Regression Estimates of Different Land Type Prices and Time Adjustments

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ABSTRACT

Appraisers use puritan sales to estimate the ratio of prices for different types of land. However, puritan sales may be hard to find in areas where parcels contain upland, bottomland, meadow, pasture, irrigation, recreational land, and CRP. This paper uses regression to identify the value of different land types from sales that have a mixture of types. A second issue is adjusting values for time. Regression can be used to calculate a time adjustment. However, there are major modeling decisions that need to be made to make sure that the model fits the price adjustments occurring in the market.

Introduction

Land values have been changing very rapidly over the last few years driven in large part by the higher crop incomes due to the low carryover stocks of grains, primarily corn. Land values in the corn belt were the first to rise rapidly, but land prices in other states have also been rising, following the lead of the price rises in the corn belt. During periods like this, having good information on land values is extremely important, and sales data are a good source of values, particularly when compared to information that comes from surveys of opinions of value (Schurle et al., 2013).





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During periods of rapid change in values, it may be important to look at the relationships between the prices of different categories of land. While the land value increases in recent years may apply to all categories of land, it is possible that the relationships between prices for different types of land might change. In particular, it might be expected that the increase in land prices in recent years for land productive enough to raise corn might have increased faster than pasture land for example, thus changing the ratio between the prices of the two different categories of land. Having a ratio to use between the different types of land is extremely valuable for appraisers.

Appraisers often use puritan sales and paired sales comparisons to estimate the ratio of prices for different types of land. One difficulty with this method is that it may be difficult to find puritan sales in some areas because most parcels have some combination of land categories, rather than being only one land category. That is particularly a problem in the northeast part of Kansas where most land parcels have both cropland and pasture. In addition there may be upland, bottomland, meadow/pasture, and CRP in some combination in many of the parcels. This makes it difficult to find puritan sales of only one land category to do the paired analysis. This paper will look at the use of regression to identify the value of different land types from sales that have a mixture of types.

A second issue in recent years, again due to the rapid increase in land values, is the issue of adjusting values for time. When prices are changing rapidly, it is particularly important to adjust for time, and the adjustments can be much larger than when prices are not changing so rapidly. Regression again can be used to calculate a time adjustment. However, there are major modeling decisions that need to be made to make sure that the appropriate calculations and adjustments can be made. One procedure that is often used in regression is to use the date of the sale, and fit a linear trend through the dates. This may or may not fit what land prices are doing at the time. There may be larger increases some years than others, and this method finds an adjustment over the whole period somewhat similar to an average.

A second method that could be used is to use dummy variables for each year. That would make a uniform adjustment for all sales within the year. This modeling effort would fit if there is a single adjustment from one marketing year to the next, and then within the marketing year, the prices would not adjust. Observations in this area seem to suggest that there is a lull in sales during the summer, and then in the fall, number of sales increase substantially. Figure 1 shows the number of sales by month, showing the large increase in the number of sales in the fall through spring, with the particularly small number of sales in July and August. Observations of price behavior over years suggests that prices often seem to increase in the fall, and then remain somewhat flat over the winter and into the springtime. That kind of pricing behavior would suggest that the marketing year is not the calendar year, but rather, it runs from late summer through late spring of the next calendar year. Selecting the beginning and the ending dates for a marketing year are important issues when using dummy variables to estimate the changes in price over time. So, there are a number of modeling decisions that need to be made to get accurate adjustments in prices over time from regression models.

This paper will address two issues. The first is to calculate price ratios between different types of land. Regression will be used on sales that are not puritan sales, to find the values of the different land types so that ratios can be calculated. Second, this paper will look at two models to see which provides a better fit for the price data. These models will be used to get the best time adjustments for appraisal purposes.

Use of Regression in Appraisal

Regression is a technique that can be used for many appraisal purposes and for evaluating factors that impact the price of land. Postier et al. (1992) estimated the impact of several different variables on land values. Wild (2009) argued that real estate appraisers may need to analyze datasets objectively to estimate a number of values of importance to appraisers and that regression is a tool that can be used for the analysis. Stephens (2013) shows the use of regression to estimate the value of rainfall, selling at auction and time adjustments for land values. These articles all suggest that regression can be a useful tool for appraisal purposes.

