2022

Analysis of Illinois Farmland Values & Rental Rates By Soil Productivity Class in Region 7

Ryan Archibald
ryan.archibald@siu.edu

ANALYSIS OF ILLINOIS FARMLAND VALUES & RENTAL RATES BY SOIL PRODUCTIVITY CLASS IN REGION 7

by

Ryan Archibald

B.S, Southern Illinois University Carbondale, 2021

A Research Paper
Submitted in Partial Fulfillment of the Requirements for the
Master of Science

Department of Agribusiness Economics
in the Graduate School
Southern Illinois University Carbondale

May, 2022

RESEARCH PAPER APPROVAL

ANALYSIS OF FARMLAND VALUES & RENTAL RATES BY SOIL PRODUCTIVITY CLASS IN REGION 7

By

Ryan Archibald

A Research Paper Submitted in Partial

Fulfillment of the Requirements

For the Degree of

Master of Science

in the field of Agribusiness Economics

Approved by:

Dr. Dwight R. Sanders

Graduate School
Southern Illinois University Carbondale
May 18, 2016

AN ABSTRACT OF THE RESEARCH PAPER OF

RYAN ARCHIBALD, for the Master of Science degree in AGRIBUSINESS ECONOMICS, presented on MAY 18th, 2022 at Southern Illinois University Carbondale.

TITLE: ANALYSIS OF ILLINOIS FARMLAND VALUES & RENTAL RATES BY SOIL PRODUCTIVITY CLASS IN REGION 7

MAJOR PROFESSOR: Dr. Dwight R. Sanders

Land prices and rental rates have always been an integral part of agribusiness. The price fluctuations can alter the decisions made by farm managers across the Corn Belt and other areas. According to Paulson and Schnitkey (2014), "Illinois land values have increased at an average annualized rate of 12.4% from 2004-2014" (p. 252). Farmland prices in Illinois have seen a constant rise in price, more so over the last few years though. This is partially due to farmland presenting itself as an investment option to investors not originally involved in agriculture. Rental agreements have also shown to be a factor of constant change. More recently, fixed-case leasing agreements have proven to be the rental agreement of choice. Keuthe and Bigelow (2018) found that 47% of Midwest farmland is rented, 70% of which is contracted under fixed-cash agreements. The times of crop-share and flexible-cash leases seem to have hit the wayside. With this study, multiple regression analysis will use data from ASFRMA (American Society of Farm Managers and Rural Appraisers) to show that 30-year bond interest rates have a significant impact on all land value classifications. It will also show that rental rate is not a significant explanatory variable for land values, except for excellent productivity land value. This study also demonstrates that the variability in good, average, and fair productivity could influence their ability to appropriately estimate land values.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Over the last several decades, there have been many changes in agriculture. Farmers run their operations through different methods than previous generations did from the effects of technological advances, land ownership trends, rental agreements, agricultural policy and fluctuations in the price of land. With so many different aspects affecting agriculture in general, it is imperative that farmers try to stay up to date on the current trends and fluctuations whether it's land prices, input prices, rental rates, or interest rates. Farmland prices seem to have shown to be a steady but true investment. This has caused those outside of agriculture to consider farmland as a viable choice when it comes to long-term investments. Farmers have also seen changes in the means of renting farmland from landowners. More and more often, farmers and landowners settle on fixed-cash rents over crop shares for various reasons. It provides a more secure income for landowners while also allowing them to not be as involved in the actual farming itself. For farmers, it eliminates the task of keeping the landowner's grain separated which becomes more and more of a problem when farming for many different landowners.

Keuthe and Bigelow (2018) found that 47% of Midwest farmland is rented, 70% of which is contracted under fixed-cash agreements. Fixed-cash agreements seem to be on the rise, making it more important to consider the current prices and outlook of rental rates. The current prices and outlook of farmland are also another very important aspect of farming that must be considered. Chipman (2021) addresses the outlook on agricultural land across the U.S. Corn Belt which includes all of Iowa and most of Illinois, Indiana, Michigan, and

Wisconsin. Chipman (2021) wanted to survey the outlook on farmland because of recent price increases over the last year due to lower interest rates and an increase in livestock product trade. Chipman (2021) surveyed 137 agricultural bankers across the U.S. Corn Belt and found that the majority surveyed, 58%, predicted farmland values would go up. The other 42% of agricultural bankers expected the land values to remain stable (Chipman, 2021). This clarifies the outlook of financial advisors, who work directly with farm producers. Agricultural bankers have a lot of experience dealing with land values, interest rates, and the loans used by farmers to purchase agricultural real estate. The perspectives of those in the industry can have an effect as the outlook of farmland values itself can influence decisions.

The major objective of this paper is to analyze the price fluctuations of land prices and rental rates, two major factors in farming, through economic variables that have a significant influence on those prices in that area. The area of focus is Illinois' region 7 (West Central), which is defined as Menard, Cass, Sangamon, Morgan, Scott, Greene, Jersey, Calhoun, Macoupin, and Montgomery counties. This multiple regression model shows the significant influence that 30-year bond interest rates have on land values of all classifications, and that it is negatively correlated, meaning that as bond interest rates decrease, land values increase and vice versa. This model also demonstrates that rental rates is not a significant explanatory variable for most land values, although this could be due to the variability in rental rates.

CHAPTER 2

REVIEW OF LITERATURE

It is no doubt that farmland values and rental rates have increased significantly over the past several years. As previously mentioned, Paulson and Schnitkey (2014) found that, "Illinois land values have increased at an average annualized rate of 12.4% from 2004-2014" (p. 252). This can be troublesome to farm managers as a sharp increase in land prices could mean lowered land prices in the future. Another problem for farm managers is the increase in rental rates over the last several years. For farm managers who operate mainly through leases, this can greatly affect their annual costs even with minimal increases per acre. Although, land prices have risen at a more increasing rate than the associated rental rates. For example, the average annual growth in farmland rental rates from 2003-2014 was 6.1% (Paulson and Schnitkey, 2014). While both prices are rising, farmland values have shown to rise at a faster rate than the rental rate. These price fluctuations can become worrisome to not only farm managers, but to farmland owners and investors also. With uncertain price fluctuation, uncertain returns come for all investors involved with farmland.

