An Empirical Analysis of the Louisiana Rural Land Market (Bulletin #857)

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FOREWORD

Structural changes in the farm production sector, continued pressure to reform existing agricultural policies, and an increasing demand for nonagricultural real estate emphasize the need for rural land market research. Rural land, with a wide diversity of physical characteristics and use, continues to be a large portion of Louisiana's total land base. Of Louisiana's total 28,493,440 land acres, cropland and pastureland account for 7,811,413 acres or 27 percent (1992 Louisiana Census of Agriculture). If timberland is included (USDA, Forest Service, 1991), rural land accounts for 79 percent of Louisiana's total land acreage. The measurement of economic, locational, and topographic variables hypothesized to influence rural land values is expected to be useful in managing Louisiana's land resource. This report presents estimates of the effects of various rural real estate characteristics on the value of rural real estate. This analysis does not include macroeconomic variables and aesthetic or psychological factors that may influence rural real estate prices. Therefore, information provided herein should be used in a general context and should not be used as the sole source of valuation for any specific parcel of rural real estate. Current local market conditions may not be accurately reflected in the results because of the limited data and the complexity of factors influencing values in a local land market.

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INTRODUCTION

The price of a commodity in a competitive market is determined by the interaction of supply and demand. For homogeneous commodities, like corn or cotton, the determination of price is relatively straightforward. The application of supply and demand analysis becomes more difficult for heterogeneous goods, such as rural real estate, which have varying characteristics. Traditional supply and demand analysis would suggest that, for each tract of rural real estate, there exists a separate market in which each of the characteristics are sold. Although it is conceptually possible to assume that each tract of rural real estate has a separate market, it is of little practical value.

Hedonic modeling offers a procedure in which the valuations of various characteristics are determined implicitly through regression analysis by assuming that heterogeneous goods are sold in a single market within which the characteristics are allowed to vary. Hedonic models focus on markets in which a heterogeneous commodity or asset can embody varying amounts of each of a vector of characteristics. The basis of the hedonic methodology is a regression equation or "hedonic function" in which prices from different varieties of an asset are the dependent variable, and the characteristics or attributes of that asset are the independent or explanatory variables.

Rural real estate, exchanged for its productive or consumptive value, can be considered to be a differentiated good, with each parcel having differing characteristics. Because rural real estate is essentially a heterogeneous asset whose value is determined by various market demand characteristics, a hedonic function for rural real estate could take the following general form:

$$P_i = \beta X_i + \varepsilon_i,\ i = 1,\ldots,N, \qquad (1)$$

where P_i represents the price of the i^{th} parcel of rural real estate, X_i is a vector of demand characteristics for the i^{th} parcel of rural real estate, and ϵ_i is an error term. The coefficients are estimated by regression. Dollar valuations (called implicit or "shadow" prices) of rural land characteristics can be calculated from these coefficients (Triplett, 1986).

The hedonic methodology is especially appealing since areas that exhibit similar characteristics should experience similar land values, given a perfectly inelastic supply of land. Demand curves for the various characteristics will intersect the vertical land supply curves at the implicit prices estimated by the hedonic price equation. Therefore, the implicit prices will reflect the market's valuations of those characteristics. In addition, if all buyers are assumed to be alike, the implicit prices represent valuations to the representative or “typical” buyer (Berndt, 1991).

While hedonic modeling offers a procedure in which the valuations of various characteristics can be determined implicitly through regression analysis, it is often difficult to include certain topographic and locational attributes, such as soil type and distance variables, in the modeling effort. For example, productivity or income-earning capacity of a tract of land would be expected to influence tract value. However, unless some variable or index is available to reflect the tract’s productivity, inclusion of a measure of income-earning capacity in the hedonic equation is problematic. The percent of cropland in the tract is often included in the hedonic model as a proxy for the quality of the soil. The previous lack of success with this approach suggests the need to develop alternative procedures (Danielson, 1984).

This research report presents rural land value models that may be used to explain the variation in Louisiana rural real estate values. This report also illustrates a method for including economic, topographic, and locational variables in the hedonic analysis of rural land values. Geo-referencing the location of each tract of rural land with a geographic information system (GIS) allowed modeling efforts to include soil and distance variables, in addition to economic and other key variables expected to influence rural land values. Implicit valuations of rural land characteristics are expected to be useful to landowners, appraisers, realtors, farm credit agencies, policymakers, and others needing reliable land market information.

OBJECTIVES

The general objective of this research is to analyze, by homogeneous land market area, rural land market activity in Louisiana based on an examination of the factors that are hypothesized to influence rural land values. The specific objectives are to:

1. identify relatively homogeneous rural land market areas within Louisiana;
2. identify economic, topographic, locational, and other key variables that influence Louisiana rural land market values;
3. estimate the implicit valuations of rural land characteristics by developing a hedonic land value model for each homogeneous land market area; and,
4. examine the relationships between rural land characteristics across homogeneous land market classifications.

PREVIOUS RESEARCH

The hedonic methodology described by equation (1) can be traced back to Court (1939). Although hedonic pricing received considerable application in the 1960s (Griliches, 1961; Ridker and Henning, 1967), it was not until 1974 that Rosen developed a theoretical model capable of serving as a basis for empirical techniques. Rosen (1974, p. 34) defines hedonic prices as “the implicit prices of attributes” and notes that they “are revealed to economic agents from observed prices of differentiated products and the specific amounts of characteristics associated with them.” Prices of these characteristics are implicit because there is no direct market for them. Rosen’s two-stage model is considered to be the standard reference in almost all works in the hedonic field (Palmquist, 1989). The model considers the interaction of consumers of a differentiated product and the producers of that product.

While most applications of the Rosen model have been concerned with differentiated consumer products, the hedonic price approach has also been applied in the study of urban housing markets to determine the hedonic prices of housing, neighborhood, and service characteristics, as well as to isolate the benefits of environmental quality characteristics (Miller, 1982). Downing (1973) and Chicoine (1981) extended the approach to include differentiated factors of production, particularly agricultural land. However, these earlier applications of the hedonic approach to farmland markets were limited due to the lack of a detailed model. Pioneering efforts to address some of the theoretical problems in specifying the hedonic model to rural land markets include Danielson (1984) and Palmquist (1984, 1989).

Palmquist and Danielson (1989) used a hedonic approach to value the effects of erosion control on farmland values in North Carolina. Land values were significantly influenced by both potential erosivity and drainage requirements. Results of the study suggest that hedonic models are useful in valuing changes in the characteristics of farmland. The authors further contend that hedonic results can be used in policy decisions, such as cost sharing for erosion control practices. Hedonic models could also be used to estimate the value of farm program benefits. This would allow the determination of the level of subsidies required to maintain a particular level of erosion control. In a similar study, Miranowski and Hammes (1984) applied a hedonic analysis to estimate the value that land purchasers place on topsoil depth and the costs attributed to greater erosivity in Iowa. Results of the study presented econometric evidence that differences in soil characteristics are reflected in farmland prices. The regressors used in the model, including a variable measuring topsoil depth and an interaction term composed of topsoil depth and erosivity potential, had significant coefficients with correct signs. The authors concede, however, that their results may be sensitive to the derived functional specification and the type of data used.

Analyses of land prices at the rural-urban fringe have been another application of the hedonic methodology to land markets. Nonagricultural demand for rural land has become an important determinant of rural land prices near urban population centers. Spatial and property-specific characteristics have been proposed to be important determinants of land prices near the urban fringe (Hushak and Sadr, 1979; Chicoine, 1981). Shonkwiler and Reynolds (1986) suggest that land conversion from rural to urban does not proceed smoothly over time and space; therefore, there tends to be an intermix of land uses in urbanizing areas. Because the hedonic technique is limited when applied to goods with multiple uses, Shonkwiler and Reynolds introduce an appropriate hedonic method for analyzing land sales data in circumstances where alternative uses for the parcels appear likely. The authors account for physical and locational characteristics of rural land in an urbanizing area by introducing qualitative variables that reflect the potential for nonagricultural use in order to account for the heterogeneity of uses for each parcel. Shonkwiler and Reynolds further suggest that hedonic analyses of land prices at the urban fringe can assist policymakers in making decisions regarding property valuation, preferential property tax treatment, urban zoning, and programs such as purchasing development rights to agricultural lands. Adrian and Cannon (1992) analyzed the transitional nature of the agricultural land market and estimated the impact of selected factors affecting land prices in the rural-urban fringe of Dothan, Alabama. Distance variables, such as distance to the center of Dothan and distance to a major U.S. highway, were highly significant in explaining per acre bare land values for property located within a 15-mile radius of Dothan.

After disaggregating the Georgia farm real estate market into 12 smaller, more homogeneous submarkets using multivariate techniques, Foster (1986) applied hedonic price equations to analyze farmland prices within individual rural land submarkets. The hedonic approach allowed estimation of the impact of individual parcel attributes or characteristics on rural land prices. Results indicated that parcel size and distance to nearest town are significant and negatively related to per acre land prices in Georgia. Box-Cox estimations suggested the superiority of the log-linear over the linear functional form of the hedonic farmland price equation. In a similar study of the Georgia farm real estate market, Elad, Clifton, and Epperson (1994) formulated hedonic models for five regional submarkets of farmland. Econometric results of the study suggested that the significance and importance of attributes on land pricing varies according to regional locations of a parcel of land. The estimated marginal implicit prices of attributes were shown to be influenced in magnitude and direction by locational circumstances. Given the significance of regional sensitivity, the authors conclude that an aggregate agricultural farm real estate market for the entire state of Georgia is unlikely to exist.

DATA AND HOMOGENEOUS LAND MARKET AREAS

This study is based on 948 Louisiana rural real estate sales that occurred between January 1, 1993 and June 30, 1994 (Kennedy, Henning, and Vandeveer, 1995). The data were collected using the 1994 Louisiana Rural Land Market Survey and a statewide listing of individuals with knowledge of Louisiana rural land markets. 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. Because the aggregate rural land market can be viewed as a conglomerate of smaller, more homogeneous areas, multivariate procedures of principal component and cluster analysis were used to divide the

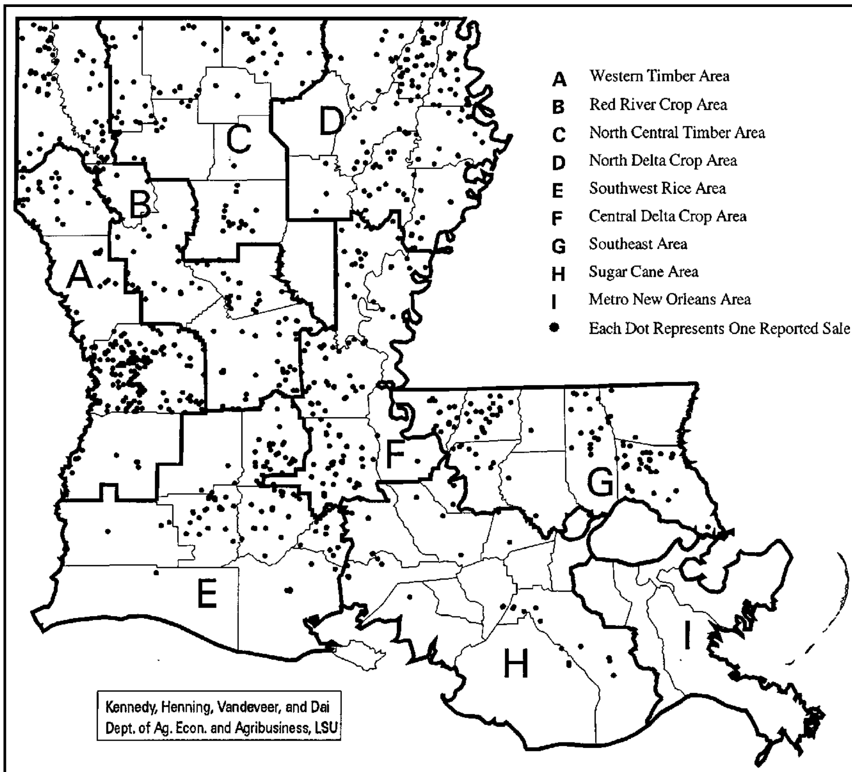

Figure 1. Louisiana rural land submarket areas and the location of reported sales, Louisiana rural land market survey, 1994

Louisiana rural land market into the nine geographic submarkets that are illustrated in Figure 1 (Kennedy, 1995). Based on the tract legal description, ARC/INFO, a GIS software package, was used to spatially summarize the location of each reported sale (Figure 1). The Metro New Orleans Area (Submarket I) was not included in this study due to limited data on rural real estate sales.

