Farmland Values at the Urban Fringe: An Analysis of Sale Prices

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Several researchers have statistically explored the importance of various factors in determining urban land values or agricultural land values (e.g., Downing 1973; Richardson, Vipond, and Furbey 1974; Reiss and Kensil 1979; Jennings and Kletke 1977). Few empirical analyses, however, have concentrated on land values in urban fringe areas, where agricultural and urban forces interact and complicate the estimation and understanding of values.[1]

The rural-urban fringe generally includes those areas bordering central cities, surrounding close-in suburbs and noncontiguous nearby towns, and extending into the adjacent, open countryside. It is in these areas that urban demands for farmland are substantial; present and expected shifts from agricultural to urban uses are a major market phenomenon. Generally, the interaction of agricultural and urban market forces in fringe areas results in increased values accruing to farmland owners. But because of uncertainties of actual urban conversion and the usual intermix of land uses, conflicts often emerge. Property taxes become burdensome for profitable agricultural use. Tax burdens and benefits may become unbalanced, and agricultural investments are often prematurely foregone. Various forms of preferential assessment of agricultural lands and growth management policies have been discussed or adopted in many states and localities in response to public concern for fringe area land-use problems (Regional Science Research Institute 1976).

The purpose of this paper is to explore the natural and man-made factors that affect the price of farmland in an urban fringe market, including factors not reported in previous studies. This is accomplished by the development and empirical estimation of a hedonic price model for an urban fringe farmland market near Chicago, Illinois. First, the model is presented with expectations about the impacts of land characteristics and institutional factors on urban fringe farmland prices. The study area and data are then briefly described, followed by the presentation of the model estimates. Finally, some implications are discussed.

THE MODEL

The market for farmland at the urban fringe is characterized by the interaction of agricultural and urbanizing factors.[2] The model developed in this study does not use the conventional supply and de-

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[1] The notable few who concern themselves with the urban periphery are Adams et al. (1968), Clonts (1970), Hushak (1975), and Hushak and Sadr (1979).

[2] For a discussion of the supply of and demand for farmland at the urban periphery see Regional Science Research Institute (1976, pp. 48–63).

Land Economics, Vol. 57, No. 3, August 1981
0023-7639/81/0003-0353 $1.00/0

mand approach, since the heterogeneity of land violates the homogenous products assumption underlying these conventions. Alternatively, a hedonic price model based on property characteristics is used. The identification of specific characteristics readily accommodates the heterogeneous qualities of land. Using this model, implicit prices for characteristics that differentiate parcels can be determined from observations on land prices and measures of associated characteristics (Rosen 1974).[3] Accordingly, the value of urban fringe farmland is hypothesized to be a function of access to points of economic and social attraction, amenity and physical properties, the availability of public services, and institutional factors that influence the land market and its participants.

Access has long been recognized as important in determining both urban and agricultural land values (e.g., Hass 1922; Brigham 1965; Downing 1973; Hushak 1975; Jennings and Kletke 1977; Boyce et al. 1977).[4] Although travel time may be the primary concern, distance measures supplemented by surface transportation system characteristics should reasonably represent access. Relevant points of attraction for urban fringe farmland included in this study are Chicago, the central city; Joliet, a major secondary city and county seat; and the nearest incorporated town. Transportation system factors included are distance to the nearest freeway exchange and type of road frontage.[5]

Physical land features reflect on-site factors that determine the efficiency and capacity with which land performs services and provides benefits. Soil productivity, a feature related to agricultural income-producing capabilities (expressed as an index with a base of 100) has been found to be positively related to farmland prices (Reiss and Kensil 1979).[6] However, if urban factors are dominant in the urban fringe farmland market, this factor may not significantly influence prices. Impervious soils and subsurface rock, which affect the drainage and seepage of the land, may limit the land's use for certain types of urban development, including large-lot residential development with septic systems. These and associated features that impose limitations for septic-tank filter fields are expected to negatively affect farmland prices, while agricultural soil productivity and prices are expected to be positively related.