Farmland has shown to give stable financial return over the long run, in comparison with other investment options. Those outside the farming community have begun to think of farmland as a new way to diversify the portfolio due to its attractive historical performance. Interest rates have shown to correlate farmland values, along with other types of investment options. For example, farmland values are negatively correlated to equities, positively correlated with inflation, and have a near-zero correlation with fixed-income investments, like bonds (Sherrick, 2018). Farmland is negatively correlated with interest rates, in that if interest rates go up, farmland values usually tend to decline (Sherrick, 2018). This is an important correlation when considering the values of farmland because it could explain outliers during certain periods. If the marginal prices of farmland values drop significantly during a period of years, with no effect on rental rates, it's possible interest rates could be the cause.

Rental rates of farmland over the last 30 years have fluctuated but have shown increased rates over the long term, much like farmland values. Rental rates have increased by 3.6% per year from 1987-2014. From 2006-2014 alone it rose 7.4%. However, from 2014-2017, rental prices had decreased by $16, or 6.8% (Schnitkey, 2017). This is partly due to increased commodity prices from 2006-2013, which in turn, causes cash rent values to respond by also increasing. The increase in commodity prices during this period is due to increased ethanol production and growing export demand for soybeans. The problem that produced afterward was that cash rents steadied, and commodity prices fell, leaving farms with less capital to pay expenses. Farmers have a difficult time releasing rented farmland due to high cash rent values because that then eliminates any future returns when commodity prices recover. The same goes for landowners, as they would view lower cash rents as a lowered return from their asset(s). Knowing the trends and correlations of fixed cash rental rates of farmland and farmland values themselves, better prepare farm owners/operators. Being able to predict and plan for the farm would allow for better decision-making in the future. Having this knowledge may also help relations between landowner and farm operators, as they would be able to explain, with data, the reasoning behind asking a particular fixed cash rental rate.

CHAPTER 3

FARMLAND VALUES

Giri, Lovercamp, Sharma, and Protopop (2017) analyzed whether Nebraska's agricultural land values and rent reflected increased differential in yield and crop price. The data used was taken from the latest report from the University of Nebraska-Lincoln's extension containing farmland values and cash rental rates from 1981 to this report, 2016. The data for the price and yield of corn was obtained from the United States Department of Agriculture (USDA). They chose to use corn for their research crop. They had data showing the average agricultural land value for South and Southeast Nebraska for irrigated and dryland. Along with this, they had the prices for the land with different types of irrigation systems. In their analysis of the correlation between land values and price and yield, they discovered that it was not linear. This means that the variables price and yield are not correlated with the associated land values. So, adding a percentage increase in the price and yield does not necessarily result in a percentage increase in the land value. They discovered that, instead, the total revenue instead of just price or yield more accurately relates to an increase or decrease in agricultural land values although it is not strong (Giri, Lovercamp, Sharma and Protopop, 2017).

They followed through with the same procedures in analyzing the correlation between agricultural land values and price or corn yield for analyzing the correlation between land rental rates and price or corn yields. Using the same data in the report from the University of Nebraska-Lincoln's extension, they discovered that the relationship between an increase in agricultural rent values with price and yield is also not linear (Giri, Lovercamp, Sharma, and

Protopop, 2017). This also means that there is no correlation between the variables. However, like 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 although the correlation is not strong (Giri, Lovercamp, Sharma, and Protopop, 2017). This research shows the analysis of linear relationships, which I will use in my paper. Their procedures for finding the correlation between land values and rental rates and the price of corn and yield will be of use as I analyze different relationships between variables.

Huang, Miller, Sherrick, and Gómez (2006) researched the factors influencing farmland values by estimating a hedonic price model of Illinois farmland values using county-level cross-section time-series data. Their explanatory variables were land productivity, parcel size, permanent improvements, distance from Chicago or other large cities over 50,000, urban-rural index, swine farm production density, population density, and inflation. They also used income per capita as an explanation for farmland values. They used these variables to find the spatial and series correlation between the variables and land values.

They found that farmland values decline with parcel size, ruralness, and distances to Chicago and cities with populations over 50,000. Farmland values increased with permanent improvements, population density, and per capita personal income. Soil productivity and per capita income were the most correlated to the land price at 0.68 and 0.471 respectively (Huang, Miller, Sherrick, and Gómez, 2006). Huang, Miller, Sherrick, and Gómez (2006) also found the influence of Chicago and other large cities had an interesting correlation at –0.179 for Chicago and –0.028 for other cities over 50,000. This means that Chicago has 6 times the influence on land price as other cities over 50,000. The prices of neighboring counties' land also influenced the land price of the observed county, with every 1% increase in the price of the neighboring county's land price equating to a 0.284% increase in the observed county's land price. Swine production also negatively impacted the potential land development surrounding the production facilities.

This research shows the factors that influence farmland prices, which include certain correlations that should be addressed when researching farmland values. The explanatory variables and correlations in this paper help to further assess farmland values and what causes the variations in price over time.

Burns et al. (2018) examined the factors that influenced the farmland appreciation we saw in 2000-2016 and how this appreciation affected farms through changes in their equity. This paper used data from the USDA's National Agricultural Statistics Service (NASS), the Agricultural Resource Management Survey, and the 2014 Tenure, Ownership, and Transfer of Agricultural Land (TOTAL) survey.

Burns et al. (2018) found that farmland returns during this period did not support real estate values. They found this by using a price-to-value ratio (PTV). Since the PTV value was over 1, it showed that real estate values were not supported, and that interest rates would need to be lower to be supported. Farmland appreciation also led to fewer financially stressed farms, although not across the board. The appreciation of farmland values benefited major owners (50% or more owned) more than minor owners (own less than 50%) (Burns et al., 2018). Farmers who owned more land had a larger portion of their operation appreciate, so they were worth more value. Major owners can use this appreciation to borrow more since their collateral has increased in value. So, major owners should have benefited more because their appreciation value was greater than those who owned less than 50%. Burns et al. (2018) concluded that changes in farmland returns, interest rates, and U.S. agricultural policy will affect farmland prices in the future.

