Spring 4-17-2019

Price Determinants of Recreational Land in Illinois

Cameron Hupp
cameron.hupp4@siu.edu

PRICE DETERMINANTS OF RECREATIONAL LAND IN ILLINOIS

by

Cameron Hupp

B.S., Southern Illinois University, 2018

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

Department of Agribusiness Economics
Southern Illinois University Carbondale
August 2019

RESEARCH PAPER APPROVAL

PPRICE DETERMINANTS OF RECREATIONAL LAND IN ILLINOIS

by

Cameron Hupp

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. Ira Altman, Chair

Graduate School
Southern Illinois University Carbondale
April 17, 2019

AN ABSTRACT OF THE RESEARCH PAPER OF

Cameron Hupp, for the Master of Science degree in Agribusiness Economics, presented on April 17th, 2019 at Southern Illinois University Carbondale.

TITLE: PRICE DETERMINANTS OF RECREATIONAL LAND IN ILLINOIS

MAJOR PROFESSOR: Dr. Dwight R. Sanders

It's no secret that Illinois farmland is extremely expensive and has been on a steady rise for the past several decades. The highly sought after features of many different pieces of Illinois farmland coupled with the favorable growing climate found in Illinois translates to advantageous yields and potential for substantial revenues for farmers and landowners. Although prices have remained relatively stagnant throughout the past few years, it can be inferred that the long-term trend of farmland value will continue its path trending upward. With this being said, the margin for profit will become even slimmer and the ag real estate market will be as competitive as ever. Recreational properties have had an increase in popularity in recent years, and many people are purchasing recreational properties purposely placing recreation ahead of farming practices and income. Because of this, recreational farmland in certain areas of the state that can offer these characteristics could benefit in value. Recreational characteristics including total buck harvest, CRP enrollment per square mile, timberland forest cover per square mile, proximity to metropolitan areas, and others will be used to explain the potential affect to average recreational land values in different areas of the state.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

<u>FIGURE</u>

CHAPTER 1

INTRODUCTION

Average Illinois farmland values, across all regions, have been trending upwards over the past 20 years. Reports conducted by the Illinois Society of Farm Managers and Rural Appraisers (ISFMRA) show that from 2001-2010, the continuously compounded annual growth rate (CCAGR) of all categories of farmland in Illinois including excellent, good, average, fair, and recreational tracts increased substantially, with an average growth rate of 9.402%. From 2010 to 2017, the CCAGR across all regions was significantly less with an average growth rate of 3.264%, most of this being due to the relatively stagnant and even slightly decreasing average growth rates from the past few years. However, the long term trends suggests that farmland values will continue to increase in the future.

Based on these figures coupled with the current economic state and the ever narrowing window for profits, it is clear that Illinois farmland values are of great importance to a variety of parties. While it is clear that the potential for farm profits is the driving force behind the highly sought after nature of productive Illinois farmland tracts, it is the recreational tracts that are much less attractive to revenue-seeking farmers and landowners that this research will be focused on. Statistically, recreational tracts are worth significantly less than all other types of farmland in Illinois, but when considering that these tracts are still worth an average price per acre in 2017 of $3,420 across the state of Illinois (Baker, Klein, Haight, Sherrick, 2018), the buying and selling nature of these tracts is still highly competitive. Although these recreational tracts offer less financial benefit compared to other types of tracts, they can offer an “unmeasurable” added value to buyers that are looking for recreational properties with certain characteristics. To better understand this, consider Illinois's popularity among outdoorsman, especially deer hunters. According to the Quality Deer Management Association (QDMA), Illinois falls in the category of states with 5-8 hunters per square mile, which places it in the upper tier of all states in hunter density (Adams, 2016). Among all of these hunters, there are a number of deer hunters that place personal recreation above any type of farmland productivity and income. Because of this, recreational tracts in Illinois could potentially garner more interest and value based on certain characteristics that add to the favorability of these types of properties. For example, Pike County in Illinois is a traditional hotspot for producing large deer in Illinois, much more so than most other counties in Illinois. With this considered, does the shear nature of recreational tracts in this county make them more valuable when looking at price per acre? In South Dakota it was determined that 64% of all non-local land purchases were for hunting purposes (Shultz, 2007). Although Illinois and South Dakota are two different states, they share the fact that both contain an abundance of quality recreational properties that are considered valuable to some buyer. However, similar to tracts that are concerned strictly with productivity, recreational tracts also have added value based on location, quality of the property, and various other related variables.

The goal of this study is to determine which of these variables most directly affects average recreational farmland value per acre in Illinois. Information collected from this study will help spread insight to landowners looking to sell their recreational properties in search of ultimate value that may not have realized some of the potential that their property may have had. Also, it could help supplement professional farm managers and appraisers looking to best serve their clients, farmers searching for the best cash rent rates, and even potential recreational land buyers looking to attain the best price possible on a new property. Because of the diversity within the state of Illinois, certain regions of Illinois display traits much different than other parts of the state, and this affects the average price of recreational properties. A hedonic pricing regression analysis will be used to help describe the variables' effect on the average recreational land price per acre in Illinois. The explanatory variables included in the model will be average size (Acres), average productivity index (PI), % tillable, number of sales, proximity to metropolitan areas, total buck harvest per square mile, timberland acreage per square mile, and CRP enrollments per square mile.

