# Taxing Farm Real Estate: The Market Value of Agricultural Land in Kansas

## Introduction

Changes in land values are a major concern to agricultural producers, landowners, community businesses, and financial agencies. Farm real estate accounts for more than 80 percent of the value of all farm assets in the United States totaling approximately $1.13 trillion (ERS). Given the magnitude of this investment, agricultural land owners have a significant interest in changes in the value of their land. Large swings in land value have an impact on a landowner’s net worth and borrowing ability. These changes spark the interest of financial agencies and may change their position on lending.

Movements in land prices affect sectors outside of agriculture as well. Changes in land prices encourage or discourage the conversion of agricultural land into residential or commercial development. Urban sprawl may drive up land prices near cities, discouraging production agriculture for two reasons. The increased land price makes difficult for agricultural producers to afford to purchase the land. Secondly, higher land prices may encourage producers to sell to developers who will convert the land out of agricultural production.

Given the importance of land valuation to the various stakeholders, the objective of this research is to develop a theoretically sound model that estimates the market value of land in Kansas, accounting for urban influence. This will enable one to determine how residential rents may be affected by a property tax policy change to market value appraisal of all land types (residential, agricultural, commercial, etc.).

The market value of land will be estimated using a hedonic model for the state of Kansas that includes factors related to urban sprawl. Using sales data from the Property

Valuation Division of the Kansas Department of Revenue (PVD), I will estimate parameters for productive and location attributes of the acreage sold. The sales data used include all open market, arms-length sales of agricultural land in Kansas between 1996 and 2000. The contribution of this research is the inclusion of the negative exponential approach within a hedonic model, enabling the estimates to incorporate both traditional characteristics of agricultural land and urban pressures specific to agricultural land.

## Literature Review

Hedonic models are prominent in the land valuation literature. Rosen (1974) presented a general theoretical framework for using hedonic prices to analyze the demand and supply of attributes of differentiated products. Early applications of Rosen's (1974) theoretical model to agricultural land values include Chicoine (1981), Miranowski and Hammes (1984), and Palmquist (1989). Freeman (1974) and Anderson and Crocker (1972) are two examples of the continuing debate over the proper theoretical framework for the analysis of property values and the interpretation of regression coefficients. According to Freeman (1979), some criticisms include skepticism that the relationship between particular components modeled and property values reflect merely correlation and not a true relationship. Other critics suggest that the assumption of market equilibrium renders the technique useless (Freeman, 1979). Still others attack the underlying theory, which requires restrictive assumptions about the nature of utility functions (Freeman, 1979). The criticisms of hedonic models are varied, but according to Freeman (1979), the hedonic technique performs as well as any empirical technique for estimating demand, production, and consumption functions.

Bin and Polasky (2004) estimate the effect on residential property value of houses located within a floodplain using hedonic analysis. For sales that occurred before and after a major flood in North Carolina, they found that an average house located within a floodplain sold for $7,463 less than a comparable house outside the floodplain. The estimated pre-flood discount for a house located within the floodplain was $4,888, while the post-flood discount is $10,825. They further show that estimated sales price differentials are less (more) than the capitalized value of flood insurance before (after) the flood. Bin and Polasky conclude this indicates that "…recent experience with flooding tends to increase the perceived risk associated with flooding" (p. 499).

Shultz and Taff estimate the implicit price of wetlands in areas of production agriculture. Using Geographic Information Systems (GIS) data, they separate eased and non-eased wetlands to determine whether the wetland was wet throughout the crop year (permanent) or might dry up (temporary). The permanent classifications, wet throughout the year, prove to be statistically and economically significant in their model. Each additional acre of non-eased and eased permanent wetlands decreases sale price by $161 and $321, respectively, implying a 40% and a 79% reduction in average sale price per acre, respectively. This research illustrates the importance of separating eased and non-eased wetlands and the importance of determining whether or not the wetland was permanent. Shultz and Taff state, "Our estimated implicit prices of eased and non-eased wetlands appear to be consistent with economic theory in that they reflect the relative opportunity costs associated with foregone agricultural production on different types of wetlands" (p. 510).

Klose, Outlaw, and Anderson (2004) analyze the impacts at the farm level of eliminating agricultural use valuation for property taxes and agricultural use exemptions from sales taxes. These impacts are measured using actual producer data from 183 farmers and ranchers in Texas. They find that eliminating use valuation would increase annual property taxes per farm $21,000 on average representing a loss of 17% of net cash income annually.

Capozza and Helsley (1989) show that there is confirmation of a positive relationship between the rate of urban growth and the price of housing. In two examples, they show that in rapidly growing cities, the value of expected future rent increases may account for at least half of the average price of land. Making some general assumptions about the values of the variables, they show that the ratio of the price of urban land net of the servicing costs to the value of agricultural land rent changes from 10.2 to 37.7 at growth rates of two percent and four percent, respectively. This finding implies that the alternative treatment of agricultural land leads to significant loss in property tax revenue to local governments. The foregone revenue either means lower expenditures by the local government or higher taxes on the remaining property tax base.

