FACTORS INFLUENCING AGRICULTURAL LAND VALUE IN THE SUGARCANE AREA OF LOUISIANA

Steven A. Henning, Louisiana State University
Janis Bruner Breaux Louisiana State University
Lonnie R. Vandeveer, Louisiana State University
Gary A. Kennedy, Louisiana State University and Louisiana Tech University

ABSTRACT

This paper presents the results of a two-stage hedonic analysis of rural land market sales in the sugarcane submarket area of Louisiana. This study demonstrates that rural agricultural land values in the sugarcane submarket area of Louisiana are influenced by a number of factors, both farm and nonfarm. Growing pressures from nonfarm uses (commercial and residential), together with the geographic limitations of land suitable for development, contribute to the value of land in the area.

INTRODUCTION

Sugarcane is Louisiana's number two agricultural commodity in cash receipts [16]. Total sugarcane production in Louisiana in 1997 was 10.7 million tons, with 77.1% of it produced in the sugarcane submarket area [4]. The estimated value of all sugarcane production in Louisiana in 1997 was $230 million [13]. Sugarcane production value totaled $306.5 million in 1998, 11% of the value of all state crops [12].

The sugarcane submarket area is one of nine rural Louisiana land submarkets defined in previous research [8]. The sugarcane submarket area includes eleven parishes: Ascension, Assumption, Iberia, Iberville, Lafourche, St. James, St. John the Baptist, St. Martin, St. Mary, Terrebonne and West Baton Rouge. There are 20 sugarcane mills and two sugarcane refineries in Louisiana. All of the mills and one refinery are located in the sugarcane submarket parishes.

The amount of land suitable for agricultural development in the sugarcane submarket area of Louisiana is limited. This area is contained within the Barataria-Terrebonne National Estuary System (BTES). The BTES is a wedge of land between the Mississippi and Atchafalaya Rivers, beginning near Morganza in Pointe Coupee Parish and extending south to the Gulf of Mexico [2]. Sugarcane is the number one agricultural crop in the BTES, accounting for more than half of all BTES agricultural revenue [1]. The sugarcane submarket area includes all parishes in the BTES except Jefferson, Orleans, Plaquemines, Point Coupee and St. Charles. Jefferson, Orleans and Plaquemines parishes did not report any sugarcane production in 1997. Pointe Coupee reported harvesting 19,800 acres and St. Charles reported harvesting 2,200 acres, with combined production of 575,000 tons [4].

In 1993, the Louisiana State Department of Environmental Quality (LDEQ) estimated a total of 4,158,939 acres of land in the BTES. LDEQ assessment of the BTES classified more than 78% of the area as wetlands or open water [10]. Agricultural land use in the BTES is estimated at more than 12%, leaving only 10% for forest, urban and industrial use [10].

Population in this area of Louisiana is projected to increase by more than 11% (projections based on 1990 Census counts) by the year 2010. Because 78% of the area is marsh or open water, this population increase will necessarily be concentrated on the natural levees. This will increase the competition for land resources and therefore increase the value of land that is currently used for sugarcane production [2].

The amount of land available for development in the sugarcane submarket area is limited because of the large percentage of wetlands and open water. As population and associated industrialization increase, so will the demand for a comparable portion of land for urban use. Employment in Planning District 3 of Louisiana, which includes most of the sugarcane submarket area, is projected to increase by 1.94% annually through the year 2010 [11]. As population and associated industrialization increase, the land available for agricultural use is expected to become more valuable.

HEDONIC PRICING MODEL

Hedonic regression provides a means of estimating the effects of the various characteristics of rural land in determining land value. The hedonic approach allows the estimation of individual parcel attributes or characteristics. Historically, rural land market studies have reported that the relationships between rural land prices and various land attributes are nonlinear [8].

Two equations are estimated. In the first stage, the hedonic model is estimated and the implicit prices of the characteristics are calculated using the partial derivative of the hedonic equation with respect to each characteristic ($\partial P_t / \partial z_i$). In the second stage, the inverse demand for selected characteristics, income, and other socioeconomic variables hypothesized to explain the demand for the characteristic are estimated. It is assumed that the market-clearing price, P(z), will be determined by the simultaneous interaction of the bid and offer functions, but, since the supply of land is inelastic, bid functions are sufficient to derive equilibrium prices [5].

First Stage Hedonic Model

Rosen's [15] two-stage hedonic pricing model was used by Kennedy [8] to derive coefficients for the characteristics of rural land. The following hedonic model was specified for the Louisiana rural land market by Kennedy [8]:

$$P = \beta_0 Z_1^{\beta_1} \exp\left[\sum_{i=1}^{m} \alpha_i X_i + \sum_{j=1}^{n} \gamma_j D_j + \epsilon\right], \qquad (1)$$

where P is price per acre of land, Z is the size of the tract of land in acres, m is the number of additional continuous variables, X, n is the number of discrete variables, D, and ϵ is the error term.