Burns et al. (2018) show the importance of interest rates and the effects they can have on farmland. It also outlines the effects of land appreciation and shows how the amount of land ownership can determine the financial wellness of the farm. This relationship shows that farmers who rent more production ground are liable to be more stressed even with land appreciation. The relationship between interest rates and farmland values is also highlighted. Burns et al. (2018) shows two important effects that interest rates have on farmland: 1.) Interest rates can raise or lower the cost of buying farmland and 2.) Higher interest rates make equally safe financial investments potentially more valuable, leading to a decline in farmland investment (Burns et al., 2018). This also means that, inversely, lower interest rates make farmland a more attractive investment in comparison to other investments.

CHAPTER 4

FARMLAND RENTAL RATES

Schnitkey (2015) analyzed the decreasing cash rents on professionally managed farmland. Much like Chipman (2021), Schnitkey (2015) wanted to direct his research towards the personal outlook of those in the agricultural field. His data came from a survey used by ISPFMRA, asking farmers what their current rent price is and what their expectations are for next year, 2016. Schnitkey (2015) used 4 classifications of soil productivity to organize the survey results. They are defined as Excellent (190+ bu/acre), Good (170-190 bu/acre), Average (150-170 bu/acre), and Fair (<150 bu/acre). These are common classifications by ISPFMRA, which categorize land productivity based on the corn yield per acre.

Schnitkey (2015) found in his analysis that cash rent has been and is expected to decrease. Cash rent, for Excellent land productivity, has decreased from $374 in 2014 to $350 in 2015 and is expected to be ~$318 in 2016 (Schnitkey, 2015). Professionally managed farmland cash rents did respond more quickly to operator/land returns than average cash rents. Both professionally managed farmland and normal farmland showed, graphically, the lag between land rental rates and returns.

Schnitkey (2015) shows how farmland productivity can affect the rental rate behavior and price of farmland. The classifications of farmland productivity are important in the analysis of farmland prices because of their variation in value. The other important takeaway from this article is the concept of lags in rental rates as they adjust to operator/land returns.

There is some research in examining land ownership and leasing trends of farmland. This research analyses the changes in ownership and leasing based on different demographics, usually separated by age. Katchova and Ahearn (2016) examined farmer age and experience rather than only age when analyzing the ownership and lease trends. They decided to track the farms that were recorded for all 3 previous censuses so that the growth rates in farmland ownership and leasing were collected. They wanted to draw inferences from this data that may explain how young and beginning farmers enter agriculture and how they accumulate the large capital investments that are needed for a farm operation.

Katchova and Ahearn (2016) used data from the Census of Agricultural data. They found that government policy and government payment affect the financial performance of beginning farmers more than the performance of the rest of the farmers (Katchova and Ahearn, 2016). This is likely due to our government’s policy to favor farmers who have 10 years or less of experience. They happen to get opportunities that veteran farmers do not such as leasing exclusive farmland that had been placed in CRP, lower interest rates for financing farmland, and insurance incentives. Young farmers also use farmland leasing as a larger portion of their operation than beginning farmers and all farmers. The trend seems to be that the older the farmer is, the larger proportion of their operation’s land is owned.

It was also found that “... after initial entry into agriculture, beginning farmers further expand their operations only if they are also young” (Katchova and Ahearn, 2016, p. 348). This could mean that middle-aged and older farmers seem to begin farming for the lifestyle and/or investment aspect of farming rather than to expand and build upon the business. Young farmers also usually have other occupations as their main source of income, whereas the older generation uses farming as their main source of income.

The research conducted by Karchova and Ahearn (2016) shows the importance of distinction in variables. Much research concerning this topic is conducted using the definitions of old vs young or beginning vs experienced farmers. It is important to mesh these together to identify trends by farmers who do not have much experience but are older and how they operate their farms. This research also shows that areas with older farmer populations likely have most of the land under their ownership. Likewise, areas with a younger farmer population will likely have a larger proportion of their land leased in comparison to older farmers.

Engsted (1996) tests the PV (present value) model that previous researchers, Tegene and Kuchler (1993), used to test for bubbles by implementing long time-series data for land prices and rents in three U.S. agricultural regions (Lake States, Corn Belt, and Northern Plains). Engsted (1996) uses vector auto-regressive (VAR) methodology as his underlying theoretical framework assuming constant discount rates and expectations are rationally formed (using the best possible forecast based on the most current available information). Previous researchers used PV as their underlying theoretical framework and found little evidence to reject their null hypothesis of rents determining farmland prices.

Looking at the inferences Tegene and Kuchler (1993) made, Engsted (1996) had a few problems with information that wasn't addressed. Those being, if expected future rents were formed "backward-looking" (adaptively) or "forward-looking" (rationally) and if discount rates were constant or time varying (Engsted, 1996). Using rationally formed expectations means we also assume errors are uncorrelated with the information used to generate the forecast and that discount rates are constant. These are the assumptions that Engsted (1996) uses as he formulates his data.

Engsted (1996) used the same data used by Tegene and Kuchler (1993) to conduct his research. Engsted (1996) found “the actual observed spread moves directly opposite to the rational forecast of the present value of future changes in rent” (Engsted, 1996, p. 78). These results provide strong evidence against the PV model used by Tegene and Kuchler.

This paper provides useful inferences collected by both researchers. The model that is used in analysis can alter the results and therefore alter the inferences made from the calculated data. Engsted (1996) shows the problems associated with the PV model which include the importance of specifications of data used, such as how expectations were formed for future rents and if discount rates were constant or time varying in this case.

CHAPTER 5

TRENDS IN FARMLAND MARKETS

Farmland values are also good indicators of how well farmers are doing financially in their region. The values of farmland are bound to change as you go from region to region, so looking at them individually helps show a more accurate depiction as different regions can vary in soil productivity, the proximity of urban areas, and irrigation if it is used in those areas. Nickerson et al. (2018), looked at the prices of farmland, rental rates, and interest rates and the factors that affect them. Nickerson et al. (2018) examined both the macroeconomic (interest rates, alternative investments, debt servicing capability) and parcel-specific factors (irrigation, urban pressures, potential development uses) that affected farm values. They used trend and correlation analyses along with line and bar graphs to make sense of the data.