CHAPTER 2

REVIEW OF LITERATURE

While it is known that agricultural land prices have generally increased over time, the determining factors contributing to the increases are less well known. Farmland value in Illinois over the past couple decades has seen a relatively steady upward trend, but as of the past few years, farmland value is decreasing. Similar trends were seen in Kansas and this was recognized and attempted to explain. The authors of the study, “Determining Land Values Using Ordinary Least Squares Regression”, set out to break down why this sudden decrease in land value may be by looking at several factors relating to land values and prices (Taylor, Schurle, Rundel, Wilson, 2015). A sample based on the average value of land was created to reference the individual land values. A breakdown of the analysis also allowed researchers to categorize the land based on quality, size of parcel, and location, and furthermore, the location of the land also had factors including tax rates, proximity to urban areas, and rainfall patterns that also helped determine why land values were higher or lower in certain areas. Although they weren’t able to determine a market downturn or any confirmed reasoning behind this sudden downward trend because of a lack of time and space, they were able to determine that the regression analysis they used to determine agricultural land values in Kansas proved to be useful for this application.

So why is this increase of farmland value in Illinois substantial and who does it affect? Farmland accounts for approximately 80% of the value of all assets in the farm sector which makes it crucial for us to understand what variables and characteristics compose its value (Huang, Miller, Sherrick, Gomez, 2006). Farmland is classified as a capital asset which means that its useful life is deemed to be more than a year and it is not intended to be sold during its use. “The idea is to obtain the asset for a price that is less than the real earnings (future earnings adjusted for inflation) that it will produce. The lower the price paid for an asset in relation to its future earnings, the better the rate of return earned on the investment” (Gloy, Hurt, Boehlje, Dobbins, 2011 p. 8). With potential for future earnings and an investment that will most likely increase in value with time, it is evident why farmland is such a competitive faction of agriculture.

Before recreational variables are considered, it is important to realize what “traditional” characteristics contribute to the value of farmland in Illinois. Paulson (2013) performed a study to help identify the factors that determine revenues, returns, and profitability on row crop farms, specifically corn and soybeans, in Illinois (Paulson, 2013). With only so much time and money to allocate to certain aspects of the farm, farmers are constantly trying to determine what will provide the most efficient return to their farm, whether that be trying to maximize yields, minimizing costs, or better marketing their grain. Overall, Paulson (2013) was able to determine that certain farms outperformed their peers by having better productivity and lower costs. Although seemingly obvious, this shows that part of a farm’s land value relates directly with the productivity of the land.

There has been substantial research on topics related to land value and how different land characteristics may affect farmland value. However, this research is focused more on production factors and various other non-farm factors affecting land values, excluding a recreational focus. Huang et al. (2006) realized the lack for a study that accounts for both farm and non-farm variables, so they created a study aimed at covering a wide variety of variables that could impact farmland value. They also decided to account for temporal and spatial variation, as various characteristics of farms vary over time and geographical location. Their independent variables included commonly examined variables such as soil productivity, permanent improvements, and parcel size. Non-agricultural influences, including development potential and non-farm uses, are proxied by the distance to Chicago and other large cities, population density, ruralness of the county in which the land is located, and nonfarm income. The use of a spatial lag, a serially coordinated hedonic pricing model allowed the researchers to develop statistics. Hedonic pricing models have been used previously in similar studies concerned with farmland values and can be considered relatively reliable. Results indicate that farmland values increase with soil productivity, population density, and personal income, but decline with parcel size, ruralness of the county, and distance to Chicago and other large cities. The model also showed that Illinois farmland values are spatially and temporally correlated, indicating substantial spatial effects across Illinois counties and the presence of dependence over time. (Huang et al. 2006)

The two main aspects of this paper that need to be stressed are average land value and the recreational variables that affect it. However, because of the minimal amount of studies looking at the relationship between average land value and recreational variables, we will have to split up our contributing literature into different categories. One of the categories, average land value based on production and non-farm variables, was covered in the above study. Now that we have an understanding and brief overview of how different farm and non-farm variables affect outright farm value, we can move on to the recreational category of this paper. Since this study is mostly concerned with recreational variables, it is important to consider previous studies that have dealt with recreational variables and determine how they could contribute to this study.

Henderson and Moore (2006) look at the notion that properties with recreational leasing options can lead to increased farm land values for owners. And more specifically, this study is trying to determine whether farmland values are higher in areas that have higher wildlife recreation income. A Hedonic price model was used to analyze the wildlife recreation income data. The dependent variable being county farmland value, based its value off of 12 independent variables. Hunting lease rates, population density, population growth, non-metropolitan counties adjacent to metropolitan counties, metropolitan counties, county crop receipts, county livestock receipts, county government payment receipts, natural amenity geography index, farms receiving recreation service income, average county recreation service income per acre, and deer per 1000 acres were the independent variables considered. Overall, it can be determined that Texas farmland values are higher in areas that have higher wildlife recreation income. With this being said, land appraisers and land owners that have been valuing land strictly based off its agricultural potential may need to reconsider their practices. Although this isn't a carbon copy of what will be covered in my study, there are various findings that can be taken away, including the use of a deer related variable.

To become further familiarized with how recreational variables can contribute to marginal property values, "The Value of Hunting Package Attributes" (Buller, Hudson, Parkhurst, Whittington, 2005) breaks this concept down into a slightly different manner than Henderson and Moore. The data in this study was gathered from 13 different private firms that offer fee-based hunting. From the 13 different private firms, over 78 different hunting packages were offered and characteristics included number of days being hunted, bag limits, lodging, food, guide service, trophy fees, fishing, photography and species being hunted (Buller et al. 2005).

This study analyzed the explanatory variables using regression analysis. The variables included species pursued on each of the properties split up into deer, waterfowl, dove, and quail or pheasant. The remaining explanatory variables included price, number of days being hunted, food availability, lodging availability, fishing, transportation, guide availability, trophy fee, and limits. Results showed that days, fishing, and lodging were all positive and significantly different than zero. The species that were used in the model all had positive coefficients suggesting that all species increased package prices relative to the base category of dove. The coefficients for food contained negative values and it was not statistically significant. Transportation, trophy fee, and guide service were also not statistically significant at the 5% and 1% levels. Overall, this study concluded that, based on which species of animal being pursued, as well as the overall amenities surrounding the property and a few other variables, significant value can be attributed to hunting packages. This article helps show that certain hunting-based variables can add significant value to a property.

