

## **Do Nebraska's Agricultural Land Values and Rent Reflect Increased Differential in Yield and Crop Price?**

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### **Abstract**

Agricultural farmland values should ideally reflect future earning potential. Agricultural land cash rent values should signal the same. Using south and southeast region of Nebraska, as a case study, for three different types of land- center pivot irrigated, gravity irrigated and dryland, a comparative analysis was done in this paper to investigate if farmland values and cash rental rates reflected the increased differential in yield and crop price. Our analysis found that there was no linear relationship between increase in land values or cash rental rates and increase in yield and price. This study also found that total revenue relates more closely to land values than price or yield alone. Furthermore, Land values fluctuated more compared to the cash rental rates for the last 30 years. For southeast region cash rental rates have more than doubled compared to 1981 for all land types; whereas, for south only dryland rates have more than doubled. Land values for all types have more than doubled for all regions. Furthermore, irrigated land values with gravity and pivot system switched after 2000. Until 2000 gravity land values were always higher compared to pivot land values for both regions.

## 1. Introduction

Different types of land prices in general reflect or signal different values. For instance a residential property, based on hedonic method, reflects cumulative value of the characteristics of the structure and surroundings; whereas, a business property reflects return on investment in short-run and long-run. Agricultural land prices are unique as they reflect future earning potential from a parcel of land. For the most part, on average land price is a function of soil quality, historical average rainfall, irrigation potential and/or irrigation including the management practices. The superior (inferior) the quality of soil the higher (lower) the price of agricultural land. The higher (lower) average historical rainfall the higher (lower) the price of agricultural land. In cases of dryland, the land with potential for irrigation command a higher price compared to the land that do not have the same potential. The land with irrigation equipment installed get a premium due to the capital investment in the land which results in higher yield. Finally, historical and present management practice is also reflected in the agricultural land practices. In the long-run, land that has been managed well, will result in higher yield and/or lower production costs which is translated to increased profitability and reflected in higher land value.

Most of the land grant universities in the Midwest and across the country maintain a database of agricultural land values and rental rates differentiated by land types and crops. There are studies which examine the long run trends in agricultural land values (Visser, O, 2016.; Marella et. al, 2016). Also, there are studies which examine the profitability of different crops (Brandes et.al., 2016; O'Donnell, 2016) . However, authors of this study could not find any comparative study done for the state of Nebraska. University of Nebraska-Lincoln does produce and publicly provide every year an extension publication 'Nebraska Farmland Values and Rental Rates' which has data in appendix for all the regions and does an annual assessment of how the land values, rents, etc. have changed. The same study, however, does not do a comparative analysis with crop yields for those regions.

## 2. Data

Nebraska is divided into eight agricultural districts northwest, north, southwest, central, south, southeast, east and northeast. University of Nebraska-Lincoln's extension every year publishes a report, "Nebraska Farmland Values and Rental Rates", which has data on farmland values and cash rental rates since 1981. The data used in this study were taken from the latest report published in August of 2016. Instead of using all eight regions only south and southeast regions were analyzed in this paper. Data for price and yield of corn was obtained from United States Department of Agriculture (USDA).

## 3. Descriptive Analysis

There are two ways to analyze the purposed question, using the cash rental rates and the agricultural land values. In this paper we use corn as choice crop and south and southeast as two regions for comparative analysis.