Anderson and Griffing's (2000) research focuses on estimating the lost tax revenues created by preferential treatment of agricultural land. They examine two contiguous urban counties in Nebraska using a negative exponential model of the difference between market value and use-value per acre. They compare market and use-value for a land parcel. For the two counties they examine, they find that the use-value assessments are 63.9 percent and 24.77 percent of market. Moreover, they find that the rates of decay in the difference of value are very similar across these contiguous counties, implying that this rate may be more generalizable beyond their data set. Their results indicate that the expenditure lost due to use-value assessments is significant: 36% of total tax revenue for one county and 75% of total for the other. These rates may be inflated because they do not segregate agricultural land from other real estate classifications. Anderson and Griffing state that using the integration method may overstate tax expenditures because all land categories are valued at use-value and at market value. This method does not allow for the segregation of agricultural land that would be the only land class affected by a tax policy change.

### Theory

Capozza and Helsley (1989) develop a theoretical model that assumes capital is durable and landowners have perfect foresight. The price of urban land can be derived by summing four components: the value of agricultural land rent, the cost of development conversion, the value of accessibility, and the value of expected future rent increases. They view the capitalized value of agricultural rent and the value of capital improvements applied to the land as invariant to distance. The other two aspects of the price, the value of development conversion and the value of accessibility, are dependent on the location of the land in relation to the Central Business District. Capozza and Helsley represent the price of developed land as:

$$(2.1) \quad P^d(t,z) = A/r + C + (1/r)(T/\bar{L})[\bar{z}(t) - z] + (1/r)\int_t^{\infty} R_t(\tau,z)e^{-r(\tau-t)}d\tau$$

where $A$ is the value of agricultural rent and $r$ is the discount or capitalization rate. $C$ represents the value of capital improvements applied to the land. The value of accessibility depends on transportation cost, $T$, mean lot size, $\bar{L}$, and declines with distance, *z*, to the city boundary, $\bar{z}(t)$.[1] Capozza and Helsley state that urban growth affects the price of land and that in a static context, land price is proportional to land rent. This would make the price of land on the urban fringe equal to the value of agricultural land rent. In a dynamic model, they argue that this is not the case. Specifically, the price of agricultural land is:

$$(2.2) \qquad P^a(t,z) = A/r + (1/r)\int_t^{\infty} R_t(\tau, z)e^{-r(\tau-t)}d\tau.$$

Substituting (2.2) into (2.1), the relationship between developed land and agricultural land can be seen as:

$$(2.3) \qquad P^d(t,z) = P^a + C + (1/r)(T/\bar{L})[\bar{z}(t) - z]$$

implying that the price of developed land is equal to the price of agricultural land plus the capital improvements plus the value of accessibility. Using Liebnitz' rule, they find that land is developed when in urban use rent equals the opportunity costs of land and conversion capital. The rent outside the urban area is simply the agricultural rent. Rent at the edge of the urban area increases by the opportunity cost of the capital used to convert land for development. Rents rise inside the urban boundary by transportation costs per unit distance per unit land.

According to Anderson and Griffing (2000), little empirical research has evaluated the implications on tax expenditures of favorable treatment of agricultural land. In their 2000 study, Anderson and Griffing discuss more complex models developed by Capozza and show that market value exceeds agricultural value, and this differential decreases with increasing distance from the Central Business District. Anderson and

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[1] Models of urban land price theorize that the market value of the land per acre should decline as distance from the Central Business District increases.

Griffing's (2000) research focuses on estimating the lost tax revenues created by preferential treatment of agricultural land. They use a negative exponential model of the spatial variation in the difference between the two sets of prices and integrate the area between them over the urban area. The negative exponential model implies that the distance to the Central Business District accounts for the difference between market value and use-value. Empirically:

$$\ln(Diff) = \beta_0 - \beta_1 * Distance \tag{2.4}$$

where *Diff* is the difference between market value and use-value. *Distance* is the distance of the parcel from the Central Business District. A concern when using the negative exponential function with time-series data is the function's reliance on distance as the influence on the FMV/UV difference.

## Methodology

The objective of this research is to estimate the magnitude of the influence of urban location on the market price of agricultural land in Kansas. Use-value tax policy allows agricultural land to be assessed its use value, measured through productive income, instead of at its market value. A nonlinear model that combines site-specific explanatory variables that are traditionally included in hedonic models with potential urban influences is estimated. Other urban influence is incorporated using the negative exponential function used by Anderson and Griffing. The negative exponential function is used to calculate the difference between market value and use value based on a parcel's distance from the Central Business District. Figure 2.1 illustrates graphically the premise of the negative exponential function with regard to land sales price. Essentially, this figure shows the theory behind the negative exponential function in that urban influence declines nonlinearly as the distance of the parcel location increases from the Central Business District.

In its simplest form, a hedonic land price model assumes that the price of land is determined by the summation of the product of the price and quantity of the characteristics of the parcel and the distance the acreage is from metropolitan statistical areas (MSA) in Kansas. Although Kansas is a relatively agricultural state, it is composed of two larger metropolitan areas (Kansas City and Wichita). Urban forces may be stronger in states with more agricultural acres because there are virtually no expansion limitations such as geographic barriers. Thus, it is especially important to include developmental pressures in estimating market value of agricultural land.