Regression is a technique that can be used to estimate the land price per acre for each category of land even when the parcels have combinations of land categories. Models can be estimated in many forms in order to generate information that is needed. In this case, a model will be estimated to find the price per acre of each type of land. The data contained information on number of acres in each parcel that was class A land, bottom land, pasture land (including meadows), recreation land, irrigated land, and CRP. The data also included information on type of sale (auction or private treaty), county of the sale, and date of the sale.

The following model was estimated:

Price/Acre= Intercept
+ B1 * Proportion of acres of bottom land
+ B2 * Proportion of acres in pasture
+ B3 * Proportion of acres in Recreation
+B4 * Proportion of acres irrigated
+B5 * Proportion of acres in CRP
+B6 * Auction dummy variable
+B7 * Date
+B8 * Dummy for county

The B coefficients (B1 through B5) represent the adjustment that needs to be made to the intercept for the different land types. The intercept (adjusted for auction/private treaty, date, and county) represents the value per acre of class A land. The value of Bottom land then becomes the sum of the class A land and the B1 Coefficient. The value of pasture becomes the sum of the class A land and B2. The rest of the variables are interpreted in a similar fashion.

Description of Data

Sales data for two counties in Kansas were collected from 2010 to 2012. There were 177 sales in total before the sales data were inspected to make sure they were the kinds of sales to use for the analysis. Sales that had building sites were dropped, decreasing the number of sales from 177 to 143. Then sales with fewer than 70 acres were dropped, dropping seven more sales. Then the value of the land was calculated, by using the land contribution and dividing by the acres. The land contribution is the value of the land after excluding the value of buildings. Then the percent of the land in each type of land was calculated for Cropland A, cropland bottom ground, pasture, recreation land, irrigated land, and land in CRP. Meadow acres and tame pasture acres were combined with pasture acres. There were five parcels with irrigation which is not a very large number of observations. However, irrigation has a huge impact on land value, and we want to get as much information about the differences between land types as we can. The irrigation observations were left in the data set, but it is important to remember that the estimates come from a small number of observations and carefully evaluate the regression output in light of the small number of observations. If the estimates coming from the model are unreasonable, then it would be prudent to delete the observations and estimate the model again. Prices were evaluated also, and one sale price was substantially higher than all the other prices, so it was dropped. That left 134 sales with date of the sale, total acres in the parcel, and price per acre as well as proportion of the land in each of the land type categories, and whether the sale was an auction or private treaty sale. Table 1 summarizes the data.

Land tracts averaged 203 acres, and ranged from 72 acres to 2,895 acres. The table shows prices averaging $1,960.02 and ranging from $906.25 per acre to $7,017.71 per acre. The table also shows the average proportion of each type of land. Just over 50% of the land was pasture land in this sample. While the table does not show it, there is only one puritan bottom land parcel, three puritan recreation land parcels, and 34 puritan pasture land parcels. This suggests that there would be great difficulty in using puritan sales to get the ratio of values between different types of land, because there are not enough puritan sales to make the comparisons.

Calculating Ratios from Regression Results

The data for 2012 from both counties were combined to calculate values that can be used to estimate the ratios between the land types. The model described previously was estimated for the 38 observations in the dataset for 2012. Table 2 shows the regression results. The regression equation has an R square of .87 indicating that 87 percent of the variation in the price per acre has been explained by the variables used. The coefficients were all significant with the exception of the CRP variable and the dummy variable for Clay county. The coefficients are then used to estimate the price of each type of land. For example, the price per acre for cropland A sold at auction on July 1, 2012 in Clay county is estimated as:

Price for Cropland A= -119,827.33 + 468.78 * 1 (for auction) + 2.99 * Date -109.84 * 1 (for Clay County)
Date in excel is 41,091 for July 1, 2012. This gives a result of $3,559.40 per acre. The coefficients on crop bottom, pasture, recreation, irrigated, and CRP are the differences in price from cropland A if all

acres are of those types. So, $1,466.84 is added to the cropland A to get the value of bottomland. To get the price of pastureland $1,619.96 is subtracted. To get the value of recreation land $1,726.05 is subtracted. To get irrigated land $4,029.32 is added and to get the value of CRP $630.13 is subtracted. From these values then, you can calculate the ratios between the land types. Table 3 shows the values and the ratios of land prices relative to cropland A values.