### 3.1 Land values

Figure 1 shows that for all types of land the nominal values have increased significantly. On the onset, it is important to note as stated earlier, that most of the irrigated agricultural land have machineries in the land which is reflected in the agricultural land values. The per acre value of dryland for south region has increased from slightly more than \$750, in 1981 to more than \$3,500 in 2016 (more than 370% increase). Similarly, for southeast the value has increased from more than \$1,000 to \$4,845 (slightly more than 350% increase). There has also been increase in irrigated farmland value for both south and southeast region. For south region gravity irrigated cropland value went from \$2,230 per acre in 1981 to \$6,265 in 2016 (181 % increase) and pivot irrigated cropland value went up from \$1,732 per care in 1981 to \$\$7,240 per acre in 2016 (318% increase). For the southeast region gravity irrigated cropland value went from \$2,026 per acre in 1981 to \$7,375 in 2016 (264% increase) and pivot irrigated cropland value went up from \$1,900 per care in 1981 to \$9,185 per acre in 2016 (383% increase). This shows that the increase in land values has not been proportional between different types. Figure 1 also shows that for the most recent years, since 2013, the land values have started to decrease for all land types most likely due to reduced prices and more land being into production. The spread between land types has also significantly increased in the past 35 years.

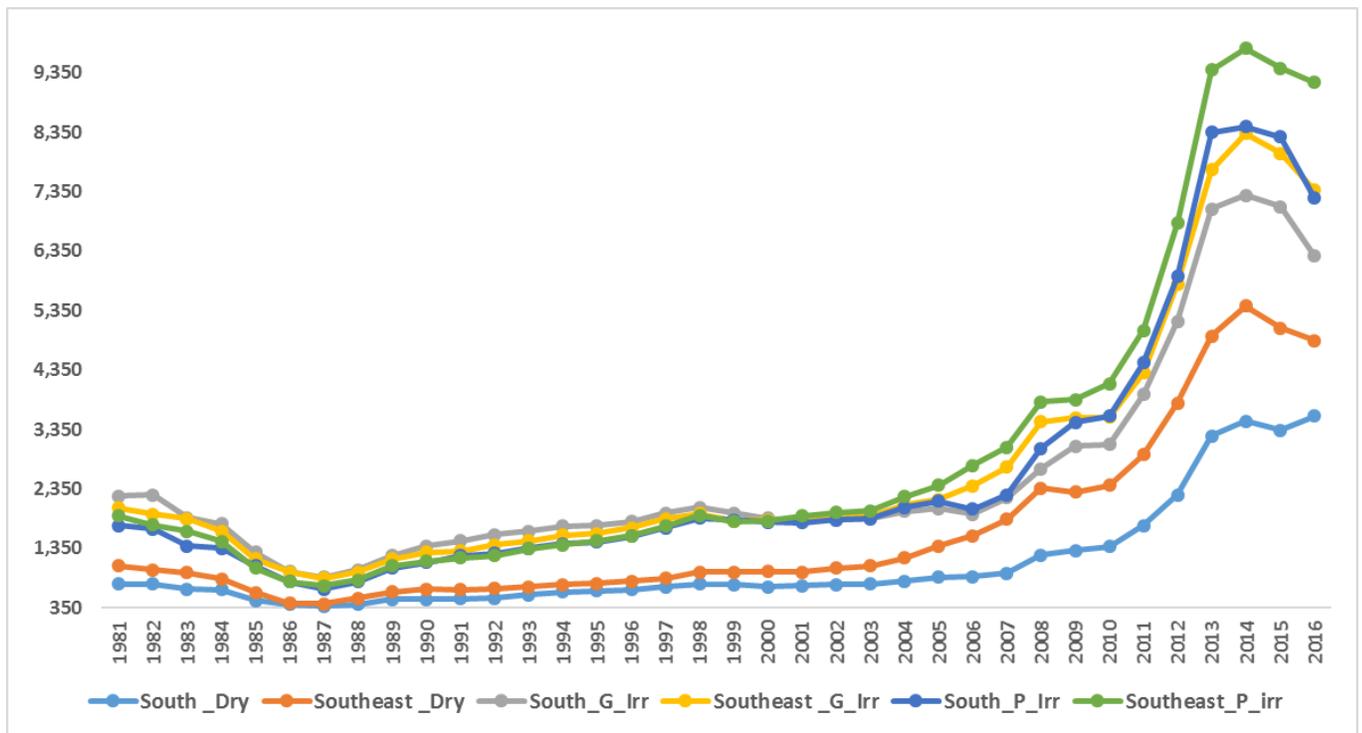


Figure 1: Average agricultural land value for South and Southeast Nebraska for irrigated and dryland