The double-log empirical specification of the hedonic model used in this research is as follows:

$$
\begin{aligned}
LSPA = {} & \beta_0 + \beta_1 * Lacres + \beta_2 * Lrain + \beta_3 * PctIrr + \beta_4 * PctImppast + \\
& \beta_5 * PctGrass + \beta_6 * Lprod + \beta_7 * Rolling + \beta_8 * PubUtil + \\
& \beta_9 * NoUtil + \beta_{10} * PavedRoad + \beta_{11} * DirtRoad + \beta_{12} * NoRoad + \\
& \beta_{13} * Trend + \exp(\beta_{14} - \beta_{15} * KSCity) + \\
& \exp(\beta_{16} - \beta_{17} * Wichita) + \exp(\beta_{18} - \beta_{19} * minGreater10000).
\end{aligned}
\tag{2.5}
$$

*LSPA* is the estimate of the logged full market value, or sale price, per acre. *Lacre* is the logged value of total acres in the transaction. *Lrain* is the logged county average annual rainfall. The percent of irrigated acreage is designated as *PctIrr*; *PctImppast* is the percent of improved pasture; and *PctRange* is the percent of native pasture or rangeland. These estimates are relative to non-irrigated acreage, which is the default. *Lprod* is the logged value of the weighted average productivity index. *Rolling* is the percent of the acres sold for which the topography was not level; the coefficient is interpreted relative to level land. *Pub_util* is a binary variable representing the presence of public utilities on the property; *no_util* indicates no utilities are present, and private utilities are the default. *Imp_rd* is a binary variable for access from a semi improved road; *dirt_rd* indicates dirt roads; *no_rd* indicates there is no road access; and paved roads are the default. The *Trend* variable is a binary variable representing the year of the sale and is included to capture the overall trend in land sales price. *Trend* was equal to 1 through 5; for example, if the sales year was 1996 then *Trend* was equal to 1, and if the sales year was 2000 then *Trend* was equal to 5.

Components included in the nonlinear portion of the model explain urban influences on land price. The $\beta_{14}$ parameter is the intercept term for the distance to Kansas City, and $\beta_{15}$ is the percentage rate of change in *LSPA* per mile of distance increase from *KSCity*. The $\beta_{16}$ parameter is the intercept term for the distance to Wichita, and $\beta_{17}$ is the percentage rate of change in *LSPA* per mile of distance increase from *Wichita*. The $\beta_{18}$ parameter is the intercept term for the minimum distance calculated between each parcel and any community with a population of more than 10,000 people. The $\beta_{19}$ parameter estimate represents the percentage rate of change in *LSPA* per mile of distance increased from communities with a population of over 10,000. The intercept terms represent the difference between the sale price and the use-value when distance is zero, or the parcel located in the Central Business District. The intercept represents the largest difference between use-value and market value of the acreage sold. Distances are calculated using GIS data that measures the distance between a parcel and the two primary metropolitan areas in Kansas and the minimum distance between a parcel and a *greater than 10,000* community.

Interpretation of parameter estimates in this model, in most cases, is relatively straight forward. The parameter estimates for the logged independent variables can be interpreted directly as elasticities. Those variables that are in percentage form can also be interpreted as elasticities. For the case of binary variables, the elasticity of the binary variable equals the exponential of the variable's parameter estimate minus one (Halvorsen and Palmquist). The impact of the exponential components on the difference between market and non-urban use value will be graphically displayed.

## Data

The Property Valuation Division (PVD) of the Kansas Department of Revenue (KDOR) is the main source of data. The sales data consist of actual arms-length, open market agricultural land sales in Kansas between 1996 and 2000 and has over 11,000 complete observations. It contains both the sales price and the use-value assessment of the property. These data consist of all agricultural parcels in Kansas sold in the specified years. The sales data contain information on parcel identification number, county number, sales class, certificate of value, month, year, sale type, sales price, sales validity code, agriculture use type, soil mapping unit, agriculture size, acres, agricultural use value, building value, topographical codes, utility codes, and access codes. Definitions and descriptions of these codes are contained in KSCAMA Residential/Agricultural Data Collection Course 1-104-2.

*Agricultural use type, soil mapping units, agricultural size, and agricultural use value* are variables, which together, describe a sub-unit of the parcel. Soil mapping units define a particular soil type. The agricultural size data define the acreage associated with the soil mapping unit, while the agricultural use type provides information on how the sub-parcel is used.  In these data, land is classified as non-irrigated and irrigated crop acreage, improved pasture acreage, and/or rangeland acreage.  The agricultural use value provides a monetary measure of the sub parcel's appraised value based on its income generating capacity.  When aggregated, these sub-parcel components define each parcel's characteristics.  These characteristics were used to create the acreage and productivity variables, *Acres* and *Lprod*, respectively.  *Acres* is the calculated sum of all sub-parcel agricultural size components as discussed above.

