Determinants of Kansas Agricultural Land Values

By

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Motivation & Discussion of Research

The primary research objective of this study is to examine the impact that various site, spatial, and transactional factors have on the value of agricultural land in Kansas; this study also examines the changing role of these factors over time. Estimates of different regional models will be used to test the robustness of geographic model estimates. This will enable us to determine how the regional elasticities can be generalized. This research will use a unique dataset obtained from the Property Valuation Division (PVD) of the Kansas Department of Revenue.

U.S. farm real estate accounts for nearly 75 percent of the value of all farm assets. Of this 75 percent, farm buildings account for only about one-fifth (ERS). The remainder is actual land: cropland, pasture, range, and woodland.

This research is important because the value of land and buildings is a vital indicator of the health of the Kansas farm sector. Real property is often used as collateral to buy additional land and equipment, so the property value determines how much the farmer may borrow. In addition, the value of farmland is a measure of wealth in the agricultural sector and is considered a major determinant of net worth of the farm sector. Therefore, a shift in property values affects a farmer's net worth and credit-worthiness.

An accurate evaluation of the value of farmland is essential for a number of other reasons. Many individuals and institutions rely on estimates of farmland values for guidance in making investment, tax, and other decisions. Agricultural programs and policies affect the value of farm commodities, which in turn influence land values. Therefore, it is important for policymakers to determine the factors that influence farmland values.

Viable agricultural land is finite and heterogeneous, making pricing competitive and involving many potential buyers other than agricultural producers. As a spatially fixed asset, land is one of the primary sources of property tax revenues. This makes both commercial and governmental parties interested in the value of the land. Therefore, many different parties are involved and interested in agricultural land sales.

Review of the Literature, Theoretical Considerations & Proposed Procedure

The literature reveals that the price of land can be conceptualized as having four major components. These include the productivity component, the consumptive component, the speculative component, and the transactional component. The productive component is affected by a host of factors, primarily related to the income-generating capacity of the land, including, crop productivity, government payments, credit policies, and technological change. It is generally considered the primary component of agricultural land values.

The consumptive component recognizes the intrinsic value of land to the owner. Pope and Goodwin (1984) hypothesized that buyers purchase land so that they can touch, feel, and enjoy the rural experience. Factors impacting this component include income levels, population levels, levels and location of urbanization, and site characteristics.

The speculative component arises from the buyer's expectation that the price of land will follow some trend, either positive or negative, over time. Factors affecting the speculative component include trends in farmland prices, cash rents, interest rates, inflation, international currency rates, and export policies.

While the productive, consumptive and speculative components are generally viewed as determining land value, transactional components are critical in determining the price of land. Since we observe price, and not value, it is important to consider transactional components.

Transactional components can include special considerations given to the buyer and/or seller. These components can also include the nature of the sale, such as owner or special financing, forced sales, and sales to relatives. Featherstone, Schurle, Duncan and Postier (1993), Perry and Robinson (2001), Lewicki, Saunders, and Minton (1999) have all specifically modeled the impact of transaction-specific components on the price of land. Many others have implicitly modeled this impact by identifying and eliminating any observations that cannot be viewed as an 'arms length transaction' from their dataset. Other transaction-specific components include the size of the parcel, and value of improvements.

The most common economic models for examining land values are capital asset pricing models and hedonic models. Featherstone and Baker (1987), Barry (1990), Clark, Fulton and Scott (1993), and Chavas and Thomas (1999) are good examples of applications using the capital asset pricing theory. In the simplest form of this theory agents are assumed to be risk neutral, the discount rate (r) is assumed fixed for all time, and land is valued (V_L) only for its economic return. This implies that land is valued based only on its productive component (PC).

$$V_L = \sum_{i=1}^{\infty}\left[\frac{1}{1+r}\right]^{i+1} E_t(R_{t+1}) \cong \sum_{i=1}^{\infty}\left[\frac{1}{1+r}\right]^{i+1} E_t(\sum P_{Pc,i} * PC_i)$$

Recent research by Campbell and Shiller (1987), Falk (1991), and Clark, Fulton and Scott (1993) challenged whether the application of capital asset pricing theory to land values is appropriate during periods of volatile land prices, such as the 1970s. Implicit assumptions when using this model are: land prices and farm income should have the same time-series properties and should exhibit co-integration and Granger causality. According to Ladd and Martin, most datasets fail to meet these criteria.

Hedonic modeling, the other type prominent in the literature, originated in the 1920s. After advances in multivariate analyses, economic theory, and computer technology, Rosen

(1974) and Freeman (1974) provided the basis for modern hedonic modeling of heterogeneous consumer goods. Although other consistent theoretical models are used, most attention has focused on the theory of hedonic prices and Rosen's work in 1974. Rosen 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).

The evaluation of a hedonic model involves two conceptually distinct steps: using the hedonic price equation to estimate marginal implicit prices of characteristics, and using these implicit prices to estimate inverse demand functions or marginal willingness to pay functions for groups of households. Completion of the first step of this process was enough to meet the objectives of this study. Further research could be focused on completing the second step in the hedonic technique.