As part of the survey, the respondent was asked to indicate the primary agricultural enterprise (if any) of each tract reported. One of seven primary agricultural enterprises (cotton, soybeans, sugarcane, rice, pasture, pine timber, or hardwood timber) was indicated for 529 of the 948 sales used in this study. A GIS plot of these sales, by primary commodity, is illustrated in Figure 2 (larger map inserted in bulletin). GIS plotted rural land sales in Figure 2 indicate a consistent pattern of sales by primary commodity across the rural land submarkets defined.

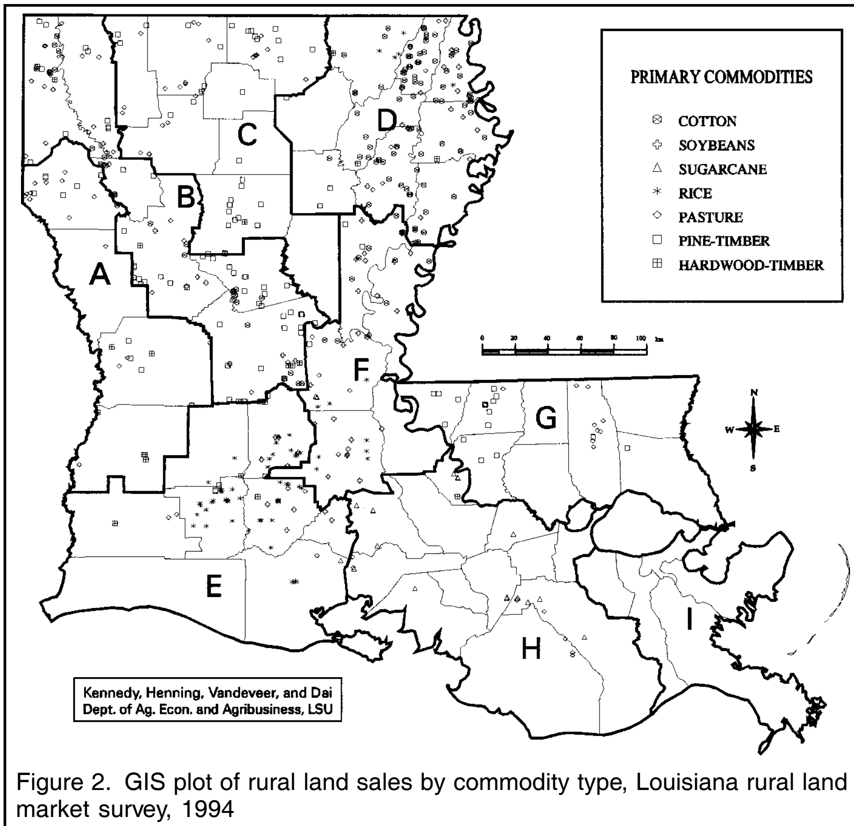

Figure 2. GIS plot of rural land sales by commodity type, Louisiana rural land market survey, 1994

HEDONIC PRICING MODEL

Rosen's (1974) model of hedonic pricing, as refined for differentiated products and rural land market applications by Danielson (1984), Epple (1987), and Palmquist (1989), served as the theoretical model employed in this study. The price per acre at which rural land sells is a function of its characteristics, z, and can be written as:

$$P(z) = P(z_1, z_2, \ldots, z_n) \qquad (2)$$

This hedonic function emerges from the interaction of buyers and sellers of rural land.

While estimation of equation (2) does provide information on how land values are affected at the margin by changes in the level of a characteristic, the resulting coefficients are not valid for large changes in the level of characteristics and do not reflect the impacts of demand and supply shifters (i.e., income and socio-economic factors) that are not associated with the tract of land itself. Therefore, following the approach developed by Rosen, two equations are estimated in the following steps: (i) estimate equation (2) and determine the marginal implicit prices of the characteristics by calculating the partial derivative of the hedonic equation with respect to each characteristic ($\partial P/\partial z_i$); and, (ii) estimate the inverse demand or bid function for selected characteristics by regressing the implicit prices of the characteristic upon characteristic, income, and other socio-economic variables hypothesized to explain the demand for the characteristic.

The market-clearing equilibrium price, P(z), is assumed to be determined by simultaneous interaction of the bid and offer functions. If the supply of land with given characteristics is not completely inelastic, the offer function for the characteristic must be incorporated in a system of simultaneous equations to solve the second step of the approach. However, because the supply of rural land can be assumed to be inelastic, offer functions are superfluous and bid functions are sufficient to derive equilibrium prices (Freeman, 1979).

Following the approach used by Danielson (1984), a transcendental function was specified for each rural land submarket identified in this study:

$$\text{Price} = \beta_0 Z_1^{\beta_1} \exp\left[\sum_{i=1}^{m} \alpha_i X_i + \sum_{j=1}^{n} \gamma_j D_j + \epsilon\right], \qquad (3)$$

where Price is the per acre price of land, Z_1 is the size of tract in acres, m is the number of additional continuous variables (X_i), n is the number of discrete (dummy) variables (D_j), and ϵ is a random disturbance term. Taking the natural logarithm of both sides of equation (3) gives:

$$\ln \text{Price} = \ln \beta_0 + \beta_1 \ln Z_1 + \sum_{i=1}^{m} \alpha_i X_i + \sum_{j=1}^{n} \gamma_j D_j + \varepsilon. \qquad (4)$$

Because the price of land is hypothesized to decline as the size of tract (Z_1) increases, but at a decreasing rate, nonlinearities were incorporated for Z_1. Therefore, β_1 is hypothesized to be negative, although the specification allows it to be negative or positive.

The implicit marginal price of each characteristic is an estimate of the amount by which the per acre land price changes, given a unit change in the characteristic. For all except the discrete variables in equation (3), the implicit marginal prices (i.e., the partial derivatives) are given by the following:

$$\partial \text{Price}_t \,/\, \partial Z_{1,t} = \text{IMPSIZE}_{1,t} = [\, \beta_1 \,/\, Z_{1,t} \,] \times \text{Price}_t$$
$$\partial \text{Price}_t \,/\, \partial X_i = \text{IMPX}_{i,t} = \alpha_i \times \text{Price}_t. \qquad (5)$$

The subscript, t, implies that there are implicit marginal prices associated with each land transaction. An estimate of the implicit marginal price at the mean price and mean level of characteristic over all observations is obtained by substituting mean values of each variable in equation (5).

The derivation of implicit prices for discrete variables (D_j) in semilogarithmic equations is not as straightforward. Kennedy (1981) suggests the following estimation procedure where the variance of the coefficient of the discrete variable is taken into account:

$$\text{IMPD}_j = (\exp [\, c_j - 1/2\ V(c_j) \,] - 1) \times \text{Mean Price}, \qquad (6)$$

where IMPD_j is the implicit price of the discrete variable, c_j is the estimated coefficient of the discrete variable parameter, D_j; $V(c_j)$ is the variance of the estimated coefficient, c_j; and Mean Price is the mean price per acre over all observations used in the model. Taking $V(c_j)$ into account can lead to less bias in the estimate when the variance of c_j is substantial.

Implicit prices derived in equation (5) are used to calculate implicit prices of the characteristic for each sale successively. This provides a set of implicit prices for the characteristic, one for each sale. These implicit prices are then regressed upon the quantities of the explanatory variables, income, and other socio-economic variables to yield the inverse demand or bid function for the characteristic. Palmquist (1984) indicates that bid functions can be consistently estimated by ordinary least squares.

Following the approach used by Elad, Clifton, and Epperson (1994), each bid function in this study is specified by:

$$IMPX_i = \beta_0 + \beta_1 \ln Z_1 + \sum_{i=1}^{m} \alpha_i X_i + \sum_{j=1}^{n} \gamma_j D_j + \sum_{k=1}^{r} \theta_k Y_k + \mu, \qquad (7)$$

where $IMPX_i$ 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 socio-economic variables (Y_k), and μ is a random disturbance term.

VARIABLES USED IN ESTIMATIONS

The primary data used in hedonic pricing models and for the estimation of bid functions in this study consisted of 948 actual sales of Louisiana rural real estate. Parish-level income and socio-economic data necessary to estimate bid functions were from the *Statistical Abstract of Louisiana* (Division of Business and Economic Research, 1994) and the *1992 Census of Agriculture* (U.S. Department of Commerce, 1994). The observational unit for each variable used in the first-stage hedonic analysis is measured on a per tract basis. Variables used in the estimation of hedonic pricing models, including variables used in the estimation of bid functions and their expected signs, are presented in Table 1. Because each rural land submarket identified is different with respect to characteristics modeled, each model used only those variables listed in Table 1 that were relevant to each respective submarket. The dependent variable used in the first stage hedonic model (PRICE) reflects the per acre selling price for each tract of rural land, including all improvements.

Tract size (SIZE) is a key physical characteristic that is expected to influence the selling price of rural land. Because a larger tract of rural land often has a higher total value than a smaller tract, the number of potential buyers was expected to be reduced. Previous rural land research suggests that the size of tract reflects a curvilinear relationship, with value per acre decreasing at a decreasing rate as tract size increases. Therefore, SIZE was expected to have an inverse relationship to the per acre price and entered the hedonic equation in a nonlinear form.

The proportion of land in a tract devoted to cultivation (CROP) is a physical characteristic that is expected to have a positive influence on per acre land values. Because cultivated land represents an intensive use, it may be priced at a premium over less developed rural land. Similarly, the proportion of land devoted to pasture (PAST) may also contribute to rural land values, depending on the extent of improvement.

Table 1. Hedonic pricing model variables, Louisiana rural real estate market, 1994

Symbol	Variable	Expected Sign
Continuous Variables[a]		
PRICE	Per acre price of land ($)	
SIZE	Size of tract (acres)	(-)
CROP	Percent of cropland in tract	(+)
PAST	Percent of pastureland in tract	(+)
TIMB	Percent of timberland in tract	(-)
VALUE	Value of improvements ($)	(+)
ROADFT	Road frontage (feet)	(+)
DISFT	Distance to largest parish town (feet)	(-)
MINERAL	Percent of mineral rights purchased	(+)
Discrete Variables (1,0)[a]		
RT	Paved access road	(+)
RPE	Reason for purchase: expansion	(+)
RPI	Reason for purchase: investment	(+)
RPF	Reason for purchase: establish farm	(+)
RPR	Reason for purchase: residence	(+)
CB	Presence of cotton base	(+)
RB	Presence of rice base	(+)
SC	Presence of sugar cane	(+)
Discrete Soil Variables (1,0)[a]		
S1	Coastal Plain	(+)
S2	Gulf Coast Flatwoods	(+)
S3	Gulf Coast Prairies	(+)
S7	Recent Alluvium-Mississippi River	(+)
S8	Recent Alluvium-Red/Ouachita River	(+)
S10	So. Miss. Valley Silty Uplands	(+)
Socio-economic Variables[b]		
POPDEN	Parish population per square mile	(+)
PCINC	Parish average per capita income ($)	(+)
NFI	Parish net farm income ($)	(+)

[a]Source: Louisiana Rural Land Market Survey, 1994.

[b]Source: *Statistical Abstract of Louisiana*, 1994 and *U.S. Census of Agriculture*, 1992.

Other physical characteristics expected to positively influence rural land values included the value of improvements (VALUE) and the amount of road frontage the tract contains (ROADFT). The value of improvements reflected the dollar valuation made by the survey respondent for any improvement made on or to the tract, including buildings, barns, fences, irrigation equipment, etc. The amount of road frontage was expected to reflect development potential and accessibility. Because mineral rights represent a potential income stream, the percent of mineral rights purchased (MINERAL) was expected to have a positive impact on per acre land values.