The final study evaluated related to average farmland value covers how Illinois recreational leases can supplement landowner income. Eberle and Wallace (2008) retrieved the data for this model via survey. The survey was prepared and sent to the ISFMRA and it included several different types of questions to be answered by farm managers within the society. Responses were split up based on whether the managers had recreational leases or not. A hedonic model was used to analyze independent variables including regional location, size of tract, land composition, term of lease, land management practices, superior leases, and quality of wildlife, while the dependent variable was lease rates per acre. Because of the relatively low survey response rate, it was tough to determine the actual integrity of the model. Although they couldn’t deem their results completely reliable, their results led them to the conclusion that opportunities for recreational leases provide landowners with an extra means of creating income from their property. “Our results suggest that location, cropland percent, and adoption of land management practices to enhance habitat had positive impacts on lease rates for high-valued recreational property” (Eberle and Wallace, 2008, p. 33).

Although these last three studies were focused on the landowners capitalizing on supplemental income via recreational leases/hunting packages instead of focusing on outright land values, plenty of evidence needs to be provided that recreational characteristics can add or subtract some sort of financial value to a recreational landowner. With an abundance of credible, academic studies focused on the topic of recreational leasing contributing to farm income and a much smaller number of academic studies focusing on recreation and its contribution to average land value, I felt these studies were important to help bolster the idea that recreational variables contribute financial value. “How Much Influence Does Recreation Have on Agricultural Land Values?” is a study dedicated to determining whether recreational activities such as hunting, fishing, bird watching, and photography have a significant impact on the price of agriculture land values in Oklahoma, and it was also the study that I utilized the most in the preparation of my data and model (Guiling, Brorsen, Doye, 2007).

It was determined that investment and recreation were the top two reasons for land purchases in Oklahoma in 2002 and 2003, and this is part of what sparked this study by Guiling et al. (2007). The data included 7,387 observations of agriculture land sale prices from 2001-2005. Farm Credit Services in Oklahoma had extensive records and data for many variables of all 77 counties in Oklahoma including land price per acre, the dependent variable, and the independent variables of county location, sales date and land use separated into pasture, cropland, timber, waste, irrigated cropland, recreation land use, and areas of water. Rainfall, cattle market value, crop value, population growth and density, deer harvest data, and a few other variables were gathered by outside data sources as well. A hedonic regression model was utilized in determining the significance of these variables and completing this study. Over 80 variable were looked at in this study making it the most extensive study I've seen to date. The authors were able to determine many variables that had a statistically significant impact on land prices in Oklahoma. Some of the variables including rain, pasture, timber acres, irrigated cropland, and percent of cropland all were significant at a .01 α level and contained the expected positive or negative signs. Percent of water was also found to be significant and positive in tracts greater than 80 acres.

This study was not perfect due to limitations in gathering data related to recreation. Although not all variables proved to be significant and contained the signs that the authors expected them to, they were able to conclude that although land productivity, interest rates, and cash rent have always been seen as the main contributors to agriculture land prices. Recent literature and studies have shown that recreation, urban effects, and other non-farm uses are also affecting agriculture land prices.

Next, the variables that will be used in this research paper need to be considered. While the first 4 variables of number of average tract size, average productivity index, percent tillable, and number of sales are control variables to help account control for potential effects of countywide tillable ground and tract characteristics to the dependent variable, the remaining 4 variables will actually be considering recreational characteristics of Illinois recreational ground.

While the RUCC variable has been used in several previous studies and its direction and level of significance are pretty consistent within these previous studies, the remaining 3 variables have some question marks. “A Hedonic Pricing Model for Hunting in Denmark” examines variables that affects the prices on hunting leases in Denmark (Lundhede, Jacobsen, Jellesmark, 2008). The lease of hunting rights can contribute to a landowner’s income in Denmark, therefore it is valuable to understand what makes certain hunting lands more attractive to hunters. The part of this study that contained the most relevance, however, is the variable they used to represent the value deer contribute to lease values. The variable they used analyzed the bag rate of deer in Denmark, and it was named bagrate_deer. The results for this variable indicated that the bag rate of deer did have a positive influence on price in Denmark, although the effect wasn’t as substantial as expected. The coefficient indicated that the lease price only changed by about 2% per deer in bag. Although there will be several differences between this study and mine, it does show that a variable accounting for deer harvest can have a significant effect of land/lease value.

With the fact that a deer harvest variable can contribute positively and significantly to a value based dependent variable, it seems that presence of timberland and CRP ground would follow pattern considering they are two extremely important parts of a white-tailed deer’s habitat, as well as various other species of wildlife in Illinois. Ferris and Siikamäki (2009) created a study that looks at the numerous benefits of land retirement to the ecosystem. The part of this study that pertains directly to my studies deals with the recreational benefits of the Conservation Reserve Program. The data that I pulled comes from Feather et al. (1999) and states that for every acre enrolled in CRP, roughly 15$ of recreation value is created. Also, a random sample of 4,000 landowners with enrollments in CRP determined that over 57% of landowners enrolled used all, or part of their CRP ground for recreational purposes (Ferris and Siikamäki, 2009). These findings helped my decision in including a CRP variable in my study. A timberland variable is included as well because timberland is the primary determiner of recreational ground and supports habitat for various different types of sought after species of wildlife in Illinois.