Freeman (1971) 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. Some criticisms include skepticism that particular components modeled and property values reflect a true relationship rather than merely correlation. Other critics suggest that the assumption of market equilibrium renders the technique useless. Still others attack the underlying theory for requiring restrictive assumptions about the nature of utility functions. 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

This study follows a hedonic approach similar to that used by Featherstone, et al., in 1993. Some previous land value models (Hardi, Narayan, and Gardner; Miranowski and

Hammes) made estimations for broad geographic regions. This study extends the literature by focusing not only on the entire state of Kansas, but also on the Farm Service Agency (FSA) crop-reporting district (multi-county). The estimates of these different regions will be used to test the robustness of regional geographic model estimates.

Data

The data used in this analysis have not been analyzed before. It contains all sales of agricultural land in Kansas between 1986 and 1999. The Property Valuation Division (PVD) of the Kansas Department of Revenue collected this information. PVD maintains extensively detailed records for each parcel of land in Kansas, enabling an accurate description of the topography, amenities, relative productivity, tax value, and location of the parcel sold. Each sales transaction also contains information as to the type of sale it was, e.g. arms-length, related parties, forced sale, etc. For the purpose of this analysis, we included all types of agricultural land sales occurring between 1986 and 1999. Originally this data set contained approximately 96,000 observations. After eliminating incomplete observations, data on about 67,000 observations remained for the state. Monthly and yearly binary variables were used to capture market factors such as income, inflation, interest rate changes, government payment changes, and other time-related factors.

Sales information for parcels and a sales number for each transaction are entered by the personnel in the county in which the parcel is located. By use type (irrigated, nonirrigated, or pasture/grassland), each sale included the tax value, relative productivity, acres, and descriptive information (amenities) for each parcel involved in the sale.

Conceptual Model

In its simplest form a hedonic land price model assumes utility maximizing behavior on the part of the buyer.

$$\begin{aligned} Let:\quad & X = Quantity of\ Land \\ & Y = Quantity of\ Other Goods \\ & P_X = Price of\ Land \\ & P_Y = Price of\ Other Goods \\ & I = Income \end{aligned}$$

Then the problem becomes: $Max U(X, Y) \quad s.t. P_X X + P_Y Y = I$ by choosing X and Y.

Recognizing that X is a vector of component characteristics including productive components (PC), consumptive components (CC), speculative components (SC) and transactional components (TC) the problem can be rewritten as

$Max U(X_{(PC,CC,SC,TC)}, Y) \quad s.t. PC * P_{PC} + CC * P_{CC} + SC * P_{SC} + TC * P_{TC} + P_Y Y = I$ Recognizing that each component of price is a vector of several sub-components, and then, solving the first order condition yields the demand curve:

$$P_{Land} = \sum_{i=1}^{a} P_{PCi} * PC_i + \sum_{i=1}^{a} P_{CCi} * CC_i + \sum_{i=1}^{a} P_{SCi} * SC_i + \sum_{i=1}^{a} P_{TCi} * TC_i + f(P_Y, I)$$

Assuming a highly inelastic supply curve for land implies that the above equation represents the equilibrium value. This model tells us that the price of land is determined by the summation of the product of the price and quantity of the characteristics of the parcel. We categorize the characteristics into the productive, consumptive, speculative, and transactional components. The productive components should include attributes that contribute to the income generating capability of the land. The consumptive components should include attributes thought to influence a consumer's decision. The speculative components should include characteristics of the land that would tend to influence investors. The transactional components should include characteristics that are specific to a particular sale, not necessarily related to the parcel sold.

Empirical Model

The empirical specification of the model is:

$$P = \beta_0 + \beta_1 Acre + \beta_2 Large + \beta_3 Small + \beta_4 Nirrpct + \beta_5 Irrpct + \beta_6 Nativepct + \beta_7 Bldg + \beta_8 SV^1 + \beta_9 SV^2 + \beta_{10} SV^3 + \beta_{11} SV^4 + \beta_{12} SV^5 + \beta_{13} SV^6 + \beta_{14} SV^8 + \beta_{15} SV^9 + \beta_{16} ProdIrr + \beta_{17} ProdNIrr + \beta_{18} ProdNative + \beta_{19} PC^1 + \beta_{20} PC^2 + \beta_{21} PC^5 + \beta_{22} PV^2 + \beta_{23} PV^3 + \beta_{24} PV^5 + \beta_{25} Y86 + \beta_{26} Y87 + \beta_{27} Y88 + \beta_{28} Y89 + \beta_{29} Y90 + \beta_{30} Y91 + \beta_{31} Y92 + \beta_{32} Y93 + \beta_{33} Y94 + \beta_{34} Y95 + \beta_{35} Y96 + \beta_{36} Y97 + \beta_{37} Y98$$