Since the price of land is hypothesized to decrease at a decreasing rate as tract size increases (suggesting a nonlinear relationship), we take the natural log of both price and parcel size in the equation, yielding the following:

$$\ln P = \ln \beta_0 + \beta_1 \ln Z_1 + \sum_{i=1}^{m} \alpha_i X_i + \sum_{j=1}^{n} \gamma_j D_j + \epsilon . \qquad (2)$$

Marginal Implicit Prices of Characteristics

The implicit marginal price of each characteristic is an estimate of change in per acre land price brought about by a one-unit change in that characteristic. For continuous variables, the partial derivatives, which are the marginal prices, are as follows:

$$\partial P_t / \partial Z_{1,t} = IZ_{1,t} = [\, \beta_1 / Z_{1,t} \,] * P_t$$
$$\partial P_t / \partial X_i = IX_{I,t} = \alpha_i * P_t \qquad (3)$$

where IZ is the implicit price per acre of land and IX is the marginal change in the continuous variable. The t subscript indicates that there are implicit prices associated with each transaction. To estimate the implicit marginal price at the mean price and mean level of the characteristic over all observations, the mean value of each variable must be substituted into the equation [8].

The derivative for discrete variables is given in semilogarithmic equations using the variance of the discrete variable [9]:

$$ID_j = (\exp [\, c_j - ½ V(c_j) \,] - 1) * \text{mean price}, \qquad (4)$$

where ID_j is the implicit price of the discrete variable, c_j is its estimated coefficient, $V(c_j)$ is the variance of the c_j, and mean price is the mean price per acre over all of the observations used in the model. Using the variance of the estimated coefficient can lead to less bias in the estimate when $V(c_j)$ is substantial.

Second-Stage Bid Functions

Estimation of the bid function enables analysis of the effects of the influence of the socioeconomic variables on the marginal implicit prices of the significant characteristics. Implicit prices derived in equation (3) are used to calculate the implicit price of each characteristic of each successive sale. These implicit prices are then regressed upon the quantity of each independent variable, income, and other socioeconomic variables to calculate the inverse demand or bid function for the characteristic.

The bid function used in this study follows the approach used by Elad, Clifton, and Epperson [3] and are specified by:

$$IX_i = \beta_0 + \beta_1 \ln Z_1 + \sum_{i=1}^{m} \alpha_i X_i + \sum_{j=1}^{n} \gamma_j D_j + \sum_{k=1}^{r} \theta_k Y_k + \mu . \qquad (5)$$

where IX_i is the implicit price of the characteristic, Z_1 is the size of the tract in acres, m is the number of additional continuous explanatory variables (X_i), n is the number of discrete variables (D_j), r is the number of income and socioeconomic variables (Y_k), and μ is a random error term.

THE DATA

Data for this study were reported using mail survey techniques. The Louisiana Rural Land Market Survey is sent to a statewide listing of knowledgeable individuals of rural land markets. The survey has been conducted annually since 1994. The 1998 survey, for example, included 501 individuals who were state certified appraisers, officers in commercial banks, personnel of the Farm Service Agency, Federal Land Bank and Production Credit Association, and members of the Louisiana Chapter of the American Society of Farm Managers and Rural Appraisers, and the Louisiana Realtors Land Institute.

The survey was constructed to facilitate the reporting of detailed information on actual sales of rural real estate in Louisiana and to record subjective information based on the respondent's knowledge of the local land market. For the purposes of the survey, rural real estate was defined as all land outside the city limits of the major metropolitan areas in Louisiana, 10 acres or more in size, and included attachments to the surface, such as buildings and other improvements.

Statewide, 2,706 sales have been reported during the January 1, 1993 to June 30, 1998 period. The data were spatially plotted based on the legal description of each tract using the GIS software package ARC/View.

The data set for this study, a subset of the statewide data set, has 61 observations that were reported from actual sales transactions that occurred from January 1, 1993 through June 30, 1998 in the eleven sugarcane submarket area parishes. This data set represents only reported sales where sugarcane was listed as the primary crop planted on the parcel at the time of the sale. The data are both cross-sectional and time series data.

THE VARIABLES

Sale price per acre is the dependent variable in this study. Table 1 lists the variables used in both stages of the hedonic model analysis. The table includes both continuous and discrete variables. Continuous variables are quantitative in nature while discrete variables are qualitative, representing the presence or absence of a condition or characteristic. Each variable used in the both stages of the hedonic model analysis of this regression is discussed below.

Table 1
Hedonic Pricing Model and Bid Function Variables, Sugarcane Submarket Area, Louisiana.

Symbol	Variable	Expected Sign
Continuous Variables		
LNPRICE	Natural log of per acre sale price of land	
LNACRES	Natural log of size of tract in acres	(-)
PERCROP	Percentage of cropland in tract	(+)
ROADFEET	Road frontage in feet	(+)
PERMINRL	Percentage of mineral rights purchased	(+)
PERPAST	Percentage of pastureland in tract	(+)
PERTIMB	Percentage of timberland in tract	(-)
PEROTHER	Percentage of tract not used for crops, timber, or pasture	(-)
VAL	Value of house, barn and improvements ($)	(+)
PRIACRES	Number of acres use in production of primary	(+)

	crop	
TNDIS	Distance to largest parish town (feet)	(-)
HW_MLS	Distance to nearest superfund site (miles)	(+)
ML_MLS	Distance to nearest sugar mill	(-)
DNC_ML	Distance to nearest metropolitan statistical area (miles)	(-)
Discrete Variables[a]		
RT	Paved Access Road	(+)
RP1	Reason for Purchase: Expansion	(+)
RP2	Reason for Purchase: Residence	(+)
RP3	Reason for Purchase: Investment	(+)
D1	Presence of Sugarcane	(+)
Time	Trend (month)	(+)
FB	Farm Bill (April, 1996)	(?)
Discrete Soil Variables[a]		
S7	Recent Alluvium-Mississippi River	(+)
S5	Fresh-water Marsh	(-)
S10	Water	(-)
Socio-economic Variables[b]		
POPDEN	Parish population per square mile	(+)
PCINC	Parish average per capita income ($)	(+)
NFI	Parish net farm income	(+)

