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"Analysis of the Effects of Above and Below Ground Commodities on Land Value"

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Abstract

This study is intended to determine what impact the price of above and below ground commodities have on the value of land. In this study, I gathered quarterly data ranging from Q1 2000 – Q4 2016 and performed a linear regression on three different types of land with five different commodities serving as independent variables. The types of land I analyzed were dryland crop land, irrigated crop land, and ranchland. The five commodities used in this analysis are corn, wheat, sorghum, cattle, and oil. I achieved statistically significant results for corn, cattle, and oil. Each of these had a positive impact on one or more of the three types of land studied. The hypothesis of this study was that each commodity tested would positively impact the value of land, meaning that if the price of a commodity increased then the value of land would also increase. The statistically significant results supported this hypothesis.

I. Introduction

The purpose of this study is to determine what impact the price of different above and below ground commodities have on the value of land. Farmland is an asset that is very commonly owned in Oklahoma. While its value has steadily risen over the last 16 years, it has not done so without fluctuations. If one can attribute the movement of farmland values to specific changes in commodity price, then it is theoretically possible to predict how the value of farmland will change. Prior literature has found that commodities are correlated with land value. A firm that already employs commodity traders could leverage the capability to successfully speculate on commodity prices into speculating on the best time to invest in a fixed asset such as land for their firm. The commodities used in this study are corn, wheat, sorghum, cattle, and oil. I chose these commodities as they provide a variety of uses for farmland both above and below ground. Three different types of land were used in this study: dryland crop land, irrigated crop land, and ranchland. I chose these three types of land as they represent three major forms of farmland.

II. Prior Literature Review

For this study I examined prior literature titled, "The Dispersion of Farmland Values in the Tenth District." Cortney Cowley of the Federal Reserve Bank of Kansas City conducted this study. The portion of her research that directly relates to my study looked into how different land attributes affect farmland values, specifically agricultural commodity sales. Cowley found with statistical significance that: livestock sales positively affect dryland crop land and ranchland, corn sales have a positive affect on irrigated crop land, wheat sales have a negative affect on dryland crop land, and oil and gas production had a negative impact on ranchland (Cowley, 2017). Cowley found it logical that livestock sales would have the largest positive

affect on ranchland as livestock grazing is a typical use of ranchland (Cowley, 2017). Cowley also expected the result that she received related to corn sales. She expected that corn sales would have the largest positive impact on irrigated crop land, and her results showed this to be true (Cowley, 2017). Cowley explains the results displayed by wheat sales by explaining that wheat can grow on lower quality land than crops such as corn can grow. She concluded, "wheat sales may be correlated with lower-quality, lower-valued farmland" (Cowley, 2017). Finally, Cowley explains the negative effect associated with oil and gas could be explained by cattle ranchers opting out of leasing contracts to preserve more of their land for grazing.

III. Methodology

The main limiting factor in this study was the availability of data on land values. The Eleventh Federal Reserve District possessed average land values for its district for three land types: dryland crop land, irrigated crop land, and ranchland. These prices ranged from Q1 2000 – Q4 2016 (Land, 2017). This data is what set the time horizon I used in the study as well as the area I would focus on. The area covered by the Eleventh Federal Reserve District is displayed by the map in Figure 1 below (Map, 2017). The oil prices I used in this study were retrieved from the U.S. Energy Information Administration. The prices are the New York Mercantile Exchange Futures Nearby Contract Cushing Crude Oil, Light-Sweet. I chose this specific set of oil prices because of its public availability, and proximity to the Eleventh Federal Reserve District (NYMEX, 2017). The crop and cattle prices I used in this study were all gathered from the National Agricultural Statistics Service. Corn and wheat prices are both measured in dollars per bushel, while cattle and sorghum are both measured in dollars per hundredweight. The crop prices I gathered represented the average of the state of Texas for the time period measured, and the cattle prices represent a national average for the time period. The locations of the data I used

were determined once again by public availability of data, and proximity to the Eleventh Federal Reserve District. Finally, all numbers displayed in this study are adjusted to 2016 inflation (2016=100%). I made this inflation adjustment using the Consumer Price Index retrieved from the Bureau of Labor Statistics (Consumer, 2017).

