A STATEWIDE SPATIAL ANALYSIS OF THE EFFECTS OF LOCATION AND ECONOMIC DEVELOPMENT ON RURAL LAND VALUES

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ABSTRACT

The effects of location and economic development on rural land markets are becoming increasingly important with increasing population pressures and continued economic development. Geographical Information Systems (GIS) and spatial econometric estimation of hedonic models are used to measure the effects of location and economic development in the Louisiana rural land market. These procedures are then used to estimate rural land price contours. The rural land price contours are estimated to provide a spatial view of the rural land price variation associated with location and economic development. Figures presented in color may be viewed at http://atlas.agadm.lsu.edu.

INTRODUCTION

The value of rural real estate is determined by a number of factors including its inherent productive capacity, location and accessibility, and alternative uses. Continued economic and population growth increases the need for land , which puts upward pressure on the value of rural land. With more and more rural land acres being converted at the urban fringe, buyers, sellers, planners, appraisers, tax assessors, and others are expected to have an increasing need for information related to the effect of location and economic development on rural land values. Important questions relate to the magnitude of these influences and to the spatial extent of these influences in rural land markets. Generally, research aimed at identifying the effects of location and economic development on rural land market values is expected to provide improved information for both private and public decisions.

The general objective of this study is to measure the effect of location and economic development on Louisiana rural land values. Because the Louisiana rural land market is spatial in nature, Geographical Information Systems (GIS) and spatial econometric procedures are used in this analysis. GIS procedures are necessary for determining the spatial component in the data and spatial econometric procedures are necessary for diagnostic tests for spatial autocorrelation and for estimating spatial econometric models. These procedures are important because modeling the real estate market in the presence of spatial autocorrelation using traditional OLS procedures may result in models with less than desirable statistical characteristics (Dubin). Similarly Pace et al. indicates that real estate and spatial statistics complement each other, and employing spatial estimators provide benefits over ignoring dependencies in the data. The benefits include improved prediction, better statistical inference through unbiased standard errors, and better estimates because of the way that location is handled within the modeling procedure.

The effects of location and economic development on rural land values on a statewide basis is estimated using eight rural land submarkets estimated by Kennedy et al. Spatial statistics and spatial econometric procedures are used to estimate a hedonic model for each of the rural submarkets in Louisiana. Hedonic analysis is used to identify and to measure the effects of location and economic development in each rural land submarket. The effects of location and economic development in each market are estimated by marginal implicit prices computed from respective submarket hedonic models. The combined effect of location and economic development is then isolated in each rural land submarket by developing predictions for each observation. Specifically, rural land price predictions are estimated by holding all non-locational and non-economic development variables constant and by letting locational and economic development measures vary. These predictions, which reflect the effect of location and economic development on rural land values, are combined on a statewide basis, and GIS rural land price contours are used to provide a visual representation of these relationships. In following sections, conceptual relationships of value, model specification, model estimation, and data collection procedures are presented and discussed. Final sections describe the estimated rural land values models and land price contours, which show the spatial effects of location and economic development on rural land values in Louisiana.

VALUE, LOCATION, AND ECONOMIC DEVELOPMENT

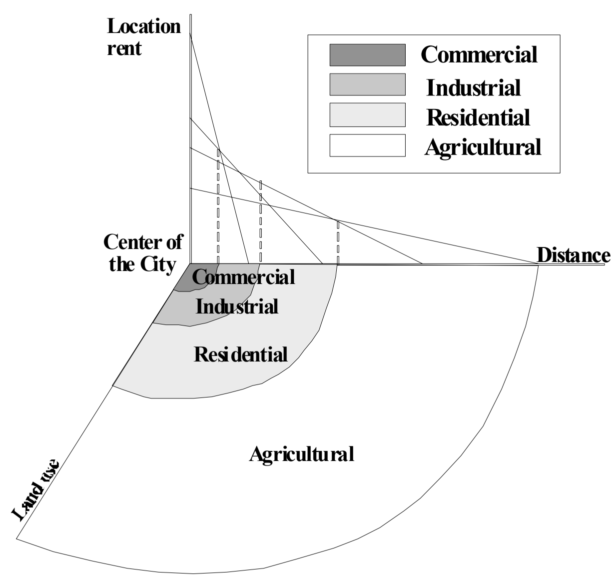
The complexity in rural land markets requires the use of many different characteristics to explain rural land values. These include site characteristics, buyer and seller characteristics, general economic trends, external forces, and future expectations. Much of the early research used microeconomic theory of the firm to model rural land markets. These studies have generally shown that site characteristics are highly correlated with rural land values. More recent research has successfully used location and economic development to explain rural land values (Kletke, Adrian and Cannon). Other research has found spatial variation in rural land markets suggesting the importance of location (Clifton and Spurlock, Elad, Clifton, and Epperson).

Location theory was first introduced into economics by Heinrich von Thunen. Von Thunen's model considered the controlling factor in determining agricultural land use to be economic rent and the primary factor which influences economic rent to be transportation cost. This model has been modified to explain the spatial organization of land use (Dicken and Lloyd). In its very simplest form, a location-rent model illustrated in Figure 1 allocates land use around a market center. Straight lines in Figure 1 represent rents for different services of land. Downward sloping lines indicate decreasing economic rent as distance from market and transportation cost increase. Through competitive bidding, steeper rent curves produce higher rents and result in locations closer to the center of the city. It follows that land closer to markets receives higher rents and higher capitalized values than areas located at longer distances from markets. Thus, differential rents form the basis for concentric land uses with differing radiuses from the center of the city.