Locational factors, such as where the tract is situated with respect to population centers or markets, areas of economic development, and transportation routes, are hypothesized to affect land values. GIS analysis of tract location (Figure 1) indicated that the largest town in the parish was generally the closest area of economic development for each tract. GIS procedures were then used to estimate the straight line distance to the largest town in the parish (DISFT) for each reported sale (Figure 3). While not reflecting the impacts of rivers, roads,

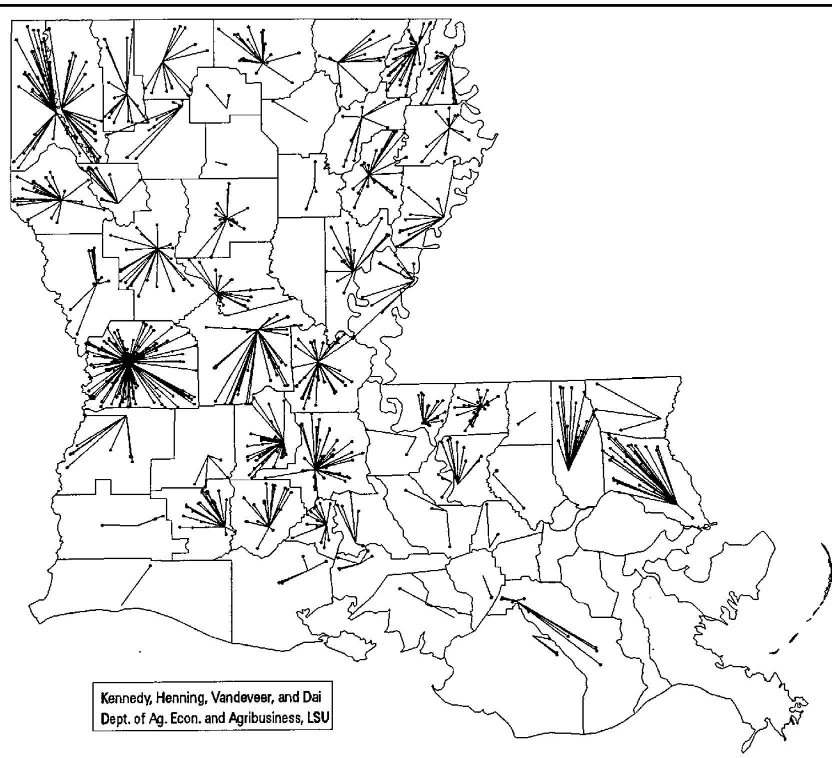

Figure 3. GIS-estimated straight line distance between sale tract and largest parish town, Louisiana, 1994

national forests, lakes, and other factors that may alter actual transportation routes, straight line distances served as a proxy for the distance from the tract to areas of economic development. Since location theory suggests there is an inverse relationship between distance to input and output markets and land prices, the coefficient of DISFT was expected to be negative. Estimates presented in Figure 3 suggest a substantial amount of variation in distance estimates (DISFT) for most tracts of rural land used in this study.

Several factors expected to affect land values were modeled as discrete variables. These included the presence of a paved access road (RT), principal reasons for purchase of the tract, and variables that attempted to measure the effects of governmental crop support programs on rural land values. Significant reasons for purchase included expansion of current land holdings, regardless of purpose (RPE), investment (RPI), establish farm (RPF), and residence (RPR). Benefits from federal commodity price support programs are hypothesized to be capitalized into the value of the land. A discrete variable was defined for tracts containing land enrolled in acreage reduction programs. These crops included cotton (CB) and rice (RB). Although sugarcane is a subsidized crop, there is no acreage reduction program. Sugarcane was supported through import quotas restricting the import of foreign sugar and marketing allotments during the period of this study. Therefore, higher sugar prices are hypothesized to be capitalized into the values of land capable of producing sugarcane. A discrete variable was included for tracts producing sugarcane (SC).

Spatially overlaying the location of each rural land sale on a GIS map of the general soil areas in Louisiana allowed the estimation of discrete (dummy) variables for the general soil classification associated with each tract of rural land. The location of each sale by general soil association is illustrated in Figure 4 (larger map inserted in bulletin). Information presented in Figure 4 suggests a wide variation of soils in Louisiana. This wide variation in soils affects the range of crops that can be grown. For example, Coastal Prairie soils in southwest Louisiana have an impervious subsoil suitable for rice production, whereas, many of the alluvial soils of the Mississippi, Ouachita, and Red River areas are well suited for cotton and other row crop production. Variation in commodity production affects the income producing capacity and, hence, rural land values. Data presented in Figure 4 indicate substantial variation in soils across the 948 reported rural land sales.

Ideally, second-stage estimation procedures would include the use of variables obtained on tract-specific buyer and seller characteristics. Such variables would include buyer and seller income, reason for purchase, reason for sale, type of financing, and identification of buyer (individual, partnership, or corporation). However, detailed data on the characteristics of the buyer and seller of each tract were not available. Because buyers of rural land tend to be regionally located, parish-level income and socio-economic variables were used in the estimation of hedonic bid functions. These variables included population per square mile (POPDEN), average per capita income (PCINC), and net farm income (NFI). These factors are hypothesized to be important rural land demand shifters that are not directly associated with the tract of land itself. In general, income and population are expected to have a positive influence on the demand for rural land.

Mean values of all variables used in rural land submarket hedonic models are presented in Table 2. Results in Table 2 indicate that mean rural real estate values ranged from $640 per acre in the North Delta Area to $2,298 per acre in the Southeast Area. Mean tract size ranged from 87 acres in the Southeast Area to 386 acres in the Central Delta Area. Mean values given in Table 2 also indicate substantial variability for several rural land characteristics. For example, the standard deviation for price per acre ranged from $236 in the North Delta Area to $1,364 in the Southeast Area. This suggests that approximately 68 percent of the reported sales in the North Delta Area are expected to fall in the price interval of $404 to $876 per acre (the mean plus and minus one standard deviation) and approximately 68 percent of the reported sales in the Southeast Area are expected to fall in the price interval of $933 to $3,661 per acre. This variation in per acre real

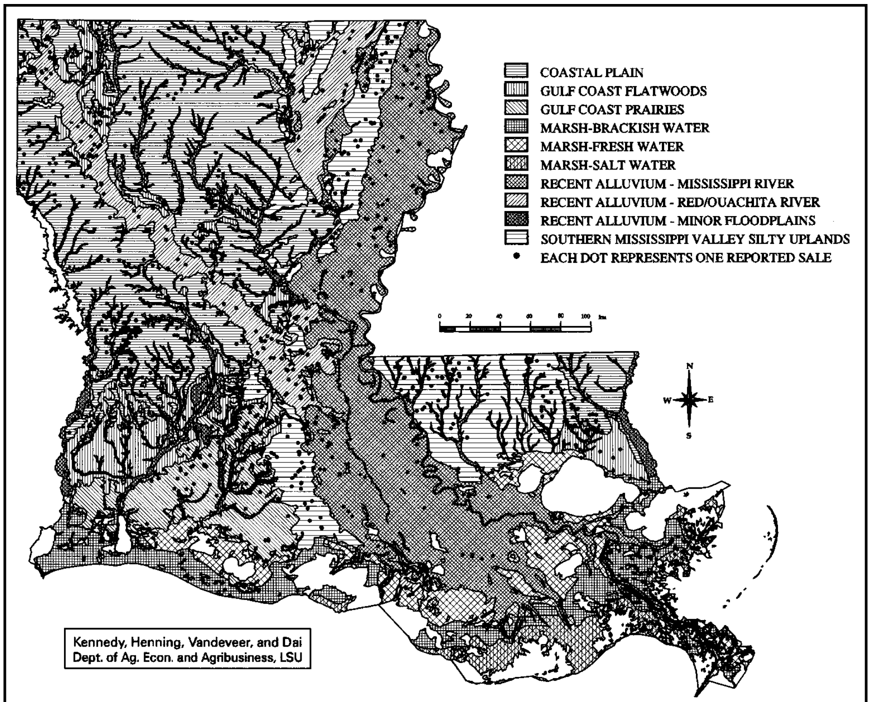

Figure 4. GIS plot of each sale tract on the general soil map, Louisiana, 1994

estate values is expected to be due to locational, productivity, and other differences that exist among reported real estate sales. Other rural real estate characteristics exhibiting a relatively high amount of variation include size of tract, value of improvements, amount of road frontage, and distance to the largest town in the parish. Substantial variation in rural real estate characteristics across rural land submarket areas suggests a need to measure the influence of rural real estate characteristics on rural land values.

EMPIRICAL RESULTS

First-stage OLS hedonic regressions for each submarket area, using the model specification given by equation (4), are presented in Table 3. Each submarket column in Table 3 corresponds to an explanatory variable on the left-hand side. Because each rural land submarket is unique, models were individually specified. While variables such as size of tract (SIZE), value of improvements (VALUE), road frontage (ROADFT), distance to the largest town in the parish (DISFT), percent of mineral rights purchased (MINERAL), and paved access road (RT) were included in all submarket models, the inclusion of other continuous and discrete explanatory variables depended on their relevance to each respective submarket. Only those variables included in each submarket model have a corresponding parameter estimate and t-ratio (Table 3).

To test hypotheses and examine levels of significance of parameters in each hedonic pricing model, certain assumptions of the properties of the random disturbance term (ϵ) must be true. These properties include: (i) ϵ are random variables with expected values of zero; (ii) ϵ have the same variance and are therefore homoskedastic; (iii) ϵ have zero covariances; and, (iv) ϵ are independent of the regressors. In addition, it is further assumed that the random disturbance terms are approximately normally distributed.

Breusch-Pagan-Godfrey, ARCH, Harvey, and Glejser tests (SHAZAM, 1993) for the assumption of constant variance (homoskedasticity) for the random disturbance term for each submarket model indicated failure to reject the null hypothesis of homoskedastic disturbance terms for each submarket model. Also, Pearson correlation coefficients were computed between all pairs of explanatory variables. The magnitude of the correlation coefficients did not suggest multicollinearity problems. The Shapiro-Wilk test statistic (W) was used to test the null hypothesis of normal random disturbance terms for each submarket model (Table 3). Normality was not rejected for the North Delta Submarket at the 0.01 level of significance. In all the remaining submarket models, the null hypothesis of normality was not rejected at the 0.05 level of significance.

Table 2. Mean values of variables used in hedonic analysis, Louisiana rural real estate market, 1994

	Rural Land Submarket Area							
Variable[a]	Western	Red River	North Central	North Delta	Southwest	Central Delta	Southeast	Sugar Cane
PRICE ($/ac.)	974.78	846.92	647.90	640.30	1038.41	733.34	2297.96	1646.72
	(1095.47)[b]	(909.01)	(343.05)	(236.69)	(748.18)	(376.22)	(1364.17)	(1065.54)
ln PRICE	6.60	6.45	6.34	6.39	6.78	6.49	7.57	7.26
	(0.69)	(0.71)	(0.53)	(0.38)	(0.54)	(0.46)	(0.60)	(0.53)
SIZE (ac.)	104.91	174.61	91.89	246.49	158.16	386.17	87.05	257.30
	(389.87)	(266.48)	(82.72)	(327.28)	(174.70)	(871.12)	(127.53)	(492.57)
ln SIZE	3.68	4.42	4.16	5.00	4.52	4.94	3.86	4.46
	(1.05)	(1.19)	(0.88)	(0.98)	(1.09)	(1.31)	(1.07)	(1.34)
CROP (%)		27.21		75.72	51.47	48.00		46.78
		(41.73)		(31.93)	(45.62)	(45.95)		(44.75)
PAST (%)	9.66	16.73	31.84				25.52	
	(27.25)	(34.31)	(42.75)				(39.03)	
TIMB (%)	18.75	42.03	52.12				36.49	
	(37.28)	(47.57)	(46.29)				(42.20)	
VALUE ($)	31653.35	13704.20	5853.56	4743.51	5828.51	6715.53	17829.94	10288.76
	(225173.80)	(32804.04)	(16918.68)	(14265.97)	(11983.07)	(26227.63)	(41072.45)	(29122.43)
ROADFT (ft.)	156.23	846.33	390.71	832.29	891.63	549.90	626.17	514.88
	(965.00)	(1625.24)	(823.80)	(1164.57)	(2404.72)	(1398.28)	(969.26)	(1726.30)
DISFT (ft.)	66354.45	86741.66	58559.13	60141.34	55447.16	62690.22	85336.67	58621.11
	(36600.36)	(37608.42)	(34205.32)	(28702.33)	(22902.99)	(27798.81)	(54219.61)	(49573.37)
MINERAL (%)	11.11	52.07	35.37	40.85	30.53	30.03	50.73	18.29
	(30.65)	(43.84)	(44.78)	(43.25)	(39.21)	(40.32)	(42.13)	(34.92)
RT	0.06	0.54	0.57	0.45	0.54	0.42	0.70	0.63
	(0.23)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.46)	(0.49)
RPE	0.06	0.21	0.27	0.56	0.31	0.38		0.22
	(0.25)	(0.41)	(0.45)	(0.50)	(0.46)	(0.49)		(0.42)
RPI	0.08	0.40		0.17	0.15	0.15	0.14	
	(0.28)	(0.49)		(0.38)	(0.36)	(0.35)	(0.35)	
RPF				0.11				
				(0.31)				

Table 2. Mean values of variables used in hedonic analysis, continued

	Rural Land Submarket Area							
Variable[a]	Western	Red River	North Central	North Delta	Southwest	Central Delta	Southeast	Sugar Cane
RPR	0.05	0.17					0.38	0.27
	(0.21)	(0.38)					(0.49)	(0.45)
CB		0.12		0.51		0.11		
		(0.33)		(0.50)		(0.31)		
RB				0.04	0.40			
				(0.19)	(0.49)			
SC								0.51
								(0.51)
S1	0.76	0.38	0.79				0.23	
	(0.43)	(0.49)	(0.41)				(0.42)	
S2							0.10	
							(0.29)	
S3					0.66			
					(0.47)			
S7				0.50		0.39		0.78
				(0.50)		(0.49)		(0.42)
S8		0.43				0.34		
		(0.50)				(0.48)		
S10					0.16	0.19	0.60	
					(0.37)	(0.40)	(0.49)	
POPDEN	42.55	124.06	32.40	31.34	127.35	54.95	162.34	88.69
	(7.83)	(101.41)	(21.72)	(19.68)	(185.50)	(27.45)	(213.70)	(33.36)
PCINC ($)	12488.78	15023.99	13484.30	12124.22	12865.56	12526.29	14682.29	13738.39
	(574.06)	(2257.33)	(821.17)	(921.91)	(1924.06)	(882.55)	(3112.98)	(1656.63)
NFI ($)	3420.51	5030.91	8314.27	19903.29	7291.47	14332.40	3917.70	21477.37
	(2292.52)	(5498.03)	(10553.27)	(12124.76)	(1804.37)	(7647.91)	(3648.70)	(11809.07)
N	216	151	82	131	119	103	105	41

[a]Variables are defined in Table 1.
[b]Standard deviations are in parentheses.

