FARM LAND PRICES: EXPLAINABLE OR ILLOGICAL?

Melvin G. Blase and Clyde Hesemann

Of all markets, the land market has been thought to be one of the most difficult to explain. Techniques for predicting land prices leave much to be desired. Nevertheless, the importance of this market continues to grow as fixed costs of commercial farm firms escalate, due to farm expansion and other factors.

Conventional techniques for building models to explain farm land prices have not been as useful as when similar statistical procedures have been used elsewhere. Data problems have been conspicuous. The heterogeneity of many populations has created difficulties. Clearly, additional refinement of models is needed.[1]

The objectives of this analysis were to

(1) explain the variation in land prices for a sample of Missouri farms, and

(2) explore a methodology which might overcome some of the difficulties alluded to above.

To accomplish these objectives special efforts were made to obtain data on a homogenous sample of farm transactions. Further, an effort was made to include a considerable amount of detail in the model.

DATA ANALYZED

In order to obtain detailed information concerning recent farm transactions, cooperation was obtained from members of the Missouri Society of Farm Managers and Rural Appraisers who were participating in a land pricing project of that organization. These cooperators were sent a questionnaire which requested information for 27 independent variables.[2] Respondents were asked to report on one randomly selected 1970 transaction with which they were familiar. Of the 155 questionnaires sent, 63 were returned with essentially complete information about a given sale. An additional 53 respondents returned partial data about a transaction, e.g., if bare land were involved the questions concerning buildings were irrelevant and, therefore, not answered. Virtually all sales reported were for tracts in outstate Missouri rather than near major metropolitan centers. Thus, the sample data analyzed were from a relatively homogenous population.

The data obtained were grouped into several categories. In addition to the dependent variable, price per acre, seven groups of independent variables were specified. They included (1) indicators of land productivity; (2) extent and condition of buildings and fences; (3) proximity to and size of educational institutions; (4) location relative to urban centers and arteries of transportation; (5) reason for purchase, i.e., for farm consolidation, investment, family operation, etc., (6) extent of competition in the land market in the area; and (7) financial requirements, i.e., down payment and interest rate.[3] These categories of information were specified in 27 independent variables initially (Appendix A). Subsequently, the model was reduced to five variables for purposes of examining its structural parameters.

MODELS EMPLOYED

A linear multivariable regression equation was

Melvin G. Blase is associate professor and Clyde Hesemann is graduate student of agricultural economics at the University of Missouri. The authors wish to express their appreciation to the following individuals who reviewed an earlier version of this paper: Drs. Frank Miller, Robert Bevins, Francis McCamley and Robert Finley.

[1] For several of the more interesting efforts, several of which use data aggregated above the firm level, see [1, 2, 3, 4, and 5].

[2] See Appendix A for a copy of the questionnaire.

[3] See Appendix B for definitions of all the variables used.

fitted to the data by conventional least squares techniques. A stepwise routine was used initially in the effort to gain insights into the effects of individual variables. The results are reported in terms of the variables significant at the 90% level of probability or above, in Model I, Table 1. Model II, also reported in Table 1, was developed to eliminate the major multicollinearity problems present in the first model, so that its structural parameters could be more carefully evaluated.

Table 1. SUMMARY OF MODELS I AND II OF LAND PRICES FOR A SAMPLE OF MISSOURI FARMS SOLD IN 1970

	Item	Model I	Model II
	R^2	0.86	0.72
	F ratio	10.216***	29.047***
	Constant	-329.309	65.479
X_1	Percent of land capable of producing row crops	804.829***	362.180***
		(233.576)	(38.230)
X_2	Percent of land capable of producing pasture but not row crops	483.189**	
		(226.040)	
X_3	Percent of land considered waste or in timber	461.028*	
		(237.297)	
X_4	Size of farm (acres)	- 0.190**	
		(0.093)	
X_7	Age of most important barn (years)	- 1.102*	- 2.005***
		(0.576)	(.411)
X_8	Size of most important barn (square feet)	0.017**	0.014***
		(0.007)	(0.006)
X_{14}	ASC corn yield rating for farm (bushels per acre)		0.569***
			(0.099)
X_{20}	Distance to closest city with terminal market (miles)	0.323*	
		(0.198)	
X_{21}	Number of similar farms offered for sale in area	5.715*	
		(2.940)	
X_{23}	Percent of purchase price required for down payment	1.089***	0.685*
		(0.412)	(0.394)
X_{26}	Purchase for family operation (yes or no)	-75.108**	
		(35.707)	

