Variables Related to Farm Real Estate Values in Minnesota Counties

By Anne E. Hammill

Farm real estate values are influenced by a number of variables, some of which are directly related to the farm while others are related to the farm community and to factors in the nonfarm community. These influences may be grouped into three categories: soil quality, local development, and location.

The purposes of this paper are to explain the selection and construction of variables used in multiple regressions designed to explain 1959 and 1964 farm real estate values in Minnesota counties, and to present the results of the regression analyses.

Variables Selected

Soil quality refers to the characteristics of soils that influence productivity. They may be represented in several ways: soil types, land capability classes, or indexes incorporating various components that indicate effects of soil quality. Limitations associated with soil types or land capability classes as measures of soil quality include the following: Soils vary widely in quality even within a given type or capability classification; therefore, detailed knowledge of soils in an area is essential for accurate identification. The information represented by soil maps or capability classes is often too gross to adequately represent soil quality on a given farm. The comparison of one soil type or classification with another is hazardous since management practices may have altered for better or worse the initial quality of the soil. In using soil types or land capabilities, such conditions as temperature and rainfall are not considered.

For this study, a crop production value index was constructed in an effort to avoid the shortcomings associated with using soil types or land capabilities and hopefully to achieve closer approximation to soil quality as it influences productivity. It is recognized that a crop production value index may have inherent weaknesses due to the degree of accuracy and dependability of the data included.

The crop production value index was constructed from data on acres, production, and prices for those crops that were grown on 80 percent or more of a county's acreage in 1959 and 1964. Production for each crop was multiplied by average prices for the respective years to give a value figure. Values for each crop were added and the total was divided by the total crop acres. This resulted in the average value of crops per acre per county. This crop production value index was expected to represent the cropping patterns that would yield the highest profits for a given county. Thus management considerations are included implicitly as are temperature and weather conditions that could influence yields. Also included implicitly in the crop production value index are the influences of various farm programs as they affect the amounts and kinds of crops grown. No attempt was made to include direct Government payments associated with farm programs.

Cropland as a percentage of all land in farms was entered as a second soil quality variable to ascertain the influences on farm real estate values of the amounts of farmland suitable for crops as opposed to farmland in forests or other uses.

Local growth was defined as local economic activity that would indicate purchasing power, local pressures for land, and population densities. The variable selected to represent this concept in the 1959 equation was percentage of the population consisting of rural nonfarm and urban. This variable was expected to indicate concentrations of nonfarm persons with the largest percentage representative of the most business development, greatest pressures for rural land, and highest incomes.

Location, defined as distance from major cities, could be represented in several ways: Actual miles, zones of various distances, or travel time. However, none of these separate measures takes into account the influence of the size of a city as well as its distance. For this study, the distance was measured (provided it was 200 miles or less) from the center of a county to a standard metropolitan statistical area (SMSA). This distance was divided into the population of the SMSA. When more than one SMSA fell within 200 miles of a county, the ratios were added to give a total effect. SMSA's that influenced Minnesota counties were the Twin Cities; the Fargo-Moorhead area along the Minnesota-North Dakota border; the Duluth-Superior area on the Minnesota-Wisconsin border; Sioux Falls in South Dakota; Sioux City, Waterloo, and Dubuque in Iowa; and Madison and Green Bay in Wisconsin.

The dependent variable for this study was the county average value of farm real estate per acre expressed in dollars.²

Hypotheses Tested

If farm real estate values are influenced by location relative to major cities, one would expect high values to occur near the Twin Cities Metropolitan Area (TCMA) and other major cities, with progressively lower values occurring as one moves away from the TCMA and other cities. And if the size of the city is important, one would expect higher values near the TCMA than near a smaller city. If soil quality and local economic development have an influence on farm real estate values, one would expect high values to be associated with better soil and greater growth both near and away from major cities.

To evaluate the relationships among farm real estate values, location, local growth, and soil quality in Minnesota, all counties in which the rural farm population accounted for 25 percent or more of the total population were studied. Counties excluded by this criterion in the 1959 equation were Anoka, Beltrami, Blue Earth, Carlton, Clay, Cook, Crow Wing, Dakota, Hennepin, Itasca, Koochiching, Lake, Mower, Olmstead, Ramsey, Rice, Sherburne, St. Louis, Washington, and Winona. These are chiefly counties that have major urban centers or are in nonagricultural areas in the northern part of the State (see map 1).