where P is the logged per acre price for the sale; and Acre is the log of the number of acres involved in the sale. Large and Small are binary variables representing parcels greater than 320 acres and less than 20 acres, respectively; the default is acreage between that range. Nirrpct, Irrpct, and Nativepct are the logged percent of acres of the parcel sold that are nonirrigated, irrigated, and native pasture, respectively; the default is tame pasture. Bldg is the logged value of any buildings involved in the sale. The SV variables are binary representing different classifications of sales, 1 through 9, with 0 being the default: valid sale (default), multi-parcel, not open market, changed after the sale, related entities, forced, financed, includes excessive personal property, and unvalidated. The Prod variables are the weighted average productivity of the nonirrigated, irrigated, and native pasture acres included in the sale. PC^1 is a binary variable for level land; PC^2 is a binary variable for the presence of utilities; the default property code is PC^5, a binary variable for land located near a neighborhood. The year variables are binary variables representing the year of the sale; the default is 1999.

We anticipate a negative signs on Acre because we expect the price per acre to decrease as parcel size increases. We expect positive signs for Large and Small. We expect that people would be willing to pay more for larger parcels to expand their operation significantly. We anticipate small parcels would be more appealing for home buyers or hobby farmers. So those market participants might be willing to pay more per acre than someone using the land in a large-scale production operation. We expect positive signs on the use-type productivities because more productive land should be valued more. We expect Bldg to have a positive sign because the higher the value of the building, then the higher should be the price of the land.

The anticipated signs for the SV variables are both negative and positive. We expect negative signs for all, except SV3 and SV8. The other SV sales classifications are some type of market limitation that could tend to reduce the price from the competitive level. We expect the signs for PC^1 and PC^3 property code variables to be positive because level land and the presence of utilities should add to the value of the parcel sold. The sign of the PC^5 variable may vary depending on whether buyers prefer land located near a neighborhood or not.

Results

Double log models were developed on state and FSA crop reporting district (district) levels. The state model had an R^2 of 0.2813, while the district models' R^2 ranged from 0.2324 to 0.3710. All models included the same variables. In the state model, all but two variables were significant at or above the 95% confidence level. Exceptions were productivity of irrigated land and unvalidated sales binaries. Because there are nine district models, only the state model is discussed in depth. The results of the district models are presented in the appendix. The district models will be discussed only in regard to their roles in robustness testing.

The fact that weighted productivity of most types of land is important because Kansas calculates tax values on the income producing capability of the land, which is largely driven by relative productivity indices for soils. This supports the theory that land prices are being established based on the discounted value of future income, and the tax value is representative of that income producing capability of the land. It is also interesting that the weighted productivity of irrigated land was significant only at the 90% confidence level. This could imply that perhaps soil productivity is less important in the price of irrigated land.

Results also support the theory that the size of the parcel, whether very large or very small, is important. Results show that the makeup of the use types, productivity, and the geographic features of the sales package are important in establishing the sales price per acre.

Parameter estimates varied widely across district lines, but generally had the expected signs. These differences may support the theory of regional land markets within Kansas.

After all models were estimated, we measured the robustness of the state model using an out of sample F-testing procedures. Because the dataset is so large, we felt that using out-of-sample testing would be a better indicator of the robustness of the state model. We randomized the data three times and estimated coefficients for all nine districts and the state, resulting in 30 regressions. The coefficients from these regressions were used to test the predictive ability of the state model versus the regional models using an F-test. The regional models predicted out-of-sample better than the state model 25 out of 27 times. Results of the individual F-tests are included in the appendix. The null hypothesis was that the parameter estimates of district and state models were the same. The alternative hypothesis is that those parameter estimates from the state and district models are significantly different. F-test results, using a critical value of 1.70 for degrees of freedom (30, infinity) showed that parameter estimates differed across the models. The F-tests showed that null hypothesis should be rejected and supported the theory that elasticities from state level or larger regions are significantly different from smaller regional elasticities. This would tend to support the idea that land markets are more localized than previous studies have taken into account. This could be specific to the agricultural land market because, due to feasibility and management concerns, a producer is going to be much more active in the land market near his current operation than he is in the land market across the state. However, developers would not have that constraint, but would not be interested in land that was a significant distance from urban fringe areas. Therefore, competing interests in some markets may stem from different plans for the land. Competition in other markets may stem from producers who plan to keep the land in agricultural production, but want to expand their individual operation. These differing market participants could be creating structurally different markets for land that must be examined on a more local level.

Conclusion

While the primary research question is important, obtaining reasonable results will open the way to explore a variety of other interesting topics. At the present time, for property tax purposes, Kansas values agricultural land based on its productive capability rather than using fair market value. No research has looked at the relationship between productive capability and fair market value in Kansas. The successful completion of the original research question will allow the property valuation issue to be addressed.

The valuation and allocation of water resources is another topic of importance to Kansas. Current technology allows the PVD database to be combined with well capacity provided by the Kansas Water Board. While our original research will place a value on irrigated land, subsequent analyses can be expanded to give values for water rights, and well capacity.