You can see from the table that crop bottomland is substantially higher, with a ratio of 1.41 of the price of cropland A. Pasture and recreation land are lower, with ratios of .54 and .52 of the price of cropland A. Irrigated land is 2.13 times the value of cropland A and CRP is .82 of the price of cropland A. These ratios may change based on the relative profitability of crops and livestock operations. In recent years, pasture had been about .60 the value of cropland, but as this analysis shows, pasture values have not increased as rapidly as cropland, and is estimated at .54 the value of cropland A. This type of analysis may need to be done yearly as these ratios may change when land prices are changing rapidly.

All these ratios were similar to those being used by a professional appraiser who works in this area, except for the irrigated land. The irrigated land ratio was higher than what the appraiser was using. This might be explained by the fact that there were limited observations (only 5 irrigated sales) or that the pent up demand for good irrigated land caused the sale price of the properties to be higher than historical sales would indicate. Additional evaluation of this ratio may be warranted.

Estimating Time Adjustments

There are many ways to estimate the impact of time of sale on land price. Stephens (2013) estimated a time trend using month as the time variable. Estimating time adjustments as a linear trend is a common way to estimate impact of date of sale on price. However, this method may not be accurate if prices are not changing in a linear fashion. For example, if the change from one year to the next is larger or smaller than the change the previous year, then fitting a linear trend may not be an accurate representation of how values changed. If prices change in a stair step fashion, then using dummy variables may be a better model of price behavior. We will explore two methods of estimating the impact of time on land prices.

Results of Models Used to Estimate Time Adjustments

A different data set was used for the following analysis. The full set of data described in Table 1 including data for two counties and three years was used for this analysis. The longer period of time was needed for this analysis because we wanted to examine the time trend. Table 4 shows the results of the regression model. The model had the same variables as the model used in the first part of this paper. However, attention is concentrated on the time variable. In this model, a linear time trend was estimated to be $1.17 dollars per acre per day over this three year period. Figure 2 shows the price per acre, and the trend line over the period. The other variables are highly significant with the exception of the variable for Clay County. The coefficients for bottom, pasture, recreation, irrigated and CRP represent the best estimates over the three year period of adjustments to the value of cropland A, and they are similar to the values shown in Table 2.

An alternative way to estimate the time adjustment is to model it as a stair step adjustment, using dummy variables for the marketing year in which it sold. In this case, it is assumed that a marketing year goes from July through June of the following year. This assumption is due to the low number of sales through the summer as discussed earlier, and the observation that prices tend to rise in the fall, and then be somewhat stable over the winter and early spring months. Since we had three calendar years of data, we have data that fall into four marketing years: January to June 2010, July 2010 to June 2011, July 2011 to June 2012, and July 2012-December 2012. To model these time periods, three dummy variables are created to represent the difference in value from the first period. Table 5 shows the regression results using dummy variables for the marketing year. The R square and adjusted R Square are both higher for this model than the model that used a linear time trend suggesting it is a slightly better model. The results indicate that sales prices were $29.97 higher in the July 2010 to June 2011 period than the January-June 2010 period. Sales prices were $349.05 higher in the July 2011 to June 2012 period than in January-June 2010. And finally, prices were $1,197.35 higher in the July to December 2012 period than in January-June 2010. This model formulation allows for different adjustments each year, and as such seems to fit the data slightly better. These results suggest that there is merit in considering the marketing year to be a July through June year rather than a calendar year.

The data in figure 1 shows the fact that the number of sales drop significantly in the summer, and then pick up again in the fall, and stay fairly active until late spring. Observations by the author who is a professional appraiser suggested that he had observed pricing behavior where prices increased in the fall, but then seemed somewhat flat through that winter. These model results confirm that in this market (northeast Kansas), there seems to be some evidence that his observations are confirmed by this model. The small number of sales in the summer may form a break in the year, with increased prices occurring in a stepwise fashion rather than a linear fashion. So, we need to think about how we model price increases over time, and a linear trend through prices might not be the best representation of what prices do.

Summary and Conclusions

This paper demonstrated the use of regression to estimate the value of different types of land in order to calculate the ratios between land prices for different land types. This procedure can be quite valuable when there are few puritan sales which can be used in paired comparisons. The ratio of prices between land types can change due to changes in profitability of different types of land, so adjusting price ratios between land types should be done particularly when prices are changing rapidly.