Economic growth and associated economic development also exert a positive influence in rural land markets. With development, there is an increasing need of land for industrial location, housing, transportation, wholesale and retail trade, health care, recreation, and other service activities, which increases the demand for rural land. Speculators, investors, or developers who anticipate future economic growth take advantage of these opportunities by bidding up the price of rural land in these areas. This bidding process is expected to shift the rent curves in Figure 1, which results in a new set of concentric land use zones.

A combination of theories including marginal productivity, location, and economic growth theories is necessary to explain valuation in rural land markets. The concept of comparative advantage offers a useful way of integrating these theories. Barlowe points out that comparative advantage not only comes from the natural resource endowment but also comes rom favorable combinations of production inputs, favorable location and transportation costs, favorable institutional arrangements, and desired amenity factors. This suggests that not only site characteristics, but locational and economic development factors are expected to affect land use and affect highest and best use of the land. Multiple uses of land and the selection of highest and best use of land are expected to increase bidding activity in rural land markets and hence influence land values in affected areas.

Figure 1



MODEL

The hedonic pricing model is used in this analysis to measure the effect of hypothesized factors in the rural land market. Rosen defined hedonic prices as 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. Value in a rural land submarket (y) is specified by the following transcendental function:

$$y = \beta_0 Z_1^{B1} \exp [\sum_{i=1}^{m} \alpha_i X_i + \sum_{j=1}^{n} (\gamma_j D_j + \varepsilon], \quad (1)$$

where y 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 (1) gives:

$$\ln y = \ln\beta_0 + \beta 1 \ \ln Z_1 + \sum_{i=1}^{m}\alpha_i X_i + \sum_{j=1}^{n}\gamma_j D_j + \varepsilon \quad (2)$$

This model is formulated to include nonlinearities because the price of land is hypothesized to decline as the size of tract (Z_1) increases. This results in a negative relationship between per acre value and size of tract.

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 (2), the implicit marginal prices (i.e., the partial derivatives) are given by the following:

$$\partial y_t / \partial Z_{1,t} = IMPSIZE_{1,t} = [\beta_1 / Z_{1,t}] \times Price_t$$

$$\partial y_t / \partial X_i = IMPX_{i,t} = \alpha_i \times Price_t. \quad (3)$$

The subscript, t, implies 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 (3).

The derivation of implicit marginal 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:

$$IMPD_j = (\exp [c_j - 2 \ V(c_j)] - 1) \ H \ Mean\ Price, \quad (4)$$

where $IMPD_j$ is the implicit marginal 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.

SPATIAL ESTIMATION

The characteristics of rural land markets, including the spatial arrangement of rural land sales and the information used within the rural land valuation process, can lead to spatial autocorrelation within the data. Hedonic model estimation using standard econometric procedures in the presence of spatial autocorrelation may result in estimates that are not efficient. Inefficient estimates may result in misleading inferences from the model. Following Anselin, spatial autocorrelation is the situation where the dependent variable or error term at each location is correlated with observations for the dependent variable or error term at other locations. This means that for neighboring locations i and j:

$$E(y_i y_j) \neq 0 \quad (5)$$

or

$$E(,_i,_j) \neq 0 \quad (6)$$

where (5) is defined as a spatial lag situation (Anselin). The spatial lag situation is specified by the following model:

$$y = \rho Wy + X\beta + \varepsilon \quad (7)$$

where:

y = vector dependent observations,
ρ = spatial autoregressive coefficient,
Wy = spatially lagged dependent variable,
X = matrix of explanatory variables,
β = vector of regression coefficients, and
ε = vector of error terms

W is a spatial weights matrix that takes into consideration the spatial arrangement of observations. In this spatial autoregressive model, if ρ is not equal to zero, then ordinary least square estimates will be biased and inefficient. Intuitively, the spatial lag model is consistent with the real estate appraisal process of using comparable sales in valuation, in that nearby rural land sales are used to explain per acre rural land prices in the spatial lag model.

When spatial dependence occurs in the error, as defined in (6), a regression specification with a spatial autoregressive error term is used to develop model estimates. The spatial error model is:

$$y = X\beta + \varepsilon \quad (8)$$

$$\varepsilon = \lambda W, + \xi \quad (9)$$

where:

y = vector of dependent observations,
X = matrix of explanatory variables,
β = vector of regression coefficients,
ε = vector of error terms,
$W\varepsilon$ = spatial lag for error terms,

λ = autoregressive coefficient, and
ξ = error term with mean 0 and variance matrix $\Phi^2 I$.

Again, W is a spatial weights matrix that takes into consideration the spatial arrangement of observations. This matrix is based on distances between observations. The logic of this model is that it is generally difficult to develop variables that explain all dimensions of the rural land market. With this situation, the spatial error model makes adjustments for spatial interaction in the error term.

Diagnostic statistical tests are used to test for spatial dependence and to identify the correct model (i.e., spatial lag or spatial error) for estimation (Anselin). For this analysis, Lagrange Multiplier tests are used to test for spatial dependence. The joint use of the Lagrange Multiplier error and Lagrange Multiplier lag tests is used to determine which spatial model is appropriate. When both Lagrange Multiplier tests have high values and are statistically significant, the one with the highest value will tend to indicate the appropriate model (Anselin).