Data source: Extension of University of Nebraska- Lincoln

Figure 2 shows average per acre difference in value of different types of agricultural land for south and southeast region of Nebraska. There are few interesting observations in the long-term trend in difference of the values. First, unsurprisingly, the differences are not homogenous

among different land types. As expected the difference between irrigated and dryland is higher than types of irrigated land. In the long run it appears that difference in values has widened over time. The magnitude of difference has been increasing and particularly more since 2000. For the entire period before that the differences were almost the same. One of the more surprising finds from figure 2 is that since 2001 the difference between gravity and pivot system has switched. Until 2000 gravity land values were always higher compared to pivot land values; however, ever since the trend has reversed and now pivot systems are valued higher than gravity for both south and southeast region. The difference between pivot and gravity land was almost a thousand dollars for 2016 for south region and slightly more than \$1,800 for the southeast region. The difference between pivot and dryland for Southeast region was \$4,340 for 2016, 417% increase compared to 1981 when the difference was \$840. The difference between gravity and dryland for Southeast region was \$2,690 for 2016, 182% increase compared to 1981 when the difference was \$1,476. The difference between pivot and dryland for South region was \$3,665 for 2016, 275% increase compared to 1981 when the difference was \$978. It is noteworthy that except for 2016 pivot agricultural land in South had higher value than their counterparts in Southeast. The difference between gravity and dryland for Southeast region was \$2,530 for 2016, 162% increase compared to 1981 when the difference was \$966. The difference between gravity and dryland for South region was \$2,690 for 2016, 82% increase compared to 1981 when the difference was \$1,476.