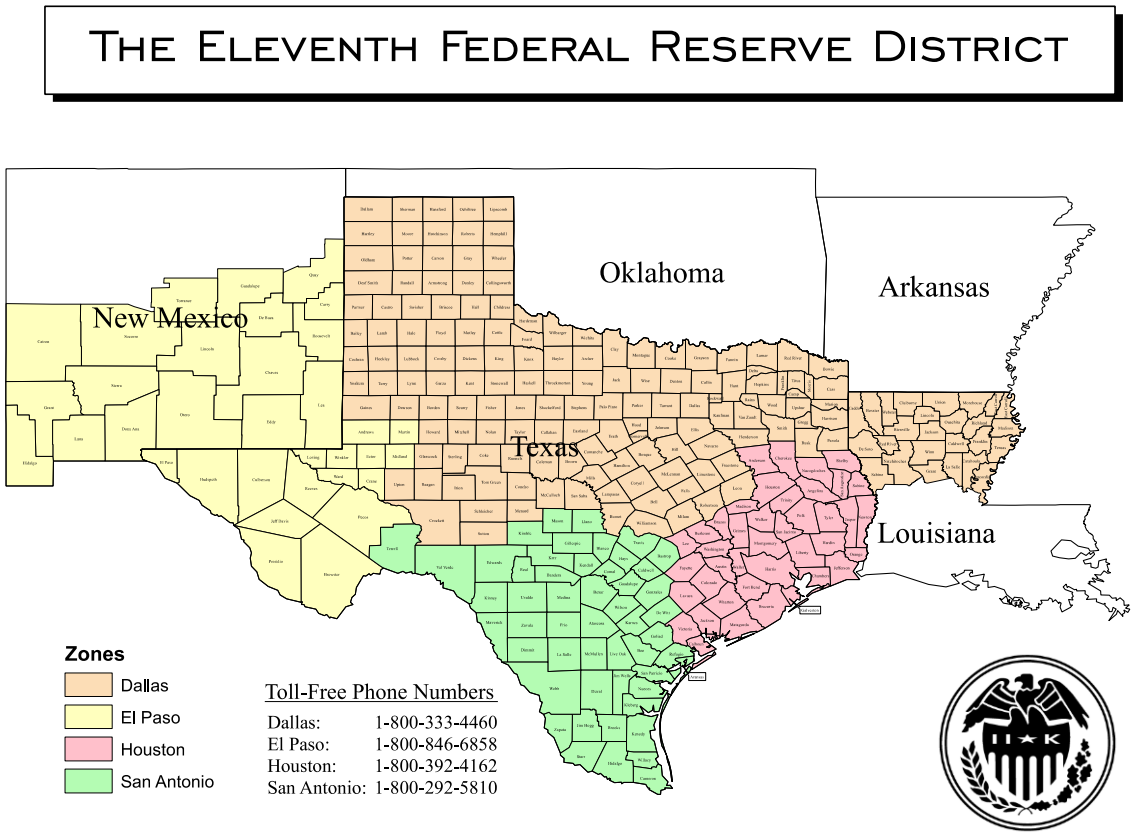

Figure 1 Map of Eleventh Federal Reserve District

I performed linear regression for each of the three different types of land (dryland, irrigated land, ranchland) with each of the commodities (corn, sorghum, wheat, cattle, and oil) serving as the independent variables. The general function behind this study is $Land\ Value_{i,t} =$

$\alpha + \beta_1 CornP_t + \beta_2 SorghumP_t + \beta_3 WheatP_t + \beta_4 CattleP_t + \beta_5 OilP_t + \varepsilon_t$ where i = land type (dryland, irrigated land, ranchland) and t = time period. My hypothesis for this study is that each of the Beta values will be greater than 0, alternatively stated, each commodity price will positively affect the price of land.

The graph shown in Figure 2 displays the data used for the analysis. The graph displays the data on two axes. The left axis charts the commodity prices while the right axis charts the land values. Corn, sorghum, and wheat prices all move very closely together, but the larger variance in oil and cattle prices is noticeable. As mentioned in the introduction, the price of all types of land has risen steadily since 2000. All of these figures have been adjusted to 2016 inflation.