The construction of *Lprod* is more complicated.  In 2001, the Natural Resource Conservation Service (NRCS) developed the General Crop Productivity Index, known as the KS_SRPG in Kansas, as the land classification system that is incorporated into PVD's agricultural valuations.  The NRCS developed the first version of the KS_SRPG model in 1992.  This model arrays soil mapping units[2] relative to their potential to produce crop growth assuming average management.  In 2001, Powers, Ransom, and Vanderlip modified the KS_SRPG for irrigated cropland.  The resulting Kansas Irrigated Productivity Index (KIPI) arrays soil mapping units relative to their potential to produce crop growth under full irrigation.  Both the KS_SRPG and KIPI models account for six groupings of soil properties including surface characteristics, water features, soil chemistry, soil climatic factors, physical profile, and landscape features.  The Rangeland and Improved Pasture Productivity Index (RIPPI) was developed at Kansas State University and encompasses both rangeland and improved pasture (KDOR).  The scale

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[2] Based on soil type and topographical characteristics

for rangeland is from 0 to 1, and the scale for improved pasture is from 0 to 3.[3] Productivity indices were created using the KS_SRPG, KIPI, and RIPPI indices and the parcel specific soil mapping units.

Topographical codes describe whether the parcel is *level* or *rolling*. The rolling binary variable is one if more than 50% of the acreage on the parcel is defined as level by the county appraiser and zero otherwise. Utility codes provide information on the source (*public* or *private*) of utilities. Access codes define the type of road access to the parcel (*paved*, *semi-improved*, *dirt*, or *no road*). Data by county from the Kansas Weather Library was used to estimate the thirty year average rainfall measured in inches per year, *Lrain*.

The distances between a parcel and the Central Business District of Kansas City, Wichita, and communities with more than 10,000 people are calculated. A 21 character identifier for each parcel (PID) is available for most parcels. Embedded within the PID are fields which specify the county, township, and section for the parcel. While the township identifier is different than the township and range identifier used in the Public Land Survey System, the physical boundaries are the same. As such, the PID contains all information normally present in a parcel's legal description, allowing GIS data to be matched to each parcel sold.

Sales and GIS data are combined to estimate the distance variable, necessary to use the exponential function. The LEO System, designed by the Kansas Geological Society, converts location reference, legal description of a parcel, to a parcel's center point location in geographic (longitude, latitude) coordinates (KGCC). The Geographic

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[3] For a more in-depth discussion of the indices see Kansas Department of Revenue (KDOR) Web site at http://ksrevenue.org/pvdaguse.htm.

Information Systems (GIS) data for all Kansas cities came from the USGS Geographic Names Information System (GNIS). Using Cartesian coordinate geometry, the geodesic distance between a parcel and all Kansas cities was calculated.[4] To calculate distance, latitude and longitude are converted from decimal degrees to radian degrees using the following formulas:

$$long\_rad_i = long_i\_dec * (\pi/180) \tag{2.6}$$

$$lat\_rad_i = lat_i\_dec * (\pi/180). \tag{2.7}$$

The formulas used to calculate the distance are shown below:

$$AA = \sin(lat_i) * \sin(lat_{i+1}) + \cos(lat_i) * \cos(lat_{i+1}) * \cos(long_i - long_{i+1}) \tag{2.8}$$

$$CC = arc\cos(AA) \tag{2.9}$$

$$distance = earthradius * CC \tag{2.10}$$

where *AA* is an intermediate calculation to use the "great circle" formula for calculating geodetic distances using latitude and longitude in radians. $Lat_i$ ($Long_i$) and $Lat_{i+1}$ ($Long_{i+1}$) are the latitudinal (longitudinal) location in radians of each parcel and each city, respectively. *CC* is the arc cosine of *AA*; and *distance* is the geodetic distance in miles between each parcel and each city.[5] *Earthradius* is the Earth's mean radius of approximately 3959 miles (Wikipedia).[6] This would be the radius of a hypothetical perfect sphere that had the same surface area as the Earth.

## Results

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[4] When talking about distance on the earth, "geodetic distance" and "geodesic distance" are the same things: the shortest path along the ellipsoid of the earth at sea level between one point and another.

[5] The source for the Great Circle distance is http://www.ac6v.com/greatcircle.htm denoted as GCD in references.

[6] The mean radius is derived by averaging the center-to-surface distances on all points on the globe. For the formula used to calculate the radius, see http://en.wikipedia.org/wiki/Earth_radius (Wikipedia).

Summary statistics for the explanatory variables are listed in table 2.1. The average sales price per acre of land in nominal dollars was $2,508/acre, with a range of $20 to $975,992 per acre.[7] Parcels that sold ranged from 0.01 to 1980 acres, with the mean of 153. Average rainfall was 30 inches, increasing from the West to the East. The average productivity was 1.03, indicating that the average parcel sold had soil that was slightly above the average quality of the entire state. During the period, 55% of the acres sold were nonirrigated cropland and for irrigated, improved pasture, rangeland, 4%, 7%, and 34%, respectively. Most of the acreage sold, 68%, was considered rolling terrain. The percentages of sales with private, public, and no utilities were 6%, 10%, and 84%, respectively. The percent of land sold with paved road access was 18%, but, 48% of land sold had some kind of improved access other than pavement. About one-third of the sale acreage had dirt road access, and 6% of land sold with no road access.