This paper also demonstrated the use of regression to estimate two different adjustments for time. The first method was to estimate a linear trend for adjusting prices for time. The second method was to use dummy variables to estimate adjustments between marketing years. The number of land sales in this area of Kansas drops off substantially in the summer, and then there have been observations in the past that prices rise in the fall and then tend to stay fairly steady in winter and into spring. We used dummy variables to make adjustments from one year to the next. The model with dummy variables fit the data slightly better lending support to the idea that land prices are modeled better with a shift from marketing year to marketing year rather than a linear trend across years.

An appraiser can use regression analysis in various ways. If the appraiser is familiar with a market they can use regression to check to make sure that the ratios they are using are still relevant. An appraiser may get "stale" and continue to use the same ratios even when the market is changing. There are times when one land type is moving faster than the rest of the land types. A regression analysis may help the appraiser adjust their ratios to better reflect the current market. The appraiser can either use the ratios derived from regression or continue to use the old ratios. However, regression results should make the appraiser aware that the market may be changing and that they may need to adjust their ratios. It should be noted that just because the data comes up with the ratios it is imperative that the appraiser take the time to see if the ratios make sense. The appraiser needs to have a grasp of the values before using them. Remember the old adage garbage in, garbage out. Results must be scrutinized heavily and good judgment is a critical element in the selection of models and evaluation of regression estimates.

Another example of regression use is when an appraiser goes into a new market or territory. The appraiser will gather all of the sales in this market and then use regression analysis. It will help the appraiser estimate ratios to break out the contributory value of each land type. It should be noted that after the appraiser has researched a new market and estimated a regression model that they should check with an appraiser that works the area to make sure that the ratios are reasonable. Regression analysis can provide an appraiser some confidence when valuing a property in a familiar market. However, an appraiser working in a new market or territory should work with an appraiser that is familiar with the market to determine if the ratios are reasonable.

Regression can be a powerful tool if used judiciously in analyzing land prices and adjustments to land prices. Careful selection of an appropriate model is extremely important as it determines the types of relationships imposed on the data. Good judgment is extremely important in selecting data for the analysis and interpreting coefficients that are estimated. It is extremely important to carefully scrutinize the estimates from any model to make sure that they make sense for the environment being modeled.

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Table 1. Summary of Land Sales Data

	Total Acres	Land Price/A	Prop A	Prop Btm	Prop Past	Prop Rec	Prop Irr	Prop CRP	Auction
Average	203	$1,960.02	0.27	0.07	0.51	0.05	0.02	0.07	0.33
Minimum	72	$906.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum	2,895	$7,017.71	0.96	1.00	1.00	1.00	0.88	0.89	1.00

Table 2. Regression Results used to estimate ratios of land values for different types of land

Regression Statistics	
Multiple R	0.933828933
R Square	0.872036477
Adjusted R Square	0.836736195
Standard Error	601.9539137
Observations	38

ANOVA

	df	SS	MS	F	Significance F
Regression	8	71609879.96	8951235	24.70339	0.0000
Residual	29	10508106.91	362348.5		
Total	37	82117986.87			

	Coefficients	Standard Error	t Stat	P-value
Intercept	-119,827.33	39,426.77	-3.04	0.0050
Crop Bottom	1,466.84	441.64	3.32	0.0024
Pasture	-1,619.96	370.50	-4.37	0.0001
Recreation	-1,726.05	517.49	-3.34	0.0023
Irrigated	4,029.32	587.57	6.86	0.0000
CRP	-630.13	775.60	-0.81	0.4232
Auction	468.78	225.01	2.08	0.0461
Date	2.99	0.96	3.13	0.0040
Clay Co.	-109.84	248.31	-0.44	0.6615

Table 3. Prices for different types of land, and the ratio to cropland A

Land Type	Price per Acre	Ratio relative to cropland A
Cropland A	$3,559.40	1.00
Crop Bottom	$5,026.24	1.41
Pasture	$1,939.45	0.54
Recreation	$1,833.35	0.52
Irrigated	$7,588.72	2.13
CRP	$2,929.28	0.82

Table 4. Regression results using a linear time trend

Regression Statistics	
Multiple R	0.9009
R Square	0.8117
Adjusted R Square	0.7996
Standard Error	504.2020
Observations	134

ANOVA

	df	SS	MS	F	Significance F
Regression	8	136975721.2	17121965	67.35	0.0000
Residual	125	31777457.16	254219.7		
Total	133	168753178.4			

