THE OPPORTUNITY COST OF THE CONSERVATION RESERVE PROGRAM ON KANSAS AGRICULTURAL LAND

by

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Abstract

Because Conservation Reserve Program (CRP) contracts take land out of production for at least ten years, when deciding to enroll a parcel of land, a landowner must weigh the opportunity costs of hindering production flexibility against a guaranteed constant annual return. This thesis discusses whether having a CRP contract on a parcel of land in any way effects the value of that parcel. This is accomplished through the use of a hedonic model using data from 1998-2014 on Kansas agricultural land transactions. Results show that unlike in previous literature, while the effect of CRP is typically negative, it can become positive depending on the state of market factors at the time of the transaction.

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Chapter 1 - Introduction

1.1 Introduction

The Conservation Reserve Program was implemented by Congress as part of the Food Security Act of 1985. This program provides government funds to reimburse producers who choose to pull their most environmentally impactful land out of production. This land, which must have been planted to regular crops for 4 of the past 6 years, is then reverted back to natural cover in an effort to "control soil erosion, improve water and air quality, and enhance wildlife habitat" (USDA, 2008). Producers enter into contracts that last 10 to 15 years that ensure the government will pay them for this land should they continue to leave it dormant. The amount received by the producer is determined by a competitive bid system and is fixed over the life of the contract. A producer can offer as many acres as they want at up to maximum bid prices established by the government. Because this system is competitive, the lower the price offered by the producer, the greater the chance of the bid's acceptance. Acceptance of the bid is based on an environmental benefits index (EBI) which is a formula written and tabulated by the USDA. The higher a parcel of land's EBI, the more likely it is to be accepted. The criteria included in the EBI range from potential wildlife and native plant species benefits, to air and water quality concerns, to water and wind erosion potential of the parcel in question As of October 2015, CRP enrollment included 23.36 million acres, of which 2.11 million acres were located in Kansas. Kansas is second only to Texas in total acres currently enrolled in the Conservation Reserve Program.

While this program's continued existence proves its popularity, the fact remains that many still find fault with this program. The most pressing stems from the lengths of the contracts offered. When conservation first began in earnest in the US with the 1954 Farm Bill, producers could enter similar conservation programs for as few as three years. However, the USDA felt that a longer contract would allow the natural cover more time to grow and provide more environmental benefits. Therefore, in 1985, the 10 and 15 year contracts were established. Some praise this change as it provides a constant source of income for producers, especially when farm incomes are low. These payments represent a guaranteed stream of revenue for at least the length of the contract. However, as has been well documented over the past decade, crop prices and farm incomes are volatile. Therefore, when prices rise, producers who have CRP contracts on their land do not have the flexibility to plant what they want when they want. Because of this restriction, the question remains as to what effect the perceived opportunity cost of owning a parcel of land with a CRP contract has on land value.

1.2 Objective & Motivation

The Conservation Reserve Program (CRP) has been a source of controversy since its implementation. While most believe the program has had positive environmental benefits, some question the economic methods used to obtain these results. CRP contracts require producers to take land out of production and revert that land to natural cover. In return, the government provides annual payments to the producer. These contracts last from 10 to 15 years and in order to opt out, producers face substantial fines. Therefore, when applying for a CRP contract, a producer must weigh the benefits of having a constant stream of revenue over at least the next decade with the flexibility forfeited by taking the given land out of production. However, the question remains if there are any unforeseen consequences that agreeing to a CRP contract can present, especially when it comes to selling land that holds a contracted designation. Will potential buyers prefer to receive the constant stream of payments? Or would they rather purchase land that allows for complete flexibility? From 1998 to 2014, the average CRP payment to Kansas landowners was just under $40 per acre. Therefore, if the profit potential of land enrolled in CRP is greater than that figure, then the presence of the CRP contract has the potential to decrease the sale price if this parcel is sold. However, if potential profitability is below that figure, the land under contract may actually be worth more in the market than land not under contract.

Previous research has attempted to quantify the effect of CRP contracts on land sales, but only over relatively short periods of time and not for Kansas. Therefore, the objective of this research is to utilize parcel-level land sales data in the state of Kansas and determine whether or not the presence of a CRP contract on a parcel of land affects the sale value of that land and how that impact changes over time. The analysis is conducted over times of both exceptional and average profitability in the farming sector (1998-2014), allowing measurement of any changes in land buyers' valuation of the opportunity cost associated with CRP contracts. A cross-section of Kansas land sales data observed over 17 years which includes descriptions of land parcels including location, productivity, accessibility, and the presence or absence of a CRP contract, is used to estimate land values. A hedonic model regression is employed to allow for the estimate of the demand for certain land traits and characteristics. It will be shown that the presence of a CRP contract can have a positive or negative effect on land values, depending on the profitability of the Kansas agricultural sector relative to the payments received under a CRP contract.

Chapter 2 - Literature Review

2.1 CRP and the Behavior of Landowners

In 1989, four years after the implementation of CRP, Shoemaker published an article that argued that in a time of declining land prices, CRP was actually driving up the value of eligible lands. His argument focused on the frequency of sign-ups for CRP and the readily available nature of the maximum bids the government was willing to accept. He found that producers could wait until later sign-ups and receive higher premiums for lower quality of land because of the government mandate to enroll 40 million acres. Therefore, CRP could be shown to have a positive effect on national land values.

Similarly, Kirwan, Lubowski, and Roberts (2005) analyzed sign-ups for CRP from 1997 to 2003. They focused on the environmental benefits index (EBI) which the USDA uses to determine whether or not to accept a bid. It was shown that those producers who knew they had land that was more beneficial to the program and had higher EBI values were likely to ask for more money to retire that land through CRP. Additionally, this study showed it was possible for producers to receive a windfall for their enrolled land, thereby again increasing the value for CRP land on the whole.

2.2 The Application of Hedonic Models

While the above studies are important, their employed methods did not consider the potential for the value of the CRP contract to change in relation to the forgone option of farming that land. One way to analyze the impact of a specific characteristics of land (with or without a current CRP contract) on overall land value is to employ the hedonic pricing model originally put forward by Rosen (1974).

Taff and Weisberg (2007) estimated a hedonic model using observations of farm sales with CRP contracts in Minnesota from 2002 to 2004. They implemented six different hedonic models with slightly varying data sets. Each data set used the log of price per acre as the dependent variable, but included or modified certain variables to compare the effects of certain traits. They found a reduction in price per acre was 8% to 15% when a CRP contract was in place for a given parcel. Taff and Weisberg concluded that their analysis suggests appraisers should both consider the effect of CRP when appraising land under contract and ensure that sellers of similar, non-contracted parcels are not being harmed by comparisons of CRP-contracted lands to their own.

A similar analysis was conducted on agricultural land in North Dakota from 2000 to 2004 (Schmitz and Shultz, 2008). However, for this analysis, CRP sales data was not immediately available. Instead, Schmitz and Schultz used geographic information systems (GIS) data of 33 state-held and maintained sites known to be under CRP contracts to establish criteria that would allow for similar parcels of land to be declared CRP sales. Sales of 98 parcels were found to have met the established criteria. Again, a hedonic model was employed using a binary variable for the presence of CRP land. Also included were binary variables for year and region, as well as continuous variables for log of parcel size, distance to an interstate, spring wheat yield, and the percentage of wetland which was also gleaned from GIS data. The results of this analysis found that a CRP contract decreased the value of a parcel of land by 13.8% relative to parcels with no CRP contract.

The hedonic model specifications found in previous studies provide a roadmap for the current analysis. Although the variable of interest is the presence of a CRP contract, other parcel-specific parameters must be included in the model to control for the heterogeneity of land and its impact on sales prices. Land characteristics shown to be statistically significant in hedonic models of agricultural land values include parcel size, timing of the sale, parcel location, and land quality. This variable is especially important due to the fact that the CRP program is designed to set aside land that is environmentally sensitive. This often includes highly erodible land, which would have a lower productivity rating and, thus, a lower value. Schmitz and Shultz used spring wheat yield to measure quality, while Taff and Weisberg used a University of Minnesota productivity index to rate the quality of land. In this study, a rating of quality is made by professional land appraisers and recorded in the sale data. One drawback of the existing literature addressing the impact of CRP contracts on land values is that it is constrained to a limited number of states and relatively short observational time periods. Given the relatively large number of CRP acres in Kansas and the availability of a dataset containing seventeen years of land sales, this research makes a notable contribution to the literature.

Chapter 3 - Model

3.1 An Explanation of CRP Opportunity Cost

In its simplest form, the decision to enroll a parcel of land in the Conservation Reserve Program is driven by a comparison of the present value of payments received over the life of the contract defined as

(1) $V_0^C = \sum_{t=1}^{k} C_t/(1+r_t)^t$

where V_0^C is the value of land in at the end of period 0; C_t is the rent received from the CRP program at the end of period *t*; *k* is equal to either 10 years or 15 years, depending on the contract length; and r_t is the constant real discount rate for year *t*. Similarly, the present value of farming the land can be represented as follows

(2) $V_0^F = \sum_{t=1}^{k} F_t/(1+r_t)^t$

where V_0^F is the value of the land at the end of period 0; F_t is the annual cash rent received from the land being farmed; and all other variables are as defined previously. If the present value of returns from CRP, V_0^C, is greater than the present value of cash rents received from farming the land, V_0^F, over the same time horizon, then the landowner will prefer a CRP contract. In this context, the opportunity cost is defined as

(3) $V_0^C - V_0^F$.