Table 3. Estimated coefficients of first-stage hedonic models, by rural land submarket area, Louisiana, 1994

	Rural Land Submarket Area							
Variable	Western	Red River	North Central	North Delta	Southwest	Central Delta	Southeast	Sugar Cane
ln SIZE	-0.2700	-0.3759	-0.2582	0.0199	-0.1487	-0.0793	-0.2405	-0.1564
	(-5.16)***a	(-7.27)***	(-4.80)***	(0.58)	(-3.64)***	(-2.05)**	(-4.40)***	(-2.72)***
CROP		0.0016		0.0003	-0.0043	-0.1E-4		0.0062
		(0.71)		(0.26)	(-3.56)***	(-0.01)		(2.22)**
PAST	0.0012	0.0019	0.0050				-0.0012	
	(0.54)	(1.01)	(3.10)***				(-0.77)	
TIMB	0.0014	-0.0016	0.0021				-0.0033	
	(1.01)	(-0.88)	(1.50)				(-2.39)***	
VALUE	0.9E-6	0.9E-5	0.1E-4	0.3E-5	0.1E-4	0.1E-5	0.3E-5	-0.1E-5
	(3.87)***	(6.38)***	(3.52)***	(1.11)	(3.61)***	(0.77)	(2.03)**	(-0.48)
ROADFT	0.6E-5	0.3E-4	0.4E-4	-0.3E-4	-0.3E-5	0.3E-5	0.0001	0.4E-4
	(0.12)	(1.02)	(0.69)	(-1.05)	(-0.18)	(0.09)	(1.98)**	(1.02)
DISFT	-0.2E-5	-0.2E-6	-0.4E-6	-0.4E-6	-0.5E-5	-0.3E-5	-0.2E-5	0.2E-5
	(-1.68)*	(-0.14)	(-0.26)	(-0.37)	(-3.20)***	(-1.64)*	(-2.00)**	(1.05)
MINERAL	0.0045	0.0025	-0.0006	0.0015	-0.0007	-0.0020	0.0040	0.0032
	(2.62)***	(2.37)***	(-0.56)	(1.99)**	(-0.67)	(-1.60)	(3.27)***	(1.26)
RT	0.3122	0.2815	0.2984	0.1140	0.3143	0.2155	0.1970	0.2717
	(1.33)	(2.77)***	(2.80)***	(1.72)*	(3.88)***	(2.30)**	(1.71)*	(1.78)*
RPE	-0.1459	0.0861	0.0033	-0.1816	0.1003	-0.0647		-0.3534
	(-0.66)	(0.61)	(0.30)	(-2.05)**	(1.02)	(-0.58)		(-1.65)
RPI	-0.0242	0.0522		-0.3223	-0.0998	-0.2074	0.2136	
	(-0.13)	(0.37)		(-2.91)***	(-0.85)	(-1.45)	(1.38)	
RPF				-0.3239				
				(-2.63)***				
RPR	0.4176	0.3284					0.1899	0.4447
	(1.83)**	(2.16)**					(1.67)*	(2.21)**
CB		0.3830		0.2432		0.2377		
		(2.37)***		(3.49)***		(1.77)*		

Table 3. Estimated coefficients of first-stage hedonic models, by rural land submarket area, continued

	Rural Land Submarket Area							
Variable	Western	Red River	North Central	North Delta	Southwest	Central Delta	Southeast	Sugar Cane
RB				0.2697	0.2380			
				(1.53)	(1.98)**			
SC								0.3572
								(1.50)
S1	0.2159	0.1098	0.2123				0.3382	
	(2.05)**	(0.92)	(1.86)*				(1.55)	
S2							0.4196	
							(1.78)*	
S3					0.2146			
					(2.04)**			
S7				0.1416		0.2327		-0.1549
				(2.09)**		(1.34)		(-0.75)
S8		0.0906				0.5081		
		(0.55)				(3.06)***		
S10					0.5565	0.4240	-0.2504	
					(4.11)***	(2.32)**	(-1.32)	
Intercept	7.5264	7.4735	6.7762	6.1815	7.4178	6.7066	8.7369	7.2376
	(32.28)***	(28.61)***	(23.07)***	(32.86)***	(32.31)***	(29.78)***	(26.57)***	(15.39)***
R^2	0.24	0.55	0.50	0.26	0.56	0.35	0.47	0.57
F-Value	5.26	10.95	7.18	3.18	11.40	3.63	6.31	3.45
W^b	0.9883**	0.9810**	0.9871**	0.9643***	0.9844**	0.9879**	0.9873**	0.9846**
N	216	151	82	131	119	103	105	41
Dependent Variable: ln PRICE								

[a] 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.

[b] Shapiro-Wilk test statistic for normality; *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level.

The coefficient for size of tract (ln SIZE) was statistically significant and had the expected negative relationship with per acre land value in seven of the eight rural land submarket areas. The North Delta Area was the only submarket where the coefficient of size was not statistically significant. The expected inverse relationship of size of tract and value may not exist because the North Delta Area is a major production area for cotton and other row crops, and larger tracts may offer economies of size in production and thus command a premium over smaller tracts.

The value of improvements (VALUE) had an expected positive coefficient and was statistically significant in five submarket areas. While the coefficient for the amount of road frontage (ROADFT) was positive and statistically significant for the Southeast Area, it was not significant for any other submarket area. The coefficients for distance to the largest town in the parish (DISFT) had the expected negative sign in all four rural land submarket areas where the coefficient was statistically significant. Percent of mineral rights purchased (MINERAL) was statistically significant and had the expected positive coefficient in four rural land submarket areas. The presence of a paved access road (RT) had an expected positive coefficient and was statistically significant in seven of the eight rural land submarket areas. Coefficients of the remaining explanatory variables are discussed by relevant submarket area.

Submarket A: Western Area

Respondents to the 1994 Louisiana Rural Land Market Survey cited investment, expansion, and residence as the most frequently given reasons for tract purchase in the Western Area. Less often cited reasons for purchase included recreation, commercial development, and establishment of a farm. Thus, discrete variables for investment (RPI), expansion (RPE), and residence (RPR) were included in the first-stage hedonic model for the Western Area (Table 3). Results of this analysis indicated a significant coefficient for RPR. The positive value for this coefficient was expected because of residential competition for rural land in the area.

Geo-referencing the location of reported sales in the Western Area indicated that 164 of the 216 tracts (76 percent) were located in the Coastal Plain general soil area. The remaining tracts were located in the Gulfcoast Flatwoods and Minor Floodplains (see Figure 4). A soil type binary variable (S1) was included in the analysis to measure the effect of soils on land values. Results in Table 3 indicate that the discrete variable for tracts located in the Coastal Plain (S1) resulted in a statistically significant and positive coefficient. These results suggest that the hilly Coastal Plain, which is highly suitable for growing softwood timber, is priced at a premium over the Gulfcoast Flatwoods and Minor Floodplains that are suitable for slower growing hardwood timber. In addition, the upland regions are generally subject to greater demand for alternative uses, such as residences.

Other statistically significant variables included size of tract (SIZE), value of improvements (VALUE), distance to the largest town in the parish (DISFT), and percent of mineral rights purchased (MINERAL). The expected signs for all statistically significant coefficients in the Western Area rural land value model were correct.

Submarket B: Red River Area

Red River Area respondents also indicated that investment, expansion, and residence were the most frequent reasons for tract purchase. Less often cited reasons for purchase included recreation, commercial development, and establishment of a farm. Including discrete variables into the Red River model for investment (RPI), expansion (RPE), and residence (RPR) resulted in a statistically significant coefficient for RPR. This relationship was expected because of residential competition for rural land in the rural urban fringe areas of Shreveport and Alexandria.

Geo-referencing each of the 151 reported sales in the Red River Area indicated that 65 of the tracts (43 percent) were located in the highly productive Recent-Alluvium Red River general soil area. Fifty-seven tracts (38 percent) were located in the Coastal Plain general soil area. The remaining tracts were located in the Gulfcoast Flatwoods and Minor Floodplains. Discrete variables for the tracts located in the Coastal Plain (S1) and the Red River (S8) general soil areas were included in the analysis to measure the effect of type of soil on land values. Neither of these variables was statistically significant.

Over 9,000 acres of government program crop base acreage were reported by Red River Area respondents. The largest proportion of reported base acreage was cotton base (39 percent), with the remaining base divided between smaller amounts of rice, wheat, corn, oat, and grain sorghum acreage. A discrete variable for the presence of cotton base (CB) was included in the model. As indicated in Table 3, the coefficient of this variable was both statistically significant and positive.

Other statistically significant variables in the model included size of tract (SIZE), value of improvements (VALUE), percent of mineral rights purchased (MINERAL), and presence of a paved access road (RT). The signs for all statistically significant coefficients in the Red River Area land value model were as expected.

Submarket C: North Central Area

North Central Area respondents indicated that expansion was the most frequent reason for tract purchase. Less often cited reasons for purchase included investment, residence, recreation, commercial development, and establishment of a farm. A discrete variable in the North Central Area model for expansion (RPE) did not indicate a statistically significant relationship between expansion and rural land values. This suggests that buyers did not pay more for land purchased for expansion of current land holdings compared with rural land purchased for other reasons.

Geo-referencing each of the 82 reported sales in the North Central Area indicated that 65 of the tracts (79 percent) were located in the Coastal Plain general soil area. The remaining tracts were located in the Gulfcoast Flatwoods and Minor Floodplains. As Table 3 indicates, including a discrete variable for the tracts located in the Coastal Plain (S1) resulted in a statistically significant positive coefficient. Like the Western Area, the North Central Area is a major softwood and hardwood timber production area.

Twenty-six of the 82 tracts of rural land reported pasture as the primary enterprise. Because pasture and hay production are complementary enterprises to the expanding poultry industry in the North Central Area, percent of tract in pasture (PAST) was expected to have a positive influence on per acre land values. As Table 3 indicates, the coefficient of the continuous explanatory variable PAST was both statistically significant and positive.

Other statistically significant variables in the model were size of tract (SIZE), value of improvements (VALUE), and presence of a paved access road (RT). The signs were consistent with prior expectations for all statistically significant coefficients in the North Central Area rural land value model.

Submarket D: North Delta Area

North Delta Area survey respondents indicated that expansion, investment, and establishment of a farm were the most frequently given reasons for tract purchase. Less often cited reasons for purchase included recreation and residence. Including discrete variables into the North Delta Area model for investment (RPI), expansion (RPE), and establishment of a farm (RPF) resulted in statistically significant and negative coefficients for all three variables. The inverse relationship between these variables and per acre land prices was expected if these were marginal tracts of agricultural land that tend to change hands frequently.

Geo-referencing each of the 131 reported sales in the North Delta Area indicated that 66 of the tracts (50 percent) were located in the highly productive Recent-Alluvium Mississippi River general soil area, a major cotton producing area. Most of the remaining tracts were located in the Recent-Alluvium Ouachita River and Southern Mississippi Valley Silty Uplands general soil areas. A discrete variable for the tracts located in the Recent-Alluvium Mississippi River (S7) general soil area resulted in a statistically significant and positive coefficient.

More than 12,000 acres of government program crop base acreage were reported by North Delta Area respondents. The largest proportion of reported base acreage was cotton base (78 percent), with the remaining base divided between smaller amounts of rice, wheat, corn, oat, and grain sorghum acreage. A discrete variable for the presence of cotton base (CB) was included in the model. Results presented in Table 3 indicate that this variable had a positive and statistically significant influence on rural land values.

Other statistically significant variables in the model included percent of mineral rights purchased (MINERAL) and the presence of a paved access road (RT). The expected signs were consistent with prior expectations for all statistically significant coefficients in the North Delta Area rural land value model.

Submarket E: Southwest Area

Expansion and investment were the most frequently given reasons for tract purchase by Southwest Area rural land purchasers. Less often cited reasons for purchase included residence and establishment of a farm. Including discrete variables into the Southwest Area model for investment (RPI) and expansion (RPE) resulted in estimated coefficients that were not statistically significant for either variable.