	Coefficients	Standard Error	t Stat	P-value
Intercept	-45,207.65	6544.81	-6.91	0.0000
Bottom	1,198.51	230.97	5.19	0.0000
Pasture	-1224.97	152.31	-8.04	0.0000
Recreation	-1,548.33	288.01	-5.38	0.0000
Irrigated	4,164.21	355.57	11.71	0.0000
CRP	-869.36	246.37	-3.53	0.0006
Auction	312.48	100.39	3.11	0.0023
Date	1.17	0.16	7.30	0.0000
Clay Co	-151.49	102.05	-1.48	0.1402

Table 5. Regression results using dummy variables for marketing year

Regression Statistics	
Multiple R	0.9079
R Square	0.8243
Adjusted R Square	0.8100
Standard Error	491.0279
Observations	134

ANOVA

	df	SS	MS	F	Significance F
Regression	10	139096850	13909685	57.6906	0.0000
Residual	123	29656328.43	241108.4		
Total	133	168753178.4			

	Coefficients	Standard Error	t Stat	P-value
Intercept	2,256.54	178.62	12.63	0.0000
Bottom	1,113.17	225.95	4.93	0.0000
Pasture	-1,211.96	149.99	-8.08	0.0000
Recreation	-1,352.60	293.14	-4.61	0.0000
Irrigated	4,366.50	350.57	12.46	0.0000
CRP	-970.90	241.28	-4.02	0.0001
Auction	362.51	97.78	3.71	0.0003
July 10-June 11	29.97	125.58	0.24	0.8118
July 11-June 12	349.05	140.00	2.49	0.0140
After July 12	1,197.35	176.31	6.79	0.0000
Clay Co	-132.58	100.82	-1.32	0.1909

Figure 1. Number of Sales by month January 1, 2010 through December 31, 2012

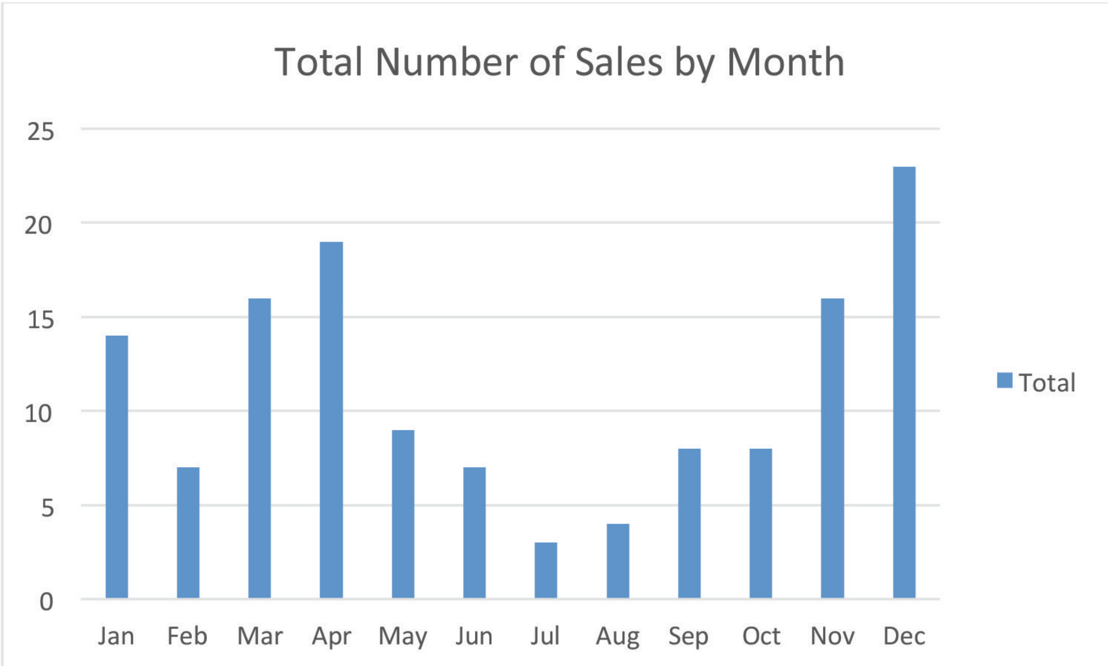

Figure 2. Price trend line over the three-year period