CHAPTER 3

DATA AND METHODS

The data for this study was gathered from a variety of contributing sources including the Illinois Society of Farm Managers and Rural Appraisers (ISFMRA), Illinois Forestry Development Council, Illinois Department of Natural Resources and Environmental Services, and United States Department of Agriculture (USDA). With the way most of the datasets were composed, it made the most sense to categorize each individual dataset by county. Categorizing the data by county also provides a more specialized analysis of the state, compared to the ISFMRA's approach of splitting the state up into 10 regions determined by geographic location.

The dependent variable, average recreational land price per acre, was provided by the ISFMRA (Baker et al. 2018). The dataset includes 17 years of information, ranging from 2001-2017, and 1,751 individual sales of recreational tracts across that timeframe in Illinois counties. 94 of the 102 Illinois counties reported at least one individual sale, with an average of 18.6 individual recreational land sales per county. The number of sales variable included in the model shows how many individual land sales each county contained. Several counties, however, contained limited number of sales which in turn doesn't provide an accurate representation of the counties and invites error into the model. Average recreational land price per acre across the 94 reported counties in Illinois totaled $3313. As previously stated over 1,751 individual sales contributed to this number, giving it a respectable amount of credibility in representing the true average. Alexander County displayed the lowest average recreational price/acre at $1739, while Boone County displayed the highest average recreational price/acre at $7925. The average tract size (acres), average productivity index (PI), % tillable, and number of sales variables were also all obtained from the ISFMRA (Baker et al. 2018). The average tract size (acres) variable was created to see the size of farms being sold in each county had an effect on the dependent variable. These individual tract sizes were grouped by county and a county-wide average tract size in acres was determined. The average tract size across the 94 reported counties in Illinois was 85 acres. A tract size variable or something similar is a relatively common variable and has been included in previous recreational studies (Huang et al. 2006 and Guiling et al. 2007). Ford County contained the smallest average size tracts at 30 acres and Schuyler County contained the largest average sized tracts at 235 acres.

The average productivity index (PI) is another variable used to control for the dependent variable. The productivity index represents the productive capacity of Illinois farm ground. To better illustrate, when considering tillable or productive acreage, ground with a lower PI will be less productive and should be worth less, while ground with a higher PI will be more productive and should be worth more. The productivity index is given on a scale ranging from fair to excellent. Tracts with a fair PI fall in the less than 100 range, an average PI covers the 100-116 range, a good PI covers the 117-132 range, and an excellent PI covers the 133-147 range. Again, these individual tract PI's were then grouped by county and a county-wide PI was calculated for each of the 94 counties included. The average PI across the 94 reported counties in Illinois was 94. Sangamon County displayed the lowest average PI at 0, which is a data error, while Boone County displayed the highest average PI at 126.

The % tillable variable was used as another control for the dependent variable. Since all forms of productive tracts are typically worth more than recreational tracts because of their income-producing nature, the % tillable of each recreational tract must be determined to accurately control for the income-producing, tillable value of the tract. For example, a recreational tract that is 50% tillable should, in theory, be worth more than a recreational tract in the same area that is only 25% tillable, because of its income-producing nature. The % tillable from each tract was then grouped by county and a county-wide percent tillable was calculated for each of the counties. The average % tillable across the 94 reported counties in Illinois was 24%. Several counties displayed the lowest % tillable of 0, while Winnebago County displayed the highest % tillable of 70%.

The number of sales variable was again used to control for the dependent variable. This variable represents the number of tracts sold from 2001-2017 in all Illinois counties. As stated earlier, there were 1,751 individual sales across 94 Illinois counties, with the 8 counties not included being centered on the Chicagoland area. The overall theory behind this variable can be disputed, however, and the way it is interpreted will depend on the regression. Ford, McHenry, Grundy, and Menard Counties displayed the lowest number of sales at 1 sale, while Jo Daviess displayed the highest number of sales at 70 sales.

The remaining variables were created through secondary datasets from several different sources, and each of the 102 Illinois counties was included in these datasets. The first variable, RUCC (2013), is a list of rural-urban continuum codes for each Illinois County and was compiled by the USDA Economic Research Service. The 2013 rural-urban continuum codes create a structured number system that categorize metropolitan counties by the population size of their metro area, and nonmetropolitan counties by degree of urbanization and adjacency to a metro area. The number system includes 1-9, with 1 being the most urban counties and 9 being the most rural counties. These RUCC's help to determine if location affects the dependent variable, and if it does, by how much. This exact method was used by Guiling et al. (2007) in their study looking at Oklahoma recreational farmland values. Bond County is an example of a county with a 1 RUCC, while Cumberland County is an example of a county with a 9 RUCC.

The total buck harvest per square mile (2005-2016) variable represents the density of total bucks harvested per county. Deer hunting is a large source of economic revenue in the state of Illinois due to its reputation and prime habitat for developing large bucks, which is why this variable is included. Avid deer hunters have, in certain cases, paid premiums for recreational property in traditional rich deer hunting counties, so it seemed sensible to try and capture the nature of these premiums statistically. The Illinois Department of Natural Resources (IDNR) compiled the total buck harvest data, but to accurately control for the size of each county, a density aspect was added. This was done by taking the total buck harvest and dividing by the size of each county in square miles, which was compiled by the ISGS. The resulting variable gives a number that fairly represents the total buck harvest of all counties regardless of size. Pike County contains the highest total buck harvest per square mile at 30.4 bucks, while DuPage County contains the lowest total buck harvest per square mile at 0.1 bucks.