If the size of parcels sold coincides with the size well-suited for the intended use, a proportional value-size relationship would exist. If tracts are larger than needed, the additional area adds little or nothing to the utility of the buyer. The costs of subdividing could result in a persistent declining marginal relationship between price and size, implying that less will be paid per acre for larger parcels. Conversely, if transferred parcels are too small, and there is value in land assembly, more will be paid per acre for larger parcels. The incremental values for assembling and subdividing land are commonly referred to as plattage and plottage value, respectively (Colwell and Sirmans 1978). It is plausible for plottage and plattage value to coexist or for land value and size to be proportional in the urban fringe farmland market. But, because of market imperfections and the localized

[3] Using durable goods theory, Hushak (1975; 1977) argues that a land-price, land-characteristic function can be referred to as the demand for land.

[4] For theoretical treatments of this relationship, see Mills (1972, pp. 78–87), Muth (1961), and Dunn (1954).

[5] For an excellent treatment of the impact of transportation improvements on land values, see Mohring (1961).

[6] The development of soil productivity indexes is given in Fehrenbacher et al. (1978).

nature of the land market, plattage value is expected to persist over the range of transferred parcels.

The ready access of urban public services to farmland located adjacent to incorporated communities is expected to be capitalized into higher values for favorably situated land. Goldberg (1975) reported access to trunk sewers to be one of four main factors important in residential land development decisions. Adams et al. (1968) estimated the availability of a trunk sewer increased the value of undeveloped land by an average of 75%.

In contrast to physical features of land, amenities (neighborhood effects) reflect off-site influences of man-made and natural conditions on land values.[7] These influences have not been extensively treated by previous studies of urban fringe land markets. Their impact depends on the land use, current or expected, and the type of neighboring activity. For example, air or noise pollution may reduce the value of a parcel for residential uses but have little or no impact on the value of land for crop production. Proximity to a large water body or a flowing stream may enhance value for residential uses, reduce agricultural value because of layout considerations, or reduce value for all uses due to flood hazards. The quality of neighboring waters has also been shown to impact residential property values (Epp and Al-Ani 1979). The measures of amenities included in this study are: 1) acres of neighboring industrial and commercial land use, 2) acres of neighboring mining and quarrying land use, and 3) the proximity of a neighboring 40-acre or larger body of water or a continuously flowing stream. The direction of the impact of the neighborhood effects on fringe area farmland prices is uncertain.

The land characteristics described thus far are mainly reflections of economic forces active in an urban fringe farmland market. Land values may also be influenced by institutional factors. Zoning regulations that implement local public land policies are expected to increase land values as the allowable intensity of use increases, e.g., from agricultural to residential to industrial/commercial.[8]

Because of variation in market information, access to capital, legal status, nonpecuniary preferences, and market functions, the type of buyer and seller (individual, corporation, partnership or land trust) involved in the sale of fringe-area farmland is expected to influence farmland prices. Corporations, partnerships, or land trusts, because of their leverage and/or legal status may pay higher prices than individuals. Individuals could be associated with lower land prices if they exchange farmland in the fringe that has less potential for immediate conversion. Individuals may also lack market information. Alternatively, corporations, partnerships, and land trusts may buy and sell farmland that is higher in value because conversion to urban use is near. In this regard, information on types of market participants may reflect intended land use. The direction of the relationship between land prices and individuals as buyers and sellers of fringe area farmland is uncertain.[9]

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[7] Cobb (1977), in a survey article, reviews the use of residential property-value studies as a method of measuring incremental benefits of amenity (environmental) changes.

[8] Data limitations prevented the consideration of property taxes in the study. However, studies from Illinois (Halcrow et al. 1973), North Carolina (Pasour 1972), and Ohio (Hushak 1975), suggest that property taxes on urban fringe farmland are expected to have a marginal effect on land prices.