Geo-referencing each of the 119 reported sales in the Southwest Area indicated that 80 of the tracts (67 percent) were located in the Gulfcoast Prairies general soil area. The Gulfcoast Prairies are important areas of agricultural production, especially rice and soybeans. Nineteen reported tracts (16 percent) were located in the Southern Mississippi Valley Silty Uplands. Most of the remaining tracts were located in the Gulfcoast Flatwoods and Minor Floodplains general soil areas. Coefficients for discrete variables of tracts located in the Gulfcoast Prairies (S3) and Southern Mississippi Valley Silty Upland (S10) general soil areas were statistically significant and positive.

Over 4,500 acres of government program crop base acreage were reported by Southwest Area respondents. The largest proportion of reported base acreage was rice base (90 percent), with the remaining divided between smaller amounts of wheat, oat, and grain sorghum acreage. A rice base (RB) discrete variable was included in the rural land value model for the Southwest Area; its coefficient was both statistically significant and positive.

Other statistically significant variables in the model included the size of tract (SIZE), percent of cropland in tract (CROP), value of improvements (VALUE), distance to the largest town in the parish (DISFT), and the presence of a paved access road (RT). The expected signs were consistent with prior expectations for all statistically significant coefficients in the Southwest Area rural land value model.

Submarket F: Central Delta Area

Central Delta Area survey respondents indicated that expansion and investment were the most frequent reasons for tract purchase. Less often cited reasons for purchase included recreation, residence, and establishment of a farm. Discrete variables included in the Central Delta Area model for investment (RPI) and expansion (RPE) resulted in coefficients that were not statistically significant.

Geo-referencing each of the 103 reported sales in the Central Delta Area indicated that 40 of the tracts (39 percent) were located in the Recent-Alluvium Mississippi River general soil area, 35 tracts (34 percent) were located in the Recent-Alluvium Red/Ouachita River general soil area, and 20 tracts (19 percent) were located in the Southern Mississippi Valley Silty Uplands general soil area. Most of the remaining tracts were located in the Minor Floodplains and Coastal Plain general soil areas. Discrete variables for the tracts located in the Recent-Alluvium Mississippi River (S7), Red/Ouachita Rivers (S8), and Southern Mississippi Valley Silty Uplands (S10) general soil areas resulted in statistically significant and positive coefficients only for S8 and S10.

Over 2,400 acres of government program crop base acreage were reported by Central Delta Area respondents. The largest proportion of reported base acreage was cotton base (58 percent), with the remaining base divided between smaller amounts of rice, wheat, corn, and grain sorghum acreage. A discrete variable for the presence of cotton base (CB) was included in the model. The coefficient for this variable was both statistically significant and positive.

Other statistically significant variables in the model included percent of size of tract (SIZE), distance to the largest town in the parish (DISFT), and the presence of a paved access road (RT). The expected signs were consistent with prior expectations for all statistically significant coefficients in the Central Delta Area rural land value model.

Submarket G: Southeast Area

Southeast Area respondents indicated that residence and investment were the primary reasons for tract purchase. Less often cited reasons for purchase included expansion, recreation, and establishment of a farm. Results presented in Table 3 indicate a statistically significant and positive effect of residence on rural land values. This result is consistent with the fact that this area includes the Baton Rouge metropolitan area and is located near the New Orleans metropolitan area.

Geo-referencing each of the reported sales in the Southeast Area indicated that 63 of 105 tracts (60 percent) were located in the Southern Mississippi Valley Silty Uplands, 24 tracts (23 percent) were in the Coastal Plain, and 10 tracts (10 percent) were in the Gulfcoast Flatwoods. Most of the remaining tracts were located in the Minor Floodplains. Coastal Plain soils (S1), Gulfcoast Flatwoods soils (S2), and Southern Mississippi Valley Silty Uplands soils (S10) were statistically significant in explaining rural land values in the Southeast Area. The Gulfcoast Flatwood soil variable may be measuring proximity to the New Orleans metropolitan area, rather than soil productivity.

Other statistically significant variables in the model included size of tract (SIZE), percent of timberland in the tract (TIMB), value of improvements (VALUE), the amount of road frontage (ROADFT), distance to the largest town in the parish (DISFT), and the presence of a paved access road (RT). The Southeast was the only rural land submarket area where the amount of road frontage was statistically significant. This suggests that the potential for residential and other development might be stronger in this submarket than in any other submarket area in Louisiana. Expected signs for all statistically significant coefficients in the Southeast Area model were consistent with prior expectations.

Submarket H: Sugar Cane Area

Sugar Cane Area respondents indicated that expansion and residence were the most frequent reasons for tract purchase. Less often cited reasons for purchase included investment, commercial development, and establishment of a farm. Including discrete variables into the Sugar Cane Area model for expansion (RPE) and residence (RPR) resulted in a significant and positive coefficient for the latter.

Geo-referencing each of the 41 reported sales in the Sugar Cane Area indicated that 32 tracts (78 percent) were located in the Recent-Alluvium Mississippi River general soil area. Most of the remaining tracts were located in the Marsh or Southern Mississippi Valley Silty Uplands general soil areas. Including a discrete variable for tracts located in the Recent-Alluvium Mississippi River (S7) general soil area resulted in an estimated coefficient that was not statistically significant.

Respondents reported a total of 664 acres of government program crop base acreage for the area. The reported base acreage was divided between corn, rice, wheat, and grain sorghum acreage. Traditionally, the Sugar Cane Area has accounted for a large portion of total sugar cane production in Louisiana. Because sugar cane is a subsidized crop, a discrete variable for the presence of sugar cane (SC) was included in the model; however, the estimated coefficient of SC was not statistically significant.

Other statistically significant variables in the model included percent of size of tract (SIZE), percent of cropland in tract (CROP), and the presence of a paved access road (RT). The signs were consistent with prior expectations for all statistically significant coefficients in the Sugar Cane Area rural land value model.

MARGINAL IMPLICIT PRICES OF CHARACTERISTICS

Due to the implicit nature of the first-stage hedonic model, only point estimates of the marginal prices are obtained using the quantities of the characteristics in question and the per acre prices paid. Therefore, marginal implicit prices are only evaluated for individual tracts on a post-sale basis, and no direct implications can be drawn from the results of these point estimates (Danielson, 1984). However, it was possible to observe the magnitude and direction of influence of the characteristics by examining implicit prices at mean values of rural land price and characteristic quantity. When the coefficient of a characteristic is positive, the resulting marginal implicit price is necessarily positive. A positive marginal implicit price indicates that an increase in that characteristic results in an increase in the price of rural land. Conversely, a negative marginal implicit price resulting from a negative coefficient has a depressing effect on rural land prices. Using the estimated coefficients from the first-stage hedonic models (Table 3) and mean levels of prices and characteristics (Table 2), the mean marginal implicit prices for rural land characteristics were estimated (Table 4). While marginal implicit prices are presented for all characteristics, only those resulting from statistically significant coefficients are discussed.

Per acre rural land values varied inversely with tract size (as hypothesized) in seven of the eight submarket areas. Resulting marginal implicit prices for tract size at mean levels of prices and characteristics ranged from $-6.35 in the Southeast Area to $-0.15 in the Central Delta Area.[2] Interpretation of these results suggests that land price declines by $0.15 per acre with a one-acre increase in tract size in the Central Delta Area. The implicit marginal price varies proportionately with per acre price. Tracts selling above the mean price of $733.34 in the Central Delta Area yield implicit marginal prices that suggest per acre land prices decline more than $0.15 per acre with a one-acre increase in size of tract; the converse is true for tracts below the mean price of $733.34. For example, if the mean per acre price for the Central Delta were $1,000 per acre, the implicit marginal price would be $-0.21 per acre; whereas, if it were $600 per acre, the implicit marginal price would be $-0.12 per acre. The effect of size on per acre values for other submarket areas are interpreted in a similar manner.

The estimated coefficient for percent of cropland in tract (CROP) was statistically significant in two of the five rural land submarket models. Implicit prices for CROP were estimated at $4.45 and $10.15 for the Southwest and Sugar Cane Areas, respectively. For example, in the Southwest Area, this estimate suggests that a one percent increase in the percent of tract in cropland raises the per acre price of land by $4.45. Therefore, the difference between a tract of land that was 100 percent in cropland and an identical tract that was 50 percent in cropland would be $4.45 × 50 = $222.50 per acre.

The estimated coefficient for percent of tract in pastureland (PAST) was statistically significant in only one of four rural land submarket models. The estimated implicit price of $3.24 suggests that a one percent increase in improved pasture in the North Central Area resulted in an increase of $3.24 per acre. Therefore, the difference between a tract of land that is 100 percent in pasture and an identical

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[2]Using equation (5), the mean values for SIZE and PRICE from Table 2 and the estimated coefficient for ln SIZE from Table 3, the marginal implicit price of SIZE for the Central Delta Area is (-0.0793 / 386.17) × $733.34 = $-0.15.

Table 4. Marginal implicit prices of characteristics at mean price and characteristic levels, Louisiana rural real estate market, 1994

	Rural Land Submarket Area							
Variable	Western	Red River	North Central	North Delta	Southwest	Central Delta	Southeast	Sugar Cane
SIZE	$ -2.51***[a]	$ -1.82***	$ -1.82***	$ 0.05	$ -0.98***	$ -0.15**	$ -6.35***	$ -1.00***
CROP		1.33		0.18	4.45***	-0.01		10.15**
PAST	1.19	1.61	3.24***				-2.65	
TIMB	1.42	-1.38	1.37				-7.60 ***	
VALUE	0.0009***	0.0075***	0.0064***	0.0017	0.0117***	0.0010	0.0060**	-0.0020
ROADFT	0.0060	0.0254	0.0281	-0.0186	-0.0031	0.0024	0.2436**	0.0698
DISFT	-0.002*	-0.0002	-0.0003	-0.0003	-0.0057***	-0.0021*	-0.0057**	0.0025
MINERAL	4.41***	2.15***	-0.42	0.94**	-0.73	-1.44	9.15***	5.20
RT	321.06	269.62***	220.34***	75.74*	378.77***	172.33**	481.84*	489.17*
RPE	-152.74	67.00	-2.14	-108.40**	103.98	-50.21		-516.58
RPI	-40.46	36.71		-179.26***	-105.10	-143.41	513.14	
RPF				-180.66***				
RPR	467.16**	315.68**					462.56*	870.45**
CB		379.15***		174.34***		188.43*		
RB				185.34	269.55**			
SC								640.90
S1	228.20**	91.62	148.03*				848.71	
S2							1102.27*	
S3					241.45**			
S7				95.73**		178.19		-266.19
S8		67.64				468.88***		
S10					756.58***	368.72**	-541.00	

[a]Unit of measurement is dollars per acre; significance of parameter used in calculation: ***0.01 level, **0.05 level, *0.10 level.

tract that was 50 percent in pasture is estimated to be \$3.24 × 50 = \$162.00 per acre. This result is consistent with the expansion of the poultry industry in this area and the complementary nature of poultry production and improved pastures.

Percentage of tract in timberland (TIMB) was included in four rural land submarket models. The coefficient was statistically significant in only the Southeast Area and exhibited an inverse relationship with per acre price of land. The estimated implicit price of \$-7.60 suggests that a one percent increase in timberland contained in the tract results in a decrease of \$7.60 per acre in land value. Therefore, the difference between a tract of land that is 50 percent in timber and an identical tract that is 100 percent in timber is \$7.60 × 50 = \$380 per acre (i.e., the tract with 100 percent timberland would be valued at \$380 less than the 50 percent timberland tract). While the percent of tract in timberland would be expected to be desirable in timber production areas, such as the Western Area and the North Central Area, large urban influences in the Southeast Area may favor less wooded land that could be more easily converted to residential and commercial use.

The value of improvements (VALUE) was included in each of the eight rural land submarket models. The coefficient was statistically significant and exhibited the expected positive sign in five of the eight rural land submarket models. Estimated implicit prices ranged from \$0.0009 per acre for the Western Area to \$0.0117 per acre for the Southwest Area. The implicit price of VALUE for the Southwest Area suggests that \$10,000 in improvements on a tract would increase per acre land values by \$117 per acre, all other factors held constant.

Although the amount of road frontage in feet (ROADFT) was included as a variable in each of the eight submarket models, it was statistically significant in only the Southeast Area. An estimated implicit price of \$0.2436 suggests that each foot of road frontage adds \$0.2436 to the per acre price of land. Therefore, a tract with 1,320 feet of road frontage in the Southeast Area would be valued at \$321.55 per acre more than an identical tract with no road frontage. These results are consistent with the fact that many reported sales in this area were influenced by residential and other nonagricultural development.