The next variable was created to try and capture the economic effects of one of the main features of recreational property, timberland. This variable, timberland acreage per square mile, will be testing whether the dependent variable, average recreational land price/acre in Illinois, can be affected by the density of timberland in the county that it is located. The data for this variable was compiled by the Illinois Forestry Development Council and Department of Natural Resources and Environmental Sciences at the University of Illinois in Champaign in 2002. This data gives a figure for each Illinois County in thousands of acres. This figure was then divided by the size of each county in square miles to create a density aspect. Illinois forests consist of about 12% (4.3 million acres) of Illinois' land area, with a large density of these forests centered on the Illinois River near Peoria, Fulton, Schuyler, Brown, Hancock, Adams, and Pike counties. (Bretthauer & Edgington, 2002) The other large densities of timberland occur at and around Fayette County, with a pretty steady trail south into the southern part of the state, especially the counties that contain the Shawnee National Forest. Several counties contained the lowest timberland acreage per square mile figure of 0, while Pope County contained the highest timberland acreage per square mile figure of 407.

The final explanatory variable, CRP enrollment per square mile, is very similar to the timberland acreage per square mile variable. However, due to the lack of data available for CRP acreage per county in Illinois, this variable instead considers the number of CRP enrollments in each county. This variable assumes that counties with a higher number of CRP enrollments will translate into a larger total CRP acreage. The data for this variable was retrieved by USDA's Farm Service Agency. The data from each Illinois County from 2001-2017 was compiled then averaged to give us an accurate representation of the CRP enrollments over a respectable time frame. To be clear, this variable doesn't look at the effect of CRP enrollments on a certain individual tract's value, but instead the effect of CRP enrollments on the value of all tracts within each Illinois County. Dupage County displayed the lowest CRP enrollments per square mile at 0 enrollments, while Massac County displayed the highest CRP enrollments per square acre at 126 enrollments.

CHAPTER 4

RESULTS

A linear, ordinary least squares regression (OLS) was used for this study to show the relationships and significance of the independent variables on average recreational land price per acre in Illinois. The following OLS estimation was used for this study with the coefficients preceding the variable:

Table 1: Regression Model with Coefficients

$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \varepsilon$

Average Recreational Land Price/Acre = 4229.15 (Coefficient) + .68 (Average Size (Acres)) + -1.26 (Average Productivity Index (PI)) + 22.45 (% Tillable) + -4.84 (Number of Sales) + -120.48 (RUCC (2013)) + 6.35 (Total Buck Harvest per Square Mile (2005-2016)) + -6.28 (Timberland Acreage per Square Mile (2002)) + -8.54 (CRP Enrollments per Square Mile (2001-2017)) + Error

Before the regression model was ran, the average PI, % tillable, total buck harvest, timberland acreage per square mile, and CRP enrollments per square mile were expected to be have positive coefficients, while the RUCC variable was the only one expected to be negative. The number of sales and average size variables, however, offered mixed ideas. It seemed that the average size of individual tracts sold per county would affect the price per acre of recreational ground in that county in a negative manner, but it was hard to put much confidence in that guess. As for the number of sales variable, it seemed that the average price per acre of average recreational ground in that county would increase with an increased number of sales, but again the theory behind that wasn't very concrete.

After running the regression model, the results proved to be interesting and offered a few surprises. The first overall regression model ran included all 8 independent variables. The regression was re-ran a second time excluding the statistically and theoretically least significant variables, average size (acres) and number of sales. This model yielded coefficients of the remaining 6 independent variables that were very similar to the coefficients in the initial regression model as well as a negligent change in the adjusted R-Squared. For the third regression model, it was decided to exclude only the number of sales variable, as it seemed that this variable had almost no significance both statistically and theoretically. Again, removing this variable didn't affect either the individual coefficients or the adjusted R-Squared significantly. Because of the minimal effect from removing these variables, it was decided to just keep the original regression model that included all variables to show the coefficients and t-test statistics of all variables tested. All variables were tested at a 95% confidence interval with degrees of freedom of 93, since 8 of the 102 Illinois didn't offer any data to construct a dependent variable. The corresponding t-critical value for all variables included was determined to be ±1.987. If the variables contain a t-test statistic that falls within the critical value range of -1.987 to +1.987, the variable will fail to be rejected and it can be concluded that the variable doesn't differ from 0 significantly and is statistically insignificant. However, if the variables contain a t-test statistic that falls outside of the critical value range, the variable will be rejected and it can be concluded that the variable varies from 0 significantly and is statistically significant.

The coefficient for average size (acres) reads that for every acre increase in average tract size by county, there is a $.68 increase in average recreational land price/acre in Illinois by county. Because of the mixed opinions on the theory behind this coefficient before the regression was ran, it's hard to tell if this result makes sense or not. Also, there have been several previous cases of extremely large farms that don't fetch near the price per acre that they're statistically worth because of the shear capital it takes to acquire a place of such size, which would disagree with the coefficient that the regression determined. The average size (acres) variable had a t-statistic of .215, so the null hypothesis in this case fails to be rejected and the variable is deemed statistically insignificant in this model.

The coefficient for average PI reads that for every 1 point increase in average PI by county, there is a $1.26 decrease in average recreational land price/acre by county. This coefficient should contain a positive coefficient as an increase in the productivity index should add to the overall land price per acre, but the regression showed otherwise. Also the statistical insignificance of this variable was surprising, because basic theory suggests that this variable should have a noticeable effect on the dependent variable, but again that was not the case. The average PI variable had a t-statistic of -.287, so the null hypothesis in this case fails to be rejected and the variable is deemed statistically insignificant in this model.

The coefficient for % tillable reads that for every 1 % increase in % tillable by county, there is a $22.45 increase in average recreational land price/acre by county. This variable makes sense both statistically and theoretically, as tillable ground is worth considerably more than non-tillable recreational ground because of its income producing nature. Again, this variable was used serves as a control variable for the last 4 variables to help account for the differences in the dependent variable that underlies the data. The % tillable variable had a t-test statistic of 2.831, so the null hypothesis in this case is rejected and the variable is deemed statistically significant in this model.