DATA

Data for this study are based on rural land market sales collected on a statewide basis for Louisiana using mail survey techniques. Data for the study are based upon multiple surveys conducted for the study period of January 1993 through June 1998. The rural land market survey was mailed to state certified appraisers, officers in commercial banks, Farm Service Agency, Federal Land Bank personnel, Production Credit personnel, members of the Louisiana Chapter of the American Society of Farm Managers and Rural Appraisers, and members of the Louisiana Realtors Land Institute. Each respondent was asked to provide rural land sales of ten acres or more including attachments to the surface such as buildings and other improvements and sales outside the boundaries of towns and cities .

A total of 2,601 rural land sales were collected in surveys conducted in 1994, 1995, 1996, 1997, and 1998. Per acre sale prices, along with latitude and longitude of each sale tract, were entered into the ARC/INFO GIS model. A geo-referenced plot of the sale tracts is presented in Figure 2. With the exception of the extreme southeastern part of Louisiana (the New Orleans Metropolitan Statistical area where no rural land sales were reported), the results indicate that sales are widely distributed across rural land submarkets. Rural land submarkets, identified in Figure 2, were estimated by previous research. This research found that Louisiana=s rural land market consists of an aggregate of eight smaller submarkets (Kennedy et al.).

Variables hypothesized to influence per acre rural land values are defined in Table 1. PRICE in Table 1 is the dependent variable used in the hedonic model and represents the per acre selling price for each tract of rural land and improvements. Continuous variables expected to have an inverse relationship with per acre selling price include size of tract (SIZE), distance to nearest city (DNC), distance to nearest town (DNT), and travel time to nearest city (TTNC). There is a negative expected relationship between size of tract and per acre selling price because fewer buyers compete in markets for larger tracts; whereas, many buyers compete in markets for smaller tracts. For locational variables including travel time, location theory generally suggests an inverse relationship between

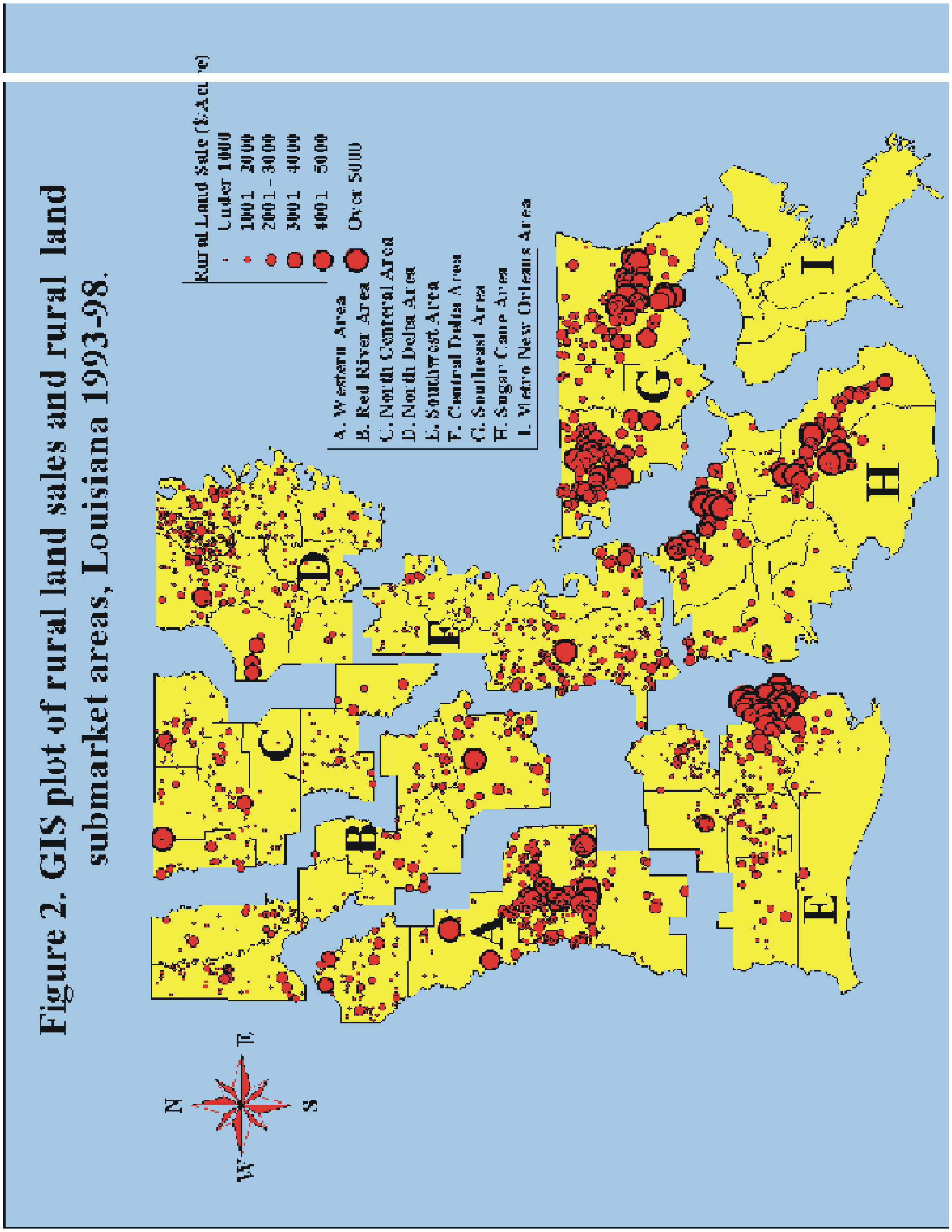


Figure 2. GIS plot of rural land sales and rural land submarket areas, Louisiana 1993-98.

distance to markets and per acre selling prices. The sign for timberland (TIMB) is expected to depend on the nature of sale tracts in the area. Merchantable and pre-merchantable timber is expected to have a positive influence on value, whereas cut-over timber is expected to have a negative influence on per acre value.