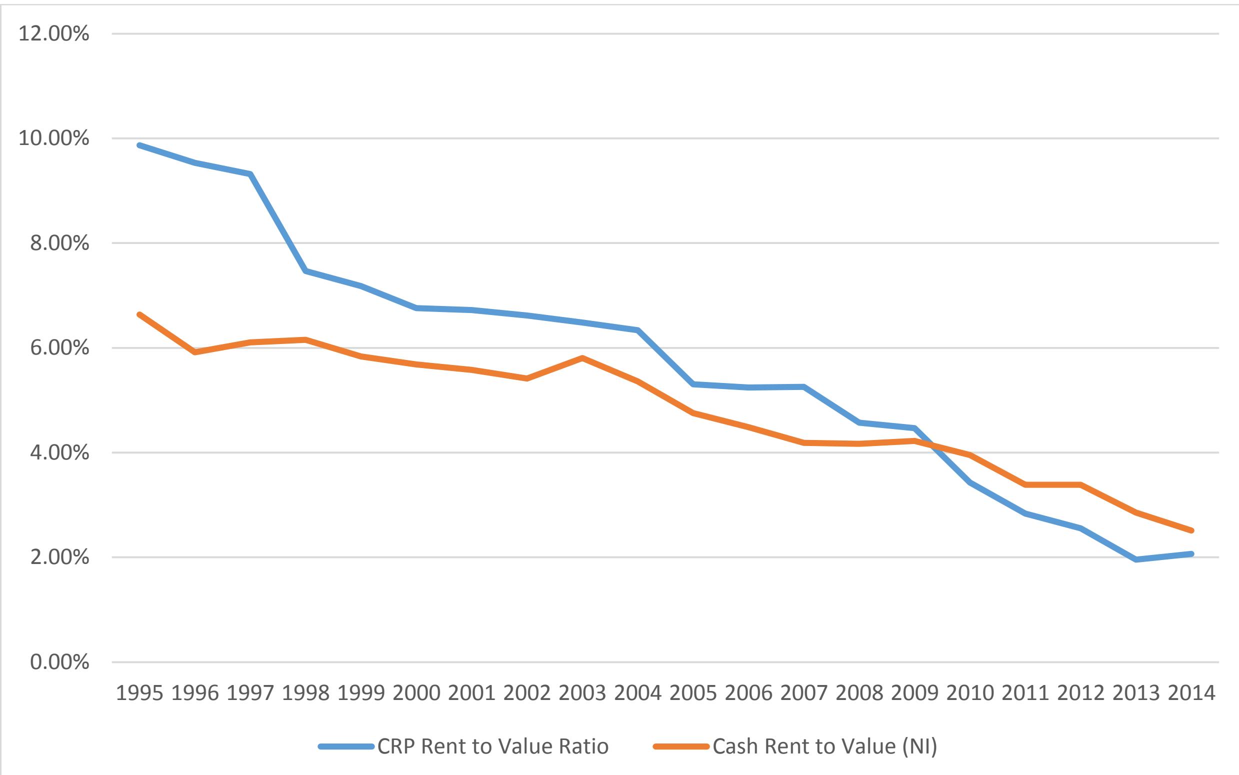
In addition to considering the monetary returns from a CRP contract as compared to farming the land, non-pecuniary benefits may accrue to the landowner from enrolling the land in CRP. For example, if the landowner places a high value on providing habitat for wildlife or slowing the erosion of soils from their land, then having a CRP contract may be even more attractive to a landowner. These non-pecuniary benefits are not observable, but may affect individual landowner’s decisions to participate in the program.

Another factor that affects the present value comparison is the impact on the productivity of the land parcel when it exits the CRP contract and farming is resumed. Land which has lain dormant for at least a decade might require an adjustment period to again reach its full yield potential based on a number of factors. This land has not been tilled, fertilized, or managed in a farming capacity over a long period of time. Therefore, entering into a CRP contract can potentially have an impact on returns to farming beyond the span of the contract itself. Again, these impacts are not easily observable and are likely to differ by both soil characteristics and farm management practices.

While the payments received from a CRP contract do not vary over the life of the contract, returns from farm will fluctuate with the profitability of the crop sector. Landowners cannot know what commodity prices or costs of production will be and, therefore, there assessment of the present value is based on imperfect information. When deciding to enroll, a landowner only knows recent profit levels for farming and cannot foresee the micro and macroeconomic drivers that will change the returns of farming a parcel of land over a multiple-year horizon.

The opportunity cost of a CRP contract relative to farming is unique to each landowner and parcel. A proxy for this tradeoff for the state of Kansas would be a comparison of the annual state average CRP rental rate to the annual state average cash rent from non-irrigated farming. To normalize these rents relative to land values, the rent-to-value ratio is calculated. This ratio also reflects the average returns to ownership of land when it is either enrolled in CRP or farmed. Figure 3.1 shows the rent-to-value ratio of both cash rents and CRP rental payments over the time period 1995 to 2014. The rent-to-value was calculated for farming using non-irrigated cropland cash rental rates for Kansas (USDA-NASS, 2016). The rent-to-value calculations for land enrolled in CRP were obtained using state-level average rents paid on all CRP contracts gathered from the Farm Service Agency (USDA-FSA, 2016). Land values were calculated using averages of the sales data for each year. The years 1995 to 1997 were not included in the dataset, so land values for those years were collected from USDA-NASS and used for both the CRP and farming rent-to-value calculations (USDA-NASS).

Figure 3.1 Average CRP vs. Cash Rent-to-Value Ratios, 1995-2014



Source: USDA NASS, USDA FSA

From 1995-2009, the average returns to land under CRP contract were higher than the average returns to farming. The difference between the rent-to-value ratios was greatest in the years 1995 to 1997, averaging 3.2% higher returns than farming. In 1998, the differential dropped to 1.3% and remained at a higher level through 2009.

Given the high returns to CRP contracts relative to the average returns to farming, it seems reasonable to ask why every landowner did not enroll their land into a CRP contract. The rules of the program ensure that mass enrollments are not possible. Along with the acreage cap, the bidding process is complex and favors land that, when retired, would bring about the most positive environmental impact. Also, the above trend reflects returns to farming for the average piece of land. If the land or the farmer's management skills are greater than average, it is quite possible that farming the land is still the economically preferential option.

According to figure 3.1, 2010 marks a shift in the relative returns to CRP over farming. High commodity prices and record farm incomes resulted in average cash rents that made farming the more profitable choice. If given the choice, it seems plausible that landowners would consider breaking their CRP contract and resume farming the land. However, this option would result in having to repay the entire amount the government has paid on the contract up to that point in time. Also, management costs associated with cash rentals tend to be higher than those associated with CRP. A landowner has to exert the effort to either find a tenant or farm the land themselves and this may require investment in machinery and other management costs. Finally, the previously mentioned nonpecuniary benefits of the program may be large enough that they are willing to accept a lower rate of return to avoid losing the environmental benefits associated with the CRP contract.

While figure 3.1 shows how the CRP and cash rent to value ratios changed on average statewide, it is also important to consider the lack of homogeneity in Kansas agricultural land. Each region has a distinct crop mix that can be attributed to its unique land characteristics. Parcels of land in Eastern Kansas tend to be better for crops like corn and soybeans, while Western Kansas favors wheat and fallow. With this in mind, figure 3.2 and 3.3 were constructed. They show the CRP and cash rent to value ratios for the Northwest Kansas Farm Management Association (KFMA) region and the Northeast KFMA region. These charts were constructed using a weighted average by county enrollment of CRP rate (USDA-FSA, 2016) and regional land values in Kansas.

Figure 3.2 Average CRP vs. Cash Rent-to-Value Ratios, Northwest Kansas

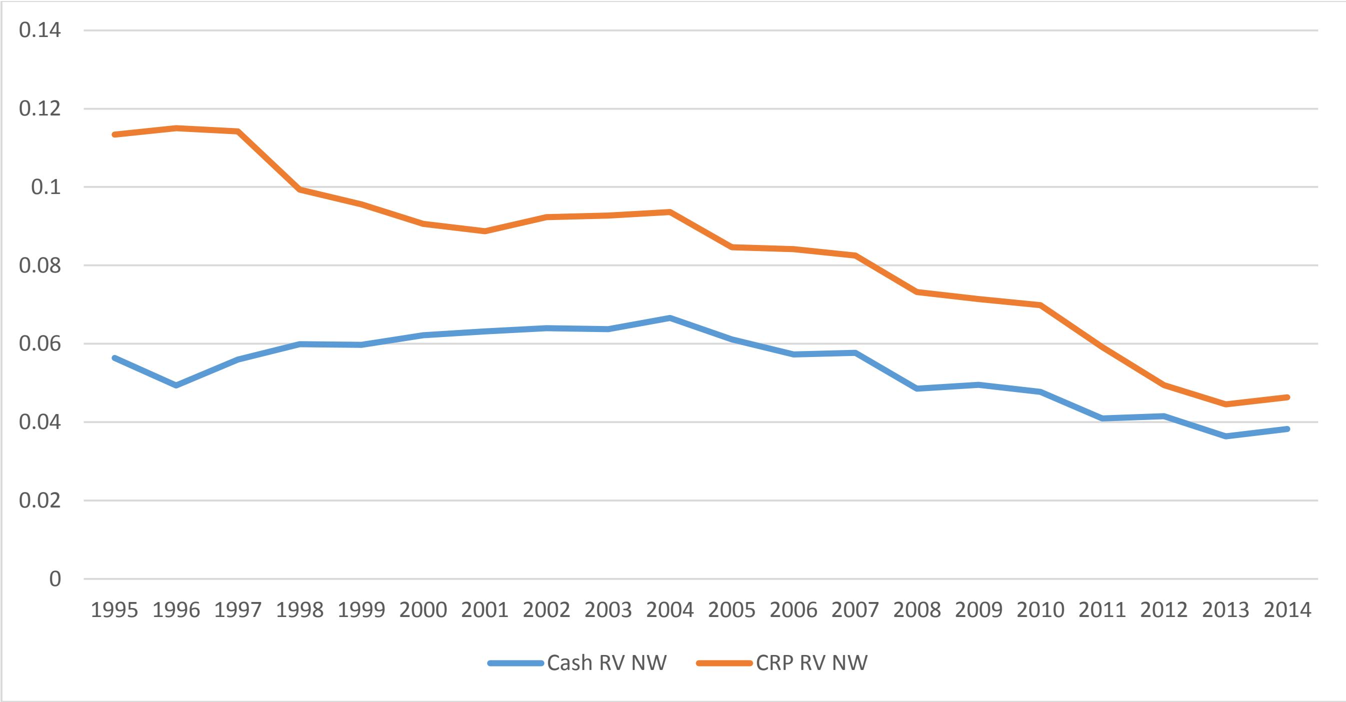
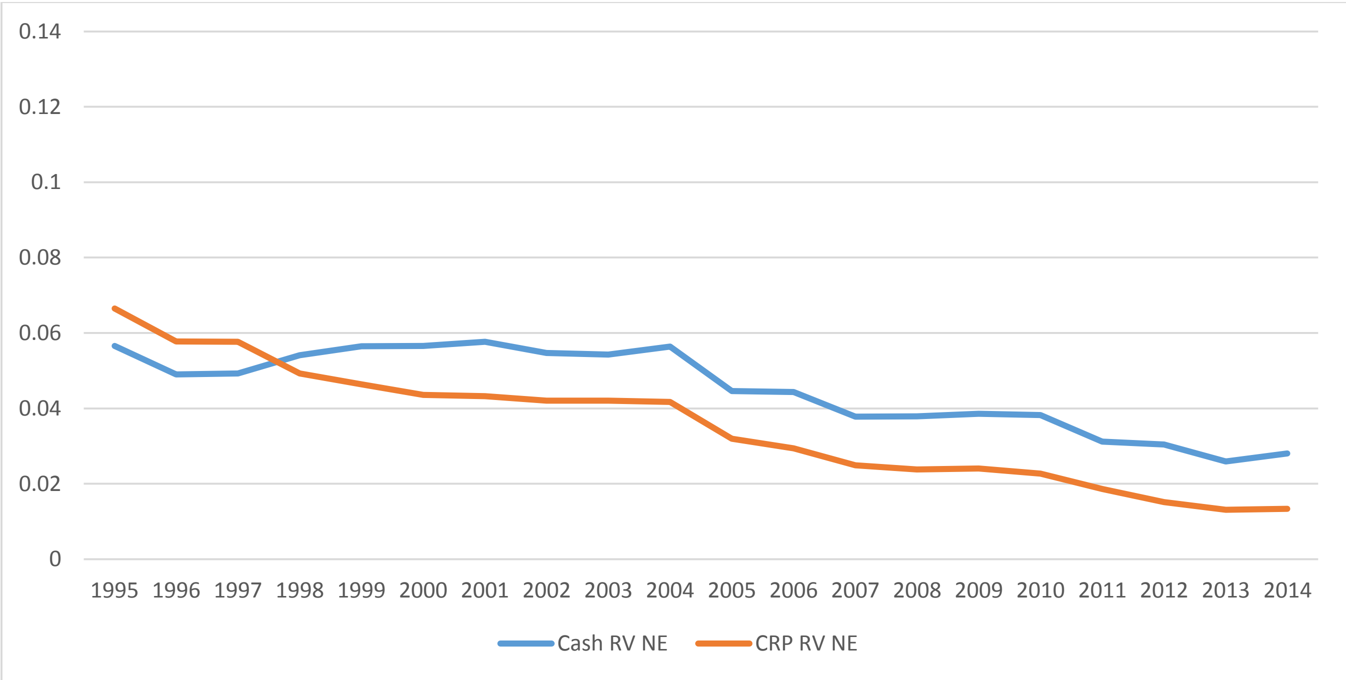