Sales occurred in all years. Since the mean of the trend is 2.7, then acreage was sold fairly evenly throughout the time frame. The distance to Kansas City ranged from 7.1 miles to 424.7 miles, with a mean of 191.4 miles. The average distance to Wichita was 119.1 miles, and distances ranged from 3.0 to 295.9 miles. The distance to cities with a population of over 10,000 ranged from 0.8 miles to 148.5 miles, with a mean of 31.3 miles.

### *Model Results*

Table 2.2 lists the parameter estimates and the explanatory power of the model assuming a homoskedastic error. The R-squared was 57%, and the RMSE of 0.7114 translates to about a $2 per acre error in sale price. Table 2.3 lists the elasticities as

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[7] The maximum is based on conversations with developers that stated that four homes priced at about $500,000, could be built on one acre leaving a net profit of about $300,000

calculated for the binary variables. We tested for and found heteroskedasticity in the model. However, using out of sample testing, the unadjusted model had better predictive ability than models that corrected for heteroskedasticity.[8]

Most of the variables were significant at the 1% level, except rain, rolling, public utilities, no utilities, and dirt road access (table 2.2). Rain and rolling were significant at the 5% level, but public utilities, no utilities, and dirt roads were not significant at any generally accepted level. With the exception of no road access, all the variables had the expected signs.

Increasing total acres decreased sale price per acre by almost 45%. In comparison, Featherstone, et al. and Nivens, et al. found statistically significant acreage discounts around 19% and 20% in Kansas, respectively. Perry and Robison in Oregon found only a 9% discount for increasing acreage. The difference in these estimates may have to do with the inclusion of very small acreage sales. Because the research focuses on urban influences rather than purely agricultural sales, small acreages must be included. However, including these sales may reflect developer purchasing tendencies as opposed to agricultural producer purchasing preferences.

Increases in rainfall and land productivity increased per acre sale price, with elasticities of 11% and 10%, respectively. The productivity coefficient is somewhat lower than that of Nivens, et al., 17%. However, Nivens, et al., included only a productivity explanatory variable rather than productivity and rainfall. Thus the difference may be due to the inclusion of rainfall in this model.

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[8] The out of sample testing was done by randomly partitioning the data into thirds and estimating the model on two-thirds, predicting for the other one-third, and testing the RMSE of the residuals. The procedure was done three times and each time the out-of-sample OLS RMSE was lower than that of the model correcting for heteroskedasticity.

Large economic impacts came from changes in the composition of the sales acreage. Relative to nonirrigated sales, increasing irrigated acreage raised the per acre price by almost 89%. Increasing the percent of improved pasture or rangeland lowered the sale price by almost 17% and 22%, respectively. The presence of irrigation resulted in a 48% premium in Featherstone, et al., so this research found a higher premium for irrigation. This difference may reflect the fact that this research does not include some of the variables that were included in other studies that had more specific data. For example, the sales of irrigated land in these data do not include information about whether the irrigation equipment was included in the sale price.

Elasticities for binary variables are shown in table 2.3. Rolling land was discounted almost 4% per acre in sale price (table 2.3). This discount was anticipated in that rolling land may be less productive than level land.

The coefficients of *paved road* and *no road* were significantly different from zero at the 1% confidence level, while the coefficients for public utilities, no utilities, and dirt road were not statistically significant. The presence of *paved road access* and *no road access* increased the per acre sale price. The premium for no road may seem counterintuitive, but may be because this coefficient is picking up some geographic influences. Over 90% of the sales with no road access occurred in eastern Kansas where the average sales price is higher than the rest of the state.

Some elasticities for the binary variables (table 2.3) fell below a 5% magnitude. All binaries increased sale price per acre, except *rolling*, which discounted sale price. *Rolling*, *public utilities*, *no utilities*, and *dirt road* access were around -4%, 3%, 3%, and 1%, respectively, indicating a small economic impact of these variables on land sale price per acre. The small impact is reinforced by the fact that two of the four were not statistically different from zero. The premium on paved road access (11%) was slightly higher than the 9% found by Featherstone, et al. *No road* access increased per acre price by 18%, reflecting the fact that the estimated coefficient for this variable is strongly influenced by lack of regional dispersion of these sales.

The coefficient on *Trend* was used as a proxy for land speculation and for changes over time in the entire land market. It was significantly different from zero at the 1% level (table 2.2). The positive sign was statistically significant and indicated that the nominal value of land has been increasing over time. Per acre sale price has been increasing at 6.3% per year (table 2.2).