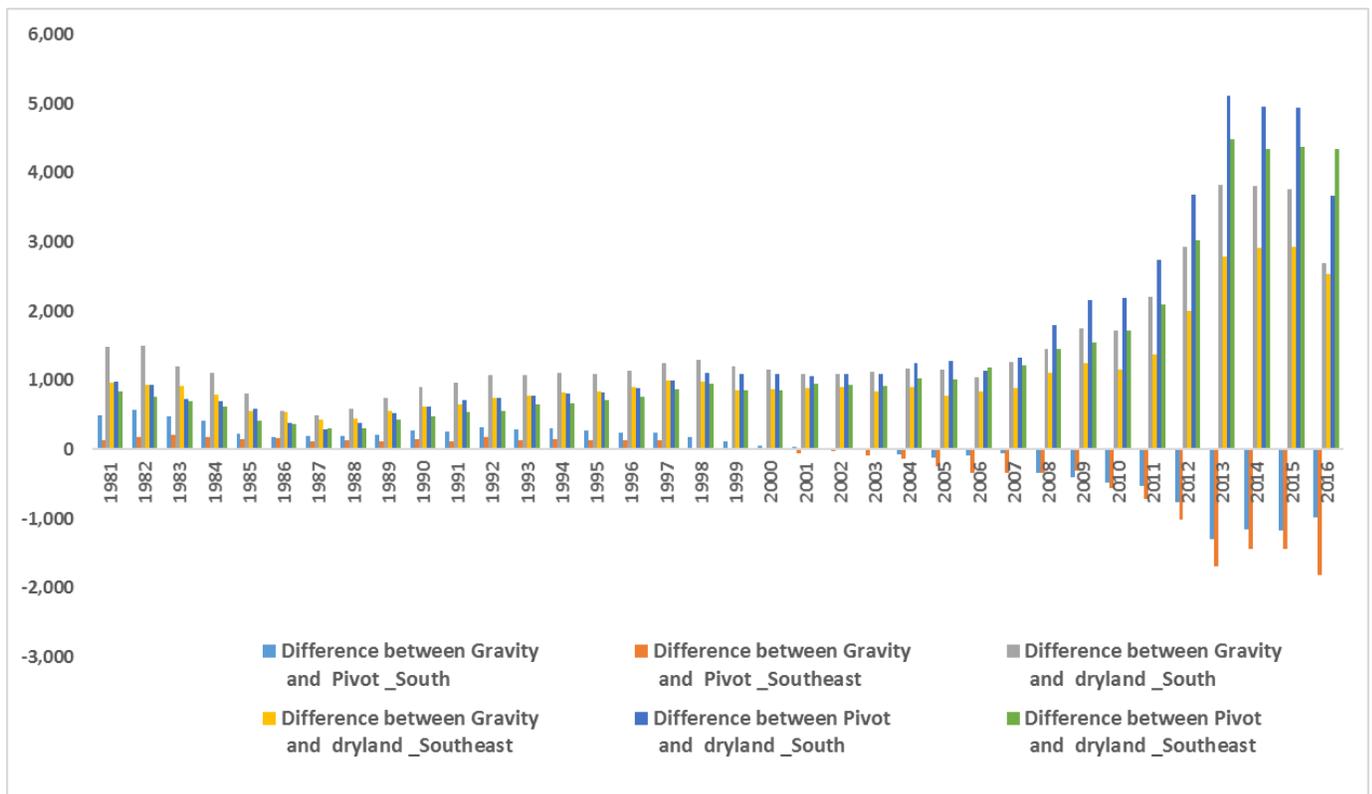


Figure 2: Difference in agricultural land values for south and southeast region of Nebraska  
 Author's calculations using data from Extension of University of Nebraska- Lincoln

As stated previously, land values reflect future earning potential, the economic theory would suggest, the difference in land values to be correlated to the total revenues and corollary, assuming linear relationship, profit generated from each type. For our case, while producers of each region can attain different prices based on their own marketing skills and/or the distance to nearby grain elevator, we assume average price received to be same for both regions. So, the only differentiating factor would be the percentage increase in yield and percentage increase in price. Since, corn is the dominant crops in the region a comparative analysis was done to see the increase in yield and price of corn with the agricultural land values for both regions.

Table 1 shows the percentage increase for price of each commodity, type of agricultural land and increase in yield for irrigated and dryland for both regions. It is apparent from table 1 and figure 1 that there was not a consistent increase in land values, yield and price. In essence it means that there was a lot of volatility in the market for price of corn and weather variability which resulted in variability in yield. However, on average barring few years there has been a consistent increase in yield as well as agricultural land values. Table 1 shows that the relationship between increase in agricultural land values with price and yield is not linear i.e. adding the percentage increase in price and yield does not result in the percentage increase in agricultural land values. Furthermore, it is also apparent that at least for 2015 while the agricultural land values across the board went up significantly compared to 1981 the increase in yield and price have not been comparable. There is a lag when it comes to value being reflected however the price and yield for 2015 were not significantly different than that of 2014. In fact 2014 dryland yield were higher for south compared to 2015. In order to see if total revenue, which would be the cumulative function of price and yield, was proportionally increasing to the land values total revenue for each region for each type of land was also calculated. From table 1 it seems that there is no linear relationship between total revenue and increase in land values. It does appear that total revenue is more closely correlated to the agricultural land values as the percentage increase in total revenue is much closer to the percentage increase in the land values. Furthermore, 2000 when dryland, gravity and center pivot (except for south) saw a decrease in land values compared to 1981 the total revenues for both types of land also showed a decrease. For the same year yield had decreased for dryland and overall price also had decreased. So, it appears that total revenue instead of just the price or yield more accurately relates to an increase or decrease in agricultural land values.