Potentially the most exciting aspect of additional research opportunities available with this data will be defining the role of government payments on land prices. This is an aspect of vital interest to all participants of the agricultural industry with significant policy implications.

The ability to cross reference location from the PVD dataset to a Farm Service Agency dataset will allow us to match specific government payments with a specific sale of land thus, giving us a unique approach to determining the impact of government payments on land price.

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APPENDIX

Northwest District 10	R-Square	0.371	Root MSE	0.40455
Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	6.8967	0.0802	86.0300	<.0001
Lacre	-0.1919	0.0292	-6.5800	<.0001
Large	-0.0018	0.0229	-0.0800	0.9371
Small	0.0480	0.0661	0.7300	0.4678
Lpnirrac	-0.0660	0.0146	-4.5100	<.0001
Lpirrac	0.0531	0.0192	2.7700	0.0056
Lpnac	-0.0071	0.0080	-0.8900	0.3722
Lbldgvac	0.0081	0.0020	4.1600	<.0001
PC1	0.1913	0.0144	13.2500	<.0001
PC2	-0.0058	0.0168	-0.3500	0.7293
PC5	0.1500	0.0158	9.5200	<.0001
D1986	-0.3522	0.0376	-9.3800	<.0001
D1987	-0.3535	0.0370	-9.5600	<.0001
D1988	-0.2998	0.0321	-9.3300	<.0001
D1989	-0.2592	0.0308	-8.4100	<.0001
D1990	-0.2530	0.0301	-8.4000	<.0001
D1991	-0.2327	0.0293	-7.9400	<.0001
D1992	-0.2422	0.0301	-8.0500	<.0001
D1993	-0.2153	0.0305	-7.0500	<.0001
D1994	-0.1296	0.0304	-4.2600	<.0001
D1995	-0.0929	0.0291	-3.1900	0.0014
D1996	-0.0927	0.0314	-2.9500	0.0032
D1997	-0.0227	0.0290	-0.7800	0.4331
D1998	-0.0245	0.0286	-0.8600	0.3923
Lpblu2	0.0787	0.0146	5.4000	<.0001
Lpblu3	-0.0259	0.0191	-1.3600	0.1742
Lpblu5	-0.0096	0.0082	-1.1800	0.2396
SV1	0.3543	0.0192	18.4700	<.0001
SV2	-0.0743	0.0206	-3.6100	0.0003
SV3	-0.0200	0.0282	-0.7100	0.4776
SV4	-0.1745	0.0212	-8.2400	<.0001
SV5	-0.0530	0.0319	-1.6600	0.0973
SV6	0.0052	0.0423	0.1200	0.9020
SV8	-0.0986	0.0262	-3.7600	0.0002
SV9	0.0174	0.0450	0.3900	0.6985

West Central District 20	R-Square	0.2324	Root MSE	0.39615
Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	6.7000	0.0916	73.1300	<.0001
Lacre	-0.8018	0.2578	-3.1100	0.0019
Large	0.0968	0.0261	3.7000	0.0002
Small	-0.0189	0.0750	-0.2500	0.8015
Lpnirrac	-0.4634	0.0747	-6.2100	<.0001
Lpirrac	-0.1788	0.2559	-0.7000	0.4848
Lpnac	-0.0181	0.0117	-1.5500	0.1219
Lbldgvac	0.0034	0.0024	1.4200	0.1544
PC1	0.0540	0.0202	2.6800	0.0074
PC2	0.0492	0.0202	2.4400	0.0147
PC5	0.1135	0.0247	4.6000	<.0001
D1986	-0.2348	0.0409	-5.7500	<.0001
D1987	-0.3295	0.0363	-9.0800	<.0001
D1988	-0.2613	0.0345	-7.5700	<.0001
D1989	-0.1996	0.0318	-6.2800	<.0001
D1990	-0.2053	0.0325	-6.3300	<.0001
D1991	-0.1961	0.0327	-6.0000	<.0001
D1992	-0.1876	0.0336	-5.5800	<.0001
D1993	-0.1874	0.0331	-5.6500	<.0001
D1994	-0.1465	0.0326	-4.5000	<.0001
D1995	-0.1335	0.0332	-4.0200	<.0001
D1996	-0.0624	0.0322	-1.9300	0.0532
D1997	-0.0653	0.0320	-2.0400	0.0412
D1998	-0.0318	0.0301	-1.0600	0.2897
Lpblu2	0.4763	0.0748	6.3700	<.0001
Lpblu3	0.2023	0.2552	0.7900	0.4280
Lpblu5	0.0019	0.0120	0.1600	0.8711
SV1	0.2499	0.0244	10.2600	<.0001
SV2	-0.0585	0.0237	-2.4700	0.0137
SV3	-0.0544	0.0296	-1.8300	0.0666
SV4	-0.1187	0.0229	-5.1900	<.0001
SV5	0.0197	0.0363	0.5400	0.5879
SV6	0.1242	0.0454	2.7300	0.0063
SV8	-0.0625	0.0224	-2.7900	0.0052
SV9	-0.0537	0.0365	-1.4700	0.1410