The coefficient for number of sales reads that for every 1 sale increase in number of sales by county, there is a $4.85 decrease in average recreational land price/acre by county. As stated earlier in the data and methods section, it was difficult to determine whether there was any theory behind this variable that made hard sense. You could assume that if there was a high number of sales in a county that the ground may not be as desirable or could be decreasing in value, but you could also make the point that a higher number of sales would correlate with increasing value leading to people wanting to buy and sell said ground. However, the coefficient sides with the first theory as there is a decrease in land value with a higher number of sales. The number of sales variable had a t-test statistic of -.655, so the null hypothesis in this case fails to be rejected and the variable is deemed statistically insignificant in this model.

The coefficient for RUCC reads that for every 1 point increase in RUCC by county, there is a $120.48 decrease in average recreational land price/acre by county. Remember, the rural-urban continuum codes are on a scale from 1-9, so an increase from 1-2 or 7-8 would result in a $120.48 decrease in the dependent variable. So the more rural a county is, the less valuable the land will be worth, which was expected based on previous studies including this variable from other states. The RUCC variable had a t-test statistic of -2.831, so the null hypothesis in this case is rejected and the variable is deemed statistically significant in this model.

The coefficient for total buck harvest per square mile reads that for every 1 unit increase in total buck harvest per square mile by county, there is a $6.35 increase in average recreational land price/acre by county. This unit makes sense directionally, but with an average total buck harvest across all 102 counties of 9.87 bucks, this variable doesn't affect the dependent variable as substantially as initially expected. So from DuPage County which has the lowest total buck harvest per square mile at .60, to Pike County which has the highest total buck harvest per square mile at 30.36, there is only a $188.98 difference in the effect on the dependent variable. Although the effect from this variable was expected to be more substantial on the dependent variable, there have been very limited studies in the past including variables of this nature to give a good base for inferences. The total buck harvest per square mile variable had a t-test statistic of .268, so the null hypothesis in this case fails to be rejected and the variable is deemed statistically insignificant in this model.

The coefficient for timberland acreage per square mile reads that for every 1 unit increase in timberland acreage per square mile, there is a $6.28 decrease in average recreational land price/acre by county. Initially, this variable sparked thoughts of the dependent variable being higher in areas with denser timberland. It seemed that recreational tracts which typically have large amounts of timberland would benefit in value from being in areas that also have large amounts of timberland because of the larger amounts of surrounding habitat and larger population of game. But instead, the coefficient worked in the opposite direction. Recreational tracts are actually worth more in areas that are less densely covered in timberland. Since this result was shown by the regression, it makes sense if you consider it in terms of being unique. Consider a county with a very low timberland acreage per square mile figure like Boone County. A recreational tract in a county like Boone is unique because there aren't many other similar recreational tracts in that county. The availability of free land also supports this notion as well. In areas that have a lot of timberland, the amount of public land that is free for use by anyone is also usually higher as well. Because of this, there is a greater supply of recreational land to use free of charge which takes from the value of recreational tracts around them. Using basic economic theory, a low supply yields a high price, and that is exactly the case for describing the results of this variable. On the other hand, a county with a high timberland acreage per square mile figure like Hardin County has a large supply of tracts that contain recreational-like properties. High supply translates to low demand, and in this case a lower dependent variable value. The timberland acreage per square mile variable had a t-test statistic of -3.551, so the null hypothesis in this case is rejected and the variable is deemed statistically significant in this model.

The coefficient for CRP enrollments per square mile reads that for every 1 unit increase in CRP enrollments per square mile, there is an $8.54 decrease in average land price/acre by county. This variable shares similarities with the previous variable in many ways, but its statistical values do differ. This is another density figure that requires a supply and demand way of thinking to interpret. Counties that have a lower amount of CRP enrollments (which also have a large presence in recreational tracts) have a smaller supply, therefore the recreational tracts in those counties will be worth more, and vice versa for counties with a higher amount of CRP enrollments. The CRP enrollments per square mile variable had a t-test statistic of -1.392, so the null hypothesis in this case fails to be rejected and the statistic is deemed statistically insignificant in this model.

The R^2 represents the percentage of the response variable variation that is explained by a linear model. The adjusted R^2 accounts for the number of variables used that the normal R^2 doesn't include, so this is the figure that was used to represent the regression model. The adjusted R^2 value of .392 means that 39.2% of the variation in average recreational land price/acre by county can be explained by the 8 independent variables included in the model. The F-statistic for the null hypothesis of H0: $\beta1 = \beta2 = \beta3 = \beta4 = \beta5 = \beta6 = \beta7 = \beta8 = 0$ is 8.501, which is well above the critical value of 2.097, so the null hypothesis can be rejected.

A fourth regression model was created to minimize errors and maximize the adjusted R^2. This model included only the % tillable, RUCC, timberland per square mile, and CRP enrollment per square mile because of their high t-test values. Although CRP enrollment didn't have a statistically significant t-test value in the first regression, it was relatively close so it was included in this last regression. If you look at the regression results in table 4 and table 5, you can see that there really isn't that large of a difference in the coefficients, t-test values, and adjusted R^2 values. Because of the minimal differences in these values, the decision was made to use and interpret the original regression that included all 8 variables.