In order to test the hypotheses suggested, a multiple linear regression was run using the following model for 1959 data:

\[ Y = a + bX_1 + bX_2 + bX_3 + bX_4 + e. \]

In this model, \( Y = \) farm real estate values per acre, \( X_1 = \) population/distance, \( X_2 = \) crop production value index, \( X_3 = \) percent cropland, \( X_4 = \) percent rural nonfarm plus urban, and \( e = \) error. Results of the regression are summarized in table 1.

Table 1.—Results of regression relating four variables to farm real estate values in Minnesota counties, 1959

<table>
<thead>
<tr>
<th>Variables</th>
<th>Regression coefficient</th>
<th>Standard error</th>
<th>t</th>
<th>Partial correlation coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population/distance</td>
<td>.0227</td>
<td>.0051</td>
<td>4.48**</td>
<td>.49</td>
</tr>
<tr>
<td>Crop production value index</td>
<td>.0150</td>
<td>.0073</td>
<td>2.06*</td>
<td>.25</td>
</tr>
<tr>
<td>Percent cropland</td>
<td>2.7726</td>
<td>.3504</td>
<td>7.91**</td>
<td>.71</td>
</tr>
<tr>
<td>Percent rural nonfarm, + urban</td>
<td>.0077</td>
<td>.0072</td>
<td>1.08</td>
<td>.13</td>
</tr>
</tbody>
</table>

\[^2\text{Values for 1959 were obtained from Farm Real Estate Values in the United States by Counties, 1950-1959, edited by Thomas J. Pressly and William H. Scofield (Univ. Wash. Press, Seattle, 1965).}\]
Map 1.—Minnesota counties included in study.
The multiple R² at .71 is respectable considering the few variables used in the equation. It is more noteworthy when it is recognized that in a previous equation, with all of the same variables except percent rural nonfarm and urban, the R² was .70. Hence this local development variable is contributing almost nothing to the explanation of the variance in this study.³

Simple correlations among variables are positive except for two relationships: (1) population/distance vs. percent cropland, and (2) percent rural nonfarm and urban vs. percent cropland. These negative correlations are so small as to be unimportant. The highest relationships are percent cropland and the crop production value index, both of which are correlated with farm real estate values. These relationships are shown in table 2.

### Analysis of residuals

Residuals were plotted on map 1. The areas in which the actual real estate values were higher than predicted are represented by positive figures. These counties are located in the southwestern and north central areas of the State.

The location and land quality variables explained approximately 70 percent of the differences in farm real estate values among Minnesota counties. The remaining 30 percent undoubtedly is attributable to the value of farm buildings and to other local factors that differ from one part of the State to another.

³ Coefficients and standard errors for the 3-variable equation are: Population/distance .0242 (.0049); Crop index .0160 (.0072); Percent cropland 2.7349 (.3492).

In an attempt to identify some of these local factors several variables were plotted against the residuals. These variables included ratio of primary to secondary industry employment, total nonagricultural employment, population of the largest city in a county, population per square mile, percent unemployed, number who worked 48 to 52 weeks a year, taxable payrolls, median family income, and population per square mile. None of these variables was correlated with the residuals to an extent that would suggest a higher explanatory value than was recorded.

Minnesota counties vary widely with respect to types of farms, soils, climate, local development, and other factors. Located in the southeastern counties are several important medium-sized and small cities. Few comparable cities exist elsewhere in the State.

In the north central section of the State, near the Twin Cities, farmland is purchased for recreational purposes and summer homes. In acres adjacent to major cities, investors influence real estate values.

The southwestern and Red River valley counties are suited for commercial agriculture, but quite different crops are grown in each area. The southeastern and east central counties support dairying. Throughout the agricultural areas of the State, purchases of land by farmers for expansion purposes have undoubtedly influenced farm real estate values.