Figure 3.3 Average CRP vs. Cash Rent-to-Value Ratios, Northeast Kansas



These figures clearly illustrate that there are potential regional differences in how CRP is valued. In Northwest Kansas, only the first three years shown in the figure (1995-1997) have a higher rent to value ratio for CRP, while during the remainder of the period observed farming has a higher rate of return than CRP enrollment. However, in Northwest Kansas, acres enrolled in CRP always have a higher rent to value ratio than farming, even during the high profitability period between 2011 and 2013. Therefore, it is crucial that the model account for these potential regional differences.

The decision to enroll in CRP is a long term one of which there is no way of accurately predicting the economic outcome. It is logical that the initial opportunity cost that a landowner takes on will change over the life of the CRP contract. It is the assertion of this analysis that these opportunity cost shifts will then be reflected in potential land buyer's willingness to pay for parcels with CRP contracts.

3.2 Basic Hedonic Model

Hedonic models have been used for decades with the first widely accepted theoretical model published by Rosen in 1974. This model dealt with a differentiated product and its demand. The application of models to land values soon followed and is highlighted by Palmquist's extension of Rosen's work (1989). Palmquist stated that a general hedonic model for land prices would consider the impact of land characteristics, x_i on the price of a parcel of land $P(x)$, such that:

$$(4) \quad \boldsymbol{P(X) = P(x_1, x_2, \ldots, x_n)}$$

For this analysis, multiple OLS regression was used to create a hedonic model of land values using transaction-level land sales data. Hedonic models attempt to analyze many potential valuation factors in an effort to show what traits possessed by a parcel of land will increase or decrease the value of that parcel. This also allows for direct comparisons between different variables of the same type; for instance good vs. average vs. poor quality land or hard road vs. gravel road vs. dirt road. By using the log of price per acre as the dependent variable, it is possible to interpret the value of the output coefficient measures as percent changes in the price per acre given the implied condition. The initial model employed is as follows:

(5) $$\ln(Price_i) = \beta_0 + \beta_1 Size_i + \beta_2 Size_i^2 + \beta_3 NICrop_i + \beta_4 IrrCrop_i + \beta_5 Average_i + \beta_6 Good_i + \beta_7 Gravel_i + \beta_8 Dirt_i + \beta_9 Auction_i + \beta_{11} \ln(NetRet) + \beta_{10} CRP_i + \mathrm{S}(Y) + \mathrm{I}(CRP_i * Y) + \mathrm{J}(CRP_i * KFMA) + \mathrm{R}Q + \mathrm{Z}C + \varepsilon_i$$

where $Size_i$ and $Size_i^2$ are the linear and quadratic terms for size in acres of a given parcel i, $NICrop_i$ is the percent of parcel *i* that is classified as cropland, $IrrCrop_i$ is the percent of parcel *i* that is irrigated, $Average_i$ and $Good_i$ are dummy variables indicating average or good land quality, respectively, of parcel i, $Dirt_i$ and $Gravel_i$ are binary variables that indicate the type of road that accesses parcel i, $Auction_i$ is a binary variable indicating if parcel *i* sold at a public auction, $NetRet$ represents the lagged regional net returns to management per acre, CRP_i is a binary variable indicating if a CRP contract is present on parcel i, Y is a vector of binary variables indicating the sale year, $CRP_i * Y$ is a vector of interaction terms between sale year and CRP_i, $CRP_i * KFMA$ is a vector of interaction terms between a binary variable indicating the KFMA region and CRP_i, Q is a vector of binary variables indicating the quarter of the year when the parcel sold, and C is a vector of binary variables indicating the county in which the parcel is located.

The variables of most interest in this research are CRP_i and $CRP_i * Y$. The coefficient of CRP_i will represent the change in price per acre of a parcel of land whether a CRP contract is present or not in the first year of the research. The interaction terms allow for this coefficient to change over the time period and give a measure of how CRP contracts are valued in different years. This, something that has been absent from previous literature, can help quantify the shifts in opportunity cost over the life a CRP contract. Additionally, the inclusion of interaction terms between CRP_i and KFMA region will account for potential differences in regional planting patterns and crop mixes. As mentioned earlier in this chapter, the shifts in this opportunity cost should be reflected in the willingness of potential buyers to pay for parcels of land that have a CRP contract on them.

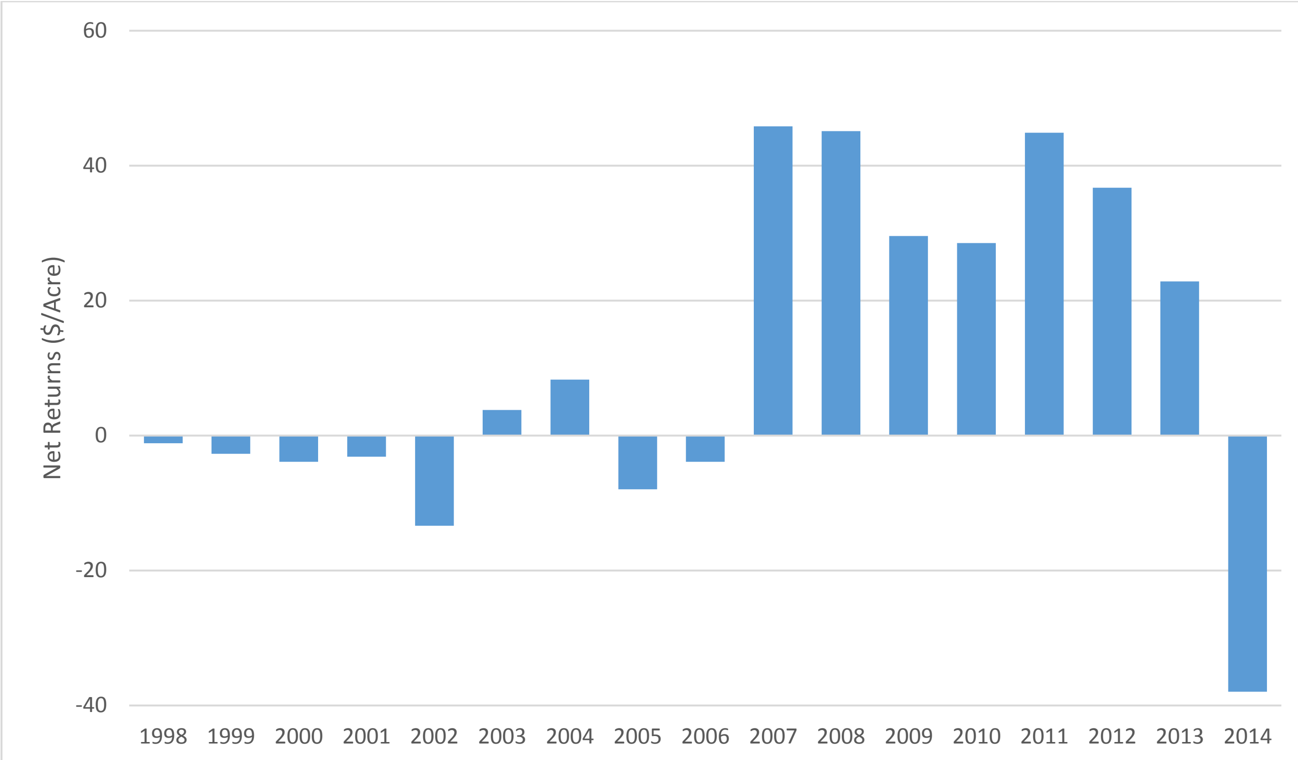
Chapter 4 - Data

In order to investigate the question of interest, data were obtained on transaction-level land sales throughout the state of Kansas from 1998-2014. This allows for the analysis to include times of both ordinary and extraordinary profitability in the agricultural sector.