The coefficient for distance in feet to the largest town in the parish (DISFT) was significant in four of the eight submarket models, with the expected inverse relationship to per acre land values. Estimated implicit prices at the mean price level ranged from \$-0.002 per acre in the Western Area to \$-0.0057 per acre for both the Southwest and Southeast Areas. An implicit price of \$-0.0021 was estimated for the Central Delta Area. Interpreting the estimated implicit price of \$-0.0057 for the Southwest and Southeast areas suggests that per acre land prices decrease by \$0.0057 with each additional foot from the largest town in the parish. In terms of miles, this would mean that each additional mile from the largest town would decrease per acre land values by \$30.10 per acre.

The estimated coefficient for percent of mineral rights purchased (MINERAL) was statistically significant in four of the eight submarket models. The expected positive relationship with per acre land values was exhibited in all models where the coefficient was significant. Estimated implicit prices for percent of mineral rights purchased ranged from $0.94 per acre in the North Delta Area to $9.15 per acre in the Southeast Area. Implicit values were estimated to be $4.41 and $2.15 per acre for the Western and Red River Areas, respectively. Interpreting the implicit value for the Red River Area suggests that a one percent increase in mineral rights purchased raises the per acre value of rural land by $2.15 per acre.

The presence of a paved access road (RT) was the only discrete variable included in all eight rural land submarket models. With the exception of the Western Area, the coefficient for RT was statistically significant in all rural land submarket models. In addition, the coefficient was positive in all models, as expected. As Table 4 indicates, the estimated implicit price of a paved access road ranged from $75.74 per acre in the North Delta Area to $489.17 per acre in the Sugar Cane Area.[3] This suggests that the presence of a paved access road in the North Delta Area adds $75.74 per acre to land values, other factors remaining constant.

As previously described, the reason for tract purchase varied by submarket area. With the exception of the Southeast Area, expansion (RPE) was given as a primary reason for purchase in all rural land submarket areas. Investment (RPI) was given as a primary reason for purchase in six of the eight rural land submarket areas. The North Delta area was the only submarket where establishment of a farm (RPF) was given as primary reason for tract purchase. The coefficients of RPE, RPI, and RPF were statistically significant in the North Delta Area only. The estimated marginal implicit prices of RPE, RPI, and RPF for the North Delta Area were $-108.40, $-179.26, and $-180.66, respectively. Interpreting the marginal implicit price of RPE for the North Delta Area would suggest that tracts bought for expansionary reasons are typically valued at $108.40 less per acre than tracts purchased for other reasons, such as residence or commercial development.

Residence (RPR) was a primary reason for purchase in four rural land submarket areas. The estimated coefficient for RPR was statistically significant and positive in all four models. Estimated implicit prices for RPR ranged from $315.68 per acre in the Red River Area to $870.45 per acre in the Sugar Cane Area. This estimate suggests that, for the Red River Area, a tract purchased for the reason of residence

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[3]Using equation (6), the estimated coefficient for RT from Table 3, the variance of RT, and the mean value of PRICE from Table 2, the marginal implicit price of RT for the Sugar Cane Area is (exp [0.2717 - 1/2(0.0232)] - 1) × $1646.72 = $489.17.

would be valued at $315.68 per acre more than tracts purchased for other reasons.

A discrete variable for the presence of government program cotton base acreage (CB) was included in the three rural land submarket areas where there was substantial cotton production. The coefficient was positive and statistically significant in all three areas. Estimated implicit prices were $174.34, $188.43, and $379.15 per acre for the North Delta, Central Delta, and Red River Areas, respectively. For the North Delta Area, the results indicate that a tract with cotton base acreage would be valued at $174.34 more per acre than a tract without cotton base acreage.

A discrete variable was also included for two submarket areas where rice government program base acreage (RB) was significant. While the coefficient was not statistically significant in the North Delta Area, it was statistically significant and positive in the highly intensive rice producing Southwest Area. An implicit price for RB in the Southwest Area was estimated to be $269.55 per acre. This estimate would imply that the presence of rice base acreage contributed $269.55 per acre to land values, as compared to land without rice base acreage.

Geo-referencing the location of each tract of rural land in the study allowed the use of discrete variables for the 10 general soil areas found in Louisiana (see Figure 4). The Coastal Plain general soil area (S1) was prevalent in four of the eight rural land submarket areas (Table 4). Of these four, coefficients for S1 were statistically significant and positive in the timber producing Western and North Central Areas. Implicit prices for S1 in the Western and North Central Areas were estimated to be $228.20 per acre and $148.03 per acre, respectively. For the North Central Area, this suggests that, on average, tracts in the hilly Coastal Plain are valued at $148.03 per acre more than tracts found in other, lower-lying general soil areas, such as the Gulfcoast Flatwoods and Minor Floodplains.

The Gulfcoast Flatwoods general soil area (S2) was included as a discrete variable for the Southeast Area model. The coefficient was both positive and statistically significant, resulting in an estimated implicit price of $1,102.27 per acre. This would imply that tracts in the Southeast Area in the Gulfcoast Flatwoods general soil area would be valued at $1,102.27 more than tracts in other general soil areas. Because the Southeast Area has limited agricultural production and given that the Gulfcoast Flatwoods are located almost exclusively in Saint Tammany Parish, the large implicit price was probably due to the proximity of the Gulfcoast Flatwoods to the metropolitan New Orleans area, rather than any productive quality of the soils.

The clay and clay loam soils of the Gulfcoast Prairies in southwest Louisiana are ideal for rice production. Therefore, a discrete variable was defined for tracts of land contained in the Gulfcoast Prairies (S3) for the Southwest Area. The coefficient was both positive and statistically significant. The estimated implicit price for S3 was $241.45 per acre. This would imply that tracts of land located in the Gulfcoast

Prairies are valued at $241.45 per acre more than tracts located in other general soil areas in the Southwest Area.

Submarkets with a relatively large number of tracts located in the highly productive Recent Alluvium-Mississippi River general soil area (S7) included the North Delta, Central Delta, and Sugar Cane Areas. However, the estimated coefficient for S7 was statistically significant in the North Delta model only. The estimated implicit price for S7 of $95.73 indicates that a North Delta Area tract located in the Recent Alluvium-Mississippi River general soil area is valued at $95.73 more per acre than a tract located in another general soil area.

The Red River and the Central Delta Areas contained a relatively large number of tracts in the Recent Alluvium-Red/Ouachita River general soil area (S8). The estimated coefficient for S8 was positive and significant in the Central Delta model. The estimated implicit price of $468.88 per acre suggests that a tract located in this highly productive general soil area is valued at $468.88 more per acre than a tract found in another general soil area in the Central Delta.

A discrete variable was included for the Southern Mississippi Valley Silty Uplands general soil area (S10) in the Southwest, Central Delta, and Southeast models. The estimated coefficients for S10 were statistically significant and positive in the Southwest and Central Delta models. Marginal implicit prices of S10 for the Southwest and Central Delta areas were estimated to be $756.58 per acre and $368.72, respectively. The proximity of Southwest tracts in the Southern Mississippi Valley Silty Uplands to the metropolitan Lafayette area may have contributed to the relatively high implicit price of S10 for the Southwest Area.

SECOND-STAGE BID FUNCTIONS

The estimation of second-stage bid functions for the marginal implicit price of rural land attributes allowed the examination of the relationships between explanatory variables and the possible impacts of non-tract variables. Bid functions relate the marginal implicit price of a characteristic, recovered from the first-stage hedonic analysis, to quantities of both tract-specific and non-tract variables. Using equation (7), bid functions were estimated for selected characteristics by regressing the implicit prices of the characteristic upon quantities of the characteristics, income, and other socio-economic variables that were hypothesized to explain the demand for the characteristic. Given the focus of this study on differences in marginal implicit prices by rural land submarket area, estimation of second-stage bid functions was limited to continuous explanatory variables that were statistically significant in at least three of the eight first-stage hedonic models. The OLS results of the estimation of bid functions for these characteristics are presented in Tables 5, 6, 7, and 8. The discussion of explanatory variables in bid functions is limited to cases where the coefficient was statistically significant.

Economic theory suggests that the sign of an own-characteristic in a bid function is expected to be negative, resulting in a diminishing marginal implicit price for the characteristic with an increase in its measure (Elad, Clifton, and Epperson, 1994). The impacts of other explanatory variables on bid functions were expected to vary by submarket area; therefore, no other expected signs of coefficients could be ascribed.

Size of Tract (SIZE)

Estimated bid functions by rural land submarket area for the size of tract (SIZE) are presented in Table 5. Because the marginal implicit prices of SIZE estimated in the first-stage hedonic equations were negative, the bid function equations for SIZE were multiplied by a negative one for convenience in the interpretation of the impacts of the explanatory variables. As expected, the SIZE coefficients were negative and statistically significant in all rural land submarket areas, implying a diminishing marginal implicit price for SIZE.

The percent of cropland in tract (CROP) exhibited a negative relationship with the marginal implicit price of SIZE in the Southwest Area. Therefore, parcels of land with larger portions of cropland tended to be discounted more for the size of tract in the Southwest Area.

The percent of timberland in tract (TIMB) was positively related to the marginal implicit price of SIZE in the timber-producing Western and North Central Areas. This may reflect a preference of land buyers in these submarket areas to purchase large tracts for timber production. The value of improvements (VALUE) was also positively related to the marginal implicit price of SIZE in the Western and North Central Areas. Apparently, the value of improvements made on and to the land enhanced the price of larger tracts in these areas.

The coefficient for distance to the largest town in the parish (DISFT) was negative in the North Central and Red River Areas, suggesting that, as the distance to the largest town in the parish increased, the discount for tract size increased. This implies that discounting for size of tract tended to be greater in more rural areas. The coefficient for DISFT was positive, however, for the Sugar Cane Area; therefore, more rural areas tended not to be discounted for size of tract in this submarket. The presence of a paved access road (RT) also exhibited a positive influence on the marginal implicit price of SIZE in the Sugar Cane Area. Thus, paved access roads tended to reduce the discounting of large tracts in this area.

The reason for purchase had a statistically significant impact on the marginal implicit price of SIZE in two submarket areas. Expansion (RPE) had a positive effect in the Southwest Area and residence (RPR) had a positive effect in the Red River area. This suggests that the values of tracts purchased for expansion or residence tended to be enhanced by larger amounts of acreage.

The Recent Alluvium general soil areas of the Mississippi River (S7) and the Red River (S8) were positively associated with the marginal implicit price of SIZE in the Sugar Cane and Red River Areas, respectively. The presence of highly productive alluvial soils tended to enhance the value of larger tracts. In the Southeast Area, tracts located in the Southern Mississippi Valley Silty Uplands (S10) exhibited a negative relationship with the implicit price of SIZE. This would imply that larger tracts located in this general soil area tended to be discounted.

The positive coefficients for parish population density per square mile (POPDEN) suggests that the value of larger tracts is enhanced by a larger population in the Southwest and Central Delta Areas. A negative coefficient for average per capita income (PCINC) in the Central Delta indicates that a high average parish income was associated with a lower marginal implicit price for SIZE. This may suggest that size of tract is less important in less rural areas.

The coefficients for parish net farm income (NFI) were positive for the Red River and Central Delta Areas but negative for the Southeast Area. This suggests that larger tract sizes were discounted less in the Red River and Central Delta Areas for higher levels of net farm income. Conversely, in the more urban Southeast Area, larger tract sizes tended to be discounted more when net farm incomes are higher.

Value of Improvements (VALUE)

The results of bid function estimation for the characteristic of value of improvements (VALUE) are presented by rural land submarket area in Table 6. Because the marginal implicit price for VALUE estimated from the first-stage hedonic model was positive, it was not necessary to multiply the bid function by a negative one in order to interpret the impacts of explanatory variables.

The coefficients for SIZE were statistically significant and negative in all bid functions for the implicit price of VALUE. This indicates that the marginal implicit value of improvements were valued less on larger tracts. Since many larger tracts reported in the survey had limited or no improvements, an inverse relationship between the marginal implicit price of VALUE and tract size was not unexpected.

The coefficient for percent of cropland (CROP) was also negative in the Southwest Area. The negative sign indicates a reduction in the value of improvements on tracts with large portions of cropland. Because southwest Louisiana is a major rice and soybean production area, improvements, such as buildings that tie up acreage suitable for production, may plausibly be valued less on tracts with substantial cropland acreage.