Continuous Variables

Survey Data Variables

Tract size (LNACRES) is expected to have the largest significant effect in the models. Because the larger tracts have a higher overall value and a smaller number of potential buyers, the effect of tract size is expected to be negative, reflecting an inverse relationship. Previous research suggests that this effect is nonlinear. The percentage of land in a tract devoted to agriculture (PERCROP) is expected to have a positive influence on the dependent variable. Cultivated land may be priced at a premium because it represents intensive use that is expected to generate an income stream in the future. Because pastureland also represents an intensive use of land, percent of pastureland (PERPAST) in the tract may also add to the value of rural land, depending on the extent of the improvements.

The presence of timberland is hypothesized in this model to have a negative influence on per acre price. More land in timber would imply that less land in the tract is available for sugarcane production. Therefore, percentage of timberland (PERTIMB) in the tract is hypothesized to have a negative sign on the coefficient.

Percentage of cropland devoted to the primary crop {PRIACRES) is also expected to have a positive relationship to price per acre. Logically, farmers will plant the most profitable crop on the best suited soils. The more land devoted to a primary crop, the higher the expected future income stream.

Percentage of land not used for pasture, crops, or timber (PEROTHER) is hypothesized to have a negative effect on price per acre. It is assumed that little or no expected future income stream is generated by this land, which implies that it does not contribute to the agricultural value of the land.

The value of the existing house, any barns on the land, and improvements (VAL) made to or on the land (such as growing crops) are expected to have direct relationships to the price per acre of land. Planted cropland is expected to have a positive relationship because of the income it is expected to produce; the house and other buildings and improvements because of the capital they add to the land.

Road frontage (ROADFEET) is also expected to have a direct relationship to the price per acre of land. Road frontage is measured in number of feet that border a road, and represents ease of access and enhances development potential for the future. The percentage of mineral rights purchased with the land (PERMINRL) is also expected to have a positive relationship to rural land values because of the potential for producing a future income stream.

GIS Analysis Variables

Proximity factors such as tract location relative to population centers or markets, areas of economic development, and transportation routes are also hypothesized to effect rural land values. Location theory suggests that there is an inverse relationship between distance to markets and land prices. Linear distance, represented in miles, to the largest parish town (TNDIS) and to the nearest metropolitan statistical area (DNC_ML), has been used as a proxy for access to transportation and population centers and is expected to have a negative effect on per acre land value. Distance to the nearest sugar mill (ML_MLS) is also expected to have a negative effect on land price in the sugarcane submarket area, representing higher transportation costs as this distance increases.

Distance to the nearest superfund hazardous waste site (HW_MLS) is expected to have a positive effect on land value because it is theorized that the farther a parcel of land is from hazardous waste, the higher the value of that land. Nearness to hazardous sites is hypothesized to be capitalized into real estate value [6].

Socioeconomic Variables

With perfect data, second-stage estimations would include the use variables representative of tract-specific buyer and seller characteristics such as reason for purchase, reason for sale, buyer and seller income, type of financing, and identification of the buyer. Unfortunately, this data was is not available. Since buyers and sellers tend to be regionally located, parish-level income and socioeconomic variables were used in the hedonic bid functions.

Parish estimates of population per square mile (POPDEN), average per capita income (PCINC), and net farm income (NFI) were used. These factors, hypothesized to be important demand shifters for rural land, are not directly associated with the tract of land itself. Income and population are generally expected to have a positive influence on the demand for rural land.

Discrete Variables

A discrete variable for the Federal Agricultural Improvement and Reform Act (FACTA) of 1995 (FB) signed in April of 1996 was included in this study to account for impacts this federal legislation had on per acre land value. It is hypothesized that prior benefits of farm programs had a positive influence on per acre prices in the sugarcane submarket area. The sign of this variable is expected to be negative, reflecting the reduction of farm benefits in the near future, beginning in April 1996.

Survey Data Variables

The discrete survey data variables are all expected to have a positive effect on the value of rural land. Paved access (RT) represents ease of access and enhances development potential for the future, the same benefits as road frontage.

Expansion as the primary reason for purchase (RP1) and investment as the primary reason for purchase (RP3) have income generating benefits. Residence as the primary reason for purchase (RP2) is also expected to have a positive effect, because the purchase of a residence is both a consumptive and investment action.

Sugarcane as the primary crop (D1) is also expected to have a positive sign in this submarket area. The variable for time (Time) is expected to have a positive effect even though there has been little overall price inflation for several years.

GIS Variables

Geo-referencing the location of each reported sale was used to develop discrete variables for general soil classifications. The soil variables are included because they effect the range of crops that can be grown. For example, in the Sugarcane Area, the alluvial soils (S7) are suitable for row crops, fresh water marsh is represented by S5, and water is represented by the variable S10. The variable for Recent Alluvium-Mississippi River Soil (S7) is expected to have a positive sign because of suitability for row crops. S5 and S10 are expected to have negative signs because of the extent that wetlands legislation restricts the available alternatives for use of wetlands and the surrounding areas, thereby restricting the income stream that can be expected.