4.1 KSFMRA

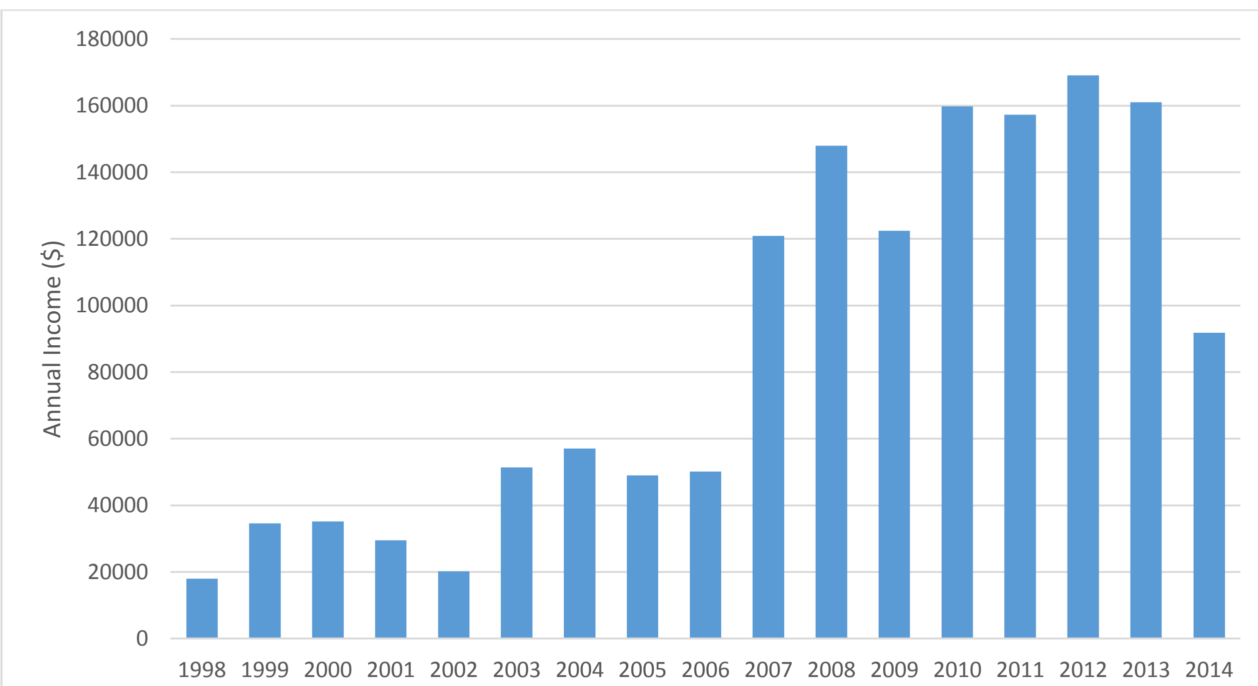
Parcel level land sales data were obtained from the Kansas Society of Farm Managers and Rural Appraisers' (KSFMRA) annual sales records (KSFMRA, 2016). This organization tracks all agricultural land sales in the state of Kansas during each calendar year. In order to ensure that periods of both extraordinary and normal returns to farming were included in this analyses, it was decided that the records dating from 1998 to 2014 would be used. Figure 4.1 shows the net returns to management of the four main crop enterprises in the state of Kansas over the given time period. Figure 4.2 shows the dryland operation net income over the same time period. These figures illustrate that returns and incomes varied greatly over the chosen years, and therefore the potential effect of CRP contracts on land sales could be observed in many economic environments.

Figure 4.1 Net Returns to Corn, Wheat, Soybeans, and Grain Sorghum Enterprises in KS



Source: Kansas Farm Management Association

Figure 4.2 Dryland Operation Net Income, 1998-2014



Source: Kansas Farm Management Association

Once the year range was selected, the data collection process began. Each year had a specific set of variables that were deemed pertinent to this analysis. Crucial initial variables included: county of sale, month of sale, location of sale, total acres, total price, price per acre, whether the road leading to the parcel was dirt, gravel, or hard paved, whether the land was assessed as low quality, average quality, or high quality, the number of cropland acres, the number of irrigated acres, and a section titled "Other Factors Affecting Value (Comments on minerals, improvements, conservation, and other factors)". It was in this last section where assessors and appraisers were encouraged to make notes about the CRP program and whether or not a given parcel of land had any CRP contracts upon it. As this section did not have clear instructions, the quality of information therein varied greatly. Some appraisers went so far as to include the number of acres of the parcel enrolled in CRP, the rate at which the acres were enrolled, as well as the date the contract would expire. Still others simply wrote "CRP" with no distinguishing details. In order to extract these instances of CRP on a parcel, an Excel "if" query, resulting in a 1 for yes or a 0 for no, was created to show if CRP was mentioned in the comment section. Each positive return was checked to ensure that the parcel was still indeed under contract when the note was made and the note was not referring to "expired" or "retired" CRP land. Then, when additional information such as number of acres enrolled, CRP rate, or CRP expiration date were present, those too were extracted and placed in a separate Excel column as a new variable. This process led to the binary variable for CRP_i which is included in this analysis.

In addition to the CRP_i variable, other important variables were constructed. Also found in the comments was whether a parcel was sold in a public forum such as an auction or whether it was sold privately. The sale of land via a public auction was also turned into a binary variable and included in the model. Some years used county name and some years used an alphabetical list of counties and their corresponding numbers to denote the sale location. These were all normalized to the binary matrix of counties included in the model. Additionally, a regional variable was constructed based on the counties found in the six KFMA regions. A quarter binary variable was also constructed based on the month data included in the original KSFMRA data sets. The cropland acre and irrigated acre numbers were divided by total acres and rendered as percentages for each parcel as well. Binary variables were constructed for access road type and land quality.

4.2 KFMA Data

In an effort to include a measure of market factors, a net returns variable was constructed. This variable took the net returns to management enterprise figures calculated annually by the KFMA for the four main Kansas crops: wheat, corn, soybeans, and grain sorghum and multiplied them by the average crop mixes in each of the six KFMA regions (KFMA, 2016). This established six different regional net returns total for each year. This variable was then lagged one year to represent the knowledge available to a landowner or producer during the year in question; that is, the decision maker in this instance knows only what has happened recently and has no way of knowing the outcomes of the given season. This figure was deflated to 1998 levels in order to reflect the treatment given to the dependent variable of log of real price per acre. Also to mirror the dependent variable, this figure was entered logarithmically. However, in order to take the log of the variable, steps had to be taken to ensure that all observations were positive, so every observation was scaled up by 24 to ensure equality.

4.3 Data Summary

The initial data set consisted of over 21,000 transactions over the 17 year period included in this analysis. Observations that did not include all necessary variables were eliminated as were parcels less than 35 acres in size as these parcels represent potential non-agricultural acquisitions. The number of transactions with valid information for all included variables was 9,444 over the 17 year period. Parcels of land that have a CRP contract present make up 6.5% of the total narrowed data set. The definitions and summary statistics of all variables included in the initial model can be found in Table 3.1.

Table 4.4.1 Summary Statistics for Basic Hedonic Model

Variable	Definition	Mean	Standard Deviation	Minimum	Maximum
Price	Price per acre of parcel	1,029.28	927.25	50	26,000
ln(Price)	Natural log of price per acre	6.56	0.58	3.89	9.95
Size	Parcel size in acres	188.99	261.67	35	8,601
$Size^2$	Parcel size squared	104,182	1,405,497	1,225	74,000,000
NICrop	Percent of parcel in non-irrigated cropland	0.625	0.366	0	1
IrrCrop	Percent of parcel in irrigated cropland	0.053	0.202	0	1
NetRet	Real regional average of net returns to management/acre based on the previous year	6.386	14.076	-23.80	58.45
ln(NetRet)	Natural log of net returns after scaling	3.296	0.573	-1.60	4.41
Average	Binary variable equal to 1 if parcel productivity rated as "average", 0 otherwise	0.174	0.379	0	1
Good	Binary variable equal to 1 if parcel productivity rated as "good", 0 otherwise	0.694	0.461	0	1
Low	Binary variable equal to 1 if parcel productivity rated as "low", 0 otherwise	0.132	0.339	0	1
Dirt	Binary variable equal to 1 if road access is dirt, 0 otherwise	0.213	0.409	0	1
Gravel	Binary variable equal to 1 if road access is gravel, 0 otherwise	0.740	0.439	0	1
Hard	Binary variable equal to 1 if road access is hard, 0 otherwise	0.047	0.212	0	1

Auction	Binary variable equal to 1 if parcel sold at public auction, 0 otherwise	0.230	0.421	0	1
Private Sale	Binary variable equal to 1 if parcel sold privately, 0 otherwise	0.019	0.138	0	1
CRP	Binary variable equal to 1 if parcel has current CRP contract, 0 otherwise	0.065	0.247	0	1
CRP_Y1998	Interaction term between *CRP* and *Y1998*	0.005	0.070	0	1
CRP_Y1999	Interaction term between *CRP* and *Y1999*	0.005	0.073	0	1
CRP_Y2000	Interaction term between *CRP* and *Y2000*	0.006	0.078	0	1
CRP_Y2001	Interaction term between *CRP* and *Y2001*	0.006	0.079	0	1
CRP_Y2002	Interaction term between *CRP* and *Y2002*	0.006	0.075	0	1
CRP_Y2003	Interaction term between *CRP* and *Y2003*	0.007	0.082	0	1
CRP_Y2004	Interaction term between *CRP* and *Y2004*	0.005	0.068	0	1
CRP_Y2005	Interaction term between *CRP* and *Y2005*	0.005	0.069	0	1
CRP_Y2006	Interaction term between *CRP* and *Y2006*	0.005	0.071	0	1
CRP_Y2007	Interaction term between *CRP* and *Y2007*	0.004	0.062	0	1
CRP_Y2008	Interaction term between *CRP* and *Y2008*	0.003	0.052	0	1
CRP_Y2009	Interaction term between *CRP* and *Y2009*	0.002	0.046	0	1
CRP_Y2010	Interaction term between *CRP* and *Y2010*	0.002	0.049	0	1
CRP_Y2011	Interaction term between *CRP* and *Y2011*	0.002	0.042	0	1
CRP_Y2012	Interaction term between *CRP* and *Y2012*	0.001	0.037	0	1
CRP_Y2013	Interaction term between *CRP* and *Y2013*	0.001	0.029	0	1
CRP_Y2014	Interaction term between *CRP* and *Y2014*	0.001	0.023	0	1

CRP_KFMA1	Interaction term between *CRP* and the Northwest KFMA region	0.013	0.115	0	1
CRP_KFMA2	Interaction term between *CRP* and the North Central KFMA region	0.018	0.135	0	1
CRP_KFMA3	Interaction term between *CRP* and the Northeast KFMA region	0.002	0.044	0	1
CRP_KFMA4	Interaction term between *CRP* and the Southwest KFMA region	0.008	0.090	0	1
CRP_KFMA5	Interaction term between *CRP* and the South Central KFMA region	0.022	0.147	0	1
CRP_KFMA6	Interaction term between *CRP* and the Southeast KFMA region	0.001	0.035	0	1
Q1	Binary variable equal to 1 if parcel sold in first quarter, 0 otherwise	0.315	0.465	0	1
Q2	Binary variable equal to 1 if parcel sold in second quarter, 0 otherwise	0.295	0.456	0	1
Q3	Binary variable equal to 1 if parcel sold in third quarter, 0 otherwise	0.184	0.388	0	1
Q4	Binary variable equal to 1 if parcel sold in fourth quarter, 0 otherwise	0.206	0.404	0	1
Y1998	Binary variable equal to 1 if parcel sold in 1998, 0 otherwise	0.118	0.323	0	1
Y1999	Binary variable equal to 1 if parcel sold in 1999, 0 otherwise	0.093	0.290	0	1
Y2000	Binary variable equal to 1 if parcel sold in 2000, 0 otherwise	0.087	0.281	0	1
Y2001	Binary variable equal to 1 if parcel sold in 2001, 0 otherwise	0.092	0.289	0	1
Y2002	Binary variable equal to 1 if parcel sold in 2005, 0 otherwise	0.085	0.279	0	1
Y2003	Binary variable equal to 1 if parcel sold in 2005, 0 otherwise	0.083	0.277	0	1
Y2004	Binary variable equal to 1 if parcel sold in 2005, 0 otherwise	0.069	0.254	0	1
Y2005	Binary variable equal to 1 if parcel sold in 2005, 0 otherwise	0.060	0.238	0	1
Y2006	Binary variable equal to 1 if parcel sold in 2006, 0 otherwise	0.062	0.240	0	1
Y2007	Binary variable equal to 1 if parcel sold in 2007, 0 otherwise	0.050	0.218	0	1