APPENDIX

Southwest District 30	R-Square	0.2798	Root MSE	0.45961
Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	7.0636	0.0937	75.4100	<.0001
Lacre	0.0077	0.0363	0.2100	0.8320
Large	0.0578	0.0261	2.2100	0.0269
Small	0.0918	0.0629	1.4600	0.1442
Lpnirrac	-0.0107	0.0130	-0.8200	0.4116
Lpirrac	0.2038	0.0310	6.5800	<.0001
Lpnac	0.0036	0.0082	0.4400	0.6595
Lbldgvac	0.0067	0.0026	2.5900	0.0096
PC1	0.0061	0.0163	0.3700	0.7083
PC2	0.0072	0.0208	0.3400	0.7310
PC5	0.1374	0.0246	5.6000	<.0001
D1986	-0.2861	0.0547	-5.2300	<.0001
D1987	-0.2911	0.0467	-6.2300	<.0001
D1988	-0.2447	0.0363	-6.7500	<.0001
D1989	-0.2291	0.0357	-6.4300	<.0001
D1990	-0.1625	0.0332	-4.8900	<.0001
D1991	-0.1759	0.0342	-5.1400	<.0001
D1992	-0.1907	0.0336	-5.6800	<.0001
D1993	-0.1615	0.0350	-4.6200	<.0001
D1994	-0.1263	0.0335	-3.7700	0.0002
D1995	-0.1152	0.0343	-3.3600	0.0008
D1996	-0.0561	0.0335	-1.6800	0.0939
D1997	-0.0723	0.0326	-2.2200	0.0268
D1998	-0.0854	0.0322	-2.6500	0.0080
Lpblu2	0.0160	0.0131	1.2200	0.2224
Lpblu3	-0.1746	0.0313	-5.5800	<.0001
Lpblu5	-0.0196	0.0084	-2.3400	0.0194
SV1	0.2410	0.0262	9.2100	<.0001
SV2	-0.1162	0.0253	-4.5900	<.0001
SV3	-0.0172	0.0367	-0.4700	0.6391
SV4	-0.2401	0.0254	-9.4400	<.0001
SV5	-0.0600	0.0384	-1.5600	0.1184
SV6	0.0150	0.0464	0.3200	0.7459
SV8	-0.0559	0.0217	-2.5700	0.0101
SV9	-0.0049	0.0479	-0.1000	0.9180

North Central District 40	R-Square	0.2922	Root MSE	0.44758
Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	7.1419	0.0622	114.7800	<.0001
Lacre	-0.2629	0.0823	-3.2000	0.0014
Large	-0.0169	0.0274	-0.6100	0.5388
Small	-0.0262	0.0384	-0.6800	0.4945
Lpnirrac	-0.0088	0.0056	-1.5700	0.1154
Lpirrac	-0.0882	0.0815	-1.0800	0.2794
Lpnac	-0.0028	0.0035	-0.7900	0.4297
Lbldgvac	0.0079	0.0015	5.3400	<.0001
PC1	-0.0046	0.0241	-0.1900	0.8488
PC2	0.0472	0.0141	3.3600	0.0008
PC5	0.2013	0.0201	10.0400	<.0001
D1986	-0.4335	0.0340	-12.7400	<.0001
D1987	-0.4533	0.0304	-14.9000	<.0001
D1988	-0.3908	0.0279	-14.0200	<.0001
D1989	-0.3662	0.0272	-13.4500	<.0001
D1990	-0.3269	0.0267	-12.2400	<.0001
D1991	-0.2585	0.0264	-9.8000	<.0001
D1992	-0.2809	0.0260	-10.7900	<.0001
D1993	-0.2159	0.0263	-8.2200	<.0001
D1994	-0.1606	0.0261	-6.1500	<.0001
D1995	-0.2134	0.0257	-8.3000	<.0001
D1996	-0.1429	0.0258	-5.5500	<.0001
D1997	-0.0830	0.0249	-3.3300	0.0009
D1998	-0.0627	0.0255	-2.4600	0.0140
Lpblu2	0.0207	0.0055	3.7800	0.0002
Lpblu3	0.1200	0.0809	1.4800	0.1383
Lpblu5	-0.0143	0.0035	-4.1100	<.0001
SV1	0.2397	0.0199	12.0700	<.0001
SV2	-0.1235	0.0166	-7.4600	<.0001
SV3	-0.0169	0.0221	-0.7600	0.4444
SV4	-0.2581	0.0175	-14.7800	<.0001
SV5	-0.0606	0.0262	-2.3100	0.0207
SV6	0.0544	0.0289	1.8800	0.0602
SV8	-0.0663	0.0212	-3.1200	0.0018
SV9	0.0502	0.0364	1.3800	0.1678