Table 5. Estimated coefficients of the second-stage bid functions for the implicit price of SIZE, Louisiana rural real estate market, 1994[a]

	Rural Land Submarket Area						
Variable	Western	Red River	North Central	Southwest	Central Delta	Southeast	Sugar Cane
ln SIZE	-11.3313	-10.1165	-5.3391	-3.6938	-0.7236	-19.6305	-3.7179
	(-7.85)***b	(-5.69)***	(-10.49)***	(-5.36)***	(-7.00)***	(-9.49)***	(-6.09)***
CROP		-0.1050		-0.0480	0.0030		0.0296
		(-1.35)		(-2.36)**	(0.95)		(1.14)
PAST	-0.0150	-0.0396	-0.0007			0.0334	
	(-0.22)	(-0.60)	(-0.05)			(0.58)	
TIMB	0.0854	0.0256	-0.0267			-0.0015	
	(2.10)**	(0.38)	(-1.95)**			(-0.03)	
VALUE	0.2E-4	0.4E-4	0.5E-4	0.8E-4	0.8E-5	0.7E-4	0.5E-5
	(3.48)***	(0.78)	(1.78)*	(1.55)	(1.58)	(1.46)	(0.22)
ROADFT	0.0016	0.0009	0.0003	-0.7E-4	0.6E-5	0.0001	-0.3E-4
	(1.09)	(0.90)	(0.43)	(-0.26)	(0.06)	(0.07)	(-0.05)
DISFT	-0.4E-4	-0.9E-4	-0.3E-4	-0.4E-4	-0.2E-5	0.8E-4	0.5E-4
	(-1.28)	(-1.91)**	(-2.06)**	(-1.53)	(-0.45)	(1.41)	(3.80)***
MINERAL	-0.0389	0.0410	-0.0127	0.0062	-0.0027	0.0184	-0.0091
	(-0.79)	(1.10)	(-1.14)	(0.36)	(-0.85)	(0.38)	(-0.38)
RT	0.3063	3.6257	0.3853	1.9834	0.1390	5.4809	3.2442
	(0.05)	(1.03)	(0.34)	(1.43)	(0.56)	(1.28)	(1.94)*
RPE	1.1419	-3.4194	1.7298	2.6424	0.0631		-1.1719
	(0.18)	(-0.71)	(1.51)	(1.65)*	(0.22)		(-0.51)
RPI	-5.1314	-5.7015		0.6591	0.0780	-5.0146	
	(-0.91)	(-1.19)		(0.35)	(0.20)	(-0.81)	
RPF							
RPR	7.3663	9.1316				-1.3454	1.8195
	(0.88)	(1.73)*				(-0.30)	(0.93)
CB		4.5284			0.5608		
		(0.81)			(1.48)		
RB				1.5174			
				(0.77)			

Table 5. Estimated coefficients of the second-stage bid functions for the implicit price of SIZE, continued

	Rural Land Submarket Area						
Variable	Western	Red River	North Central	Southwest	Central Delta	Southeast	Sugar Cane
SC							2.8334
							(1.18)
S1	-1.2375	0.4905	1.6651			-3.1930	
	(0.42)	(0.11)	(1.47)			(-0.36)	
S2						-4.7803	
						(-0.48)	
S3				1.0028			
				(0.58)			
S7					-0.5861		4.1636
					(-1.16)		(1.83)*
S8		11.1001			-0.3914		
		(1.90)*			(-0.79)		
S10				2.1207	-0.0067	-16.3105	
				(0.84)	(-0.01)	(-2.31)**	
POPDEN	1.4400	-0.0095	0.0399	0.0269	0.0370	0.0064	-0.0078
	(-0.55)	(-0.20)	(1.00)	(2.30)*	(2.32)**	(0.41)	(-0.19)
PCINC	-0.0205	0.0012	-0.0006	-0.0013	-0.0005	-0.0011	0.0009
	(-0.62)	(0.52)	(-0.63)	(-1.12)	(-2.18)**	(-0.78)	(1.21)
NFI	-0.0011	0.0006	-0.9E-4	-0.0004	0.9E-4	-0.0017	0.6E-4
	(-0.32)	(1.98)**	(-1.33)	(-0.92)	(1.88)*	(-2.41)***	(0.84)
Intercept	376.9086	37.58	35.3403	38.1749	8.1491	118.9436	-1.3248
	(0.70)	(1.25)	(2.92)***	(2.30)**	(3.68)***	(5.18)***	(-0.18)
R^2	0.30	0.43	0.66	0.61	0.52	0.67	0.80
F-Value	5.74	5.56	10.02	10.59	5.77	10.94	7.51
N	216	151	82	119	103	105	41

Dependent Variable: marginal implicit price of SIZE

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

[b]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.

Table 6. Estimated coefficients of the second-stage bid functions for the implicit price of VALUE, Louisiana rural real estate market, 1994

	Rural Land Submarket Area				
Variable	Western	Red River	North Central	Southwest	Southeast
ln SIZE	-0.0003	-0.0031	-0.0017	-0.0015	-0.0013
	(-4.08)***[a]	(-4.56)***	(-4.75)***	(-2.27)**	(-3.61)***
CROP		0.8E-5		-0.5E-4	
		(0.27)		(-2.60)***	
PAST	-0.8E-6	0.3E-4	0.1E-4		0.5E-5
	(-0.24)	(1.09)	(1.37)		(-0.51)
TIMB	0.6E-5	0.6E-5	-0.2E-5		-0.2E-4
	(2.68)***	(0.24)	(-0.19)		(-1.67)*
VALUE	0.9E-9	0.7E-7	0.9E-7	0.1E-6	0.1E-7
	(3.04)***	(3.69)***	(4.57)***	(2.83)***	(1.15)
ROADFT	0.4E-7	0.4E-6	-0.7E-7	0.3E-7	0.3E-6
	(0.46)	(0.93)	(-0.16)	(0.11)	(0.96)
DISFT	-0.2E-8	-0.3E-7	-0.1E-7	-0.6E-7	-0.4E-8
	(-1.39)	(-1.55)	(-1.34)	(-2.30)**	(-0.42)
MINERAL	-0.3E-5	0.2E-4	-0.3E-5	0.4E-5	-0.1E-4
	(-1.08)	(1.46)	(-0.40)	(0.26)	(-1.51)
RT	0.0001	0.0026	0.0008	0.0030	0.0011
	(0.40)	(1.90)*	(1.04)	(2.29)**	(1.50)
RPE	-0.3E-4	-0.0009	0.0004	0.0021	
	(-0.09)	(-0.48)	(0.43)	(1.40)	
RPI	-0.0002	-0.0002		-0.0003	0.5E-4
	(-0.73)	(-0.10)		(-0.19)	(0.05)
RPF					
RPR	0.0005	0.0041			0.0005
	(1.21)	(2.01)**			(0.64)
CB		0.0024			
		(1.12)			
RB				0.0011	
				(0.57)	

Table 6. Estimated coefficients of the second-stage bid functions for the implicit price of VALUE, continued

	Rural Land Submarket Area				
Variable	Western	Red River	North Central	Southwest	Southeast
SC					
S1	0.0002	0.0003	0.0015		0.0003
	(1.06)	(0.195)	(1.80)*		(0.17)
S2					0.0016
					(0.95)
S3				0.0025	
				(1.54)	
S7					
S8		0.0027			
		(1.20)			
S10				0.0038	-0.0018
				(1.58)	(-1.47)
POPDEN	-0.0001	-0.9E-5	0.4E-4	0.1E-4	0.2E-5
	(-0.73)	(-0.52)	(1.29)	(1.21)	(0.66)
PCINC	-0.1E-5	0.9E-6	0.1E-6	0.6E-6	0.3E-7
	(-0.83)	(1.01)	(0.19)	(0.50)	(0.14)
NFI	-0.9E-7	0.2E-6	-0.4E-7	-0.1E-6	-0.2E6
	(-0.50)	(1.33)	(-0.94)	(-0.26)	(-1.42)
Intercept	0.0246	0.0043	0.0093	0.0103	0.0121
	(0.87)	(0.37)	(1.07)	(0.66)	(3.06)***
R^2	0.17	0.39	0.48	0.61	0.43
F-Value	2.75	4.78	4.88	10.84	4.17
N	216	151	82	119	105
Dependent Variable: marginal implicit price of VALUE					

[a]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.

For the timber-producing Western Area, the coefficient for percent of timberland in the tract was positive. This would imply that the value of improvements made on or to the land is enhanced by larger portions of timber in the tract. However, in the Southeast Area, where larger urban influences are present, the coefficient for percent of timberland in the tract was negative. In this area, larger portions of timberland tend to reduce the value of improvements made on or to the land.

VALUE coefficients were statistically significant and positive in the Western, Red River, North Central, and Southwest Areas. While own-attribute signs were generally expected to be negative, positive coefficients suggest that higher levels of improvements resulted in higher implicit values for those improvements.

The negative coefficient for distance to the largest town in the parish (DISFT) in the Southwest Area indicates that tracts with higher levels of improvements were discounted more as distance to the largest town in the parish increased. The positive coefficient for the presence of a paved road (RT) in the Southwest and Red River Areas suggests that the presence of a paved road enhances the implicit marginal price for VALUE. Therefore, in the Southwest Area, distance to the largest town had an inverse effect on the marginal implicit price of the value of improvements, while the presence of a paved road had a positive effect.

Other attributes having a statistically significant and positive effect on the marginal implicit price of the value of improvements included residence as the reason for purchase (RPR) in the Red River Area and tracts located in the hilly Coastal Plain (S1) in the North Central Area. This indicates that tracts purchased for residential purposes in the Red River Area tended to place a higher value on the marginal price of improvements over tracts purchased for other reasons. Similarly, purchasers of tracts located in the upland Coastal Plain in the North Central Area placed a higher value on the marginal price of the value of improvements compared with purchasers of tracts located in lower-lying areas.

Distance to Largest Town in the Parish (DISFT)

The results of the estimation of bid functions for the characteristic of distance to the largest town in the parish (DISFT) are presented by rural land submarket area in Table 7. Because the marginal implicit price of DISFT was negative in the first-stage hedonic models for all submarket areas, the bid function equations in Table 7 were multiplied by a negative one to allow direct interpretation of the explanatory variables.

As indicated in Table 7, the relationship between size of tract and the marginal implicit price of DISFT was negative in all rural land submarket bid functions. This suggests that the larger the size of the tract, the greater the discounting for tracts located further from the largest town in the parish.

A negative coefficient for the percent of cropland in the tract (CROP) in the Southwest Area indicates that the larger the percentage of cropland in a tract, the higher the discount for distance to the largest town in the parish. This relationship may be attributed higher transport costs to input and output markets associated with tracts located in remote areas. For the Western Area, the higher the percentage of timberland in a tract, the smaller the discount for DISFT. Tracts of land whose highest and best use is the production of timber are not expected to be highly discounted for distance to the largest town in the parish.

The relationship between the value of improvements (VALUE) and the marginal implicit price of DISFT was positive and statistically significant in the Western, Southwest, and Central Delta Areas. This indicates that the discounting of tracts further from the largest town in the parish was reduced with a higher level of improvements on or to the tract. The coefficient for DISFT was negative in the Southwest bid function, reflecting a decreasing marginal implicit price for DISFT as the distance to the largest town increased.

The effect of the presence of a paved road (RT) was statistically significant and positive for the Southwest and Central Delta bid functions. Therefore, the discounting of tracts further from the largest town in the parish was reduced with the presence of a paved access road.

In the Central Delta Area, the location of tracts in the Recent Alluvium Red/Ouachita River (S8) and Southern Mississippi Valley Silty Uplands (S10) general soil areas reduced the discounting of tracts further from the largest town in the parish. Two socio-economic variables, parish population density per square mile (POPDEN) and average parish net farm income (NFI), were also statistically significant in the Central Delta Area. The positive sign of both of these coefficients suggests an easing of the discounting of tracts further from the largest town in the parish with larger population densities and higher net farm incomes.