[9] Even though farmers, who are mainly individuals, may pay a premium for adjoining farmland to expand

To investigate the relationship between urban fringe farmland values and the natural and man-made factors described, the following transcendental function was used:

$$V_i = \alpha_0 X_{i1}^{\alpha_1} \exp\left(\sum_{j=2}^{n} \alpha_j X_{ij}\right) \quad [1]$$

where V_i is the per-acre value of the i^{th} parcel as evidenced by its actual sale, X_{i1} is parcel size, and X_{ij} are the measures of the j^{th} land characteristics describing the i^{th} parcel.[10] This model reflects the exponential relationship between value and parcel access suggested by theory (Mills 1972; Muth 1969). It also captures the nonlinear relationship between land value and time. This form permits a positive marginal relationship between value and parcel size, requires value to be zero when parcel size is zero and detects the presence of plottage value, plattage value, or a proportional value size relationship.[11]

When estimated in log form, the α_j coefficients lead to the calculation of percentage changes in V_i. For a unit change in the j^{th} characteristic, the percentage change in V_i equals $(e^{\alpha_j} - 1) \times 100$.[12] The coefficient α_1 provides the estimated percentage change in V_i for a 1% change in X_{i1}, parcel size.

EMPIRICAL ESTIMATE

A set of real estate transactions for unimproved farmland in Will County, Illinois, 1970–1974, provided the data used to estimate the model. Will County is one of the six Chicago Standard Metropolitan Statistical Area counties in northeastern Illinois. In 1977 these counties contained 63% of the state's population. The study county had a 1977 population of 306,400 and is expected to contain over 500,000 people by the year 2000. Past population increases (a 3.9% average annual increase over the last 30 years) have not been evenly distributed, geographically. Will County's northern and eastern townships, which are closer to Chicago, contain 90% of the people, 16 of the 25 incorporated communities and the majority of the employment opportunities. Joliet, the county seat and a city of over 78,000, is also located in that portion of the county, about 35 miles southwest of Chicago's Loop. Other towns in the county range from 155 to 12,674 in population, with most containing less than 5,000 people. The southern portion of the county is more agrarian in orientation. Although farm acreage is being continuously reduced, 67% of the county's more than 500,000-acre land area was reported in farms in 1978.[13]

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their operation, the resulting prices are not expected, on average, to be above prices paid for farmland purchased for urban development, ceteris paribus. The sign of the relationship between land price and type of buyer and seller may also reflect quality of land differences not otherwise captured. However, there is little reason, a priori, to expect these differences to vary systematically.

[10] Colwell and Sirmans (1978) and Hushak and Sadr (1979) have estimated models of this form.

[11] If $\alpha_1 > -1$ value is an increasing function of parcel size; if $\alpha_1 > 0$ plottage exists, if $-1 < \alpha_1 < 0$ plattage exists, and if $\alpha_1 = 0$, a proportional value size relationship exists. Implicit in the transcendental function is that the effects of land characteristics on price are relative. The marginal relationship between price and any factor is a function of all other factors, i.e., for

$$j \neq 1, \partial V_i / \partial X_{ij} = \alpha_j \alpha_0 X_{i1}^{\alpha_1} \exp\left(\sum_{j=2}^{n} \alpha_{ij} X_{ij}\right)$$

[12] As α_j approaches zero, $(e^{\alpha_j} - 1)$ approaches α_j. Therefore for small values of α_j, the percentage change in V_i for a unit change in the j^{th} characteristic will approximate α_j. With log V_i as dependent variable, certain characteristics of the log normal distribution are implicit, e.g., the average price exceeds the median price which exceeds the mode price and there are no negative prices (Johnson and Kotz 1970, p. 115).

[13] Computed from U.S. Census of Population, 1977 Estimates and *U.S. Census of Agriculture*, 1978.