Nickerson et al. (2018) found that farmland values were supported by farm earnings in 2009 and 2010. During those periods, the average farm income was sufficient to service the farmers' debt. The prices of land have progressively risen, historically, and the effects of lower interest rates are supporting those higher prices. She also found the rent-to-value ratio of farmland in the U.S. has declined over the several decades, showing that farmland rental rates have risen, but not as substantially as farmland values.

It is important to realize where we are currently in terms of farmland finance. Realizing the history of farmland ownership and values and comparing it to now is insightful as to how the macroeconomic, political, financial, and other factors affect farmland. Wendong (2018) documented the current situation of Iowa's farmland and compared his findings to that of studies that have been conducted since 1982. Wendong (2018) collected his data by randomly sampling 40-acre tracts of farmland and contacting the landowner.

This research found some major trends in Iowa farmland. The first is that Iowa farmland ownership by those 65 and older has doubled since 1982 to 60% in 2017 (Wendong, 2018). This is a trend that we see throughout most of the Midwest. Second, the amount of land being cash rented vs alternatives is increasing. According to Wendong (2018, p. 33), “In 1982, leased land was equally divided between cash rent and crop share lease agreements. By 2017, 82% of leased farmland was under a cash rent arrangement.” This trend has been caused in part by landowners becoming more dispersed and preferring cash payment over a crop share. The other consideration is that tenants now have more landowners, making it increasingly more difficult to keep grain from different landowners separated or accounted for, causing crop shares to become more laborious. From my own experience with crop shares, a common agreement on my family farm, there have been times we have had to transport very small amounts of grain 20 plus miles when the next field to harvest was far less than that. If the agreement were a fixed cash rent, we wouldn’t have to be so tedious about separating corn and soybeans from the other landowners.

Third, the proportion of farmland debt-free has increased by 20% over the last 35 years. This affects the amount of land available for other farmers, possibly increasing the value of farmland in certain areas. The last two trends found by Wendong (2018) were that there was an increase in land held for sentimental or family reasons and an increase in the amount of farmland held in trusts or corporations. Both trends further tie-up farmland, eliminating a certain proportion from supply that could be included in the market for other farmers. The land in the trusts will likely be tied up for a generation, and those who hold sentimental value for their land won't likely sell in the near future.

Wendong's (2018) research is useful in realizing the current trends in agricultural land ownership and transfer and how they compare to earlier studies. This gives us a sense of direction of where agriculture is headed. Increases in cash rent arrangements and the relationship between cash rent values and farm returns through time will become increasingly important if these trends continue.

Sherrick (2017) compares capital gain rates, current income/value, and average cropland prices in Illinois through time. Sherrick (2017) also compared different states and their cropland values through time, which includes Illinois, Iowa, Nebraska, Minnesota, California, and Washington. Some states are similar, such as Illinois and Iowa, and other states are much different in a variety of ways. California and Washington have many different commodities than the other states compared as well as climate.

Sherrick (2017) found that California's cropland values through time increased much more dramatically than the other states. This is due to, "different crop mixes and different non-ag pressures than the more agricultural states included and thus has had a more pronounced set of changes" (Sherrick, 2017, p. 1). Those non-ag pressures, urbanization pressures, are likely the reason for the average cropland value increase as it has the potential for development, especially the closer in proximity it is to larger populations. Due to its crop mixes, Washington saw a more gradual but consistent increase in values.

Sherrick's (2017) findings and the tools he used to do so help attain a better understanding of cropland prices in Illinois and other states. California is a great example of being closer to urban areas and the effect it can have on farmland prices, no matter the productivity. The Farmland Value Indexing utility is also mentioned, as it can be used to find relative values of farmland at a particular date based upon known info collected at a different date by the USDA. It can also be used to calculate the rates of capital gain and the income and total returns over the selected intervals.

Jansen (2017) uses the Nebraska Farm Real Estate Market Survey along with weighted average farmland values to monitor value changes through time. The data is based on changes in the value of diverse types of farmlands including cropland, grazing land, irrigated cropland, and an all-land average from 2016 to 2017 in Nebraska.

Jansen (2017) found that the greatest decrease in value was dryland cropland with irrigation potential at 13%. Farmers, according to the survey, were experiencing lower than average commodity prices and were anticipating lower commodity prices in the future. This is possibly the reason that dryland cropland with irrigation potential fell more drastically as farmers would be less likely to buy land that would benefit from costly improvements. Wheat prices were exceptionally low during 2016 causing the Central, Southwestern, and Southern districts to experience a greater decline in values at 15%.

Rental rates also declined with lower commodity prices. “Agricultural land ownership expenses remain high as property tax levels continued to rise on average across the state” (Jansen, 2017, p. 3). This makes the effect of lower commodity prices take more weight as negotiating rental rates becomes more difficult with both sides experiencing high costs with lower returns. These financial stressors lower the land prices since there is less disposable capital available to put towards new investments, contributing to less demand for farmland that would need further improvements as mentioned above.

This information, though in a different state and time, is helpful because it shows the effect financial stressors can have on farmers and landowners. This affects the prices of both farmland and the rental associated, though not as prominent or of as great of an effect as commodity prices. The other aspect of this paper is that it considers all different types of farmlands and calculates the change in value, putting each in perspective. This is an important aspect of my own research. Although I will not have irrigated farmland included, the productivity class based on historical yields will be.

CHAPTER 6

DATA AND METHODS

The area of focus is Illinois' Region 7 (West Central), which is defined as Menard, Cass, Sangamon, Morgan, Scott, Greene, Jersey, Calhoun, Macoupin, and Montgomery counties. This multiple regression model will analyze data taken from 2005 to 2021. The first dependent variable's data is taken from the ASFMRA land values archive that includes the average land price per acre and rental rate per acre of excellent, good, average, and fair productivity classifications. The productivity tracts are defined by indexes based on Bulletin 811, which standardizes productivity. Excellent productivity is defined as indexes above 133, good is defined as 117-132, average is defined as 100-116, and fair is defined as anything below 100.

The other dependent variable in question will be the 30-year bond rate taken from the St. Louis Federal Reserve Bank. The data being analyzed will be taken from 2005 to 2021. The 30-year bond rate will be represented by the annual average percentage. This variable will represent an alternative investment to farmland.