The sugarcane submarket area of Louisiana consists of two main ridges of land surrounded by wetlands and water. The data follow the ridges and the ridges follow the Mississippi and Atchafalaya Rivers. All residential, commercial and agricultural activities occur on these ridges. Since coastal Louisiana is winter habitat and breeding grounds for many aquatic and avian species, any pollution that occurs on these ridges has negative effects on the species that depend on this natural resource. Industrial pollution causes fish kills, thin eggshells and a myriad of other effects. Runoff from agriculture causes algal blooms and low levels of dissolved oxygen in the water. Because of these problems, wetlands are an undesirable quality for farmers, usually representing higher production costs and increased regulation.

RESULTS

The hedonic pricing model used in this study required estimation in two stages. The first stage involved estimation of the implicit price function for rural real estate as of function of its characteristics. Implicit prices of each of the characteristics were determined next, by calculating the partial derivatives of the equation with respect to each characteristic and evaluating the regression equation for each reported observation. The second stage bid function was then estimated by regressing the implicit price of each characteristic upon the quantities of the characteristic, as well as on per capita income, population density and net farm income, the socioeconomic variables that were hypothesized to explain the demand for the characteristic.

In general, simpler models are recommended because inclusion of too many variables makes the relative precision of individual coefficients worse, and because the resulting loss of degrees of freedom would reduce the power of tests performed on the coefficients. The criterion used for selecting the models that best fit the data is the

Akaike Information Criterion (AIC). This test was developed in 1974 and is commonly used in econometrics [14]. The AIC equation is as follows:

$$AIC = \ln \frac{SSE_i}{T} - \frac{2K_i}{T}. \tag{6}$$

where SSE is the sum of squared errors from the ith model, K is the number of coefficients in that model, and T is the number of observations in the data set [7].

Hedonic Pricing Model Results

The surveys reported 61 sales in the Sugarcane Area from January 1, 1993 though June 30, 1998. Per acre values of these sales ranged from $314 to $3,406 per acre, with a mean price of more than $1,440 per acre. Tract size varied from ten acres to 8,741 acres, with a mean of 555 acres. The estimated coefficients for the model are given in Table 2.

Table 2
AIC Model, Coefficients, T-Ratios and P-Values, Corrected for Autocorrelation.

Variable	First Stage Estimated Coefficients	T-Ratio	P-Value
Constant	8.7489	24.98	0.000***
LNACRES	-0.1884000000	-5.5190	0.000***
PERCROP	-0.0024080000	-1.9980	0.052*
PRIACRES	0.0000779660	1.7840	0.081*
VAL	0.0000018371	1.1860	0.242
PERTIMB	-0.0095155000	-2.4040	0.020**
PEROTHER	-0.0105280000	-4.3910	0.000***
TNDIS	0.0122080000	1.9000	0.064*
DNC_ML	-0.0088887000	-1.6940	0.097*
RT	0.1891000000	1.7730	0.083*
RP2	0.3810900000	2.5370	0.015**
RP3	0.4125600000	0.0844	0.000***
S5	-0.9684200000	-2.3780	0.022**
S7	-0.5024400000	-1.8360	0.073*
S10	-0.7806800000	-2.4980	0.016**
FB	-0.1140300000	-1.4490	0.154***
R^2	0.7006		
F-Value	10.36		
N	61		

***denotes significance at the 0.01 level, **denotes significance at the 0.05 level, and *denotes significance at the 0.10 level.

Size of tract (LNACRES), percentage of land in uses other than for crops, pasture or timber (PEROTHER), and investment as the primary reason for purchase (RP3) were significant at the 0.01 level. Percentage of timberland in the tract (PERTIMB), residence as the primary reason for purchase (RP2), soil type of freshwater marsh (S5), and soil type of water (S10) were significant at the 0.05 level.

Percentage of cropland in the tract (PERCROP), acreage in primary crop production (PRIACRES), distance to the largest town in the parish (TNDIS), distance to the nearest MSA (DNC_ML), paved road (RT), and Recent Alluvium-Mississippi River soil type (S7) were significant at the 0.10 level.

The coefficient for size of tract (LNACRES) was statistically significant and negative as expected. This relationship indicates that as size of tract increases, the price per acre decreases.

Percentage of cropland in the tract (PERCROP) was statistically significant, with the opposite sign hypothesized. This may indicate that cropland not in use for sugarcane in this area is not a favorable attribute.

Number of acres in primary crop production (PRIACRES) was positively related to price per acre and significant. This variable represents the most profitable land planted in the best soil for that crop, which is the best financial decision for farmers.

Percent of timberland in the tract (PERTIMB) was also statistically significant and had a negative sign, as expected, indicating that use other than sugarcane is not a favorable attribute in this land market area. Percentage of land in uses other than crops, timber and pasture (PEROTHER) was also statistically significant and had the expected negative sign.

Distance to the largest town in the parish (TNDIS) was statistically significant with a positive sign, not negative as hypothesized, indicating that parcels farther from town are valued higher. Distance to the nearest MSA (DNC_ML), however, had the hypothesized negative sign indicating that as distance from the nearest MSA increases, the value of rural real estate decreases.