Hence, in view of the many differences throughout the State, local factors must be considered in explaining the remaining 30 percent of the differences in farm real estate values not accounted for by the variables studied. Nevertheless, a relatively close approximation of farm real estate values in Minnesota can be made by using the coefficients for the location and land quality variables.
and taking into account the location of the property within the State. This relatively simple model indicates the importance of natural resource variables in influencing farm real estate values.4

1964 Equation

To test whether or not the three variables—population/distance, crop production value index, and percent cropland—would explain 1964 real estate values as well as they did 1959 values, a second equation was run.

For the 1964 model, the population/distance variable remained the same since the most recent population figures for SMSA's are the 1960 figures. The remaining variables were reconstructed or obtained to reflect 1964 values. Counties that were excluded because they did not meet the criterion for rural farm population in addition to those eliminated in the 1959 model were Hubbard, Kandiyohi, Lake of the Woods, Stearns, Martin, Nicollet, Scott, and Freeborn.

Results of the equation indicate that the 1964 model with an \( R^2 \) of .898 explains more of the variation in farm real estate values than did the 1959 model.


Simple correlations between the population/distance variable and farm real estate values and between the crop production value index and farm real estate values were higher in 1964 than in 1959 (see table 4).

The higher \( R^2 \) in 1964 was hypothesized to be a result, in part, of the reduction in number of counties included in the analysis. The counties studied were thought to be similar in characteristics and hence subject to the higher degree of explanation provided by the independent variables. To check the validity of this hypothesis, a regression was run on the 1959 data using the same variables and the same counties as in the 1964 run. The resulting \( R^2 \) at .69 indicates that the removal of the eight counties in the 1964 equation probably had little influence on increasing the \( R^2 \).

It is evident, however, that between 1959 and 1964, the importance of the population/distance variable and the crop production value index relative to real estate values increased substantially as indicated by the respective partial correlation coefficients. The regression coefficient for the crop production value index increased slightly in 1964 and became significant at the .01 level.

Summary and Conclusions

Four variables representing location, soil quality, and local development were selected to explain 1959 county farm real estate values in Minnesota and three variables representing location and land quality were used for 1964 data. The construction of each variable was described and results of linear multiple regressions were presented.

This was a cross-section study in which no attempt was made to consider changes in prices, technology, or

<table>
<thead>
<tr>
<th>Variable</th>
<th>Regression coefficient</th>
<th>Standard error</th>
<th>t</th>
<th>Partial correlation coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population/distance</td>
<td>.0263</td>
<td>.0035</td>
<td>7.52*</td>
<td>.71</td>
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<tr>
<td>Crop production value index</td>
<td>.0200</td>
<td>.0029</td>
<td>6.91*</td>
<td>.68</td>
</tr>
<tr>
<td>Percent cropland</td>
<td>2.2612</td>
<td>.2530</td>
<td>8.94*</td>
<td>.77</td>
</tr>
<tr>
<td>( R^2 ) .898</td>
<td></td>
<td></td>
<td></td>
<td>*-.01</td>
</tr>
</tbody>
</table>

Table 3—Results of regression relating three variables to farm real estate values in Minnesota, 1964
Table 4—Simple correlations among variables explaining Minnesota farm real estate values, 1964

<table>
<thead>
<tr>
<th>Variable</th>
<th>Population/distance</th>
<th>Crop production value index</th>
<th>Percent cropland</th>
<th>Farm real estate values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population/distance</td>
<td>1.00</td>
<td>.461</td>
<td>-.145</td>
<td>.537</td>
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<tr>
<td>Crop production value index</td>
<td></td>
<td>1.00</td>
<td>.475</td>
<td>.851</td>
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<tr>
<td>Percent cropland</td>
<td></td>
<td></td>
<td>1.00</td>
<td>.636</td>
</tr>
<tr>
<td>Farm real estate values</td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
</tr>
</tbody>
</table>

Other factors that would influence farm real estate values over time.

Results indicate that three relatively simple variables explain 70 percent of the variation in farm real estate values in 1959 and 89 percent in 1964. Because of the wide differences in local characteristics throughout the State, no one variable could be found to adequately represent the concept of local development.