CHAPTER 5

DISCUSSION

This study was created to help determine whether certain factors related to recreational land in Illinois could affect the outright value of recreational land in Illinois. The results of this study show a statistically significant relationship that also contains a coefficient that makes sense theoretically for the % tillable, RUCC, and timberland acreage per square mile variables. Considering the final model which includes these 3 variables, a recreational tract with a large percent of its land being tillable, a location that is close to a large metropolitan area, and being located within a county that has a low timberland density will bring the highest average price per acre. The remaining variables including average size, PI, number of sales, total buck harvest per square mile, and CRP enrollments per square mile all contained a coefficient that made sense directionally and numerically to an extent, but none of them were deemed statistically significant. % tillable and RUCC were expected to be statistically significant because of their use in previous studies proving significance, but the timberland acreage per square mile variable has had very little use in previous studies, especially when looking at its effects at a county-wide level. Although this study was unable to put a statistical tag on how much all these variables effect average recreational land price per acre in Illinois, it is clear that some of them play a role. Consider average PI for example. Let’s look at two, 80 acre tracts which was approximately the mean tract size sold between 2001 and 2017. Let’s say the first tract has a productivity index of 25 and the second tract has a PI of 125. From an individual tract perspective, it is clear that tract 2 should bring a significantly higher price per acre because of its higher income-producing capabilities. But when you pool all of these productivity indexes together and look at them from a county-wide level, the shear potential for differences from one tract to the next in each county is what made this variable statistically insignificant. There was just too much error present in this variable for this variable to do its job of controlling for the dependent variable.

Other sources of potential error stemmed from different parts of the study as well. One major limitation of this study was the relatively inconsistent amount of samples obtained from the ISFMRA for the dependent variable and first four variables. Although we had 1751 total samples for the dependent and only a few less for the average size variable to give us a respectable average of about 18 samples per county, it was the variance across all 94 counties that presented error. Some counties had only one or two samples representing the entire county, which is not an ideal scenario for deriving accurate statistics. Another limitation of this model was the inability to account for time correctly and its effect on the dependent variable. The dependent variable was taken over the course of 17 years, from 2001-1017. Over the course of this time, there has been a noticeable increase in land price in Illinois. And as I stated earlier, there is inconsistency in the years in which samples were collected for each county. So for example, consider two counties again. County 1 only contains 4 total sales, with all 4 sales being from 2001 and 2002. County 2, on the other hand, contain 4 total sales, with all 4 sales being from 2016 and 2017. Even if county 1 offered much better land than county 2, this shear difference in time between when each county’s tracts were sold could compose a higher average price per acre for county 2. Of course there will always be limitations with data that wasn’t gathered specifically for a study, but all the amount of error that exists in this model was minimized as much as possible.

If this study were to be repeated again, I would try another state with data that was more consistent to see if the results varied any. Also a variable that considers the amount of water per county would be interesting as well. For example, looking at property in close proximity to a large body of water and see if that has any effect on average price of that land.

FIGURES

Figure 1: Illinois County Map

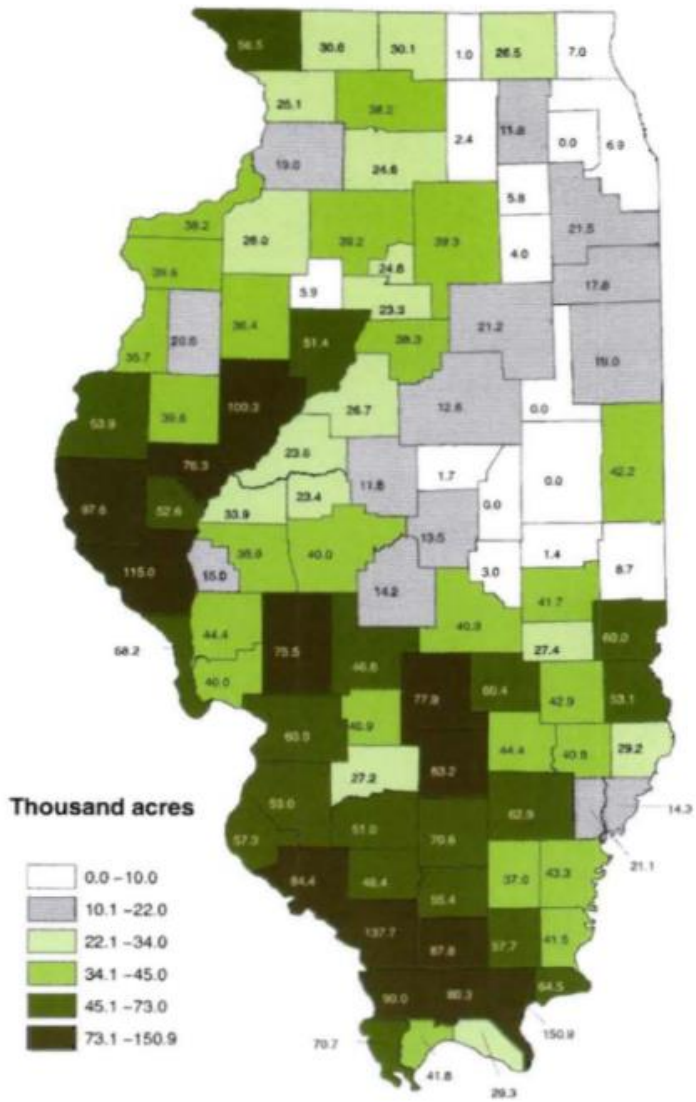

Figure 2: Illinois Timberland Acreage by County

TABLES

Table 2: Explanation of Variables

Variable	Explanation
ARP	Average Recreational Price Per Acre
SIZE	Average Size (Acres)
PI	Average Productivity Index
TIL	% Tillable
SALE	Number of Sales
RUCC	Rural-Urban Continuum Codes
TBH	Total Buck Harvest per Square Mile
TA	Timberland Acreage per Square Mile
CRP	CRP Enrollments per Square Mile

*Variable labels to be used for the following tables

Table 3: Descriptive Statistics (All Variables)

	ARP	SIZE	PI	TIL	SALE	RUCC	TBH	TA	CRP
Mean	3313	79	92	22	19	5	10	84	20
Median	2996	75	100	23	16	5	9	73	15
Maximum	7925	235	126	70	70	9	30	407	126
Minimum	1739	30	0	0	1	1	1	0	0
Std. Dev.	1093	33	24	13	13	2	6	74	17
Observations	94	94	94	94	94	102	102	102	102