Road type (RT) was significant and had a positive sign as hypothesized. This indicates that paved access is beneficial and increases the value of rural agricultural real estate.

Residence as the primary reason for purchase (RP2) and investment as the primary reason for purchase (RP3) both have positive signs as expected. Purchase as residence was expected because of urban competition for land in the rural urban fringe. The positive sign on investment was expected because of the future income stream if is expected to produce.

The discrete variable for the soil type water (S10) had a negative sign as did the discrete variable for freshwater marsh (S5). This is expected because of restrictions on wetlands use and modification.

Recent Alluvium-Mississippi River soil (S7) was statistically significant, but does not have the hypothesized positive sign. Recent Alluvium-Mississippi River soil is the predominant soil type in the area and is conducive to row crop production. This should not have had on inverse relationship to rural land value.

The t-ratios of the variables discussed above were significant, so we reject the null hypothesis that each coefficient is zero and conclude that each is individually significant in explaining the sale price of rural land in the sugarcane submarket area of Louisiana between from January 1, 1993 and June 30, 1998.

Although only thirteen variables were individually statistically significant, the model as a whole was significant. The adjusted R^2 of 0.6596 suggests that there are other variables not in this study that may have significant effects on the value of rural land in the sugarcane submarket area in Louisiana.

Marginal Implicit Prices of Characteristics

The first-stage of the hedonic model yields only point estimates of the marginal prices based on the quantity of the characteristic and the price per acre paid in the reported transaction. These values are relevant only for these transactions and therefore no direct implications can be drawn from them [8]. The direction and magnitude of influence of the characteristics is observable by examination of the implicit prices at the mean values of the rural land price and characteristic quantity. A positive coefficient and implicit price indicate that an increase in the characteristic results in an increase in the price of rural land, and a negative coefficient and implicit price indicate a decrease in the characteristic results in a decrease in the price of rural land. Using the estimated coefficients from the first stage of the hedonic model and mean levels of the prices and characteristics, the mean marginal implicit prices for rural land characteristics are estimated. These marginal implicit prices for characteristics at the mean price and characteristic level are presented in Table 3.

Table 3
AIC Model, Marginal Implicit Prices at Mean Price and Characteristic Levels

Variable	P-Value
LNACRES	$ -0.4887***
PERCROP	-3.4683*
PRIACRES	0.1123*
VAL	0.0027
PERTIMB	-13.7055**
PEROTHER	-15.1639***
TNDIS	17.5837*
DNC_ML	-12.8028*
RT	289.9645*
RP2	644.4939**
RP3	727.8207***
S5	-936.9785**
S7	-600.8970*
S10	-811.9717**
FB	-159.1964

***denotes significance at the 0.01 level, **denotes significance at the 0.05 level, and *denotes significance at the 0.10 level.

Size of tract (LNACRES) is negative, and its implicit marginal price is $-0.49. This implies that per acre land prices decline by $0.49 per acre with every one acre increase in size of tract. The implicit marginal price varies proportionately with per acre price. If a tract sells for a price higher than the mean price per acre, the implicit marginal price suggests that per acre land price declines more than $0.49 per acre with a one acre increase in size of tract. The reverse is also true. If a tract of land sells for a lower price than the mean, the implicit marginal price suggests that per acre land price will decline less than $0.49 per acre.

The marginal implicit price for percentage of cropland in the tract (PERCROP) was calculated at $-3.47. This indicates that general cropland is not valued in this area as predicted. A one acre increase in the amount of total land used for crops decreases the value of the tract by $3.47 per acre. The marginal implicit price of percentage of timberland (PERTIMB) was calculate at $-13.71. This tells us that for every one percent increase in the percentage of timberland in a tract, the price per acres decreases by $13.71. The implicit marginal price for percent of land not used for crops, timber, or pasture in the tract (PEROTHER) was estimated at $-15.16. This indicates that a 1% increase in other land in the tract decreases the price per acre of the land by $15.16.

The marginal implicit price for acreage in production (PRIACRES) of the primary production crop was calculated at $0.11, indicating that a one acre increase in the amount of land used to produce the primary crop increases the value of the tract by $0.11 per acre.

The marginal implicit price for miles to the largest parish town (TNDIS) was estimated at $17.58, indicating that for every mile farther from the largest town in the parish, the price of rural real estate increases by $17.58 per acres. Distance in miles to the nearest MSA (DNC_ML)was calculated at $-12.80, indicating that every mile farther from the nearest MSA decreases the value of rural real estate by $12.80 per acre.

The discrete variable for presence of a paved road (RT) had a positive sign and calculated implicit marginal price of $289.96. This implies that having paved access instead of dirt or gravel increases the value of a tract of rural real estate by $289.96 per acre.

The implicit marginal price of residence as the primary reason for purchase (RP2) was calculate at $644.49, meaning that a tract purchased for residence would be valued at $644.49 dollars more per acre than tracts purchased for other reasons. Investment as the primary reason (RP3) for purchase had a calculated implicit price of $727.82 per acre. Interpretation of this implicit price suggests that tracts bought for investment reasons are typically valued at $727.82 more per acre than tracts bought for residence or commercial development.