The model will show the relationship that rental rate and alternative investments (30-year bond) have with the farmland values of different types of productivity classes in Region 7 in Illinois. This model will also show the effect of alternative investments and rental rates on farmland values. Figure 1 shows Illinois' Region 7 average land values by productivity type from 2005 to 2021. From the graph, you can see that land values have steadily increased over the last 16 years, most significantly being excellent productivity land values. Excellent and good productivity also shows to have more fluctuations in price in comparison to the other productivity classes. Figure 2 shows Illinois' Region 7 average rental rate by productivity type from 2005-2021. This graph shows that rental rates have fewer fluctuations than land prices and are more consistent. It also shows that excellent productivity rental rate has had the most change over the last 16 years. Figure 3 shows Illinois' Region 7 excellent productivity regression output. Figure 4 shows Illinois' Region 7 good productivity regression output. Figure 5 shows Illinois' Region 7 average productivity regression output. Figure 6 shows Illinois' Region 7 fair productivity regression output.

CHAPTER 7

RESULTS

The following estimations were used for this study and the t-test statistics are shown below the coefficient estimates.

Regression model 1:

Excellent Productivity Land Value = 10598.0 + 16.3(*Rent*) + -1937(*Bond*)

(4.65) (3.60) (-5.76)

Regression model 2:

Good Productivity Land Value = 5965.3 + 18.3(*Rent*) + -1038.5(*Bond*)

(1.42) (1.47) (-2.34)

Regression model 3:

Average Productivity Land Value = 7104.9 + 0.1(*Rent*) + -734.2(*Bond*)

(5.48) (0.008) (-4.86)

Regression model 4:

Fair Productivity Land Value = 4358.6 + -2.6(*Rent*) + -249.3(*Bond*)

(13.57 (-1.35) (-4.25)

H_0: $\beta = 0$

H_1: $\beta \neq 0$

The coefficients and t-test statistics can be found in tables 3, 4, 5, and 6. This data was examined using a .05 level of significance. The degree of freedom for all dependent variables is 16, making the t-critical value +/- 2.120 for all regression models.

The regression model for excellent productivity land values shows that every $1 increase in the rental rate results in a $16 increase in the per-acre value of excellent productivity land. The bond coefficient shows that every 1% increase in bond interest rate results in a $1,937 decrease in the per-acre value of excellent productivity land. The R^2 value for this model is 0.87, which means that 87% of the variation in excellent productivity land value can be explained by the variation in the rental rate and 30-year bond interest rate. The t-test statistic is 3.60 for rental rate and -5.76 for bond interest rate. Both t-test statistics are outside the bounds of the +/- 2.120 t-critical value, so we reject the null hypothesis that either of these values are equal to zero for excellent productivity land value. The P-value is the likelihood that the null hypothesis is true and is also an alternative for testing the statistical significance of the independent variables. The p-values of 0.00 and 0.00 for rental rate and bond interest rate, respectively, are also less than the alpha level of 0.05. This means they are significant and that we reject the null hypothesis that rental rate and bond interest rate are equal to zero, meaning that rental rate and bond interest rate are significant explanatory variables of excellent productivity land value.

The regression model for good productivity land values shows that for every $1 increase in rental rate results in an $18 increase in the per-acre value of good productivity land. The bond coefficient shows that every 1% increase in bond interest rate results in a $1,038 decrease in the per-acre value of good productivity land. The R^2 value for this model is 0.66, which means that 66% of the variation in good productivity value can be explained by the variation in rental rate and 30-year bond interest rate. The t-test statistic is 1.47 for rental rate and -2.34 for bond interest rate. The t-test statistic for rental rate does not exceed the t-critical value of +/- 2.120. This means that we fail to reject the null hypothesis that rental rate is equal to zero for good productivity land value. The t-test statistic of -2.34 for bond interest rate exceeds the t-critical value of +/- 2.120, causing us to reject the null hypothesis that bond interest rate is equal to zero for good productivity land value. The p-value for rental rate is 0.16. This is more than 0.05, so we fail to reject the null hypothesis that rental rate is equal to zero and does not have significant impact on land value. The p-value for bond interest rate is 0.04, so we reject the null hypothesis, meaning bond interest rate is a significant explanatory variable of good productivity land value.

The regression model for average productivity land value shows us that for every $1 increase in rental rate results in a $0 increase in the per-acre value of average productivity land. The bond coefficient shows us that for every 1% increase in bond interest rate results in a $734 decrease in the per-acre value of average productivity land. R^2 for this model is 0.63, which means that 63% of the variability in average productivity land value is explained by the variation in rental rate and bond interest rate. The t-test statistic is 0.00 for rental rate, and -4.86 for bond interest rate. The rental rate t-test statistic does not exceed the t-critical value of +/- 2.120, so we fail to reject the null hypothesis that rental rate is equal to zero for average productivity land value. The bond interest rate t-statistic value exceeds the t-critical value of +/- 2.120, so we reject the null hypothesis that bond interest rate equal to zero for average productivity land value, making it a significant explanatory variable for average land value. The p-value for rental rate is 0.99, so we fail to reject the null hypothesis. The p-value for bond interest rate is 0.00 so we reject the null hypothesis.

Lastly, the regression model for fair productivity land value shows us that for every $1 increase in rental rate, fair productivity land value decreases by $3. The bond coefficient shows us that every 1% increase in bond interest rate results in a $249 decrease in fair productivity land value. R^2 for this model is 0.59, which means that 59% of the variability in fair productivity land value is explained by the variation in rental rate and bond interest rate. The t-test statistic for rental rate is -1.35. This does not exceed the t-critical value of +/- 2.120, so we fail to reject the null hypothesis that rental rate is equal to zero for fair productivity land value. The t-test statistic for bond interest rate is -4.25. This exceeds the t-critical value of +/- 2.120, so we reject the null hypothesis that bond interest rate is equal to zero for fair productivity land value, making it a significant explanatory variable for fair productivity land value.