Table 4: Complete Model (All Variables)

Dependent Variable: ARP
Method: Least Squares
Sample: 1 102
Included Observations: 94

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4229.15	433.04	9.77	0
SIZE	0.68	3.15	0.22	0.83
PI	-1.26	4.39	-0.29	0.77
TIL	22.45	7.93	2.83	0.01
SALE	-4.84	7.40	-0.65	0.51
RUCC	-120.48	42.56	-2.83	0.01
TBH	6.35	23.67	0.27	0.79
TA	-6.28	1.77	-3.55	0
CRP	-8.54	6.14	-1.39	0.17
Adjusted R-squared	0.39			
F-statistic	8.50			

Table 5: Final Model (Select Variables)

Dependent Variable: ARP

Method: Least Squares
Sample: 1 102
Included Observations: 94

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4150.25	251.43	16.51	0
TIL	20.94	6.50	3.22	0.00
RUCC	-118.53	39.90	-2.97	0.00
TA	-6.09	1.26	-4.82	0
CRP	-8.51	5.65	-1.51	0.14
Adjusted R-squared	0.42			
F-statistic	17.55			

BIBLIOGRAPHY

Adams, K. (2016, July 18). Hunter Density Across the U.S. | QDMA. Retrieved January 29, 2019, from https://www.qdma.com/hunter-density-across-u-s/

Baker, S., Klein, D., Haight, B., & Sherrick, B., Dr. (2018). 2018 Illinois Farmland Values and Lease Trends.

Bretthauer, S. M., and j. M. Edgington. (2003) Illinois Forests. Department of Natural Resources and Environmental Sciences, University of Illinois. 1-16.

Buller, V., Hudson, D., Parkhurst, G. M., & Whittington, A. (2005). The Value of Hunting Package Attributes. *Southern Agriculture Economics Association,* 1-11. Retrieved January 29, 2019, from http://purl.umn.edu/35643

Eberle, P., & Wallace, R. (2008). Recreational Leases as Means to Increase Landowner Income. *2008 Journal of the ASFMRA*, 28-36. Retrieved September 26, 2018, from http://purl.umn.edu/189873

Ferris, J., and Siikamäki, Juha. (2009) Conservation Reserve Program and Wetland Reserve Program: Primary Land Retirement Programs for Promoting Farmland Conservation. 1-33. Retrieved November 26, 2018, from https://www.researchgate.net/publication/237629983_Conservation_Reserve_Program_and_Wetland_Reserve_Program_Primary_Land_Retirement_Programs_for_Promoting_Farmland_Conservation

Gloy, B., Hurt, C., Boehlje, M., & Dobbins, C. (2011, March). Farmland Values: Current and Future Prospects [Scholarly project]. In Purdue Agriculture. Retrieved January 29, 2019, from https://ag.purdue.edu/commercialag/Pages/Resources/Farmland/Land-Prices/Farmland-Values-Current.aspx

Guiling, P., Brorsen, W. B., & Doye, D. G. (2007). How Much Influence Does Recreation Have on Agricultural Land Values? *Southern Agriculture Economics Association,* 1-21. Retrieved October 17, 2018, from https://ageconsearch.umn.edu/record/34947/files/sp07gu02.pdf.

Henderson, J. R., & Moore, S. (2006). The Capitalization of Wildlife Recreation Income into Farmland Values. *Journal of Agriculture and Applied Economics,* 597-610. Retrieved September 18, 2018, from http://purl.umn.edu/43784

Huang, H., Miller, G., Sherrick, B., & Gomez, M. (2006). Factors Influencing Illinois Farmland Values. American Journal of Agriculture Economics, 88(2), 458-470. Retrieved January 16, 2019.

Lundhede, T. H., Jacobsen, J. B., & Jellesmark, B. (2008). A Hedonic Pricing Model for Hunting in Denmark. *Scandinavian Forest Economics: Proceedings of the Biennial Meeting of the Scandinavian Society of Forest Economics,* 23-33. Retrieved October 22, 2018, from http://purl.umn.edu/198783 n.a. (2011, May 25). Illinois Counties Ranked by Area. ISGS. Retrieved January 30, 2019, from http://www.lb7.uscourts.gov/documents/12-34061.pdf

Paulson, N. D. (2013). The Impact of Revenues and Costs on the Relative Returns of Illinois Grain Farms. *2007 Journal of the ASFMRA*, 268-281. Retrieved February 2, 2019, from http://purl.umn.edu/161501

Rhyne, J., & Munn, I. A. (n.d.). Factors Determining Per Acre Market Value of Hunting Leases on Sixteenth Section Lands in Mississippi. (pp. 171-177). Retrieved January 14, 2019, from https://www.researchgate.net/publication/255606930_Factors_Determining_Per_Acre_Market_Value_of_Hunting_Leases_on_Sixteenth_Section_Lands_in_Mississippi

Shultz, S. (2007). Non-Local Purchases of Agricultural Land for Hunting Purposes. *2007 Journal of the ASFMRA,* 133-141. Retrieved October 24, 2018, from https://ageconsearch.umn.edu/record/189897/files/275_Shultz.pdf.

Taylor, M., Schurle, B., Rundel, B., & Wilson, B. (2015). Determining Land Values Using Ordinary Least Squares Regression. *2015 Journal of the ASFMRA,* 75-86. Retrieved September 5, 2018, from http://purl.umn.edu/233862

VITA

Graduate School
Southern Illinois University

Cameron B. Hupp

chupp04@gmail.com

Southern Illinois University
Bachelor of Science, Agribusiness Economics, May 2018

Research Paper Title:
Price Determinants of Recreational Land in Illinois

Major Professor: Dr. Dwight R. Sanders