Continuous variables expected to positively influence rural land values include the percent of cropland (CROP), percent of timberland (TIMB), value of improvements (VALUE), the value of forestry improvements (FORIMP), road frontage (ROADFT), and time of sale (TIME). These variables represent positive attributes of rural land and hence are hypothesized to have a positive influence on per acre rural land values.

Discrete variables (Table 1) hypothesized to provide a measure of economic development and to have a positive influence on per acre rural land values are residence reason for purchase (RPR), Monroe metropolitan statistical area (MONMSA), New Orleans metropolitan statistical area (NORLMSA), urban influence (URBINF), and commercial influence (COMINF). The location of a tract in an MSA is expected to be influenced by economic development, while residential and commercial properties are expected to produce higher rents and values. Paved road access (RT) is expected to have a positive influence on rural land values and is expected to reflect development potential and accessibility. The presence of cotton base acreage (CB) indicates the presence of government program base acres and is hypothesized to be positive because of potential income through government program payments.

Table 1
Hedonic Model Variables, Louisiana Rural Land Market Survey, 1998-98

Variable	Description	Expected Sign
Continuous Variables		
PRICE	Per acre price of land ($)	
SIZE	Size of tract (acres)	(-)
CROP	Percent of cropland in tract	(+)
PAST	Percent of pastureland in tract	(+)
TIMB	Percent of timberland in tract	(+/-)
VALUE	Value of improvements ($)	(+)
FORIMP	Value of forestry improvements ($)	(+)
ROADFT	Road frontage (feet)	(+)
DNT	Distance to largest parish town (feet)	(-)
DNC	Distance to nearest city	(-)
TIME	Month of sale	(+)
LAFSIZ	Lafayette parish size slope: Southwest area	(-)
LAFTIM	Lafayette parish time slope: Southwest area	(+)
TTNC	Travel time to nearest city	(-)

Variable	Description	Expected Sign
Discrete Variables (1,0)		
RT	Paved access road	(+)
RPF	Reason for purchase: establish farm	(+)
RPR	Reason for purchase: residence	(+)
RPREC	Reason for purchase: recreational	(-)
CB	Presence of cotton base	(+)
MONMSA	Monroe MSA	(+)
NORLMSA	New Orleans MSA	(+)
FLINF	Flooding influence	(-)
URBINF	Urban influence	(+)
COMINF	Commercial influence	(+)
LAFINT	Lafayette parish intercept: Southwest area	(+)
S1	Coastal plain	(+)
S8	Recent alluvium-Red/Ouachita River	(+)
S11	Southern Mississippi. Valley silty uplands	(+)

Two discrete variables hypothesized to have a negative influence on per acre rural land values are recreational reason of purchase (RPREC) and flooding (FLINF). Flooding is expected to restrict the use of agricultural land and hence have a depressing effect on value. The discrete recreational variable is hypothesized to have a negative relationship with per acre land values because much of the data in this analysis represent marginal marshland and upland well suited for hunting, trapping, and other outdoor uses.

Prior to developing hedonic models of the rural land market, data in each of the study areas were tested for spatial autocorrelation. Spatial autocorrelation occurs if a variable (i.e., rural land values) is correlated with itself over space (Barber). Knowledge of spatial autocorrelation is of concern because its presence means there is interdependence in the data, whereas most statistical methods assume independence in the data. As previously discussed, ignoring spatial autocorrelation in a hedonic analysis of real estate values may result in inefficient and biased econometric results.

The presence of spatial autocorrelation was tested using a simple G statistic (Table 2). The G statistic (developed by Getis and Ord) is used to test for spatial autocorrelation in per acre land values in each rural land submarket. Results indicate that z values (corresponding to the normal distribution) are statistically significant at the 10% level for all submarket areas except the north central area. This suggests the presence of spatial autocorrelation in the majority of submarkets. Moreover, G values are most statistically significant for a 10 mile range in the Red River and Southeast areas. G values are most statistically significant for a 30 mile range in the Western and Central areas, while this range is most highly significant for a 40 mile range in North Delta, Southwest, and Sugarcane areas. A positive and statistically significant z value suggests positive spatial autocorrelation in rural land value data, whereas a negative z value indicates negative spatial autocorrelation. With the exception of North Central and North Delta, results (Table 2) indicate that all areas are estimated to positive spatial autocorrelation. This means that highly valued properties affect each other and group together. Alternatively, a statistically significant z value for the North Delta indicates negative spatial autocorrelation and a grouping of low valued sales within a 40 mile range.