Table 1: Percentage increase in land values, yield, price and total revenue since 1981 for south and southeast region of Nebraska

Year	Region	Agricultural Land value			Price per bushel	Corn Yield per acre		Total Revenue per acre	
		Dryland	Center Pivot	Gravity	Corn	Dryland	Irrigated	Dryland	Irrigated
2015	South	343%	377%	218%	42%	57%	58%	123%	125%
	Southeast	377%	396%	295%	42%	64%	59%	134%	126%
2010	South	83%	106%	39%	103%	58%	42%	220%	187%
	Southeast	127%	117%	76%	103%	43%	46%	189%	196%
2005	South	15%	24%	-9%	-24%	9%	37%	-16%	5%
	Southeast	32%	27%	7%	-24%	20%	45%	-8%	11%
2000	South	-6%	4%	-17%	-24%	-2%	12%	-30%	-15%
	Southeast	-10%	-5%	-10%	-24%	-8%	18%	-26%	-15%

*Author's calculations using data from Extension of University of Nebraska-Lincoln and USDA*

### 3.2 Rental rates

Now similar analysis to the previous section is done using cash rental rates for the two regions, South and Southeast. Figure 3 shows cash rental rates for the two regions, south and southeast, for the different land types from 1981 to 2016. First off, as expected, cash rental rates have increased in the long-run with some minor decreases in between for the time period. One surprising observation is that in the most recent years since 2013 cash rental rates for all land types have started to decrease. This could be because of the stress in crop prices as well as more land being bought to production in the aftermath of 2012 commodity price increases. As the supply of more land comes into market the cash rental rates tend to decrease. However, cash rental rates for 2016 have gone up significantly for all types of land compared to 1981. For the south region, dryland the rental rates have gone up from \$38 in 1981 to \$80 (111% increase); gravity irrigated land rates have gone up from \$117 to \$215 (84% increase) and center pivot rates have increased from \$126 to \$240 (90% increase). For the southeast region, dryland the rental rates have gone up from \$55 in 1981 to \$165 (200% increase); gravity irrigated land rates have gone up from \$115 to \$250 (117% increase) and center pivot rates have increased from \$119 to \$290 (144% increase). For southeast region cash rental rates have more than doubled compared to 1981 for all land types; whereas, for south only dryland rates have more than doubled. This is most likely because of the historical precipitation levels.