The discrete variable for freshwater marsh (S5) had a calculated marginal implicit price of $-936.98, indicating that freshwater marshland decreases the value of rural real estate in the sugarcane area of Louisiana by $936.98 per acre. The discrete variable for open water (S10) had a negative coefficient, with an implicit marginal price of $-811.97. This indicates that land with water is valued at $811.97 per acre less than other rural real estate.

The discrete variable for Recent Alluvium-Mississippi River soil (S7) had a calculated marginal implicit price of $-600.90, indicating that Recent Alluvium-Mississippi River soil is not desirable for this area and decreases the price per acre by $600.90.

Second-Stage Bid Function

The estimation of second-stage bid functions allows the examination of the relationships between the possible impacts of variables not tract specific and the explanatory variables. The implicit price of the characteristics were regressed on quantities of the characteristics, net farm income, per capita income, and population density for each parish. Theory suggests that the sign of an own-characteristic in a bid function is expected to be negative, producing a diminishing marginal implicit price for the characteristic with an increase in its measure [3]. The results of the estimations of the second-stage bid functions for this model are presented in Table 4. Only second-stage bid functions for statistically significant continuous variables will be discussed.

Table 4
Estimated Coefficients of the Second-Stage Bid Functions for the AIC Model.

Variable	LNACRES[a]	PERCROP[a]	PERTIMB[a]	PEROTHER[a]	PRIACRES	TNDIS	DNC_ML[a]
LNACRES	-3.58371	-0.6057620000	-2.3937420000	-2.6484490000	-0.0196130000	-3.0710740000	-2.236063
	(4.934)***	(4.478)***	(4.478)***	(4.478)***	(4.478)***	(4.478)***	(4.478)***
VAL	-0.000020315	0.0000116150	0.0000458970	0.0000507810	0.0000003760	0.0000588850	0.000042874
	(-0.57)	(-1.751)*	(-1.751)*	(-1.751)*	(-1.751)*	(-1.751)*	(-1.751)*
PERCROP	-0.020808	-0.0082550000	-0.0326220000	-0.0360940000	-0.0002670000	-0.0418530000	-0.030473
	(0.833)	(1.774)*	(1.774)*	(1.774)*	(1.774)*	(1.774)*	(1.774)*
PERTIMB	-0.0991	-0.0546350000	-0.2158970000	-0.2388690000	-0.0017690000	-0.2769860000	-0.201675
	(1.139)	(3.371)***	(3.371)***	(3.371)***	(3.371)***	(3.371)***	(3.371)***
PEROTHER	0.004442	-0.0299300000	-0.1182720000	-0.1308570000	-0.0009690000	-0.1517390000	-0.110482
	(-0.094)	(3.406)***	(3.406)***	(3.406)***	(3.406)***	(3.406)***	(3.406)***
PRIACRES	0.002253	0.0002370000	0.0009350000	0.0010340000	0.0000076600	0.0011990000	0.000873
	(-2.368)**	(-1.335)	(-1.335)	(-1.335)	(-1.335)	(-1.335)	(-1.335)
TNDIS	0.209332	0.0667960000	0.1335470000	0.1477570000	0.0010940000	0.1713350000	0.12475
	(-1.745)*	(-1.513)	(-1.513)	(-1.513)	(-1.513)	(-1.513)	(-1.513)
DNC_ML	-0.10455	-0.0117690000	0.0465070000	-0.0514550000	-0.0003810000	-0.0596660000	-0.043443
	(1.037)	(0.627)	(0.627)	(0.627)	(0.627)	(0.627)	(0.627)
RT	0.553491	0.2952350000	1.1666560000	1.2907950000	0.0095590000	1.4967720000	1.089807
	(-0.297)	(-0.851)	(-0.851)	(-0.851)	(-0.851)	(-0.851)	(-0.851)
RP2	-1.189587	2.1376310000	8.4471060000	9.3459230000	0.0692120000	10.8372940000	7.890682
	(0.405)	(-3.911)***	(-3.911)***	(-3.911)***	(-3.911)***	(-3.911)***	(-3.911)***
RP3	2.00353	1.5343720000	6.0632540000	6.7084170000	0.0496800000	7.7789090000	5.663859
	(-1.093)	(-4.495)***	(-4.495)***	(-4.495)***	(-4.495)***	(-4.495)***	(-4.495)***
S5	-11.991575	-4.2456310000	-16.7771180000	-18.5622930000	-0.1374650000	- 21.5243610000	-15.671985
	(1.267)	(2.409)**	(2.409)**	(2.409)**	(2.409)**	(2.409)**	(2.409)**
S7	-5.978933	-2.2255540000	-8.7945420000	-9.7303280000	-0.0720590000	- 11.2830400000	-8.215232
	(0.956)	(1.911)**	(1.911)**	(1.911)**	(1.911)**	(1.911)**	(1.911)**
S10	-11.392807	-3.5205670000	-13.9119410000	-15.3922450000	-0.1139890000	- 17.8484550000	-12.995541
	(1.604)	(2.661)**	(2.661)**	(2.661)**	(2.661)**	(2.661)**	(2.661)**
FB	-0.758516	-0.1523600000	-0.6031370000	-0.0667314000	-0.0049290000	-0.7738000000	-0.563408
	(0.464)	(0.501)	(0.501)	(0.501)	(0.501)	(0.501)	(0.501)
POPDEN	0.025856	-0.0133650000	-0.0528120000	-0.0584310000	-0.0004330000	-0.0677550000	-0.049333
	(-0.708)	(1.964)*	(1.964)*	(1.964)*	(1.964)*	(1.964)*	(1.964)*
PCINC	0.000285	0.0004100000	0.0016180000	0.0017910000	0.0000132600	0.0020760000	0.001512
	(-0.427)	(-3.292)***	(-3.292)***	(-3.292)***	(-3.292)***	(-3.292)***	(-3.292)***
NFI	0.001009	0.0001540000	0.0006080000	0.0006730000	0.0000049820	0.0007800000	0.000568
	(-1.710)*	(-1.400)	(-1.400)	(-1.400)	(-1.400)	(-1.400)	(-1.400)
Intercept	19.316496	2.6602160000	10.5121630000	11.6307140000	0.0861320000	13.4866790000	9.819712
	(-1.615)	(-1.195)	(-1.195)	(-1.195)	(-1.195)	(-1.195)	(-1.195)
R2	0.5015	0.6604	0.6604	0.6604	0.6604	0.6604	0.6604
F-Value	4.353	7.482	7.482	7.482	7.482	7.482	7.482
N	61	61	61	61	61	61	61
N	61	61	61	61	61	61	61