During the 1970–1974 period over 1,400 farmland transactions of one or more acres occurred. Sales data were collected from real estate transfer declarations filed with the Illinois Department of Revenue with parcels identified as farmland on the declarations selected. Including only vacant, unimproved parcels and excluding parcels sold under unusual conditions (to the extent such conditions could be identified) and parcels with missing data reduced the sample to 491 transactions. In addition to the transfer declarations, information was obtained from the Northeastern Illinois Planning Commission, the Will County Zoning Office, and county soil and plat maps. In each case the data includes observations on price, acreage, and the characteristics of the property. The predetermined characteristics and their measurement are briefly described in Table 1.

The model was estimated by taking the natural logarithm of both sides and utilizing ordinary least squares. The regression estimates are assembled in Table 1. Because the data covers a five-year period, time was included as a continuous monthly variable to standardize parcel prices in real terms. The coefficient on time suggests a monthly and an annual appreciation rate of 1.10% and 14.0%, respectively, between 1970 and 1975.[14]

All of the coefficients on the access variables, which were measured in radial miles, are negatively signed. Distance to Chicago has the greatest effect with a land-value gradient of .4132. Since smaller communities have less to offer in terms of employment and services, their proximity would be expected to have a relatively smaller effect on fringe area farmland values. Also, distance to Chicago may partially account for the nonsignificance of other access measures. This may be particularly true for access to Joliet, given the relative location of the two cities. Because of the dominance of Chicago, access to Joliet was measured only for parcels where Joliet was geographically located between the parcel and Chicago. It was zero otherwise.

The effect of distance to the nearest town on land price may be reduced in part by the location of parcels relative to the boundaries of incorporated towns. A location contiguous to an incorporated community added over 40% to the mean price of fringe area farmland. A premium was also paid for parcels located on non-township roads and for those with good access to the study area's freeway system. On average, a non-township road frontage reflected a 13% increase in per-acre value. Sale prices increased 2% per mile for locations closer to freeway exchanges.

The coefficients on the neighboring land-use characteristics indicate price is positively related to acres of industrial/commercial land use and negatively related to acres of mining and quarries. The former relationship is likely reflecting expectations of conversion to nonfarm uses and the latter negative externalities. The negative coefficient on the presence of neighboring waters, although not statistically significant, probably reflects increased flooding hazards because of stream or water body proximity and/or unacceptable levels of water quality in the neighboring waters. The quarter sec-

[14] Using data from another Illinois city for the early 1970s, Colwell and Sirmans (1978) found an appreciation rate similar to this for residential land. A model estimate using real prices, adjusted to a 1967 base with the CPI, yielded real monthly and annual appreciation rates of .66 and 8.21, respectively.

TABLE 1
ESTIMATES OF THE IMPACTS OF SELECTED LAND CHARACTERISTICS ON PER-ACRE URBAN FRINGE FARMLAND VALUES

Characteristic	Coefficient	Characteristic	Coefficient
Distance to:		Abuts a town (1 if contiguous to corporate boundaries, 0 otherwise)	.3426* (2.50)
Chicago (in radial miles)	−.4132* (5.77)	Zoning:	
Joliet (in radial miles if an intervening opportunity, 0 otherwise)	−.01175 (1.36)	Agricultural (1, 0 otherwise)	τ
Nearest town (in radial miles)	−.0289 (1.18)	Residential (1, 0 otherwise)	.0361 (0.36)
Nearest freeway exchange (in radial miles)	−.0199* (2.31)	Industrial/Commercial (1, 0 otherwise)	.2528* (2.75)
Frontage road type (1 if township road, 0 otherwise)	−.1246* (2.10)	Individual buyer and seller (1, 0 otherwise)	−.1399** (1.88)
Neighborhood:			
Industrial/Commercial Land Use (acres in ¼ section)	−.0239* (3.87)	Individual buyer and seller-Rsdntl Zn (1, 0 otherwise)	−.2209 (1.19)
Mining/Quarrying Land Use (acres in ¼ section)	−.0125* (2.85)	Individual buyer and seller-Ind/Cmm Zn (1, 0 otherwise)	−.3608* (2.09)
Water body/Stream (1 if in ¼ section, 0 otherwise)	−.0772 (1.00)	Time (continuous monthly)	.0110* (6.29)
Soil productivity (index with base of 100)	.0001 (0.03)	Log parcel size (acres)	−.2707* (10.88)
Septic tank soil limitations (1 if limitations are severe, 0 otherwise)	−.1867* (2.68)	Constant	10.0398
		R^2	.5209
		F	28.5078
		N	491