Significant at 99 percent level of probability ***
Significant at 95 percent level of probability **
Significant at 90 percent level of probability *

Model I

For predictive purposes Model I appears to be relatively useful. It has a coefficient of determination (R^2) of 0.86 and an F ratio of 10.216.*** Although multicollinearity among independent variables precludes close interpretation in terms of cause and effect relationships, some general relationships are instructive.

The first variable brought in by the program in Model I was the percent of land in row crops. This appears logical. Productivity does appear to have an important influence on farm land prices in this case.

The percentage of land in pasture and in waste and timber were brought in next with 95% and 90% levels of significance, respectively.

Number of total acres appeared next. The -0.19* regression coefficient shows an inverse relationship of value to farm size indicating that large farms tend to be undervalued. Among other things, this may be due to the scarcity of buyers who can finance purchases of this magnitude.

Age of the most important barn was brought into the model next. This variable has a logical negative relationship. The value of a farm should increase as the age of the barn decreases. Size of barn also is important in that the larger the structure the more it can contribute to farm productivity.

Variable X_{20}, distance to a large city, then appeared. Contrary to prior expectations, price per acre increased as it did. Because (1) the regression coefficient was only significant at the 90% level and (2) the relationship does not appear economically logical, spurious correlation due to multicollinearity is apparently present in the model.

Variable X_{21} was used to estimate supply aspects of the market. The supply of farms for sale appeared to be greater near high priced ones in the sample than low priced ones, although the statistical relationship is weak.

The percent purchase price required for a down payment was significant at the 99% level. In light of the additional risk a large transaction entails, this seemed reasonable.

Farms purchased for operation by the purchaser or his family sold for less than those bought for investment or other purposes. This may have been due to differences in the degree of knowledge possessed by buyers and higher values attached to the uses of land for nonfarm purposes.

Model II

Although Model I is acceptable for prediction purposes, examination of structural parameters required refinement of the model. Hence, Model II, a reduced form equation, was developed. Two criteria were used initially to eliminate independent variables. Those with regression coefficients which were not significant at the 90% level or above were excluded. Likewise, when multicollinearity was present in the matrix the independent variable with the weakest relationship to price per acre was dropped. Consistent use of these criteria resulted in Model II (Table 1).

All variables in Model II have expected influences. That is to say, the puzzling relationships in Model I appear to have been partially, if not largely, a function of multicollinearity among variables excluded from Model II.

Four of the same independent variables occur in both models –X_1 (percent of land capable of producing row crops), X_7 (age of largest barn), X_8 (size of largest barn), and X_{23} (percent of purchase price required for down payment). In addition, one other variable appears in Model II.

Variable X_{14}, ASC corn yield established for the farm, appears to reflect the quality dimension of land productivity. It complements X_1, percent of land capable of producing row crops, which is the quantity dimension of land productivity. Both are important in light of the leading role corn plays as a crop in the state. For this sample of farms, productivity appears to be the most important influence on land prices.

SUMMARY AND CONCLUSIONS

Detailed information about a sample of 63 Missouri farm sales in 1970 was analyzed in this investigation. Model I, useful for predicting purposes, incorporated all 27 variables for which data were obtained. Model II, free of appreciable multicollinearity among independent variables, was briefly examined with respect to structural parameters. Model I underscored the importance of the following variables for prediction purposes: X_1 (percent of land capable of producing row crops), X_7 (age of barn), X_8 (size of barn), X_{23} (percent of purchase price required for down payment), X_2 (percent of land in permanent pasture), X_3 (percent of land in waste and timber), X_4 (size of farm), X_{20} (number of miles to large city), X_{21} (number of similar farms for sale), X_{26} (reason for farm purchase). Model II included the first four of these plus X_{14}, the ASC corn yield established for the farm.

Productivity appeared to be the most important determinant of land prices for this sample of Missouri farms. This fact was reflected with respect to both land and buildings. In order, these relatioships were proxied by data concerning the proportion of land capable of row crop production, the farm's yield

rating, and the largest barn on the farm. Finally, the amount of down payment required was important, not surprisingly so in light of the money market in 1970.