APPENDIX

Central District 50	R-Square	0.3043	Root MSE	0.44455
Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	7.6245	0.0592	128.8800	<.0001
Lacre	0.0331	0.1680	0.2000	0.8440
Large	0.0956	0.0292	3.2700	0.0011
Small	-0.1023	0.0327	-3.1200	0.0018
Lpnirrac	-0.0225	0.0078	-2.9100	0.0037
Lpirrac	0.2816	0.1678	1.6800	0.0933
Lpnac	0.0051	0.0033	1.5400	0.1235
Lbldgvac	0.0073	0.0014	5.0900	<.0001
PC1	0.1261	0.0108	11.6900	<.0001
PC2	0.0329	0.0135	2.4300	0.0152
PC5	0.0247	0.0145	1.7100	0.0879
D1986	-0.4676	0.0346	-13.5100	<.0001
D1987	-0.4430	0.0329	-13.4500	<.0001
D1988	-0.4239	0.0277	-15.3200	<.0001
D1989	-0.3890	0.0247	-15.7800	<.0001
D1990	-0.3348	0.0246	-13.6300	<.0001
D1991	-0.3479	0.0243	-14.3100	<.0001
D1992	-0.3258	0.0233	-14.0000	<.0001
D1993	-0.2570	0.0248	-10.3800	<.0001
D1994	-0.2645	0.0237	-11.1700	<.0001
D1995	-0.1954	0.0239	-8.1700	<.0001
D1996	-0.2340	0.0240	-9.7400	<.0001
D1997	-0.1135	0.0233	-4.8800	<.0001
D1998	-0.0478	0.0234	-2.0500	0.0408
Lpblu2	0.0285	0.0077	3.7200	0.0002
Lpblu3	-0.2525	0.1658	-1.5200	0.1278
Lpblu5	-0.0193	0.0033	-5.8200	<.0001
SV1	0.2156	0.0184	11.7300	<.0001
SV2	-0.1243	0.0154	-8.0800	<.0001
SV3	-0.0099	0.0211	-0.4700	0.6376
SV4	-0.2295	0.0158	-14.5200	<.0001
SV5	-0.0325	0.0259	-1.2500	0.2096
SV6	0.0557	0.0263	2.1200	0.0344
SV8	-0.0581	0.0196	-2.9600	0.0031
SV9	0.0398	0.0274	1.4500	0.1465

South Central District 60	R-Square	0.2595	Root MSE	0.45185
Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	7.0818	0.0759	93.2600	<.0001
Lacre	0.0388	0.0701	0.5500	0.5794
Large	-0.0290	0.0270	-1.0800	0.2823
Small	0.0101	0.0334	0.3000	0.7623
Lpnirrac	-0.0046	0.0062	-0.7500	0.4547
Lpirrac	0.2411	0.0696	3.4600	0.0005
Lpnac	-0.0112	0.0031	-3.6600	0.0003
Lbldgvac	0.0001	0.0016	0.0500	0.9564
PC1	0.1224	0.0102	11.9500	<.0001
PC2	0.0810	0.0119	6.8200	<.0001
PC5	0.2144	0.0566	3.7900	0.0002
D1986	-0.3242	0.0304	-10.6800	<.0001
D1987	-0.3470	0.0298	-11.6500	<.0001
D1988	-0.2728	0.0253	-10.8000	<.0001
D1989	-0.2137	0.0249	-8.5700	<.0001
D1990	-0.2412	0.0249	-9.6900	<.0001
D1991	-0.2840	0.0249	-11.3900	<.0001
D1992	-0.2708	0.0243	-11.1300	<.0001
D1993	-0.2320	0.0250	-9.2900	<.0001
D1994	-0.2241	0.0242	-9.2700	<.0001
D1995	-0.2038	0.0246	-8.2800	<.0001
D1996	-0.1757	0.0243	-7.2400	<.0001
D1997	-0.1030	0.0236	-4.3700	<.0001
D1998	-0.0364	0.0240	-1.5100	0.1300
Lpblu2	0.0149	0.0061	2.4600	0.0140
Lpblu3	-0.2159	0.0694	-3.1100	0.0019
Lpblu5	-0.0018	0.0031	-0.5900	0.5524
SV1	0.1558	0.0161	9.6700	<.0001
SV2	-0.0779	0.0149	-5.2300	<.0001
SV3	0.0217	0.0222	0.9800	0.3295
SV4	-0.2186	0.0159	-13.7800	<.0001
SV5	-0.0175	0.0229	-0.7600	0.4451
SV6	-0.0042	0.0296	-0.1400	0.8864
SV8	0.0211	0.0198	1.0600	0.2872
SV9	0.0853	0.0424	2.0100	0.0444