* Significant at .05 level.
** Significant at .10 level and τ reference zone excluded from estimate.
t-values are in parentheses.

tion, where a parcel is located, was used as the neighborhood for these measures.

Although the coefficient on the soil productivity index has the expected sign, it is not statistically significant. This may be a result of a dominance in the sales data of farm properties sold for speculative and urban purposes.[15] The negative and significant relationship between septic-tank soil limitations and price supports this possibility. Farmland with this limiting factor experienced, on average, over a 20% reduction in price.

[15] The nonsignificance of soil productivity could also be related to a high correlation with distance to Chicago. This does not appear problematical for the simple correlation coefficient for these factors was −.32. When the model was estimated excluding distance to Chicago and

Plattage value dominates the urban-fringe study market. The price flexibility of −.2707, reported in Table 1, implies a value-size function that increases at a decreasing rate, with parcel size reflecting declining marginal returns. Causes for the existence of plattage value in the market include subdivision costs, the liquidity position of local buyers, and the lack of market information held by the sellers.[16]

An industrial/commercial zoning classification resulted in a 28% increase in price over agriculturally zoned farmland. The coefficient on residential zoning is not significant. Based on the uses permitted in the zoning ordinance in force during the study period and the regression results, the residential zoning classification does not appear economically binding. The ordinance allowed single-family residential uses on lots 80 ft. by 120 ft. or larger in agricultural zones.

The negative significant coefficients on individual buyer and seller and individual buyer and seller–industrial/commercial zoning show that 1) sales of farmland zoned agricultural and involving only individuals were consumated for prices an estimated 15% lower, on average, and 2) sales of farmland zoned for industrial or commercial use and involving only individuals were consumated for prices an estimated 43% lower, on average, when compared to sales of similarly zoned farmland involving another type of market participant (corporations, partnerships, land trusts, etc.). The coefficient on individual buyer and seller–residential zoning, while negative, is not significant. This nonsignificance is likely associated with the local ordinance's liberal provisions for residential use in nonresidential zones.[17]

Because of the use of real estate brokers and auction sales, an informational disadvantage for individuals in the urban-fringe farmland market may be a less plausible reason for the model's results than the contention that corporations, partnerships, and land trusts buy and sell farmland that has greater urban potential and thus is of higher value. Farmland transferred among individuals regardless of current zoning may be principally for continued use in farming in the near term. By entering the land conversion process as buyers and sellers at different points, corporations, partnerships, and land trusts are associated with higher-priced land sales.[18] The complexities of the impact of the legal status of market participants on the urban-fringe market are not adequately reflected in the measures used here, but

to Joliet as an intervening opportunity, the coefficient on soil productivity was statistically significant. The explanatory power of this characteristic appears overshadowed by locational attributes.

[16] The coexistence of plottage and plattage was investigated by estimating a model of the form

$$V_i = \alpha_0 \exp\left(\alpha_1 X_{i1}^{-\rho} + \sum_{j=2}^{n} \alpha_j X_{ij}\right)$$

where V_i equals total sale price and $0 < \rho \leq 1$. If α_1 is less than zero, the value size function is shaped so plottage is possible for small parcels and plattage is possible for large parcels (Johnston 1972, pp. 52–53). The comparative performance of the two models leads to the rejection of the hypothesis that plottage and plattage coexisted in the study market. A weakness of this test, as noted by a reviewer, is that it presumes the models are comparable. A more rigorous pursuit of this question is a subject for additional research and will not be pursued here.