Y2008	Binary variable equal to 1 if parcel sold in 2008, 0 otherwise	0.042	0.201	0	1
Y2009	Binary variable equal to 1 if parcel sold in 2009, 0 otherwise	0.025	0.156	0	1
Y2010	Binary variable equal to 1 if parcel sold in 2010, 0 otherwise	0.042	0.200	0	1
Y2011	Binary variable equal to 1 if parcel sold in 2011, 0 otherwise	0.034	0.180	0	1
Y2012	Binary variable equal to 1 if parcel sold in 2012, 0 otherwise	0.023	0.151	0	1
Y2013	Binary variable equal to 1 if parcel sold in 2013, 0 otherwise	0.021	0.145	0	1
Y2014	Binary variable equal to 1 if parcel sold in 2014, 0 otherwise	0.015	0.121	0	1
County1 - County104	Binary variables denoting parcel location in one of 104 Kansas Counties	0.010	0.080	0	1

Number of Observations = 9,603

The coefficient on $Size_i$ is expected to be negative, while the quadratic term is expected to be positive. This expectation is based on the fact that the bigger parcels of land tend to attract fewer potential buyers. This could be due to constraints regarding financing or potential non-agricultural development opportunities afforded by smaller parcels. Fewer bidders is likely to result in lower bid prices for large tracts of land.

The percentage of non-irrigated cropland ($NICrop_i$) should increase the price of a parcel when compared to pasture percentage, which is excluded and accounted for in the intercept. Pasture land is the least profitable land type as compared to farm land in Kansas. Irrigated land allows for higher and more consistent productivity when compared to typical cropland and is therefore more valuable. Therefore, the percentage of irrigated cropland ($IrrCrop_i$) will have a positive coefficient greater in magnitude than $NICrop_i$.

Net returns is included in the model as a logarithmic variable [$\ln(NetRet)$]. This variable should have a positive coefficient as the higher net returns were the year before, it stands to reason that more money can be spent on land in the given year. That is, as more money is in the hands of producers, there should be more competition for land parcels and therefore higher bidding on available land.

Land that assessors qualify as good should be valued higher than that which qualified as average. Average quality land will in turn be worth more than low quality land. Additionally, accessibility in terms of road type will effect value as well, with hard paved roads allowing for easiest access and therefore being the most valuable. Gravel roads will be worth less than hard paved, but should be worth more than dirt roads, which are the most difficult to traverse. The method with which the parcel will be marketed will also have an effect on price. Previous literature has shown that land sold at auction will sell at a higher price than land sold privately (Wilson, et. al. 2014).

Fixed effect variables for year, quarter, and county are included in an effort to control for any variations in sale price that has not already been directly controlled for. County and quarter factors could include any number of variations including variation in state rainfall and weather patterns, access to urban areas, and the marketing patterns of regional crop producers. Year fixed effects should capture any macroeconomic differences between years including, but not limited to interest rates, expectations regarding farm policy, and shifts in international trade.

Also included in the data set is additional information regarding the of CRP contracts for a subset of parcels. This information was not consistently provided for all parcels with CRP contracts and, therefore, could not be used to create additional variables for the empirical model. Of the 9,444 included transactions full data regarding CRP acreage, rate, and expiration year was available on only 153 transactions. However, a brief summary of that additional information reveals some insights into the nature of the contracts observed in the dataset. The average number of acres under CRP contract is 83 acres. This can be compared to the average parcel size overall which is 190 acres. The average time left on a contract at the time of the sale is 4.5 years and the average rate being paid on the contract is $41.48. While these numbers are limited and do vary widely, it is plain to see that at the time of transaction, there is a high potential for several remaining years of reduced flexibility for the land buyer.

Chapter 5 - Results

Results of the hedonic model are presented in table 5.1. The dependent variable is the natural logarithm of price per acre. Price per acre was transformed because the distribution of per acre sales was skewed by a relatively small number of high valued parcels. The use of a semi-logarithmic regression requires using Kennedy's (1981) adjustment be made to all binary variables to correct for bias. The equation for the Kennedy adjustment is as follows:

(6) $$g = \exp\left(\hat{c} - 0.5\hat{V}(\hat{c})\right) - 1$$

where $\hat{c}$ is the unadjusted coefficient resulting from the regression, and $\hat{V}$ is that coefficient's variance. The transformed coefficients are presented in table 5.1 for all binary variables.

The physical land characteristics included in the model were statistically significant and had an expected sign. Parcel size has a negative impact on sale price, but this impact diminishes as parcel size increases due to the positive sign for the quadratic parcel size variable. Non-irrigated cropland and irrigated cropland are worth more, on average, than pasture by 36.9% and 102.1%, respectively. As compared to poor quality land, average quality land is worth 18.2% more and land rated as being of good quality averages 34.2% higher value. The type of access road also affects land prices with dirt road access being worth 11.4% less than paved road access and gravel road access being worth 6.9% less. Land marketed through a public auction sells for 2.2% more than land marketed through other means.

The only variable that returned an unexpected sign is that of lagged net returns. As mentioned previously, this variable was meant to account for the financial situation of agricultural producers at the time of the land transaction in question. This was the amount of money per acre the enterprise had returned to management the year before. It was thought that this variable would lead to a positive coefficient; that having made more money last year would cause those in pursuit of land to have to pay more. Although the net returns coefficient was negative, it has a p-value of 11%, which is greater than the typical 90% and 95% confidence intervals. Therefore, although the estimated coefficient is positive, it is not a precise estimate. It is possible that alternative measurements of land buyer's expectations of net farm incomes would yield different empirical results.

Table 5.1 Hedonic Model Regression Results

Variable	Coefficient	Standard Error	P-Value	Transformed Coefficient
Size	-2.69E-04	2.570E-05	0.000	--
Size^2	3.21E-08	4.540E-09	0.000	--
Crop	0.369	0.011	0.000	--
IrrCrop	1.021	0.019	0.000	--
ln(Net Returns)	-0.015	0.009	0.119	--
Average	0.182	0.016	0.000	0.199
Good	0.342	0.018	0.000	0.408
Dirt	-0.114	0.013	0.000	-0.108
Gravel	-0.069	0.009	0.000	-0.066
Auction	0.022	0.008	0.008	0.023
CRP	-0.106	0.055	0.053	-0.102
CRP_Y1999	-0.047	0.067	0.482	-0.048
CRP_Y2000	-0.006	0.066	0.930	-0.008
CRP_Y2001	0.070	0.066	0.288	0.070
CRP_Y2002	0.036	0.067	0.590	0.035
CRP_Y2003	0.092	0.064	0.154	0.094
CRP_Y2004	0.088	0.070	0.210	0.089
CRP_Y2005	0.095	0.071	0.180	0.097
CRP_Y2006	0.196	0.071	0.006	0.213
CRP_Y2007	0.148	0.074	0.046	0.156
CRP_Y2008	0.303	0.082	0.000	0.349
CRP_Y2009	0.133	0.090	0.140	0.137
CRP_Y2010	0.118	0.085	0.168	0.121
CRP_Y2011	0.177	0.093	0.058	0.188
CRP_Y2012	0.028	0.103	0.789	0.023
CRP_Y2013	0.011	0.125	0.928	0.004
CRP_Y2014	0.054	0.152	0.721	0.044
CRP_KFMA2	-0.018	0.040	0.659	-0.018
CRP_KFMA3	-0.262	0.092	0.004	-0.234

CRP_KFMA4	-0.053	0.050	0.290	-0.052
CRP_KFMA5	-0.067	0.040	0.090	-0.066
CRP_KFMA6	-0.117	0.102	0.253	-0.115
Q2	0.010	0.008	0.238	0.010
Q3	0.030	0.010	0.002	0.030
Q4	0.051	0.009	0.000	0.053
Y1999	-0.027	0.016	0.093	-0.026
Y2000	0.014	0.016	0.381	0.014
Y2001	-0.007	0.016	0.669	-0.007
Y2002	0.032	0.017	0.055	0.032
Y2003	0.042	0.020	0.032	0.043
Y2004	0.105	0.017	0.000	0.111
Y2005	0.192	0.018	0.000	0.211
Y2006	0.208	0.020	0.000	0.231
Y2007	0.242	0.020	0.000	0.274
Y2008	0.386	0.020	0.000	0.471
Y2009	0.472	0.024	0.000	0.603
Y2010	0.528	0.020	0.000	0.695
Y2011	0.570	0.022	0.000	0.767
Y2012	0.844	0.024	0.000	1.325
Y2013	1.022	0.026	0.000	1.778
Y2014	1.110	0.029	0.000	2.034
Constant	6.007	0.314	0.000	--
R^2	0.718			
Adjusted R^2	0.714			

Notes: County-level binary variables are included in the model, but are not listed here due to space constraints.

The results also indicate that in the base year of this analysis, 1998, parcels with a CRP contract located in the Northwest KFMA region were worth 10.6% less than those without a CRP contract and located in the same region. For the remaining years in the sample, the impact of CRP on land value in each region is the calculated by adding the coefficient from CRP to the annual dummy variable interaction terms as well as the regional interaction terms. In 1999, for example, the impact on land value in the Northeast region is -39.5% (-10.6% + -2.7% + -26.2%) when a CRP contract is present. The total impact varies greatly over time and region. As shown from the results of the regional interaction terms, the region most likely to have a negative CRP value is the Northeast region whose discount begins at an extra 26.2% compared to the base Northwest region. In fact, all regions have a discount when compared to the Northwest region, meaning the Northwest region represents the region with the lowest opportunity cost for CRP contracts. Based on the geography and production tendencies of Northwest Kansas, this result is very logical. It is important to note that the regions that tend to be considered the most agriculturally productive, Northeast and Southeast Kansas, have the highest initial discount when compared to the Northwest region. The rest of this analysis will focus on Northwest and Northeast Kansas in an effort to highlight the extremes, but results for all regions can be found in Appendix A.

Figure 5.1 shows how the presence of a CRP contract affects land values over time in Northwest Kansas. The plotted values are the total effect and the linear bands represent the 90% confidence intervals for the total effect. The years that are different from zero at a 90% confidence interval are indicated in figure 5.1 with a green circle. Red squares denote total effects from CRP that are not different from zero at a p-value of 10% or better. The numerical values depicted in Figure 5.1 are also presented in Table 5.2.