APPENDIX

North East District 70	R-Square	0.2679	Root MSE	0.51595
Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	8.1215	0.1091	74.4800	<.0001
Lacre	-0.2905	0.0242	-12.0100	<.0001
Large	-0.0022	0.0442	-0.0500	0.9597
Small	-0.1409	0.0318	-4.4300	<.0001
Lpnirrac	-0.0880	0.0180	-4.8700	<.0001
Lpirrac	0.0344	0.0115	2.9800	0.0029
Lpnac	0.0061	0.0037	1.6400	0.1013
Lbldgvac	0.0056	0.0016	3.5700	0.0004
PC1	-0.0214	0.0257	-0.8300	0.4042
PC2	0.0446	0.0161	2.7800	0.0055
PC5	-0.0802	0.0751	-1.0700	0.2856
D1986	-0.5507	0.0393	-14.0100	<.0001
D1987	-0.5001	0.0379	-13.2100	<.0001
D1988	-0.4759	0.0344	-13.8500	<.0001
D1989	-0.4237	0.0337	-12.5700	<.0001
D1990	-0.4195	0.0331	-12.6700	<.0001
D1991	-0.4238	0.0334	-12.6800	<.0001
D1992	-0.3796	0.0331	-11.4600	<.0001
D1993	-0.3324	0.0328	-10.1400	<.0001
D1994	-0.2916	0.0324	-9.0000	<.0001
D1995	-0.2586	0.0319	-8.1200	<.0001
D1996	-0.2273	0.0319	-7.1300	<.0001
D1997	-0.1498	0.0318	-4.7100	<.0001
D1998	-0.0541	0.0317	-1.7100	0.0882
Lpblu2	0.0982	0.0179	5.4700	<.0001
Lpblu3	-0.0011	0.0127	-0.0800	0.9345
Lpblu5	-0.0180	0.0037	-4.8700	<.0001
SV1	0.1635	0.0200	8.1900	<.0001
SV2	-0.1139	0.0211	-5.3900	<.0001
SV3	0.0537	0.0247	2.1700	0.0299
SV4	-0.2390	0.0224	-10.6900	<.0001
SV5	-0.1249	0.0331	-3.7800	0.0002
SV6	0.0553	0.0344	1.6100	0.1082
SV8	-0.0983	0.0253	-3.8900	0.0001
SV9	-0.1962	0.0381	-5.1500	<.0001

East Central District 80	R-Square	0.3277	Root MSE	0.50211
Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	7.9925	0.1414	56.5300	<.0001
Lacre	-0.1442	0.6184	-0.2300	0.8157
Large	0.1215	0.0313	3.8800	0.0001
Small	-0.0515	0.0266	-1.9400	0.0524
Lpnirrac	-0.0492	0.0190	-2.5900	0.0095
Lpirrac	0.1704	0.6187	0.2800	0.7830
Lpnac	-0.0139	0.0020	-6.9800	<.0001
Lbldgvac	0.0074	0.0013	5.5900	<.0001
PC1	-0.0194	0.0194	-1.0000	0.3165
PC2	0.1022	0.0126	8.1200	<.0001
PC5	0.0183	0.0421	0.4300	0.6643
D1986	-0.6262	0.0330	-18.9500	<.0001
D1987	-0.6202	0.0316	-19.6500	<.0001
D1988	-0.5803	0.0299	-19.3800	<.0001
D1989	-0.5025	0.0281	-17.9000	<.0001
D1990	-0.5259	0.0282	-18.6400	<.0001
D1991	-0.4859	0.0288	-16.9000	<.0001
D1992	-0.4006	0.0277	-14.4600	<.0001
D1993	-0.3278	0.0274	-11.9800	<.0001
D1994	-0.2793	0.0271	-10.3000	<.0001
D1995	-0.2205	0.0281	-7.8400	<.0001
D1996	-0.2049	0.0279	-7.3300	<.0001
D1997	-0.1377	0.0274	-5.0300	<.0001
D1998	-0.0267	0.0281	-0.9500	0.3416
Lpblu2	0.0554	0.0190	2.9300	0.0035
Lpblu3	-0.1431	0.6062	-0.2400	0.8133
Lpblu5	-0.0043	0.0017	-2.5800	0.0099
SV1	0.1897	0.0163	11.6600	<.0001
SV2	-0.1531	0.0184	-8.3100	<.0001
SV3	0.0525	0.0186	2.8200	0.0048
SV4	-0.2479	0.0212	-11.6800	<.0001
SV5	-0.0776	0.0329	-2.3600	0.0185
SV6	0.0609	0.0309	1.9700	0.0489
SV8	-0.1077	0.0247	-4.3600	<.0001
SV9	0.0392	0.0325	1.2100	0.2276