Table 2
Spatial Association Among Per Acre Values By Rural Land Submarket, Louisiana, 1993-1998

Area	Distance (miles)	G-statistics[a]	Z-value[b]	Probability
Western				
	10	0.002583184	1.121142	0.262227
	20	0.007395865	1.876224	0.060625
	30	0.01348582	2.731285	0.006309
	40	0.02166765	2.183598	0.028992
Red River				
	10	0.001062307	2.885485	0.003908
	20	0.002297072	2.460544	0.013873
	30	0.003200293	2.158098	0.030920
	40	0.004358039	1.467069	0.142357
North Central				
	10	0.000629671	-1.64363	0.100253
	20	0.001795749	-0.102788	0.918131
	30	0.002508125	0.466021	0.641200
	40	0.003652867	-0.068332	0.945521
North Delta				
	10	0.001897472	-0.751964	0.452073
	20	0.005122898	-3.415831	0.000636
	30	0.00973998	-4.332529	0.000015
	40	0.01596641	-4.669897	0.000003
Southwest				
	10	0.002263586	0.860219	0.389668
	20	0.00556767	2.474239	0.013352
	30	0.01000357	3.280793	0.001035
	40	0.01618385	4.021793	0.000058
Central Delta				
	10	0.001984795	1.903267	0.057006

	20	0.005014994	2.445502	0.014465
	30	0.008470163	2.584606	0.009749
	40	0.01376776	1.563985	0.117821
Southeast				
	10	0.002827628	2.000304	0.045467
	20	0.006167904	1.299605	0.193736
	30	0.009996647	0.636732	0.524299
	40	0.01659713	1.178397	0.238639
Sugar Cane				
	10	0.004015692	0.718841	0.472239
	20	0.008858872	0.527074	0.598142
	30	0.01459416	1.607600	0.107923
	40	0.02084029	2.470996	0.013474

SUBMARKET MODELS

Because of spatial autocorrelation indicated by G tests, further diagnostic tests were conducted for the hedonic model using Ordinary Least Squares (OLS) estimation (Anselin). Results of these tests indicated statistically significant spatial autocorrelation in each of the eight rural land submarket areas. Diagnostic tests from OLS results indicated that a maximum likelihood spatial lag model (equation 7) as the appropriate model for North Central, Southeast, and Sugarcane rural land submarket areas, while a maximum likelihood spatial error model (equation 8) was indicated for the remaining rural land submarket areas. Each of the rural land submarket maximum likelihood models are presented in Table 3 and the absence of a spatial lag parameter estimate for the Western, Red River, North Delta , Southwest, and Central Delta areas indicates that a maximum likelihood spatial error model was estimated.

Model results presented in Table 3 indicated consistency of relationships across rural land submarkets for some model variables, while other variables were less consistent in influencing land values across the same submarkets. The effect of size of tract (LN SIZE) was consistently estimated to have a negative influence on rural land values across all submarket areas. Paved road access was estimated to have a positive influence on rural land values in seven of the eight rural land submarket areas. Similarly, time of sale was found to be statistically significant in seven of the eight rural land submarkets, while the value of improvements was found to have a positive influence on rural land values in six of the eight rural land submarkets. However, results of other model variables indicated a wide variation in factors influencing land values in submarkets. For example, road frontage was estimated to be statistically significant only in the sugarcane area and the percentage of cropland was estimated to be statistically significant only in the Red River area. In general, these results reflect the differences in rural land submarkets and the wide array of factors prevalent in the statewide rural land market.

Table 3. Estimated per acre maximum likelihood hedonic rural land submarket models, rural land survey, Louisiana, 1993-98.

	Rural Land Submarket Area							
Variables	**Western {tc "Western"}**	**Red River**	**North Central**	**North Delta**	**Southwest**	**Central Delta**	**Southeast**	**Sugar Cane**
SPATIAL LAG {tc "SPATIAL			-0.0354255 (-1.93)*				0.0250391 (3.13)***	0.067008 (2.63)***
LN SIZE	-0.262884 (-7.69)***	-0.29119 (-9.50)***	-0.241882 (-6.66)***	-0.0344751 (-1.71)*	-0.0663595 (-2.21)**	-0.116404 (-5.87)***	-0.219996 (-7.25)***	-0.335865 (-9.45)***
CROP		0.00379567 (3.92)***						
PAST		0.00219769 (2.24)**	0.00484851 (4.71)***			- 0.00145744 (-1.74)*		
TIMB			0.00149086 (1.81)*			- 0.00251991 (-2.29)**		
VALUE	8.75931E-07 (3.47)***	8.97514E-06 (9.13)***	1.12455E-05 (6.37)***	1.41551E-06 (1.96)*	6.47241E-06 (2.48)**		1.9883E-06 (3.70)***	
FORIMP			5.40047e-06 (5.59)***					
ROADFT								8.30799E-05 (1.96)**
DNT	-0.0136712 (-2.59)***		-0.0152916 (-3.06)***		-0.0112168 (-1.92)*	- 0.00866722 (-1.81)*	- 0.00756591 (-2.18)**	
DNC		- 0.00447908 (-1.72)*	-0.0111794 (-3.62)***		-0.0121725 (-2.80)***			
TIME		0.00865636 (4.44)***	0.00954484 (5.64)***	0.00546169 (5.36)***	0.00133709 (0.92)	0.00774705 (5.98)***	0.00959229 (4.84)***	0.00607602 (2.22)**
LAFSIZ					-0.231564 (-2.38)**			
LAFTIM					0.0251086 (5.52)***			
TTNC							-0.383333 (-3.03)***	
RT	0.32523 (2.69)***	0.335105 (5.03)***	0.239224 (3.47)***	0.0896363 (2.36)**	0.13748 (2.37)**	0.148183 (2.92)***	0.192459 (3.06)***	
RPF				-0.181116 (-2.60)***				
RPR	0.413864 (2.39)**			0.283749 (1.76)*	0.24467 (1.95)*	0.599622 (3.24)***		0.365585 (2.53)**