Figure 5.1 Linear Combinations of CRP Coefficient and Interaction Terms, Northwest KS

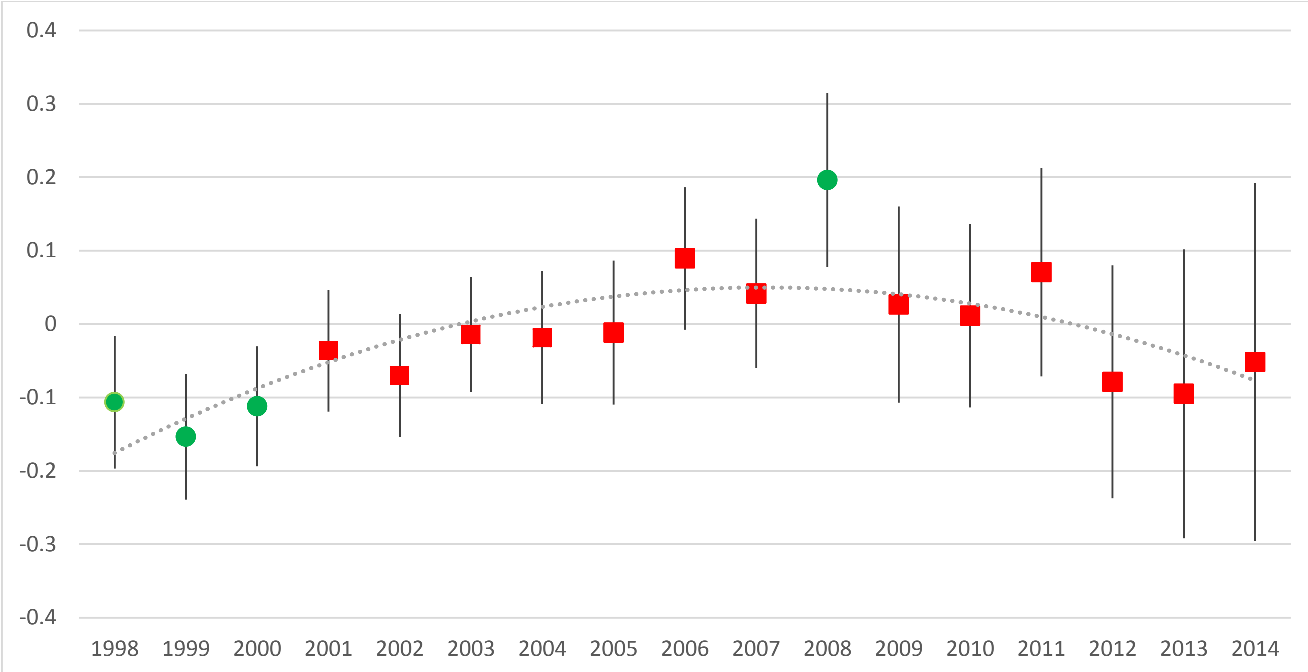


Table 5.2 Total Effect of CRP on Land Value by Year, Northwest Kansas

Year	Coefficient	Standard Error	P-Value	90% Confidence Interval	
1998	-0.1064	0.0550	0.053	-0.1969	-0.0159
1999	-0.1537	0.0521	0.003	-0.2394	-0.0680
2000	-0.1122	0.0497	0.024	-0.1939	-0.0305
2001	-0.0365	0.0503	0.468	-0.1194	0.0463
2002	-0.0702	0.0509	0.168	-0.1539	0.0135
2003	-0.0146	0.0475	0.759	-0.0927	0.0635
2004	-0.0187	0.0551	0.734	-0.1093	0.0718
2005	-0.0116	0.0595	0.845	-0.1096	0.0863
2006	0.0894	0.0590	0.130	-0.0076	0.1863
2007	0.0416	0.0619	0.502	-0.0603	0.1434
2008	0.1962	0.0719	0.006	0.0779	0.3144
2009	0.0265	0.0813	0.745	-0.1072	0.1602
2010	0.0115	0.0761	0.880	-0.1137	0.1367
2011	0.0706	0.0864	0.414	-0.0715	0.2127
2012	-0.0788	0.0964	0.414	-0.2374	0.0798
2013	-0.0951	0.1196	0.427	-0.2918	0.1017
2014	-0.0519	0.1483	0.726	-0.2958	0.1920

As figure 5.1 and table 5.2 show, the discount for CRP was relatively large in the first three years (1998 – 2000), there was a statistically significant and relatively large discount on parcels of land with CRP contracts. However, the discount became smaller during the years 2001 through 2011, becoming positive in 2006 with a statistically significant premium on contract parcels in 2008. During the last three years of the observation period, the impact of CRP contracts on land values returned to being negative. This variation in the impact of CRP contracts on land value likely reflects changes in the opportunity cost of setting aside land in CRP even in the region with the lowest initial opportunity cost for CRP contracts.

The Northeast region which tends to produce high value crops such as corn and soybeans is more obviously effected by shifting opportunity costs in CRP. Figure 5.2 shows the linear combinations of CRP, year interaction terms, and regional interaction terms in Northeast Kansas. Again, the plotted values are the total effect and the linear bands represent the 90% confidence intervals for the total effect. The years that are different from zero at a 90% confidence interval are indicated in figure 5.2 with a green circle. Red squares denote total effects from CRP that are not different from zero at a p-value of 10% or better. The numerical values depicted in Figure 5.2 are also presented in Table 5.3.

Figure 5.2 Linear Combinations of CRP Coefficient and Interaction Terms, Northeast KS

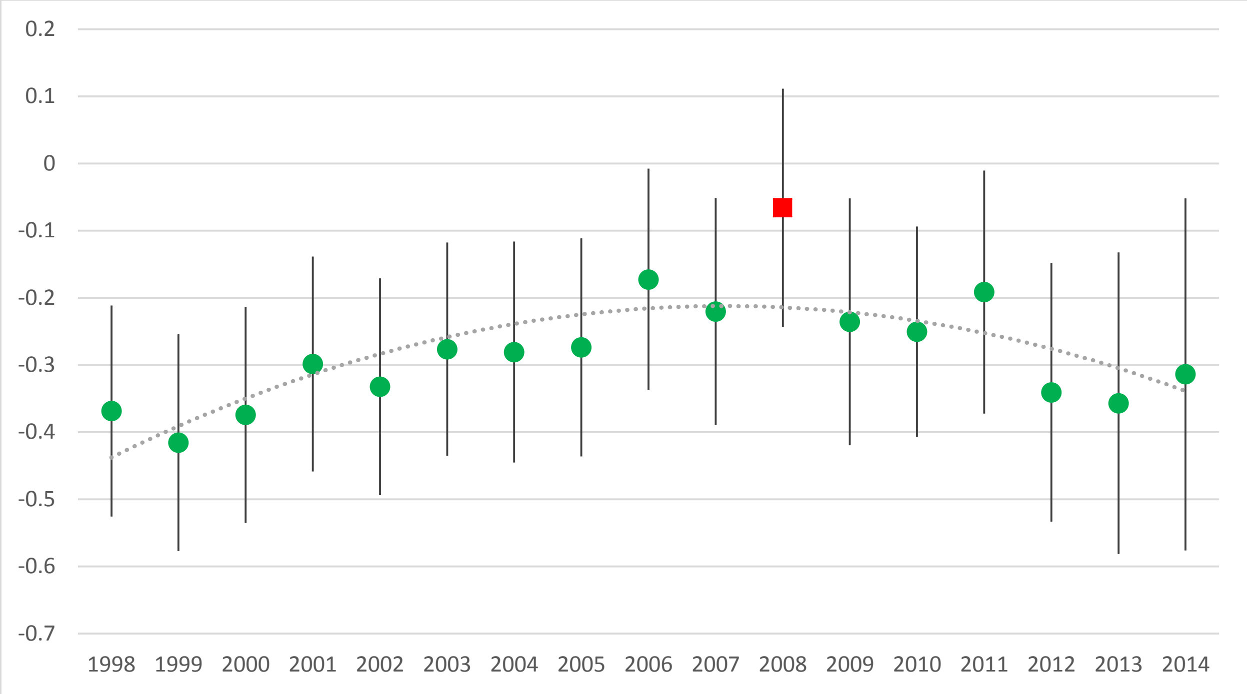


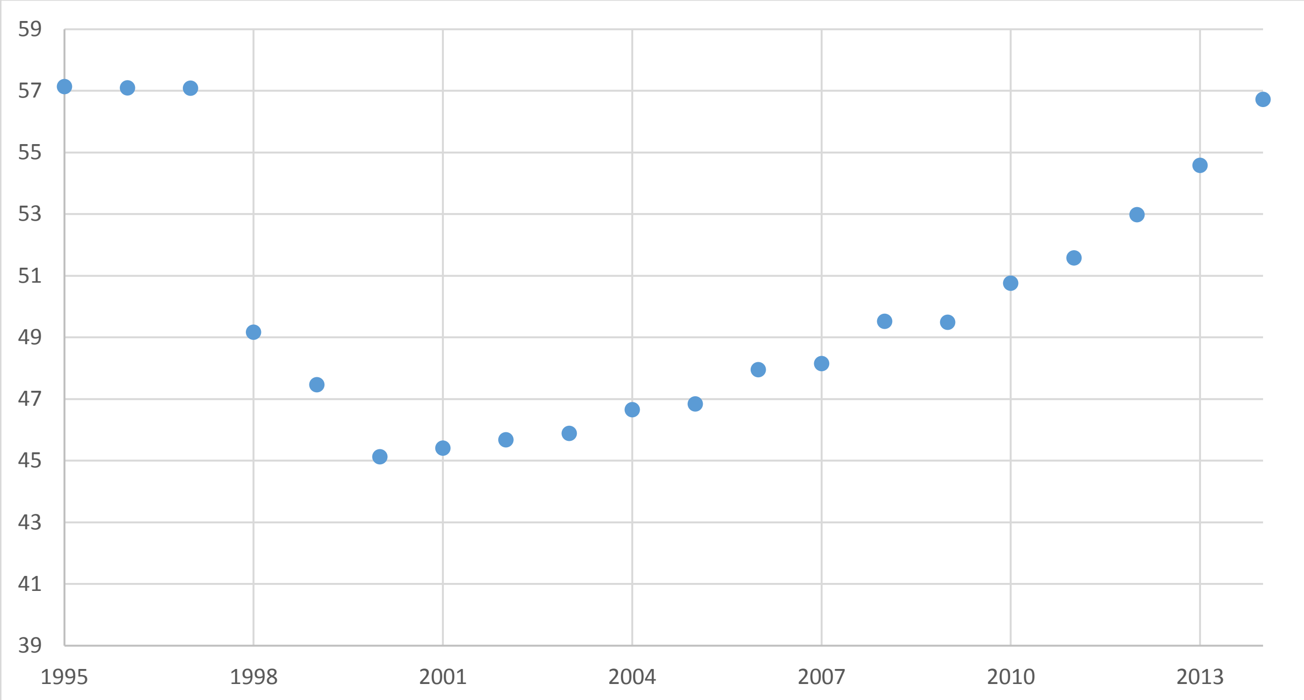
Table 5.3 Total Effect of CRP on Land Value by Year, Northeast Kansas