[a]The equations were multiplied by -1.0 for interpretation of the signs of the coefficients in the usual way.

t-ratios are in parentheses; ***denotes significance at the 0.01 level, **denotes significance at the 0.05 level, and *denotes significance at the 0.10 level.

The variable for tract size was negative and significant in all bid functions for this model. The negative sign on LNACRES exhibits the diminishing marginal implicit price for size. In the bid function for the tract size (LNACRES), the coefficient for acreage in primary crop production (PRIACRES) was positive and significant. The positive sign indicates that larger tracts with increased acreage in primary crop product tend not to be discounted for size of tract in this submarket. Distance to the largest parish town (TNDIS) was significant and had a positive sign in this bid function, indicating that larger tracts are not discounted as distance from the town increases. Net farm income (NFI) was positive and significant in this bid function, indicating that larger tracts are discounted less with higher net farm income.

The coefficient on the variable for value of improvements (VAL) was positive and significant in all bid functions for this model except for tract size (LNACRES). In the percentage of crop (PERCROP) bid function this indicates that a larger value of improvements has contributed to the value of cropland. The value of improvements also added value to timberland in the PERTIMB bid function, the percentage of crops in other uses bid function (PEROTHER), and the primary acreage bid function (PRIACRES). It resulted in less discounting of larger tracts as distance from the largest parish town (TNDIS) and distance from the nearest MSA (DNC_ML) increased.

The percentage of total cropland in a tract (PERCROP) was negative and statistically significant in all bid functions except the tract size (LNACRES). In the percentage of cropland (PERCROP) bid function this is an own-characteristic, expected to be negative, resulting in a diminishing marginal implicit price for percentage of cropland. In the percentage of timberland (PERTIMB) bid function, percentage of cropland (PERCROP) had a negative sign, indicating a reduction in the value of timberland on tracts with large portions of cropland. In the percentage of land in use for purposes other than crops, pasture, and timber (PEROTHER) bid function, percentage of cropland (PERCROP) had a negative sign, indicating a reduction in the value of land in other uses than crops, pasture, and timber on tracts with large portions of cropland. The negative sign in the bid function for primary acreage (PRIACRES) indicates a reduction in the value of primary acreage in tracts with substantial cropland acreage. The negative sign on PERCROP in the distance to the largest parish town (TNDIS) bid function indicates that the larger the percentage of cropland in a tract, the higher the discount for distance. PERCROP has the same relationship with distance to the nearest MSA (DNC_ML).

The coefficient for percentage of timberland in tract (PERTIMB) was negative and significant in all bid functions for this model except the size of tract bid function. In the percentage of timber (PERTIMB) bid function this is an own-characteristic, expected to be negative, resulting in a diminishing marginal implicit price for percentage of timberland. In the percentage of cropland (PERCROP) bid function, percentage of timberland (PERTIMB) had a negative sign, indicating a reduction in the value of cropland on tracts with large portions of timberland. In the percentage of land in use for purposes other than crops, pasture and timber (PEROTHER) bid function, percentage of timberland (PERTIMB) had a negative sign, indicating a reduction in the value of land in other uses than crops, pasture, and timber on tracts with large portions of timberland. The negative sign on percentage of timberland (PERTIMB) in the bid function for primary acreage (PRIACRES) indicates a reduction in the value of primary acreage in tracts with substantial timberland acreage. The negative sign on PERTIMB in the distance to the largest parish town (TNDIS) bid function indicates that the larger the percentage of timberland in a tract, the higher the discount for distance. PERTIMB has the same relationship with distance to the nearest MSA (DNC_ML).