APPENDIX

South East District 90	R-Square	0.2841	Root MSE	0.47904
Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	7.4972	0.0964	77.7700	<.0001
Lacre	-0.2602	0.0192	-13.5800	<.0001
Large	0.0616	0.0229	2.6800	0.0073
Small	-0.0238	0.0245	-0.9700	0.3313
Lpnirrac	-0.0283	0.0113	-2.5200	0.0118
Lpirrac	-0.0069	0.0135	-0.5100	0.6110
Lpnac	-0.0183	0.0022	-8.2300	<.0001
Lbldgvac	0.0053	0.0011	4.9000	<.0001
PC1	0.0053	0.0104	0.5100	0.6108
PC2	0.0372	0.0098	3.7800	0.0002
PC5	-0.0526	0.0383	-1.3700	0.1696
D1986	-0.3413	0.0306	-11.1600	<.0001
D1987	-0.4948	0.0265	-18.6700	<.0001
D1988	-0.4959	0.0255	-19.4600	<.0001
D1989	-0.4122	0.0238	-17.3200	<.0001
D1990	-0.4191	0.0235	-17.8700	<.0001
D1991	-0.4022	0.0240	-16.7600	<.0001
D1992	-0.3791	0.0228	-16.6100	<.0001
D1993	-0.3462	0.0230	-15.0700	<.0001
D1994	-0.2827	0.0233	-12.1500	<.0001
D1995	-0.2081	0.0236	-8.8300	<.0001
D1996	-0.1595	0.0227	-7.0300	<.0001
D1997	-0.0671	0.0224	-2.9900	0.0028
D1998	0.0280	0.0228	1.2300	0.2182
Lpblu2	0.0350	0.0113	3.1100	0.0019
Lpblu3	0.0179	0.0159	1.1200	0.2609
Lpblu5	0.0024	0.0021	1.1500	0.2494
SV1	0.2413	0.0131	18.3800	<.0001
SV2	-0.1100	0.0162	-6.7800	<.0001
SV3	0.0017	0.0162	0.1000	0.9192
SV4	-0.2438	0.0196	-12.4600	<.0001
SV5	-0.0572	0.0317	-1.8000	0.0714
SV6	0.0410	0.0312	1.3100	0.1889
SV8	-0.0748	0.0161	-4.6400	<.0001
SV9	-0.0243	0.0402	-0.6000	0.5464

State Of Kansas	R-Square	0.2813	Root MSE	0.48147
Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	7.5919	0.0205	369.6900	<.0001
Lacre	-0.2547	0.0088	-28.8900	<.0001
Large	0.0728	0.0093	7.8600	<.0001
Small	-0.1109	0.0116	-9.5800	<.0001
Lpnirrac	-0.0308	0.0033	-9.3900	<.0001
Lpirrac	0.0373	0.0075	4.9900	<.0001
Lpnac	-0.0050	0.0010	-4.9500	<.0001
Lbldgvac	0.0067	0.0005	12.7300	<.0001
PC1	0.0158	0.0046	3.4600	0.0005
PC2	0.0600	0.0047	12.7500	<.0001
PC5	0.1634	0.0070	23.3700	<.0001
D1986	-0.4030	0.0124	-32.6100	<.0001
D1987	-0.4402	0.0115	-38.3500	<.0001
D1988	-0.3953	0.0103	-38.3100	<.0001
D1989	-0.3437	0.0098	-35.0200	<.0001
D1990	-0.3346	0.0097	-34.5200	<.0001
D1991	-0.3256	0.0098	-33.3900	<.0001
D1992	-0.3052	0.0095	-32.0200	<.0001
D1993	-0.2604	0.0097	-26.9000	<.0001
D1994	-0.2189	0.0095	-22.9700	<.0001
D1995	-0.1876	0.0096	-19.5300	<.0001
D1996	-0.1578	0.0095	-16.5600	<.0001
D1997	-0.0917	0.0093	-9.8500	<.0001
D1998	-0.0377	0.0094	-4.0300	<.0001
Lpblu2	0.0354	0.0033	10.8200	<.0001
Lpblu3	-0.0140	0.0075	-1.8700	0.0610
Lpblu5	-0.0088	0.0010	-8.8800	<.0001
SV1	0.2417	0.0060	40.3800	<.0001
SV2	-0.1108	0.0063	-17.5500	<.0001
SV3	0.0287	0.0076	3.7600	0.0002
SV4	-0.2280	0.0068	-33.6600	<.0001
SV5	-0.0494	0.0104	-4.7500	<.0001
SV6	0.0567	0.0114	4.9600	<.0001
SV8	-0.0856	0.0071	-12.1400	<.0001
SV9	0.0032	0.0127	0.2500	0.7994

Appendix

First 1/3 of Observations deleted

	Dist 10	Dist 20	Dist 30	Dist 40	Dist 50	Dist 60	Dist 70	Dist 80	Dist 90
Observations	1478	1227	1613	2459	2828	2980	2207	2735	3593
F statistic	5.53	8.70	5.37	1.71	1.45	3.52	7.13	7.82	1.21
F - critical	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7

Second 1/3 of Observations deleted

	Dist 10	Dist 20	Dist 30	Dist 40	Dist 50	Dist 60	Dist 70	Dist 80	Dist 90
Observations	1515	1287	1600	2525	2869	2935	2177	2804	3614
F statistic	8.70	9.01	5.09	3.04	2.02	4.46	7.87	7.85	3.06
F - critical	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7

Final 1/3 of Observations deleted

	Dist 10	Dist 20	Dist 30	Dist 40	Dist 50	Dist 60	Dist 70	Dist 80	Dist 90
Observations	1467	1246	1627	2451	2744	2895	2164	2889	3728
F statistic	6.89	7.30	5.07	4.12	1.99	3.01	4.52	6.01	2.87
F - critical	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7