Year	Coefficient	Standard Error	P-Value	90% Confidence Interval	
1998	-0.3686	0.0955	0.000	-0.5257	-0.2115
1999	-0.4159	0.0982	0.000	-0.5774	-0.2544
2000	-0.3744	0.0979	0.000	-0.5353	-0.2134
2001	-0.2987	0.0972	0.002	-0.4586	-0.1389
2002	-0.3324	0.0982	0.001	-0.4939	-0.1709
2003	-0.2768	0.0966	0.004	-0.4356	-0.1179
2004	-0.2809	0.1000	0.005	-0.4454	-0.1165
2005	-0.2738	0.0987	0.006	-0.4362	-0.1115
2006	-0.1728	0.1003	0.085	-0.3379	-0.0078
2007	-0.2206	0.1029	0.032	-0.3898	-0.0514
2008	-0.0660	0.1078	0.540	-0.2434	0.1114
2009	-0.2357	0.1118	0.035	-0.4196	-0.0518
2010	-0.2507	0.0952	0.008	-0.4073	-0.0941
2011	-0.1916	0.1101	0.082	-0.3728	-0.0105
2012	-0.3410	0.1171	0.004	-0.5336	-0.1484
2013	-0.3573	0.1365	0.009	-0.5818	-0.1327
2014	-0.3141	0.1593	0.049	-0.5763	-0.0520

The stark differences in how CRP contracts are valued in the Northwest and Northeast KFMA regions highlight the importance of the inclusion of regional interaction terms. In Northwest Kansas the maximum discount a parcel of land on which a CRP contract was present accrued over the course of this analysis was just over 15%. In Northeast Kansas, that maximum discount jumps to over 41%. Obviously, the opportunity cost of enrolling in a CRP contract in each region differs drastically based on the regional characteristics of land and the production methods employed in each region.

The challenge to interpreting the results is being able to determine what was driving the change in the relative value of CRP rents versus cash rents from farming. During this first nine years of the study period (1998 to 2007), net farm incomes were low. The question that remains is, why is the discount on CRP parcels during these first nine years large in magnitude for the years 1998, 1999, and 2000, but smaller in magnitude for the remain years or 2001 to 2007? Even in Northwest Kansas where CRP was shown to have less negative effects on land value than other regions, 1998, 1999, and 2000 had statistically significant negative coefficients for CRP land. To answer this question, it is useful to look at average CRP rates in Kansas. The annual rents for Northwest Kansas are presented in figure 5.3 for the years 1995 to 2014. As is evident, 1998 marks the first year of a significant decline in the rental rates paid for CRP contracts from a regional average of $57.08 per acre in 1997 to an average of $49.17, $47.46, and $45.13 per acre for 1998, 1999, and 2000, respectively. After 2000, the average value stabilizes at approximately $45 per acre and begins to climb again over the length of the time period. The drastic change in the average rent paid on CRP contracts is a result of the expiration of the initial round of CRP contracts signed. When first established, the Conservation Reserve Program sought to enroll 45 million acres between 1985 and 1990. The 10 to 15 year contracts would have expired in the early window of figure 5.3. At the same time, the Federal Agriculture Improvement and Reform (FAIR) Act of 1996 capped CRP enrollment at 36.4 million acres and allowed land deemed less environmentally sensitive that had been enrolled in CRP for at least five years the chance to exit the program if notice was given (Agricultural Outlook Supplement, 1996). This led to an exodus from the program of original adoptees as well as heightened competition for those looking to enroll in the program. These factors created a situation where the average CRP rental rate did not have to be as high as in previous years to meet program goals. Returning to the results of this study, it is possible the large decline in rental rates paid on CRP contracts affected the opportunity cost calculation being made by landowners and people looking to buy parcels with acres under CRP contract. That is, landowners and those seeking to purchase land perceived the opportunity cost of CRP was now higher due to the significantly reduced rental payments. Similar trends regarding the large discounts in the first few years of this analysis can be found in all six KFMA regions (See Appendix A).

Figure 5.3 Average CRP Rental Rate in Northwest Kansas, 1995-2014



Source: USDA - FSA

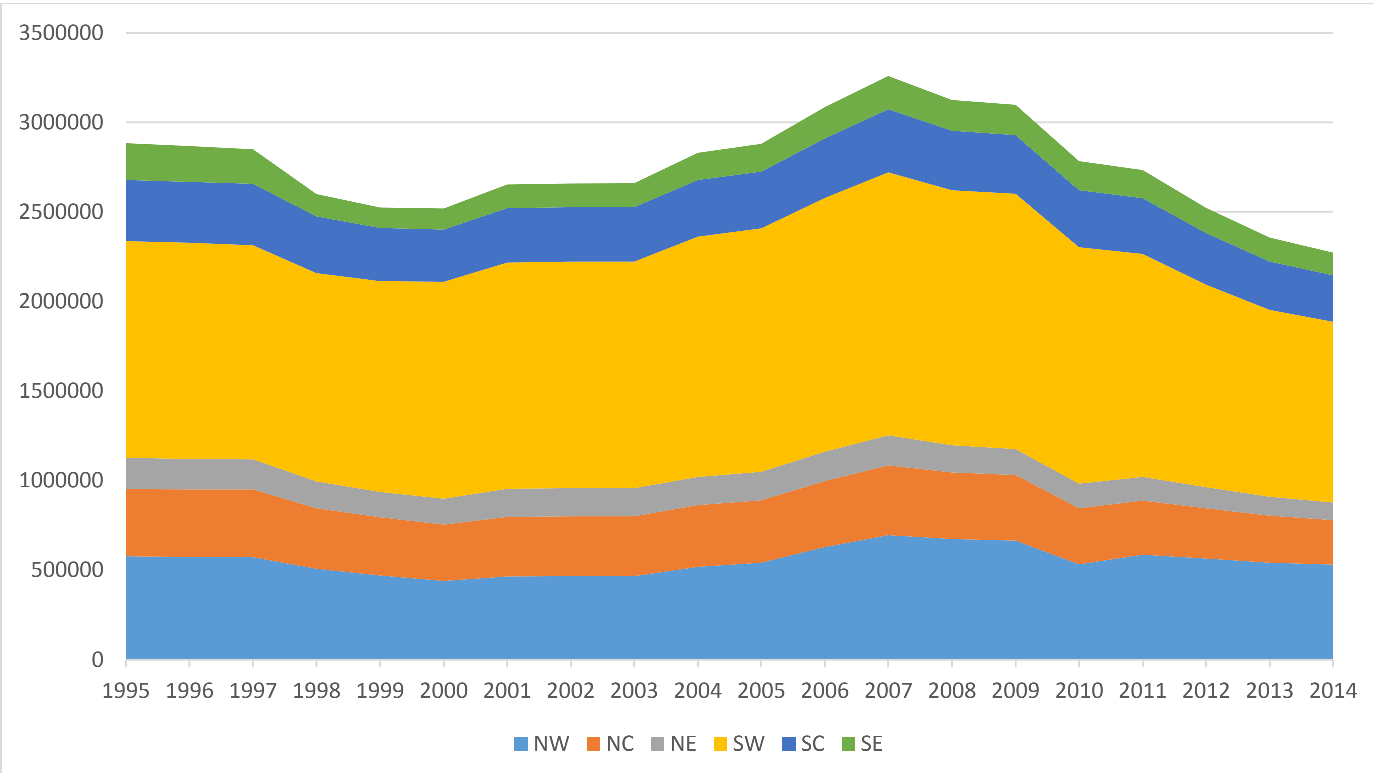
While the above discussion tackles the question of the early trend of CRP discounts, as figures 5.1 and 5.2 show, the level has changed greatly over the given time period. After the initial discount, as landowners and buyers became accustomed to the lower CRP rates, the discount lessened in magnitude and was even positive in for varying periods of time in five of the six KFMA regions.

This is important because it lends support to the validity of the analysis. An alternative interpretation of the model results would be that parcels of land with CRP contracts are discounted because of the quality of the land rather than strictly the opportunity cost of alternative uses. It is likely that land enrolled in CRP will be land that is of lower quality due to highly erodible soils. The empirical model was specified to account for this confounding effect by including the relative ranking of land quality by professional appraisers that was included in the dataset. If the CRP discount was always negative, it would be more difficult to argue that land quality was sufficiently accounted for in the model to arrive at a precise estimate of the CRP effect alone.

Toward the end of the time period, the discount again starts to increase as shown in figures 5.1 and 5.2. The driver of this change in the magnitude of the discount is likely from the relative profitability of farming. As discussed in Chapter 4, both net incomes and net returns were high, however it is hard to say how much of a direct effect this fact had on CRP. We can assume because of the large opportunity cost for CRP contracts that exists over the life of the analysis in Northeast Kansas, these times of increased profitability contributed more to this negative swing than in other regions. So, in order to explain the downward trend in Northwest Kansas where CRP land has historically brought premiums, it is helpful to reexamine figure 3.2, which compares the rent-to-value ratios of land in CRP versus land that is farmed. The drop in CRP rates discussed above and illustrated in figure 5.3 can be seen in figure 3.2 when the CRP rent to value ration drops by nearly 2% between 1997 and 1998. After that drastic drop, the two stayed roughly the same distance apart from 1999-2008. However, in 2010 the ratios begin to converge. CRP is no longer the obvious preferential investment that it once was. While it still represents the better option on average, farming becomes more and more feasible as a means to make a profit. This trend continues through the remainder of the analysis time period. It is this increase in opportunity cost for enrolling in a CRP contract relative to farming the land that drives the large negative coefficients found in 2012, 2013 and 2014 across all six KFMA regions.

Finally, in an effort to illustrate that the opportunity cost of CRP enrollment is higher in some regions than in others, figure 5.4 shows total CRP enrollment in Kansas by region. As is obvious, those regions that incur the most significant discounts historically from CRP (Northeast and Southeast) have the lowest enrollment. However, those regions that are less affected by these opportunity cost shifts and whose CRP and cash rent to value ratios never converge (Northwest and Southwest) enroll in droves.