Table 7. Estimated coefficients of the second-stage bid functions for the implicit price of DISFT, Louisiana rural real estate market, 1994[a]

	Rural Land Submarket Area			
Variable	Western	Southwest	Central Delta	Southeast
ln SIZE	-0.0007	-0.0072	-0.0003	-0.0012
	(-4.08)***[b]	(-2.27)**	(-2.85)***	(-3.61)***
CROP		-0.2E-4	-0.1E-5	
		(-2.60)***	(-0.38)	
PAST	-0.2E-5			-0.5E-5
	(-0.24)			(-0.51)
TIMB	0.1E-4			-0.1E-4
	(2.68)***			(-1.67)*
VALUE	0.2E-8	0.6E-7	0.8E-8	0.9E-8
	(3.04)***	(2.83)***	(1.76)*	(1.15)
ROADFT	0.9E-7	0.1E-7	-0.2E-7	0.3E-6
	(0.46)	(0.11)	(-0.18)	(0.96)
DISFT	-0.6E-8	-0.3E-7	-0.4E-8	-0.4E-8
	(-1.39)	(-2.30)**	(-0.97)	(-0.42)
MINERAL	-0.7E-5	0.2E-5	-0.4E-5	-0.1E-4
	(-1.08)	(0.26)	(-1.45)	(-1.51)
RT	0.0003	0.0015	0.0040	0.0010
	(0.40)	(2.29)**	(1.71)*	(1.50)
RPE	-0.7E-4	0.0010	0.4E-4	
	(-0.09)	(1.40)	(0.15)	
RPI	-0.0005	-0.0002	-0.0001	0.5E-4
	(-0.73)	(-0.19)	(-0.38)	(0.05)
RPF				
RPR	0.0013			0.0005
	(1.21)			(0.64)
CB			0.0005	
			(1.32)	
RB		0.0005	0.0011	
		(0.57)	(0.57)	
SC				

Table 7. Estimated coefficients of the second-stage bid functions for the implicit price of DISFT, continued

	Rural Land Submarket Area			
Variable	Western	Southwest	Central Delta	Southeast
S1	0.0004			0.0002
	(1.06)			(0.17
S2				0.0015
				(0.95)
S3		0.0012		
		(1.54)		
S7			0.5E-4	
			(0.10)	
S8			0.0008	
			(1.72)*	
S10		0.0018	0.0008	-0.0017
		(1.58)	(1.71)*	(-1.47)
POPDEN	-0.0002	0.6E-5	0.3E-4	0.2E-5
	(-0.73)	(1.21)	(2.37)**	(0.66)
PCINC	-0.3E-5	0.3E-6	-0.2E-6	0.3E-7
	(-0.83)	(0.50)	(-1.08)	(0.14)
NFI	-0.2E-6	-0.5E-7	0.1E-6	-0.2E6
	(-0.50)	(-0.26)	(2.19)**	(-1.42)
Intercept	0.0588	0.0050	0.0030	0.0113
	(0.87)	(0.66)	(1.48)	(3.06)***
R^2	0.18	0.61	0.39	0.43
F-Value	2.78	10.84	3.46	4.17
N	216	119	103	105
Dependent Variable: marginal implicit price of DISFT				

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

[b]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.

Percent of Mineral Rights Purchased (MINERAL)

The results of bid function estimation for the characteristic of percent of mineral rights purchased (MINERAL) are presented by submarket area in Table 8. Because the marginal implicit prices for MINERAL estimated from the first-stage hedonic model were positive, it was not necessary to adjust the bid function to interpret the impacts of explanatory variables.

The coefficients for size of tract (SIZE) had a statistically significant inverse relationship with the marginal implicit price of MINERAL in three of four bid function estimations. This implies that the purchase of mineral rights along with the tract was discounted more for larger tracts of land.

In the Western Area, a positive relationship was exhibited between the percent of tract in timberland (TIMB) and the marginal implicit price for MINERAL. Therefore, a larger portion of timberland on a tract contributed to the value of mineral rights purchased. A similar relationship was exhibited for the value of improvements (VALUE) in the Western and Red River Areas. However, TIMB and the marginal implicit price of MINERAL were inversely related in the Southeast Area.

The coefficient for DISFT was statistically significant in the North Delta Area only. The negative sign indicated a declining marginal implicit price for MINERAL. Therefore, the value of mineral rights was discounted with greater distances from the largest town in the parish. The own-attribute marginal implicit price of MINERAL was positive in the North Delta Area. This would suggest that a larger portion of mineral rights sold with the tract resulted in a greater marginal implicit price for those mineral rights.

In the Red River Area, the presence of a paved access road (RT) had a positive relationship with the marginal implicit price of MINERAL. Therefore, the presence of a paved access road increased the value of the percent of mineral rights purchased.

The reason for purchase had a statistically significant effect on the marginal implicit price of MINERAL in the North Delta and Red River Areas. In the North Delta Area, expansion (RPE), investment (RPI), and establishment of a farm (RPF) all had an inverse relationship with the marginal implicit price of MINERAL. This suggests that the percentage of mineral rights included in the sale in the North Delta Area was less important when the reason for purchase was RPE, RPI, or RPF. In the Red River Area, however, residence (RPR) was positively related to the marginal implicit price of MINERAL.

The presence of cotton base acreage (CB) in the North Delta Area was positively related to the marginal implicit price of MINERAL. Other characteristics having a positive influence on the marginal implicit price of MINERAL in the North Delta Area included tracts located in the Recent Alluvium-Mississippi River general soil area (S7) and parish average per capita income (PCINC).

SUMMARY AND CONCLUSIONS

A two-stage hedonic pricing technique was used to estimate the effects of rural real estate characteristics on the value of rural real estate. Results from the first-stage hedonic models suggested that several physical and locational tract characteristics affect per acre land values. The impact of percent cropland, percent pastureland, value of improvements made on or to the tract, amount of road frontage present, percent of mineral rights purchased, presence of a paved access road, presence of government program crop base acreage, and general soil type all had statistically significant positive influences on per acre land values. The size of tract, percent of timberland in tract, and distance to largest town in the parish were found to have statistically significant inverse relationships with per acre rural land values. However, all variables were not statistically significant for each submarket model. The results of the first-stage hedonic models are comparable to cross-sectional rural land value studies conducted in other states (Danielson, 1984; Foster, 1986; Elad, Clifton, and Epperson, 1994).

The second-stage estimation procedure allowed the examination of the relationship of rural land characteristics and selected socio-economic variables on the marginal implicit price of selected characteristics. The primary purpose of second-stage bid functions was to incorporate any effects that socio-economic variables may have on the marginal implicit prices of rural real estate characteristics. Second-stage bid functions also revealed the direction and magnitude of relationships between rural real estate characteristics. While the signs of estimated coefficients in the second-stage bid functions were generally as expected, the significance of several variables was a concern.

Second-stage bid functions may provide additional information where the addition of socio-economic variables are statistically significant. For example, using mean values of characteristics from Table 2 and the Central Delta Area bid function for DISFT (where two of three socio-economic variables are statistically significant), the predicted marginal implicit price for DISFT is \$-0.0027. This represents a 29 percent difference from the Central Delta Area marginal implicit price for DISFT of \$-0.0021, calculated at mean characteristic levels from the stage-one equation (Table 4). However, a predicted value for the marginal implicit price of DISFT using the Southwest bid function for DISFT (where no socio-economic variables were statistically significant) is \$-0.0061, only a seven percent difference from the marginal implicit price for DISFT of \$-0.0057, calculated for the Southwest Area from the first-stage equation. Therefore, second-stage estimations may not represent significant improvements in marginal implicit prices over

Table 8. Estimated coefficients of the second-stage bid functions for the implicit price of MINERAL, Louisiana rural real estate market, 1994

	Rural Land Submarket Area			
Variable	Western	Red River	North Delta	Southeast
ln SIZE	-1.6158	-0.8993	-0.0188	-1.9349
	(-4.08)***[a]	(-4.56)***	(-0.59)	(-3.61)***
CROP		0.0024	0.0007	
		(0.27)	(0.71)	
PAST	-0.0044	0.0080		-0.0076
	(-0.24)	(1.09)		(-0.51)
TIMB	0.0299	0.0018		-0.0228
	(2.68)***	(0.24)		(-1.67)*
VALUE	0.5E-5	0.2E-4	0.3E-5	0.1E-4
	(3.04)***	(3.69)***	(1.39)	(1.15)
ROADFT	0.0002	0.0001	-0.2E-4	0.0005
	(0.46)	(0.93)	(-0.61)	(0.96)
DISFT	-0.1E-4	-0.8E-5	-0.2E-5	-0.6E-5
	(-1.39)	(-1.55)	(-1.91)**	(-0.42)
MINERAL	-0.0145	0.0060	0.0014	-0.0191
	(-1.08)	(1.46)	(2.08)**	(-1.51)
RT	0.7322	0.7424	0.0858	1.6657
	(0.40)	(1.90)*	(1.45)	(1.50)
RPE	-0.1492	-0.2556	-0.1859	
	(-0.09)	(-0.48)	(-2.33)**	
RPI	-1.1363	-0.0535	-0.2979	0.0792
	(-0.73)	(-0.10)	(-3.03)***	(0.05)
RPF			-0.3182	
			(-2.92)***	
RPR	2.7765	1.1781		0.7438
	(1.21)	(2.01)**		(0.64)
CB		0.7005	0.2140	
		(1.12)	(3.46)***	
RB			0.1101	
			(0.67)	
SC				

Table 8. Estimated coefficients of the second-stage bid functions for the implicit price of MINERAL, continued

	Rural Land Submarket Area			
Variable	Western	Red River	North Delta	Southeast
S1	0.8508	0.0932		0.3937
	(1.06)	(0.195)		(0.17)
S2				2.4509
				(0.95)
S3				
S7			0.1412	
			(1.70)*	
S8		0.7768		
		(1.20)		
S10				-2.6982
				(-1.47)
POPDEN	-0.5277	-0.0028	0.0023	0.0027
	(-0.73)	(-0.52)	(1.32)	(0.66)
PCINC	-0.0076	0.0003	0.9E-4	0.5E-4
	(-0.83)	(1.01)	(2.07)**	(0.14)
NFI	-0.0005	0.5E-4	0.3E-5	-0.0003
	(-0.50)	(1.33)	(0.86)	(-1.42)
Intercept	129.1927	1.2409	-0.2204	18.2388
	(0.87)	(0.37)	(-0.47)	(3.06)***
R^2	0.17	0.39	0.32	0.43
F-Value	2.75	4.78	3.42	4.17
N	216	151	131	105

Dependent Variable: marginal implicit price of MINERAL

[a]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.

first-stage results in areas where non-tract influences are not statistically significant. The lack of statistical significance of socio-economic variables was consistent with the fact that over half of the 948 tracts of land used in this study were reported to produce an agricultural commodity (i.e., most tracts were rural in nature).

Discrete variables for expansion (RPE), investment (RPI), and establishment of a farm (RPF), as reasons for purchase, were statistically significant only in the North Delta Area. The inverse relationship of these variables and per acre land prices may be attributed to marginal tracts of agricultural land that tend to change hands frequently. Establishment of a residence was included as the reason for purchase in the Western, Red River, Southeast, and Sugar Cane submarket models. The coefficient was statistically significant in all four models. The demand for rural residences was demonstrated to have positive impacts on rural real estate values in these areas.

Geographic information system (GIS) analysis of rural land sales improved hedonic modeling efforts. Geo-referencing the location of each tract of rural land allowed each rural land submarket hedonic model to include distance and soil variables. These variables were shown to affect rural land prices at varying degrees, depending on the spatial extent of rural land submarkets in Louisiana.

Evidence presented in this study suggests that Louisiana rural land values are strongly influenced by the income-producing potential of the tract. Because mineral rights represent a potential income stream, the percent of mineral rights purchased was statistically significant and positive in four of eight rural land submarkets. Other income-producing activities, such as farming, appeared to impact rural land values in areas of highly productive and/or specialized cropland. For example, the percent of cropland in the tract was statistically significant and positive in the Southwest Area (where rice production is dominant) and in the Sugar Cane Area (where sugar cane production is dominant). The general soil areas with highly productive alluvial soils of the Mississippi, Ouachita, and Red Rivers were also indicated to positively affect land values. Government program cotton base acreage was found to be statistically significant and positive in the three areas of the state where cotton is primarily produced. Similarly, government program rice base acreage was statistically significant and positive in the Southwest Area. Changes in government price-support policies for rice and cotton would be expected to seriously impact the value of Louisiana land with rice or cotton base acreage.

LIMITATIONS AND FURTHER RESEARCH

A primary limitation encountered in this study pertained to the data. While Figure 1 illustrates that the location of reported sales are dispersed throughout the state, some rural land submarket areas had a limited number of observations. Continued emphasis on collecting sales for all areas and improving the distribution of sales among areas will be a concern for future research. In addition, increasing the number of sales would be expected to provide a basis for expanding the hedonic analysis to include a rural land value model for each primary commodity in submarket areas.

Comparing marginal implicit prices of each characteristic across rural land submarket areas suggested that the magnitude and direction of implicit prices varied significantly with respect to regional location. Although the marginal implicit price of rural land characteristics estimated in this study appeared to be reasonable, several variables not included in the hedonic models, such as macroeconomic variables and aesthetic or psychological factors, may impact the price of rural real estate. Therefore, information provided in this study should be used in a general context and should not be used as the sole source of valuation for any specific parcel of rural real estate.

Future spatial analysis of the rural Louisiana land market may include the development of land value contours, allowing the display the rural land value patterns throughout the state. Other analysis may include examining the spatial relationship of the random disturbance terms to determine if population members are related through their geographic location (spatial autocorrelation). Correction for spatial autocorrelation would be expected to improve the efficiency of parameters and standard errors in the hedonic modeling effort.

This study provides an initial data base for future land value studies. Trends in rural real estate values may be estimated when data from this study are combined with data developed over time. For example, examination of the relationship of land price and cash rental rates over time could be accomplished by the application of unit root and cointegration theory.

Other potential areas of further study include a more focused analysis of metropolitan influences on rural land values. Factors expected to affect rural land values that were not addressed in this study include the proximity of the tract to recreational areas and interstate highways.

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