CHAPTER 8

DISCUSSION

The results of this study show that 30-year bond interest rates are significant explanatory variables for land value for any of the different productivity types. 30-year bond interest rates were also negatively correlated to land value as expected, meaning that when land value goes up, bond interest rates decline and vice versa. Rental rate showed to be a non-significant explanatory variable for good, average, and fair productivity land values. The rental rate for excellent productivity land value proved to be a significant explanatory variable of land value for excellent productivity land. This gives future research a good idea of how bond interest rates can affect land prices. The rental coefficient for fair productivity is negative, which is surprising, however, it is non-significant. The standard deviation and variance for excellent productivity rental rate are higher, meaning that the data is more dispersed (variance) and more dispersed around the mean (standard deviation). With more variability, this could mean that value changes in rental rate were more detectable and easier to correlate with land value for excellent productivity. The variance and standard deviation for good, average, and fair productivity rental rate was significantly lower, which would make changes in rental rate less likely to be correlated to the variability in land value for the 3 productivity classes. This could also explain the negative rental coefficient for fair productivity rental rate.

Another limiting aspect of this study is that only 16 years of data were used. If there were access to more historical data for this region, the results would have the potential to be more accurate. This data also only included a small section of Illinois rather than large swaths of land as used in previous research. In some ways, this creates a more narrowed historical analysis of land prices and rental rates. In other ways, it could be seen as more limiting as there isn't near as much data as there would be had it included entire states or the Corn Belt as a whole.

There are also other variables that could be affecting land prices and rental rates in this area such as farm input prices, proximity to large cities, parcel size, population density, inflation, or even agricultural policy such as the CRP program which would give an alternative income to farming. However, rental rates and bond interest rates accounted for a large portion of the variability in land prices, no matter the productivity. It accounted for 58-86% of the variation in land prices depending on which regression model is being observed.

Overall, this research gives good insight into how farmland prices fluctuate with rental and bond rates. The 30-year bond rate presented itself as a good measure to predict the prices of farmland, while rental rates couldn't fail to reject the null hypothesis with excellent productivity being the exception.

BIBLIOGRAPHY

Burns, Christopher, Nigel Key, Sarah Tulman, Allison Borhcers, and Jeremy Weber. (2018). “Farmland Values, Land Ownership, and Returns to Farmland, 2000-2016.” *USDA.* Economics Research Service. Report 245. Retrieved October 1, 2021.

Chipman, Kim. (2021). “Corn Boom Sends Farmland Value Up Most Since 2012 in Midwest.” *Bloomberg.com.* Retrieved September 28, 2021.

Engsted, Tom. (1996). “Do Farmland Prices Reflect Rationally Expected Future Rents?” Applied Economics Letters, 5(2), 75. Retrieved October 12, 2021.

Giri, Anil, Kyle Lovercamp, Sankalp Sharma, and Iuliia Protopop. (2017). “Do Nebraska’s Agricultural Land Values and Rent Reflect Increased Differential in Yield and Crop Price?” *Economics & Business Journal: Inquiries & Perspectives,* 8(1), 129-138. Retrieved September 20, 2021

Huang, Haixiao, Gay Miller, Bruce Sherrick, and Miguel Gómez. (2006). “Factors Influencing Illinois Farmland Values.” *American Journal of Agricultural Economics,* 88(2), 458-470. Retrieved September 27, 2021.

Jansen, Jim. (2017). "2017 Trends in Nebraska Farmland Markets: Declining Agricultural Land Values and Rental Rates.” *Cornhusker Economics.* 754. Retrieved October 14, 2021.

Katchova, Ani and Mary Ahearn. (2016). “Dynamics of Farmland Ownership and Leasing: Implications for Young and Beginning Farmers.” *Applied Economic Perspectives and Policy* 38(2), 334-350. Retrieved October 5, 2021.

Kuethe, Todd and Daniel Bigelow. (2018). “Bargaining Power in Farmland Rental Markets.” Selected Paper prepared for presentation at the 2018 Agricultural and Applied Economics Association Annual Meeting, Washington, D.C., 5–7 August. Retrieved September 26, 2021.

Nickerson, Cynthia, Mitchell Morehart, Todd Kuethe, Jayson Beckman, Jennifer Ifft, and Ryan Williams. (2012). "Trends in U.S. Farmland Values and Ownership.” *USDA Agricultural Research Service, University of Nebraska - Lincoln*. 1598. Retrieved September 22, 2021.

Paulson, Nick and Gary Schnitkey. (2014). “Farmland Value and Rental Rate Behavior in Illinois.” *Journal of the ASFMRA* 2014, 251-264. Retrieved September 15, 2021

Schnitkey, Gary. (2015). “Decreasing 2016 Cash Rents on Professionally Managed Farmland and Lags in Cash Rent Changes.” *Farmdoc Daily* (5), 174. Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign. Retrieved October 5, 2021.

Schnitkey, Gary (2017) “Illinois Farmland Rents: 2017 State Values and 2018 Outlook." *Farmdoc Daily* (7), 143. Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign. Retrieved September 18, 2021.

Sherrick, Bruce. (2018). “Understanding Farmland Values in a Changing Interest Rate Environment.” *Agricultural and Applied Economics Association,* 33(1), 1-8. Retrieved September 16, 2021.

Sherrick, Bruce. (2017). “Updated Farmland Values and Indexing Tools - 2017.” *Farmdoc Daily* (7), 146. Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign. Retrieved October 9, 2021.

Wendong, Zhang. (2018). “Farmland Ownership Trends.” *Agri Marketing,* (7), 33-35. Retrieved October 6, 2021.