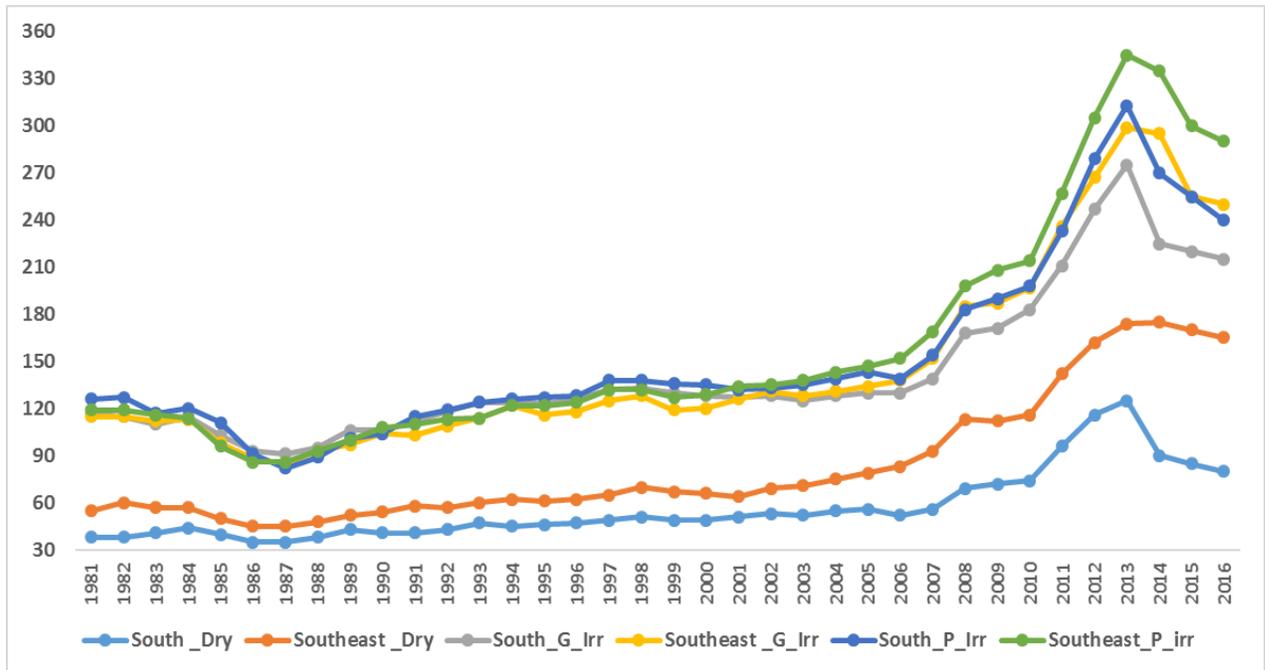


Figure 3: Average rental rates for different types of land in South and Southeast Nebraska  
 Data source: Extension University of Nebraska- Lincoln

As with the land values analysis was done of the difference in rental rates for each land type. Figure 4 shows average per acre difference cash rental rates of different types of agricultural land for south and southeast region of Nebraska. As was the case with land values differences are not homogenous. Also, as expected difference between irrigated and dryland is higher than types of irrigated land. One interesting difference compared to the land values is that unlike land values cash rental rates were higher for pivot compared to gravity for both regions since 1981, albeit the difference was almost negligible until 2003. After 2003, the difference in rental rates has been always greater than \$10 and since 2011 has been more than \$20. On average the difference between pivot and dryland is higher than gravity and dryland. Also, the difference for pivot and dryland is higher for south region. Corollary, difference for gravity and dryland is also higher for south region.

The difference between pivot and gravity rent was \$25 for 2016 for south region and \$40 for the southeast region. The difference between pivot and dryland for Southeast region was \$125 for 2016, 95% increase compared to 1981 when the difference was \$64. The difference between gravity and dryland for Southeast region was \$85 for 2016, 42% increase compared to 1981 when the difference was \$60. The difference between pivot and dryland for South region was \$160 for 2016, 82% increase compared to 1981 when the difference was \$88. The difference between gravity and dryland for South region was \$135 for 2016, 71% increase compared to 1981 when the difference was \$71.