[17] The inclusion of the interaction factors was a helpful suggestion from a reviewer. To test whether the effect of individuals was relevant for land purchases only and land sales only, the model was estimated with an individual buyer variable and an individual seller variable. Coefficients on both were negative and significant, suggesting the type of market participant on both sides of a transaction are relevant pricing factors. Although the coefficient's level of significance declined, the estimate of this model, including market participant zoning interaction factors, is consistent with the model reported in Table 1.

[18] For a discussion of farmland appreciation and conversion to urban use, see Schmid (1978).

the results of the analysis do provide some insight as well as suggest a direction for additional inquiries.

SUMMARY

The purpose of this study was to contribute to the understanding of urban-fringe farmland pricing factors. Measures of neighborhood effects, agricultural soil productivity, and market participant characteristics were introduced along with other factors more common to the limited empirical analyses of these markets. Uses of neighboring land were found to significantly impact urban fringe farmland prices. The direction of the impact varied with the neighboring land use. The negative impact on land prices of neighboring water bodies or a stream, which may be a reflection of flood hazards or poor water quality, was not significant. Soil productivity's influence on farmland prices in the urban fringe market studied appeared to be overshadowed by the locational attributes of parcels.

Farmland was exchanged at a lower price when both market participants were individuals, ceteris paribus. One explanation for this is the point in the conversion process at which the different types of market participants are active. Because corporations, partnerships, and land trusts are associated with higher-priced land sales, they may enter the market closer to the time of conversion to urban use. Accordingly, measures of market participant characteristics may be picking up implicit land-use intentions. Also, individuals could act as their own brokers more often, thus avoiding commissions and lowering prices. The available measures of market participant characteristics fail to capture the extensive influence the legal and institutional status of buyers and sellers likely has on the land market. Additional study of the functions performed by the different participants in the farmland conversion process is needed.

In addition to the introduction of these less common factors, this analysis has several other implications. First, despite the extensive suburbanization and decentralization that has occurred in the Chicago area, closer proximity to the urban core is still of value. Although the curvilinear relationship between prices and distance suggests a decline in the marginal impact of this factor, the effect of this locational attribute on farmland prices extends outward into the study area where expected population growth does not support full urban development in the foreseeable future. This fact supports urban fringe preferential farmland property tax assessments to discourage the premature removal of land from agriculture as a part of an urban growth management program.

The preferential property tax argument is strengthened by the implied urbanizing sales bias in the market. The urbanizing sales bias in the fringe area farmland transactions causes market prices to be poor guides for establishing values for fringe area property with little development potential. The persistence of plattage value in the market suggests that the total value of the parcels that comprise a "farm" or an ownership unit will be greater than the value of the total unit. This argues that size should be considered when establishing values on farmland for estate settlements, credit considerations, etc., as well as for property tax purposes.

Alternatively, because of plattage value, owners of farmland with development potential could be expected to rigorously resist large-lot zoning requirements for residential use, e.g., ten-acre minimum lot size. Their properties stand to lose value under such a policy. Similarly, owners of fringe area farmland with industrial or commercial development potential but lacking appropriate zoning may well pursue rezoning to capture the value associated with these zones. These forces place pressure on local public efforts to manage urban fringe growth. Farmland that has urban development potential and is appropriately zoned does not warrant preferential property tax treatment. But as is often the case, preferential property tax programs may be only indirectly related to local land-use planning.

Finally, there is evidence that the judicious provision of public services can be effective in implementing land-use plans at the urban fringe. And zoning ordinances that allow residential uses on relatively small plots of land in agricultural zones may not be effective in influencing the location of residential growth.

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[Footnotes]

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