(table 3 con'd)

Variables	Western{tc "Western"}	Red River	North Central	North Delta	Southwest	Central Delta	Southeast	Sugar Cane
RPREC{tc "RPREC"}				-0.362304 (-2.44)**		-0.418076 (-3.37)***	-0.23825 (-2.29)**	
CB				0.00061439 4 (3.85)***				
MONMSA				1.15535 (6.31)***				
NORLMSA							0.581652 (5.82)***	
FLINF			-0.22861 (-1.68)*			-0.395663 (-3.22)***		
URBINF		0.621072 (4.64)***						0.524941 (1.82)*
COMINF		0.651835 (2.34)**						
LAFINT					1.03944 (2.88)***			
S1				-0.362956 (-2.42)**				
S8						0.14102 (2.38)**		
S11				-0.196047 (-3.07)***				1.4425 (5.04)***
Intercept	7.65794 (52.61)***	7.27482 (49.84)***	7.48147 (37.49)***	6.4537 (62.80)***	7.41069 (35.40)***	6.95956 (60.66)***	8.43039 (42.83)***	7.94991 (31.13)***
Multicollinearity Condition Number	10.41	13.51	18.20	15.10	21.59	12.79	18.88	8.38
Spatial B-P Test	12.78**	9.57	9.18	105.71***	13.15	46.96***	10.88	86.04***
LM test of Spatial Dependence	1.88	1.06	1.11	0.35	1.98	1.15	3.82*	0.001
AIC Test	1281.86	370.18	369.75	364.84	507.28	343.10	370.73	461.13
R^2	0.12	0.46	0.51	0.24	0.58	0.39	0.40	0.43
Number	574	254	243	425	342	304	257	208

Dependent Variable: ln PRICE

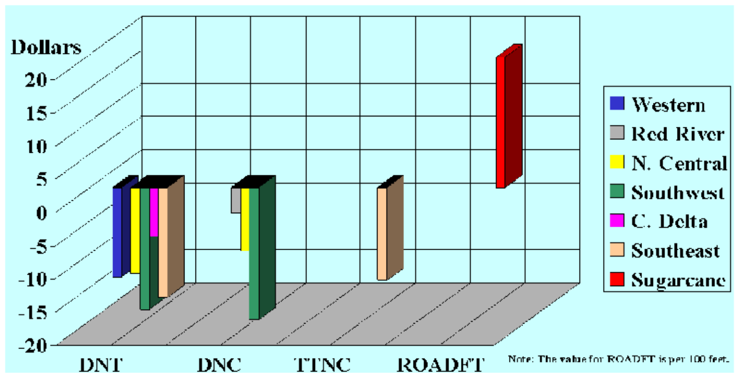
Selected diagnostic tests for each of the estimated rural land submarket models are presented in Table 3. Although the OLS results are not presented, comparison of Akaike information criterion (AIC) estimates indicates a better measure of fit for the maximum likelihood models than for OLS estimated models for each of the rural land submarkets. The multicollinearity condition number is less than 30 for each of the rural land submarket models suggesting that multicollinearity is not a problem. The Lagrange Multiplier (LM) test on spatial dependence is not highly statistically significant (.05) in any of the areas indicating that appropriate estimation procedures have been used to deal with the problem of spatial autocorrelation in the data.
However, for the North Delta, Central Delta, and the Sugarcane areas, the Spatial Breusch-Pagan test is statistically significant at the 1% level, suggesting the presence of heteroskedasticity in the estimation procedures.

Marginal implicit prices presented in Figures 3 and 4 are used to observe the magnitude and direction of influence of location and economic development on per acre land values. Marginal implicit prices were estimated from variables for respective submarket models (Table 3) using equations 3 and 4. For convenience, marginal implicit prices are evaluated at mean values of per acre price and of the characteristic. A positive marginal implicit price suggests that an increase in that characteristic results in an increase in the per acre price of rural land, other things constant. Conversely, a negative marginal implicit price resulting from a negative coefficient has a depressing effect on per acre real estate prices.

Marginal implicit prices for distance and road frontage variables by rural land submarket are illustrated in Figure 3. The marginal implicit price for distance to the largest parish town (DNT) is estimated to range from -\$7.40 per acre in the Central Area to -\$18.36 per acre in the Southwest Area. This means that a one mile increase from the largest parish town in the Southwest Area will decrease per acre rural land value by -\$18.36 per acre. Distance to nearest city (DNC) marginal implicit prices are estimated to range from -\$3.93 per acre in the Red River area to -\$19.92 per acre in the Southwest area. In addition, it is estimated that a one minute increase in travel time to the nearest city (TTNC) decreases per acre value by \$14.00 in the Southeast area. For the Sugarcane Area, 100 feet of road frontage is estimated to add \$19.63 to the per acre of land.