With the exception of the *minGtr10000 intercept*, the coefficients estimated in the negative exponential portion of the model in equation (2.5) are statistically significant at the 1% confidence level (table 2.2).[9] The coefficient on the Kansas City intercept was 0.45, implying that the difference between per acre market and use value of a parcel within the Kansas City Central Business District was 45%. The rate of decay, or rate at which market value moves to use value, was about 3% per mile. Similarly, the coefficient on the Wichita intercept was 1.23, implying that per acre market value of a parcel within the Wichita Central Business District was 123% of use value. The decrease in value for Wichita was about 9% per mile. In essence, the difference between market value and use value for parcels in Wichita starts higher than those located in Kansas City, but the difference declines much faster per mile as one moves away from Wichita. The difference between market and use would dissipate for Wichita in one-third of the distance that it would take for the difference to disappear for parcels near Kansas City.

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[9] Taken together, each intercept with the corresponding decay rate can be interpreted as elasticities.

These results differ from those of Anderson and Griffing, who found rates of decay of about 10% for the two counties in Nebraska that they examined.

The intercept for cities with more than 10,000 residents was about 5%, but statistically insignificant. The decay rate for these areas was much higher than either that of Kansas City or Wichita. Using the minimum distance for this type of city resulted in a change of almost 24% per mile, or about eight times faster than Kansas City and three times faster than Wichita.

Figure 2.2 graphically displays the changes for Kansas City, Wichita, and the Gtr10000 cities. All series are calculated at the mean for all variables, except distance, which varies to illustrate the difference in the rates of decay. This graph illustrates how different the decay rates are for the three variables. One can see that the premium over use value for parcels within the Wichita Central Business District is slightly higher than for parcels located in the Kansas City Central Business District, likely due to the lower agricultural use value in the Wichita region. However, the difference between market and use value remains much larger for a much longer distance for parcels around Kansas City. For cities of 10,000, market and use value converge by about 24 miles. For Kansas City and Wichita, market and non-urban use converge by 195 and 65 miles, respectively. This may be due to the differing growth patterns around Kansas City and Wichita, illustrating there is more upward pressure on sales price from the Kansas City area.

## Summary

The objective of this research was to quantify the impacts of site-specific characteristics and urban pressures on agricultural land market value in Kansas. To address the objective of this research, a theoretically based model was developed to estimate market value of agricultural land in Kansas. Primarily we envisioned a robust model that accurately captured the true market value of the heterogeneous nature of the characteristics of agricultural land. We estimated a semi-log hedonic model that combined site specific characteristics with negative exponential distance functions. The distance measures included were calculated as the distance of the land sold to both Kansas City and Wichita, Kansas and the distance between each parcel sold and all cities in Kansas with a population of over 10,000.

The negative exponential specification, which is frequently used in the literature for modeling land prices in urban fringe areas, was included in the model. All of the estimated coefficients on the distance variables were statistically significant. However, the rate at which market value and use value converged was very different for all three areas. This result contrasts those of Anderson and Griffing for two urban counties in Nebraska.

## Conclusion

The objective of this research was to quantify the impacts of site-specific characteristics and urban pressures on agricultural land market value in Kansas. This model combined traditional hedonic elements with a negative exponential distance function. This research used a dataset obtained from the Property Valuation Division (PVD) of the Kansas Department of Revenue that contained all agricultural land sales that occurred between January 1996 and December 2000.

Each sale contained information on the site specific characteristics of the acreage sold and the location of the parcel sold. The location information was used to calculate the distance of the acreage from Kansas City and Wichita and to calculate the minimum distance of the acreage from a city with a population greater than 10,000. These distances were incorporated using a negative exponential component in the model to capture urban fringe effects on sale price, or market value.

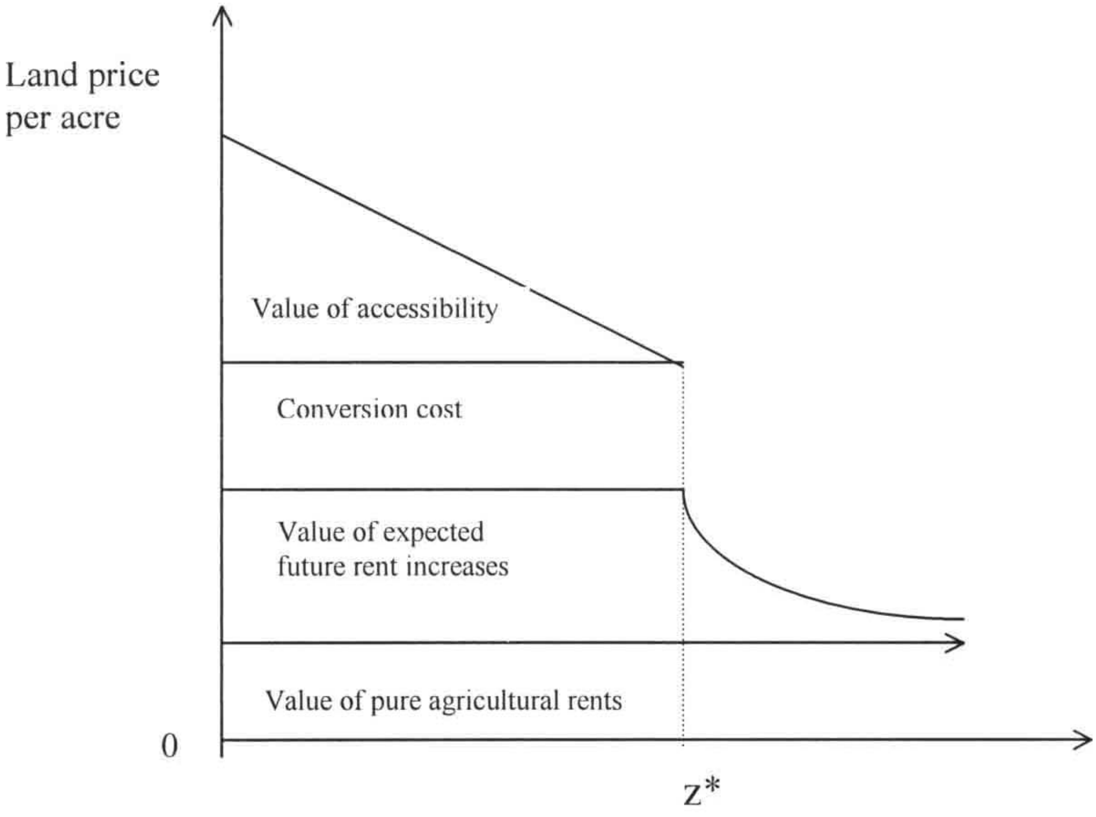
Using this combined approach, we examined over 11,000 open market, arms-length transactions. The model indicated that most of the estimated coefficients of the characteristics of the land sold were statistically significant.

