.70	1.38	3.52	2.03	1.01	.033
Maryland	4.22	1.66	3.02	2.06	.71	.029
Northeast 2						
Massachusetts	2.89	1.47	3.06	1.27	.49	.002
Rhode Island	3.71	1.43	3.10	1.33	.50	.000
Connecticut	5.63	1.67	2.76	5.78	.38	.005
New Jersey	3.73	1.34	3.37	1.72	.52	.025
Northeast 3						
Maine	2.66	1.27	3.03	1.27	1.30	.107
New Hampshire	3.84	1.37	3.33	1.39	1.80	.041
Vermont	2.47	1.70	2.96	1.10	1.88	.040
Lake States						
Michigan	2.66	1.63	3.14	1.86	.74	.063
Wisconsin	1.31	1.72	2.97	1.46	.72	.049
Minnesota	1.91	1.60	3.19	1.40	.46	.063
Corn Belt						
Ohio	2.80	1.63	3.06	1.62	.50	.034
Indiana	2.88	1.61	2.97	1.52	.43	.030
Illinois	2.37	1.58	3.15	1.43	.29	.011
Iowa	1.79	1.74	2.63	1.13	.30	.016
Missouri	2.16	1.71	2.69	1.23	.76	.043

Table 25.

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Table 25. (continued)

Region	Ratios 1962/1925				Average Amount ($)[1]	
	Land Values per pae[2]	Price Expectations	Output per Man-Hour	Population	Conservation Expenditures	Change in Conservation Reserve Payments
Delta States						
Mississippi	4.88	1.49	3.78	1.18	1.26	.041
Arkansas	3.79	1.54	3.58	1.01	.91	.057
Louisiana	6.27	1.55	3.47	1.69	.88	.035
Southern Plains						
Texas	3.58	1.66	3.19	1.91	.52	.035
Oklahoma	3.49	1.66	3.05	1.10	.64	.063
Northern Plains						
North Dakota	2.16	1.52	3.98	.97	.80	.173
South Dakota	1.41	1.72	2.98	1.08	.79	.112
Nebraska	1.54	1.75	2.84	1.11	.42	.027
Kansas	2.16	1.66	3.07	1.21	.35	.035
Mountain 1						
Montana	3.50	1.67	2.91	1.31	.70	.039
Idaho	2.03	1.56	2.89	1.59	.37	.023
Wyoming	3.30	2.07	2.37	1.73	.83	.016
Colorado	3.44	1.85	2.59	1.92	.65	.072
Utah	3.33	1.65	2.82	2.01	.52	.033
Mountain 2						
New Mexico	4.90	2.02	2.43	2.59	.75	.093
Arizona	5.95	1.84	2.89	3.88	.45	.000
Nevada	2.30	2.19	2.09	3.94	.31	.000
Pacific States						
Washington	2.45	1.55	3.07	2.05	.32	.018
Oregon	2.56	1.63	2.94	2.13	.38	.018
California	3.19	1.62	2.81	3.66	.14	.003

[1] Average amount of conservation expenditures and conservation reserve payments, respectively, per $100 of land value (1940 value).

[2] pae = pasture acre equivalent.