Marginal implicit prices for road type and economic development variables by rural land submarket are illustrated in Figure 4. The marginal implicit price for paved road access (RT) is estimated to range from \$69.23 per acre in the North Delta Area to \$459.65 per acre in the Southeast Area. The marginal implicit price for the Western area suggests that a tract with paved road access (RT) sells for \$369.37 more per acre than a tract that does not have paved road access. Economic development measures which include residential reason for purchase, urban and commercial influences, and MSA variables are shown to have a strong positive affect on per acre rural land values (Figure 4). The marginal implicit price for residential reason for purchase (RPR) is estimated to range from \$231.51 per acre in the North Delta Area to \$1,007.34 per acre in the Sugarcane Area. Similarly, a tract of land located in the New Orleans MSA (NORLMSA) is estimated to be valued at \$1,708 more per acre than a tract in the Southeast area not located in this MSA.

Figure 3. Estimated distance and road frontage related marginal implicit prices by rural land submarket area, Louisiana, 1993-98.



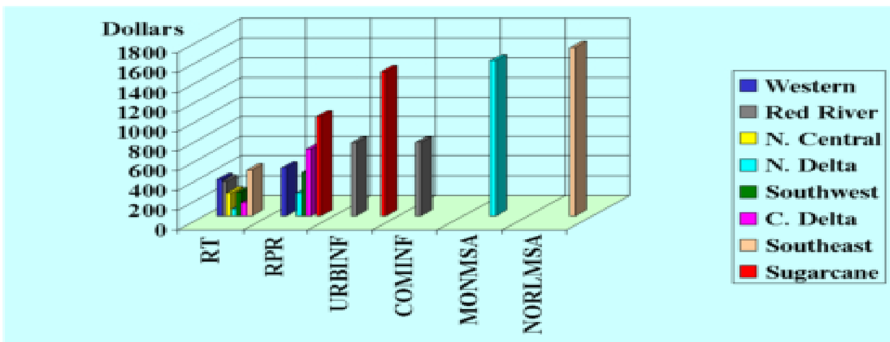
LAND PRICE CONTOURS

Statewide rural land price contours were estimated from spatial econometric models (Table 3) and GIS procedures. Rural land price contours are estimated to show the effect that location and economic development has on per acre rural land value across the state. Specifically, spatial econometric models were used to predict values based on location and economic development, while holding other model variables constant (at the mean), and these predictions were used to estimate rural land price contours with GIS procedures. A land price contour is an isoprice line that represents areas which have approximately equal prices. The method used to estimate land value contours is the Triangulated Irregular Network (TIN) available within the ARC/INFO data model. The TIN procedure provides an efficient means for estimating detailed contours without requiring a huge amount of data.

The spatial affects of location and economic development across Louisiana as estimated by rural land price contours are illustrated in Figure 5. Similar to topographic maps that show equal elevation above sea level, the Louisiana land value contour map presented in Figure 5 depicts areas with approximately equal per acre land values. Each contour line is drawn as a continuous line identifying land values at $500 price intervals. Isolines located close together indicate steep price gradients in short distances, and isolines located further apart indicate much smaller price gradients. In Figure 5, steep isolines in the Lafayette area suggest that location and economic development have a relatively strong influence on per acre rural land values.
Moreover, the results indicate that the effects of location and economic development in the Lafayette area cause land values to range from $5,000 an acre for land close to this city to $1,000 per acre as distance increases from the city.

Results presented in Figure 5 also illustrate the effects of New Orleans and Baton Rouge metropolitan areas on per acre rural land values. St. Tammany parish, directly north of New Orleans, is in the New Orleans metropolitan statistical area. This parish is also connected to the New Orleans area via the Lake Pontchartrain causeway. Results indicate that the effects of location and economic development cause land values to vary from $500 to $4,500 per acre in this area. In the Baton Rouge metropolitan area, land value contours range from $4,000 to $500 per acre. Additional rural land sales in the Baton Rouge area

Figure 4. Estimated road type and economic development variable related marginal implicit prices by rural land submarket area, Louisiana, 1993-98.



would be expected to strengthen contour results; however, these results effectively provide a visual picture of the effects of location and economic development. This information is expected to be useful to assessors, appraisers, lenders, planners, and others interested in land values in this area.

The results presented in Figure 5 generally indicate that location and economic development have a strong influence on per acre rural land prices. Per acre rural land prices generally are much higher in the areas of MSA cities illustrated in Figure 5. Results also indicate that the effects of location and economic development are larger in the southern one-half of the state than for the northern one-half of the state. These results are consistent with the population base and the general amount of economic activity in the major metropolitan areas of southern Louisiana. The effects of location and economic development in the Lake Charles and Shreveport areas are not as pronounced as other areas of the state. Additional data for analysis in these areas would be expected to improve the GIS results.