In the percentage of land in use for purposes other than cropland, pastureland and timberland (PEROTHER) bid function, PEROTHER is an own-characteristic, expected to be negative, resulting in a diminishing marginal implicit price for percentage of other. In the percentage of cropland (PERCROP) bid function, percentage of (PEROTHER) had a negative sign, indicating a reduction in the value of cropland on tracts with large portions of land in use for purposes other than cropland, pastureland and timberland. In the percentage of cropland (PERCROP) bid function, percentage of timberland (PERTIMB) had a negative sign, indicating a reduction in the value of cropland on tracts with large portions of timberland. In the timberland (PERTIMB) bid function, percentage of other (PEROTHER) had a negative sign, indicating a reduction in the value of timberland on tracts with large portions of land in uses other than for crops, pasture, and timber. The negative sign on percentage of other (PEROTHER) in the bid function for primary acreage (PRIACRES) indicates a reduction in the value of primary acreage in tracts with substantial acreage in uses other than for crops, pasture, or timber. A negative coefficient for percentage of land in other uses in the distance to the largest parish town (TNDIS) bid function indicates that distant tracts are discounted higher for distance than smaller tracts. The same relationship exists with distance to the nearest MSA (DNC_ML).

In all bid functions except size of tract (LNACRES), there were positive coefficients on residence as the reason for purchase (RP2) and investment as the reason for purchase (RP3). In the percentage of timberland (PERTIMB) bid function, the positive sign indicates that tracts purchased for residence or investment were afforded a higher value for timberland than tracts purchased for other reasons. In the percentage of cropland (PERCROP) bid function, the positive sign indicates that tracts purchased for residence or investment were afforded a higher value for cropland than tracts purchased for other reasons. In the percentage of land in use for purposes other than for crops, pasture, or timber (PERTIMB) bid function, the positive sign indicates that tracts purchased for residence or investment were afforded a higher value for other land than tracts purchased for other reasons. Primary acreage (PRIACRES) is valued higher when the reason for purchase is residence or investment, as evidenced by the positive sign in the primary acreage bid function. The positive sign in the distance from the nearest town (TNDIS) bid function indicates that discounting of tracts farther from town was reduced with residence or investment as the primary reason for purchase. The same relationship exists with distance to the nearest MSA (DNC_ML).

The coefficients for all the soil variables were also statistically significant and negative in all bid functions except for tract size (LNACRES). The presence of open water (S10), freshwater marsh (S5) and Recent Alluvium-Mississippi River soil (S7) all had a negative effect on the implicit price of all characteristics that were significant in this model.

The socioeconomic variable for per capita income (PCINC) carried a positive sign and was statistically significant in all bid functions except tract size. The positive sign on per capita income (PCINC) indicates that higher parish income was associated with higher marginal implicit on all variables that were significant in this model. The positive coefficient on the socioeconomic variable for population density per square mile (POPDEN) suggests that the value of all significant variables in this model are enhanced by larger populations.

CONCLUSIONS AND IMPLICATIONS

Results of the first-stage hedonic model suggest that several characteristics, both physical and locational, affect rural land prices. These results also suggest that, when studying agricultural land markets, care should be taken to consider only land that is in agricultural production, and that there may be smaller markets within the submarkets in the rural real estate setting.

The AIC model that was the best fit for the sugarcane data set had thirteen statistically significant variables. Size of tract, percentage of total cropland in the tract, percentage of timberland in the tract, percentage of land in uses other than cropland, pastureland and timberland, Recent Alluvium-Mississippi River soil, freshwater marsh, and open water as soil type and distant to the nearest MSA had inverse relationships to rural land value. Paved road, acreage in primary crop production, distance to the largest town in the parish, residence as the primary reason for purchase and investment as the primary reason for purchase had direct relationships with per acre rural land value. The adjusted R^2 for this model was 0.7006.

The unique geographic layout of the land in the sugarcane submarket area of Louisiana seems to have important influence on rural land value in the area. All land use occurs on two ridges of land that together account for only 22% of the area. This could also help explain why distance to the largest parish town exhibited a positive relationship to per acre land value. Proximity to the Baton Rouge and New Orleans metropolitan statistical areas may cause increased competition for the smaller, more affordable sized tracts, and location inside protected wetland watersheds may have major influences in purchases for agricultural use.

The results indicate that acreage for sugarcane holds a premium, while acreage for other agricultural crops is discounted. Acreage in primary crop production was significant, with the marginal implicit price indicating rural land value increasing by $0.11per each additional acre of primary crop. Investment as the primary reason for purchase and residence and the primary reason for purchase were also significant and support the suggestion that both farm and nonfarm factors are influencing the value of land in the submarket .

Second-stage bid functions were calculated for continuous variables from the first-stage hedonic regressions that were statistically significant. Marginal implicit prices of the characteristics were regressed upon quantities of the characteristics, parish per capita income, parish net farm income, and parish population density. These estimates allowed examination of non-tract characteristics and rural land attribute relationships.

Size of tract was highly significant in estimation of bid functions for marginal implicit prices of other characteristics. Value of improvements, percentage of cropland, percentage of timber, percentage of land in other uses, purchasing for a residence, purchasing for investment, all three soil variables, parish population, and parish average per capita income were also significant in all bid functions, except size of tract.

Parish population illustrated a negative relationship to the bid price for agricultural land use, implying that as population increases, demand for other uses of the land will be greater than for continued agricultural use. Given the geographic limitations of land suitable for alternative uses in the submarket area, this outcome is expected. Parish average per capita income had a positive impact on the agricultural land bid functions, implying as incomes in the submarket increase, so will the price paid for agricultural land.

This study demonstrates that rural agricultural land values in the sugarcane submarket area of Louisiana are influenced by a number of factors, both farm and nonfarm. Growing pressures from nonfarm uses (commercial and residential), together with the geographic limitations of land suitable for development, contribute to the value of land in the area.

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