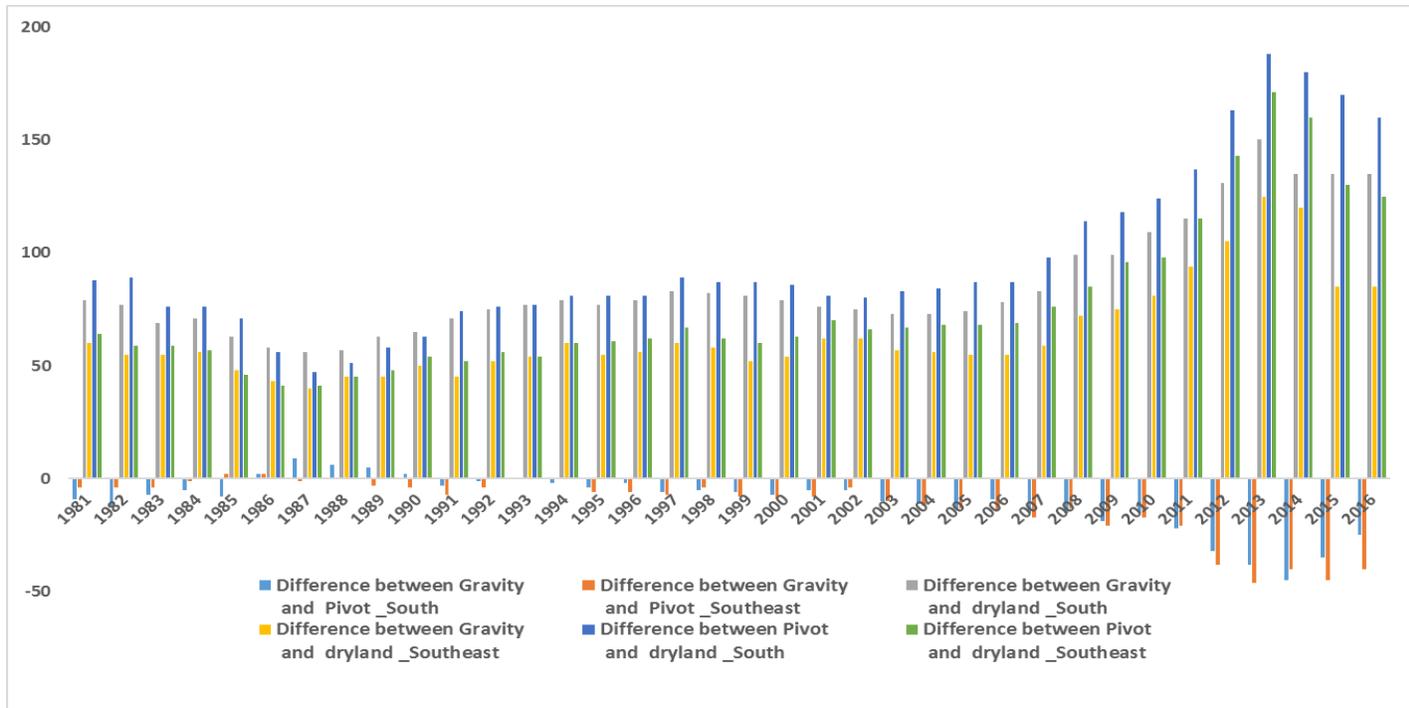


Figure 4: Difference in agricultural land cash rental rates for south and southeast region of Nebraska

*Author's calculations using data from Extension of University of Nebraska- Lincoln*

As for the land values table 2 shows the relationship between increase in agricultural rent values with price and yield is not linear i.e. adding the percentage increase in price and yield does not result in the percentage increase in agricultural land values. Unlike land values the cash rental rates have consistently gone up in the recent years compared to 198. This suggests that either the cash rental rates are less volatile than the farmland values themselves. This also could be because renters come and go from market, which would result in supply demand dominated rates. Just as with land values, it appears that total revenue instead of just the price or yield more accurately relates to an increase in agricultural cash rental rates at least in the recent years.

Table 2: Percentage increase in agricultural land rent, price and yield of corn and total revenue for the south and southeast region of Nebraska

Year	Region	Agricultural Land Rent			Price per bushel	Corn Yield per acre		Total Revenue per acre	
		Dryland	Center Pivot	Gravity	Corn	Dryland	Irrigated	Dryland	Irrigated
2015	South	124%	102%	88%	42%	57%	58%	123%	125%
	Southeast	209%	152%	122%	42%	64%	59%	134%	126%
2010	South	95%	57%	56%	103%	58%	42%	220%	187%
	Southeast	111%	80%	71%	103%	43%	46%	189%	196%
2005	South	47%	13%	11%	-24%	9%	37%	-16%	5%
	Southeast	44%	80%	17%	-24%	20%	45%	-8%	11%
2000	South	29%	7%	9%	-24%	-2%	12%	-30%	-15%
	Southeast	44%	8%	4%	-24%	-8%	18%	-26%	-15%

*Authors calculations using UNL and NASS data*

#### 4. Conclusions

Agricultural farmland values ideally should reflect future earning potential. The farmland values and cash rental rates should signal the same. Using price and increase in yield this hypothesis was tested and this study found that the relationship non-linear. Furthermore, at for the south and southeast regions until 2000 gravity irrigated land was more valuable than center pivot. This study also found that total revenue to be more closely associated with land values rather than just price or yield. The relationship was also non-linear for increase in cash rental rates and yield and price. And, even though total revenue was more closely correlated to cash rental rates the relationship was not as strong compared to land values.

## References

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