All the coefficients estimated on the distance variables were statistically significant, except the intercept term for cities with population in excess of 10,000. Parcels within the Wichita Central Business District received a slightly higher premium over use value, relative to those in the Kansas City area. However, the difference between market value (sale price) and use value remained much larger for a much longer distance to Kansas City, relative to distance to Wichita. In essence, the upward, urban pressure on price is greater for Kansas City. The distance to cities with over 10,000 was also statistically significant, however, the intercept for this part of the function was not significantly different from zero. This implies that the difference between use value and market value in rural areas is virtually zero. Enforcing this idea is the high rate of decay for these areas; it was eight times faster than that of Kansas City.

These results imply that state property tax policy may differently affect land owners involved in sales in different areas. In Kansas, agricultural land is taxed based on its use value rather than its market value. Therefore, land owners who own land outside

Kansas City may be receiving a larger tax benefit than those who own land outside of Wichita, Kansas. In addition, those in rural areas may not really be receiving any economically significant reduction to their property taxes because market and use values converge.

FIGURE 2.1
Analysis of Components of Per Acre Land Price*



* Source: Anderson (2002).

FIGURE 2.2

Difference Between Market and Non-Urban Value

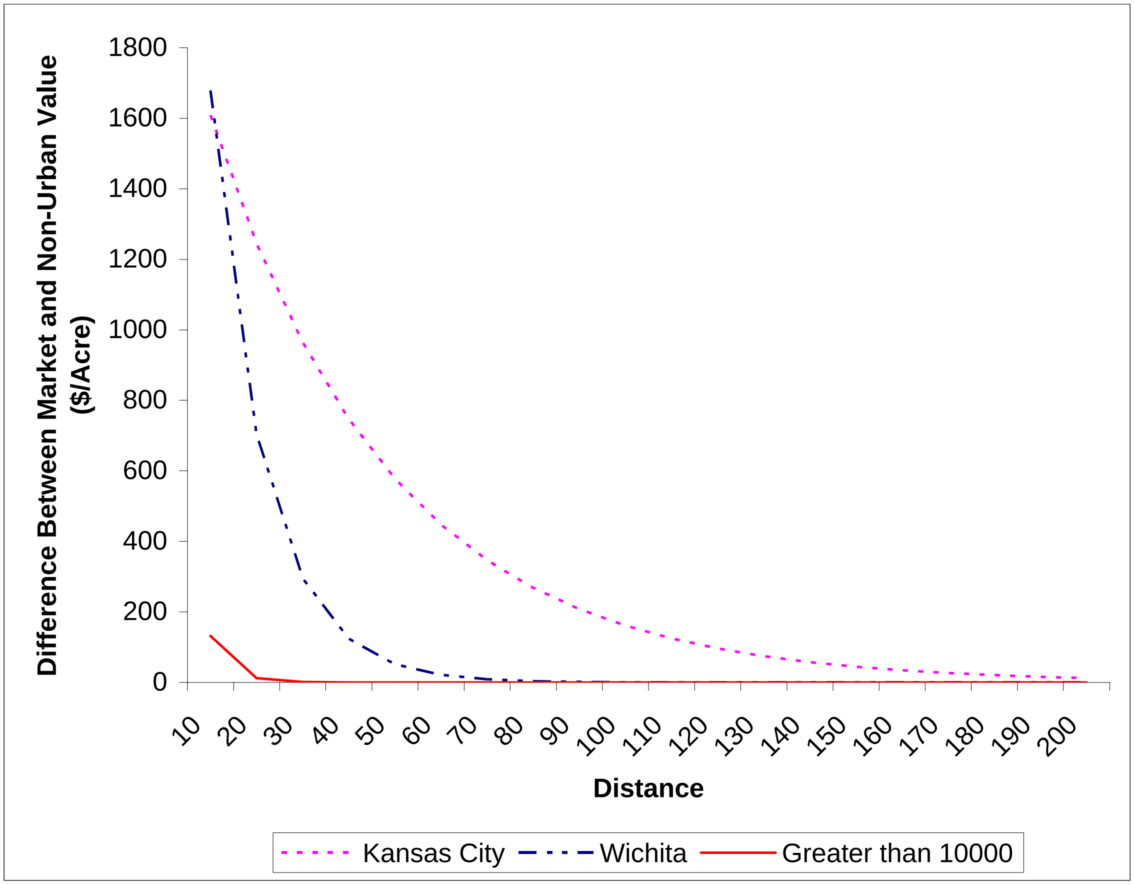


TABLE 2.1

Summary Statistics of Agricultural Parcels Sold in Kansas Between 1996 and 2000.

| Variable Definition | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|
| Sale Price Per Acre ($/Ac) (Nominal) | 2507.98 | 17383.03 | 20.14 | 975992.31 |
| Total Acres | 153.02 | 181.91 | 0.10 | 1980.00 |
| County Average Rainfall (In./Yr) | 30.05 | 7.25 | 15.84 | 43.37 |
| Productivity Index | 1.03 | 0.23 | 0.01 | 1.69 |
| Percent Of Non-Irrigated Acres | 0.55 | 0.42 | 0.00 | 1.00 |
| Percent Of Irrigated Acres | 0.04 | 0.17 | 0.00 | 1.00 |
| Percent Of Tame Pasture Acres | 0.07 | 0.22 | 0.00 | 1.00 |