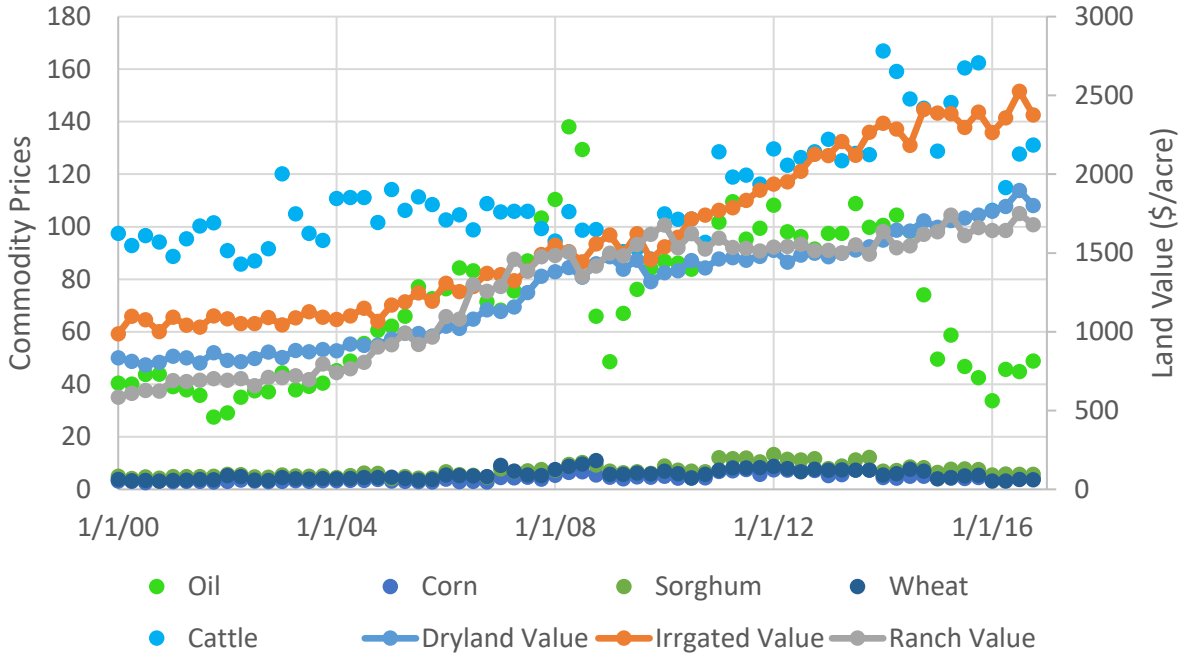

Figure 2 Commodity & Land Value Data

IV. **Results**

The results of the analysis are displayed in Figure 3. In this table *, **, and *** represents significance at the .1, .05, and .001 levels respectively. Furthermore, the numbers in this table represent the increase in land value caused by a $1 increase in any given commodity measured. For example, the results in this table show that for every $1 per bushel increase in the price of corn the value of land increased by approximately $173.50.

The analysis achieved several statistically significant results. First, corn price was significant at the .05 level for dryland crop land and was statistically significant at the .001

$$Land\ Value_{i,t} = \alpha + \beta_1 CornP_t + \beta_2 SorghumP_t + \beta_3 WheatP_t + \beta_4 CattleP_t + \beta_5 OilP_t + \varepsilon_t$$

	Dryland Model ($/acre)	Irrigated Land Model ($/acre)	Ranchland Model ($/acre)
Oil Price ($/barrel)	0.569	-0.822	3.807*
Corn Price ($/bushel)	173.497**	257.171***	147.516
Sorghum Price ($/cwt)	-51.473	-62.843	-44.785
Wheat Price ($/bushel)	-4.460	-37.075	9.978
Cattle Price ($/cwt)	8.658***	16.370***	7.237***
Intercept	-129.424	-669.556	-222.934
R^2	0.545	0.676	0.526
N	68	68	68

Figure 3 Results of Analysis

level for irrigated crop land. Cattle achieved significance at the .001 level for all three types of land studied. Finally, oil achieved significance at the .1 level for ranchland. The R^2 was above 50% for all three types of land studied. All statistically significant results supported the hypothesis that each of the Beta values would be greater than 0. In other words, all statistically significant results showed that commodity prices positively impacted land value.

V. Findings

Corn price had a greater impact on irrigated land value than dryland crop land value. I found this result to be very logical given that corn is typically an irrigated crop in Texas. Cattle price also had a greater impact on irrigated land than dryland crop land. One explanation for this result is that corn is often used as a cattle feed, and therefore, the correlation could cause higher corn prices to lead to higher cattle prices or higher cattle prices to lead to higher corn prices. Oil achieved statistical significance only for ranchland, and one explanation for this is that farmers are much more likely to allow oil wells on ranchland than they are on the two types of cropland because an oil well placed on cropland would be much more disruptive than an oil well placed on ranchland. A surprising finding in this study is that cattle had the smallest positive impact on ranchland of the three types of land tested. This was surprising given that ranchland is the type of land typically intended to be used for livestock. This finding was in contradiction to the prior literature reviewed earlier in this paper. Neither sorghum nor wheat achieved statistical significance for any of the types of land tested. Sorghum is commonly used as a feed so this could be the reason that it did not correlate well with land value. As was mentioned when discussing the prior literature, wheat is a very hardy crop capable of growing on lower quality ground, but also grown more commonly in Texas than it is in the Tenth Federal Reserve District which could have made it difficult to attribute its relation to land value either positively or negatively.

VI. Future Research

While this study accounted for much of the change in land value, the highest R^2 I achieved in this study was .676. This leaves room for many more factors to be taken into consideration when attempting to attribute commodity prices to the movement of land value.

Future studies in this vein could include the interest rate environment as that could be another important factor in determining the value of land. Another factor that could be taken into account is whether the ranchland has access to water or not, as that could change the value of holding livestock on that type of land.

Crop insurance could be another factor that plays into the value of land. A future researcher could do analysis into the amount of crop insurance claims in a region and see if there is any correlation with high or low land values. It is possible that a high number of claims could mean that the land value in that region is poor, but also more claims could potentially put more money in farmers' pockets causing an inflationary effect on the price of land.

VII. Conclusion

This study is not a complete determinant on which commodities affect the value of land and by exactly how much, but it does support the hypothesis that corn, cattle, and oil positively impact the value of land. If a firm has a trading capability, and is looking to acquire agricultural land for expansion, then attempting to attribute how much commodity prices affect the value of land could be a worthy endeavor for their firm.

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