APPENDIX

Table 1: 2005-2021 Summary Statistics of Region 7 Productivity Type Land Values

Excellent Productivity		*Good Productivity*		*Average Productivity*		*Fair Productivity*	
Mean	317.65	Mean	237.35	Mean	172.94	Mean	127.53
Standard Error	17.56	Standard Error	8.44	Standard Error	7.03	Standard Error	7.47
Median	320	Median	250	Median	185	Median	140
Mode	400	Mode	250	Mode	150	Mode	140
Standard Deviation	72.42	Standard Deviation	34.78	Standard Deviation	29.00	Standard Deviation	30.80
Sample Variance	5244.12	Sample Variance	1209.74	Sample Variance	840.81	Sample Variance	948.76
Range	215	Range	125	Range	130	Range	100
Minimum	185	Minimum	150	Minimum	120	Minimum	88
Maximum	400	Maximum	275	Maximum	250	Maximum	188
Sum	5400	Sum	4035	Sum	2940	Sum	2168
Count	17	Count	17	Count	17	Count	17

Table 2: 2005-2021 Summary Statistics of Region 7 Productivity Type Rental Rates

Excellent Productivity		*Good Productivity*		*Average Productivity*		*Fair Productivity*	
Mean	9160.29	Mean	6764.71	Mean	4602.94	Mean	3173.53
Standard Error	702.42	Standard Error	459.91	Standard Error	218.94	Standard Error	80.91
Median	10875	Median	7500	Median	4750	Median	3250
Mode	7300	Mode	7500	Mode	5000	Mode	3000
Standard Deviation	2896.15	Standard Deviation	1896.26	Standard Deviation	902.73	Standard Deviation	333.60
Sample Variance	8387660.85	Sample Variance	3595785.85	Sample Variance	814912.68	Sample Variance	111286.76
Range	8750	Range	6750	Range	3500	Range	1000
Minimum	4250	Minimum	3750	Minimum	2750	Minimum	2500
Maximum	13000	Maximum	10500	Maximum	6250	Maximum	3500
Sum	155725	Sum	115000	Sum	78250	Sum	53950
Count	17	Count	17	Count	17	Count	17

Table 3: 2005-2021 Excellent Productivity Regression Output

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.93
R Square	0.87
Standard Error	1122.49
Observations	17

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	10598.01	2277.43	4.65	0.00
X1 (Average Rental Rate)	16.33	4.53	3.60	0.00
X2 (St. Louis Federal Reserve 30-Year Bond Rate)	-1936.97	336.40	-5.76	0.00

Table 4: 2005-2021 Good Productivity Regression Output

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.81
R Square	0.66
Standard Error	1179.61
Observations	17.00

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	5965.27	4202.59	1.42	0.18
X1 (Average Rental Rate)	18.33	12.44	1.47	0.16
X2 (St. Louis Federal Reserve 30-Year Bond Rate)	-1038.48	443.60	-2.34	0.03

Table 5: 2005-2021 Average Productivity Regression Output

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.79
R Square	0.63
Standard Error	587.34
Observations	17.00

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	7104.87	1296.57	5.48	0.00
X1 (Average Rental Rate)	0.05	6.83	0.01	0.99
X2 (St. Louis Federal Reserve 30-Year Bond Rate)	-734.17	151.00	-4.86	0.00

Table 6: 2005-2021 Fair Productivity Regression Output

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.77
R Square	0.59
Standard Error	229.09
Observations	17.00

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	4358.58	321.13	13.57	0.00
X1 (Average Rental Rate)	-2.56	1.89	-1.35	0.20
X2 (St. Louis Federal Reserve 30-Year Bond Rate)	-249.25	58.71	-4.25	0.00