| Percent Of Native Pasture Acres | 0.34 | 0.40 | 0.00 | 1.00 |
| Property Has Rolling Terrain | 0.68 | 0.47 | 0.00 | 1.00 |
| Property Has Private Utilities | 0.06 | 0.42 | 0.00 | 1.00 |
| Property Has Public Utilities | 0.10 | 0.31 | 0.00 | 1.00 |
| Property Has No Utilities | 0.84 | 0.36 | 0.00 | 1.00 |
| Access By Paved Roads | 0.18 | 0.39 | 0.00 | 1.00 |
| Access By Semi Improved Roads | 0.48 | 0.50 | 0.00 | 1.00 |
| Access By Dirt Roads | 0.34 | 0.47 | 0.00 | 1.00 |
| No Road Access | 0.06 | 0.24 | 0.00 | 1.00 |
| Yearly Trend | 2.74 | 1.26 | 1.00 | 5.00 |
| Distance of Sale from Kansas City, Kansas | 191.43 | 98.34 | 7.14 | 424.71 |
| Distance of Sale from Wichita, Kansas | 119.11 | 64.21 | 3.02 | 295.89 |
| Distance of Sale from Towns with Population Greater than 10,000 | 31.26 | 24.78 | 0.83 | 148.53 |

11,436 Observations

## TABLE 2.2
## Combined Hedonic and Negative Exponential Model Parameters

| Variable | Parameters | Std. Dev. |
|---|---|---|
| **Hedonic** | | |
| Intercept | 7.8023*** | 0.1583 |
| Lacres | -0.4492*** | 0.0060 |
| Lrain | 0.1130** | 0.0476 |
| Lprod | 0.1039*** | 0.0175 |
| Pct_Irr | 0.8882*** | 0.0412 |
| Pct_Imppast | -0.1659*** | 0.0343 |
| Pct_Grass | -0.2177*** | 0.0181 |
| Rolling | -0.0380** | 0.0155 |
| Pub_Util | 0.0255 | 0.0303 |
| No_Util | 0.0319 | 0.0246 |
| Paved_Road | 0.1037*** | 0.0183 |
| Dirt_Road | 0.0072 | 0.0162 |
| No_Road | 0.1633*** | 0.0288 |
| Trend | 0.0633*** | 0.0053 |
| **Negative Exponential** | | |
| Kansas City_Intercept | 0.4459*** | 0.0796 |
| Kansas City | 0.0256*** | 0.0025 |
| Wichita_Intercept | 1.1022*** | 0.0606 |
| Wichita | 0.0869*** | 0.0048 |
| Gtr 10000_intercept | 0.0504 | 0.0987 |
| Gtr 10000 | 0.2361*** | 0.0256 |
| R-Square | 0.5720 | |
| RMSE | 0.7114 | |

***, **, * indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

TABLE 2.3

Binary Effects of Combined Hedonic and Negative Exponential Model

| Variable | Coefficient | Percent Change |
|---|---|---|
| Rolling | -0.0380 | -0.0373 |
| Pub_util | 0.0255 | 0.0259 |
| No_util | 0.0319 | 0.0324 |
| Paved_road | 0.1037 | 0.1093 |
| Dirt_road | 0.0072 | 0.0072 |
| No_road | 0.1633 | 0.1774 |

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