Two primary implications can be drawn from the analysis. The first is methodological in nature and the second related to forces operating in the land market.

Given detailed information, variable specification problems in building reliable land price models appear surmountable, based on this inquiry. In addition, care seems to be justified in identifying populations which are not heterogeneous, i.e., do not include both sales substantially influenced by urban and non-urban areas. Hence, further insights into farm land prices may be possible if additional efforts are made to develop more refined models.

Further, this study suggests that the outstate Missouri land market may function in a more rational manner than is usually thought. Productivity and immediate costs of procurement appear to be economically logical determinants of land prices.

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APPENDIX A

Choose one farm, preferably by drawing from a hat, and answer the questions below with your best estimates. Please write numerical answers using one digit per blank.

Example: 25 _____ _____ 2 _____ 5

In what county is the farm located? _____

How many acres of row crop land in the farm? _____ A.
(Could be cropped 1 year in 3 without serious erosion losses.)

How many acres of permanent pasture land? _____ A.

How many acres waste and timber land? _____ A.

How many acres in the farm? _____ A.

How old is the farm house? (If there is one.) _____ Yrs.

How many years since house was painted? (Approximate) _____ Yrs.

How old is the most important barn? _____ Yrs.

How large is the barn? (Approximate sq. ft.) _____ Sq. Ft.

How many years since barn was painted? (Approximate) _____ Yrs.

What is the average age of the other buildings? (Approximate) _____ Yrs.

How many miles of fence, able to hold cattle on the farm? (Approximate) _____ Mi.

How many acres of wheat and feed grain base on the farm? _____ Bu./A.
If unknown, please check with ASC office or identify farm clearly enough so I can check.

What is the average ASC corn yield for the farm? _____ Bu.

How many miles to a town of at least 2500 people? _____ Mi.

How many miles to the nearest paved road? _____ Mi.

If farm was purchased to be consolidated with another farm, how many miles between farms? _____ Mi.

How many miles to the nearest public grade school? _____ Mi.

How many elementary pupils in this school? _____ Pupils

How many miles to the nearest of the following cities: _____ Mi.
St. Louis, Kansas City, Springfield, Memphis, Omaha (Approximate)

Last year, to the best of your knowledge, how many buyers were interested in this farm before it was sold? _____ Buyers

Percent of purchase price required for down payment? _____ %

What was the sale price per acre? _____ $

What is the interest rate on the mortgage, if there is one? _____ %

Was farm purchased for use as a farm? _____ Yes/No

Was farm purchased by family who will farm it? _____ Yes/No

List any other reasons you feel will help explain why this farm sold for the price it did. Use other side of paper.

APPENDIX B
VARIABLES USED

X_1 = Percent of land capable of producing row crops one year in three without serious errosion losses.
X_2 = Percent of land capable of producing pasture but not row crops.
X_3 = Percent of land in timber or considered waste.
X_4 = Size of farm (acres).
X_5 = Age of house (years).
X_6 = Years since house was painted.
X_7 = Age of most important barn (years).
X_8 = Size of most important barn (square feet).
X_9 = Years since barn was painted.
X_{10} = Average age of other buildings (years).
X_{11} = Space in other buildings (square feet).
X_{12} = Miles of fence able to hold cattle.
X_{13} = Number of acres of ASC wheat and feed grain base.
X_{14} = ASC corn yield rating for farm (bushels per acre).
X_{15} = Distance to town of at least 2500 population (miles).
X_{16} = Distance to nearest paved road (miles).
X_{17} = Distance between farms if purchased for consolidation purposes (miles).
X_{18} = Distance to nearest public grade school (miles).
X_{19} = Size of elementary school (number of pupils).
X_{20} = Distance to closest city with terminal markets (miles).
X_{21} = Number of similar farms offered for sale in area last year.
X_{22} = Number of interested buyers.
X_{23} = Percent of purchase price required for down payment.
X_{24} = Price per acre of this farm.
X_{25} = Interest rate on mortgage (percent).
X_{26} = Purchased for family operation (yes or no).
X_{27} = Purchased for farm use (yes or no).

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