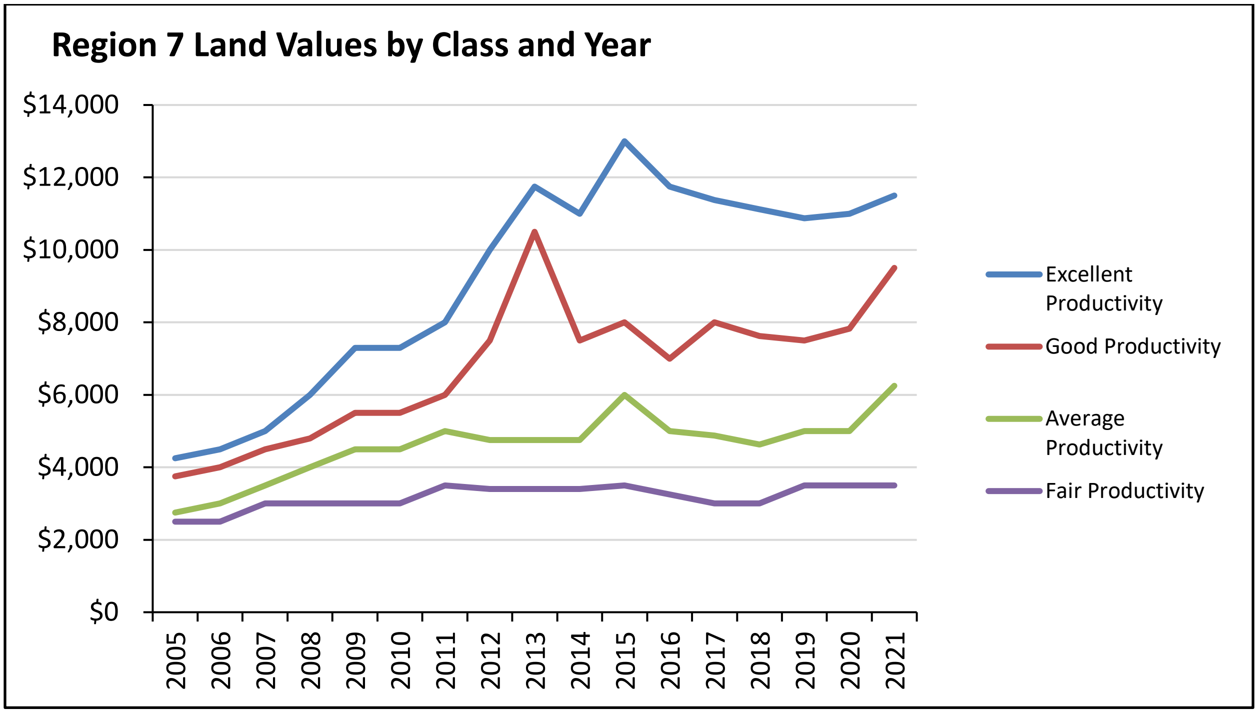

Figure 1: 2005-2021 Illinois Region 7 Average Land Values by Productivity Type

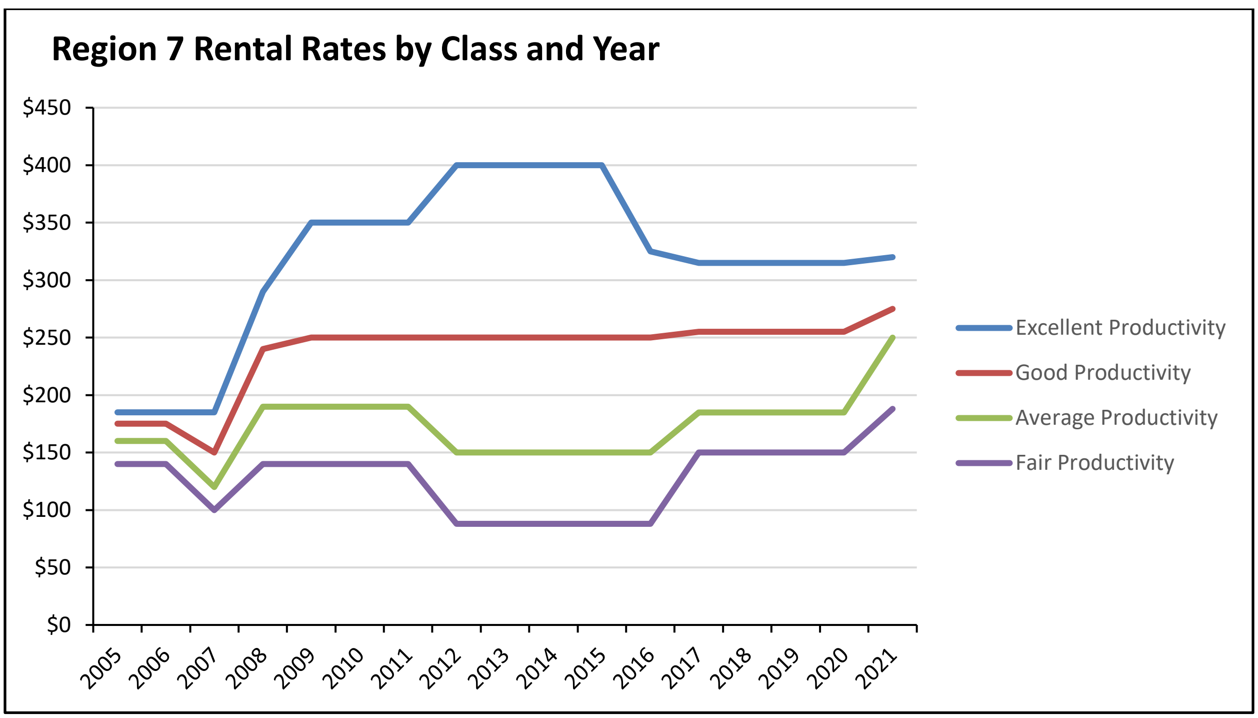

Figure 2: 2005-2021 Illinois Region 7 Average Rental Rate by Productivity Type

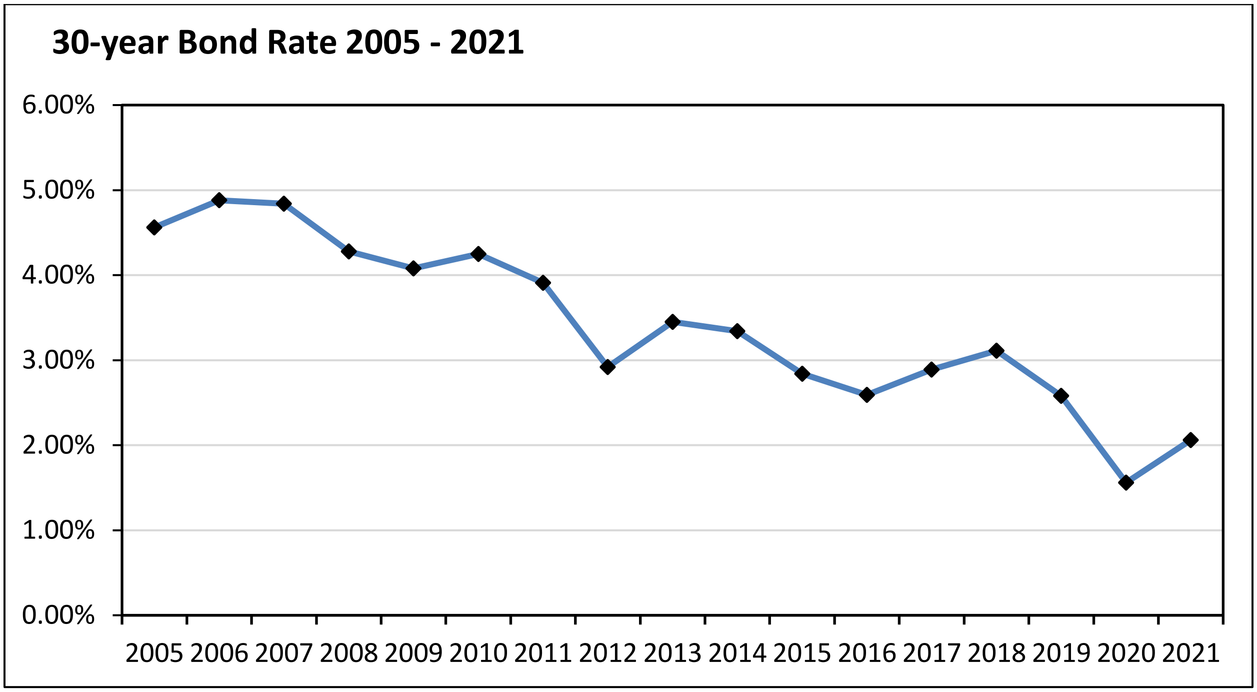

Figure 3: 2005-2021 St. Louis Federal Reserve Average 30-year Bond Rate

VITA

Graduate School
Southern Illinois University Carbondale

Ryan Archibald

ryanarchibald51@gmail.com

Southern Illinois University Carbondale
Bachelor of Science, Agribusiness Economics, May 2021

Research Paper Title:
Analysis of Illinois Farmland Values & Rental Rates by Soil Productivity Class in Region 7

Major Professor: Dr. Dwight R. Sanders