SUMMARY AND CONCLUSIONS

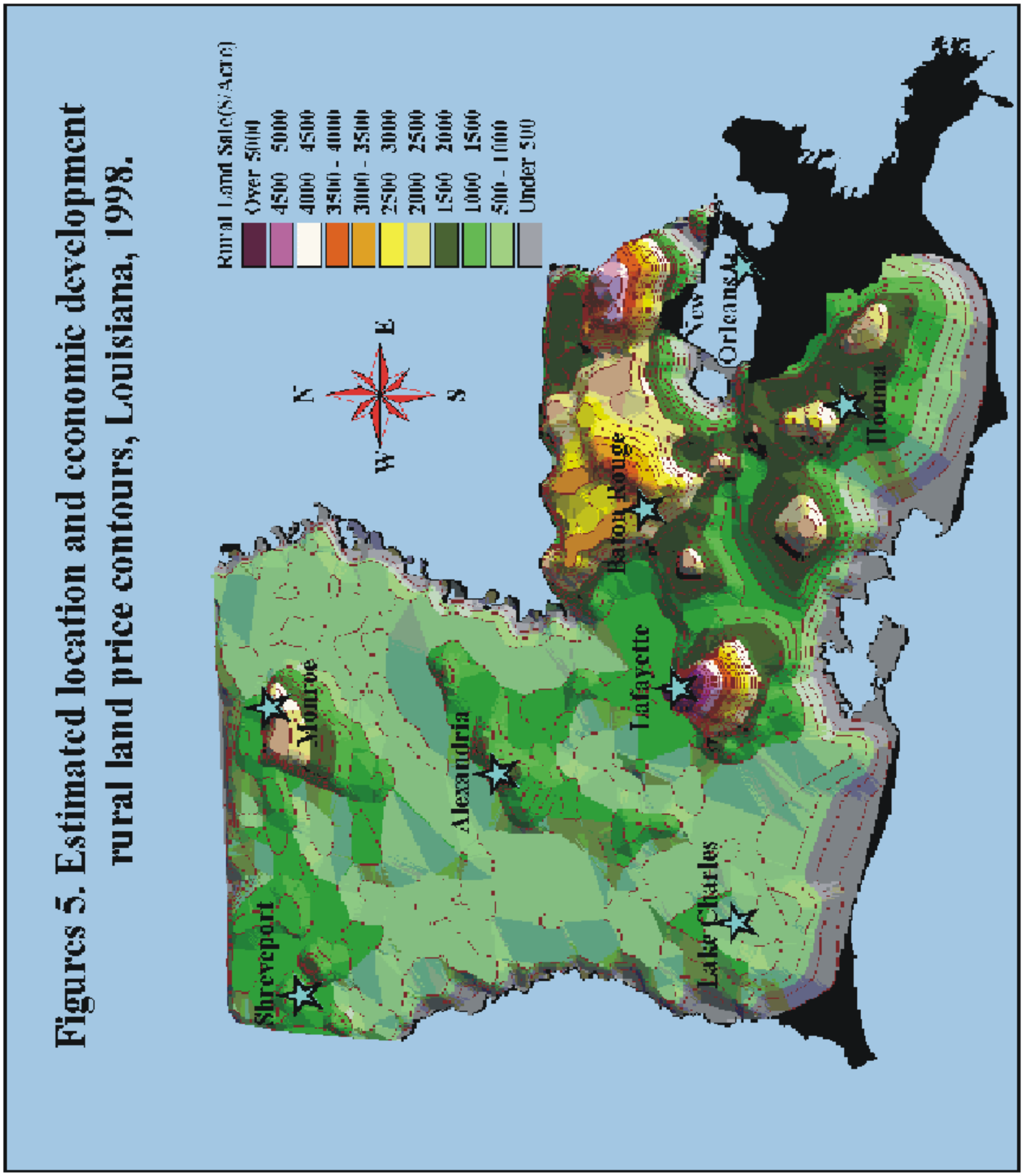
The general objective of this research was to measure the effect that location and economic development has on Louisiana rural land values. Given the spatial nature of the Louisiana rural land market, hedonic models of eight rural land submarkets were estimated using spatial econometric procedures. GIS procedures were used in data estimation, conducting statistical test, and illustrating the results of the analysis.

Statistical tests were conducted for the presence of spatial autocorrelation in the rural land value data base. These tests indicated the presence of spatial autocorrelation in the data for all eight rural land submarkets. Spatial maximum likelihood econometric methods were used because the use of tradition econometric procedures in the presence of spatial autocorrelation would have produced biased and inefficient estimates. Statistical tests generally indicated that spatial econometric models better fit the data than OLS models. In addition, statistical tests suggested that spatial econometric methods appropriately handled the problem of spatial autocorrelation within the data.

Marginal implicit prices for each rural land submarket were estimated from hedonic model results. These results generally indicate that location and economic development are important in explaining per acre land values in each of the eight rural land submarket areas. Empirical results revealed that in every rural land submarket area, at least three location and economic development explanatory variables were statistically significant in explaining rural land market values. In four of the rural land submarkets, location and economic development accounted for one-half of the model variables, whereas these variables accounted for at least one-third of model variables for the remaining rural land submarkets. The presence of these variables in the empirical models generally reflects the importance of location and economic development in Louisiana rural land submarkets.

Predictions from spatial econometric models were used to estimate rural land price contours. Statewide GIS estimated rural land price contours provided visual information on the effects of location and economic development on per acre rural land values. Empirical rural land price contours estimated in this analysis are consistent with location theory models of concentric circles of land use around an urban center. The land price contours not only provide a spatial view of the magnitude of the variation in per acre price, but also indicate where the location and economic development influences occur within the state. In addition from a planning perspective, if data and modeling efforts capture investment and economic development expectations of rural market participants, then land price contours may be used to provide a visual picture of where future economic development is likely to occur.

Figure 5


Figures 5. Estimated location and economic development rural land price contours, Louisiana, 1998.
Rural Land Sale($/Acre)
Over 5000
4500 - 5000
4000 - 4500
3500 - 4000
3000 - 3500
2500 - 3000
2000 - 2500
1500 - 2000
1000 - 1500
500 - 1000
Under 500
N
E
S
W
Shreveport
Monroe
Alexandria
Lafayette
Lake Charles
Baton Rouge
New Orleans
Houma

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