Figure 5.4 Average CRP Enrollment in Kansas by Region



Chapter 6 - Conclusion

6.1 Empirical Findings

This paper set out to empirically test whether or not the presence of a CRP contract on a parcel of land affects its value. In previous literature, only negative effects had been found due to the relatively short periods of time considered. Also crucial was the inclusion of interaction terms allowing the effect of CRP on land values to vary over time. As has been demonstrated, CRP contracts can indeed affect land value both positively and negatively, depending on the profitability of farming and the expectations of how those profits will change over time by landowners.

When choosing to enroll in the Conservation Reserve Program, a landowner is well aware that they are choosing to forego any potential profits that the parcel might have made from being actively farmed for a constant stream of payments from the federal government. This can be a blessing or a curse depending on what happens to the market. Their assessment of the opportunity cost of enrolling is based solely on the information available to them at the time of enrollment. The point is that a landowner cannot be expected to know how the opportunity cost of enrolling in the program will change over such a great length of time. Therefore, this analysis shows that the changes in opportunity cost over the length of the contract are instead reflected in the changes in value of Conservation Reserve Program land.

6.2 Policy Implications

The current CRP rental payment system establishes one payment rate over the length of the 10 to 15 year contract. The amount of this payment is agreed to by a landowner who, at the time of enrollment, possesses imperfect information regarding the how the opportunity cost that is being undertaken might shift over the length of the contract. Certainly this system of constant payments saves on administrative and oversight costs for the Farm Service Agency. However, based on this analysis, it becomes clear that a few simple changes could be made in order to position the Conservation Reserve Program as a more attractive investment for landowners. This would allow for more consistent and competitive enrollment in the program and continue to meet and improve upon the laudable environmental goals set out by the program.

The Farm Service Agency could establish a payment system that takes into account market factors such as net incomes and rent to value ratios and adjust CRP payments up or down depending on the situation at hand. A payment structure that uses price indices to either raise or lower payments according to how prices have changed over the length of the contract is another tenable option. If these payments were to change based on returns, it is plausible to assume that landowners would be more likely to enroll because the perceived opportunity costs have been offset. Since its implementation, the cap on CRP acreage has been reduced by roughly 20 million acres. If this program were ever to expand again, taking this step would help with enrollment goals. However, even if the cap were to remain near its current level, having a system in which more landowners feel empowered to enroll could make bids more competitive. Having more bidders would allow the FSA and the Natural Resources Conservation Service (NRCS) to pull the most environmentally sensitive land out of production, thus increasing the environmental benefits of the program at large. This shift in policy is not simply a one way street economically. New contracts could allow for the decrease in payments in times of low returns as well, saving the government money in certain fiscal environments. It is the elimination of the opportunity costs afforded by this policy shift that make it such a viable option.

Still other solutions include allowing for opt-outs if a producer decides that farming the land is the more economically viable option. As stated previously, the FAIR Act of 1996 allowed for such opt-outs, as did the 2014 Farm Bill. However, these opt-out periods are short and unscheduled. They can come around at any time and producers must make a snap decision about remaining in the program. Placing a five year opt-out option in new contracts would be a simple and effective way of increasing interest in the Conservation Reserve Program.

6.3 Future Research

There are many potential avenues for future research that could expand our understanding of the impact of CRP on land values. First and foremost, the inclusion of flexibility data would be very helpful. As stated previously, there is some data regarding the number of acres enrolled in CRP of a parcel, the rate at which a parcel is enrolled, as well as the expiration date of the contract in question at the time of the sale. However, these data are variable and there was not enough of it to include in this paper. Ideally, there would be a way to include these numbers as a measure of flexibility. That is, how much flexibility did the new buyer have when purchasing the land? Did the CRP contract encompass a small or large percentage of the parcel? Was the contract set to expire the next year or ten years from the time of purchase? Measuring how much flexibility each sold parcel possessed would allow for an even more interesting discussion of how CRP contracts inform land purchasing decisions.

Another measure that would expand this analysis is the value landowners derive from the environmental benefits the Conservation Reserve Program brings about. Because this paper represents a purely quantitative analysis, it fails to consider the utility that might well be derived from some landowners who enroll in CRP simply because they feel the environmental benefits are so important. The best way to quantify this might well be a survey. However, even without this data, the economic viewpoints established in the above research are sound.

The analysis could reveal more information on changes in opportunity costs by expanding the dataset back further to at or before 1995. This would allow for the observation of how the higher CRP rental rates that were in place from the program's inception in 1985 until 1998 affected the value of the CRP coefficients during that time period. Were the coefficients already negative, or did the significant drop in rental rates shown in figure 5.2 cause the extreme negativity observed in 1998 and 1999? Also, the period of 1995-1997 represents yet another instance of high net returns and farm incomes. Including these dates would allow for the observation of yet another cycle of prices from extraordinary to ordinary within the context of this analysis. Indeed, this would be the step most recommended to any who choose to continue this research.

Finally, this work could be repeated in other states to determine if the established trend is nationwide. As mentioned in the literature review, hedonic models have previously been used to consider CRP contracts in both Minnesota and North Dakota. Indeed, Schmitz and Shultz encouraged similar work be done in other states. Those states that possess the resources to accurately track land sales that are under CRP contract should do so in an effort to establish a reliable and understandable trend that future policy decisions can be based upon without hesitation.

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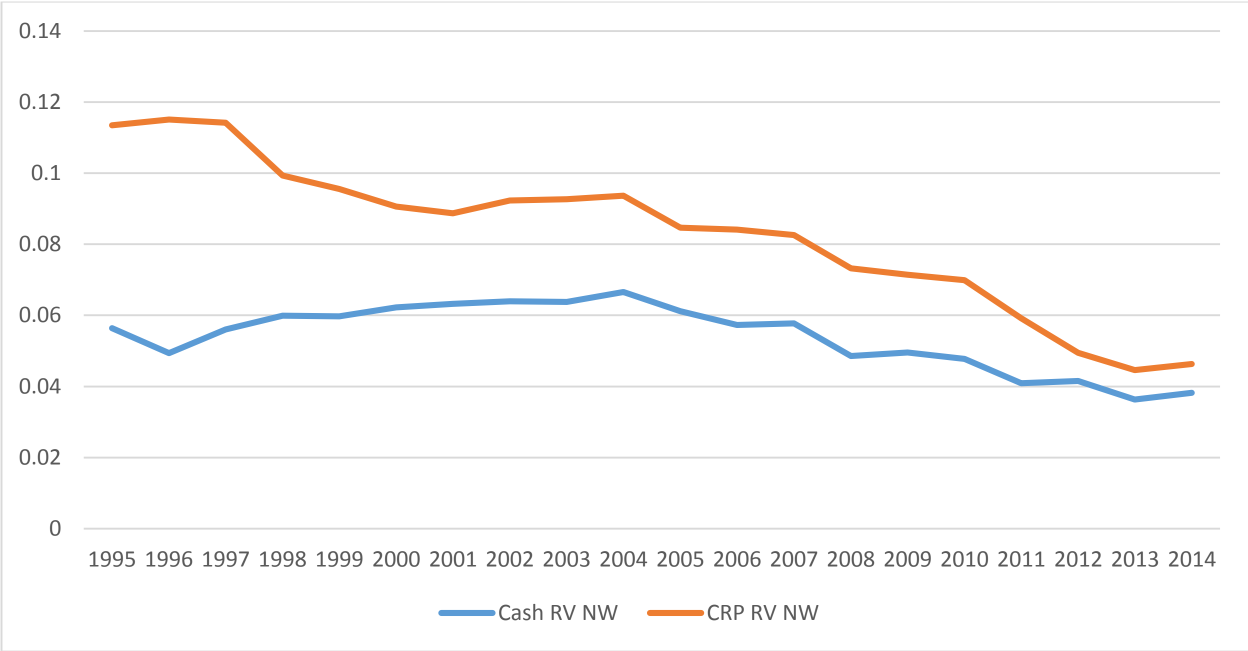
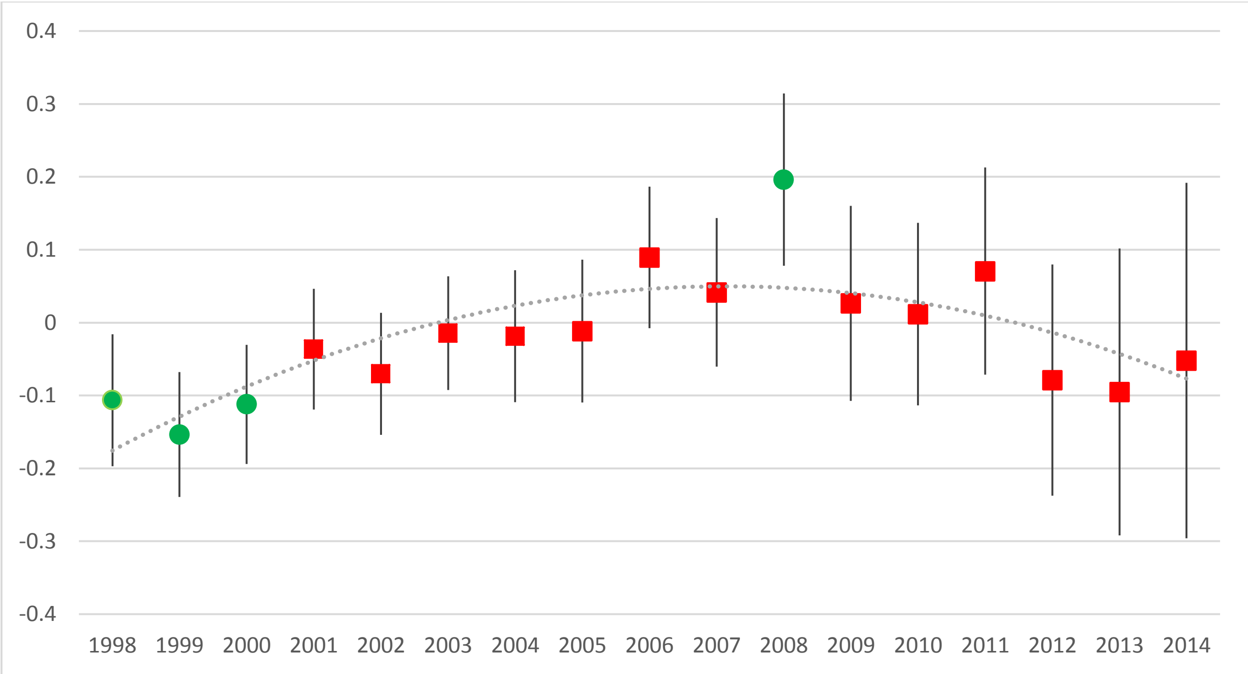
Appendix A - Results for All Kansas Regions

Northwest Kansas

Rent-to-Value Ratio



Linear Combinations of CRP Coefficient and Interaction Terms

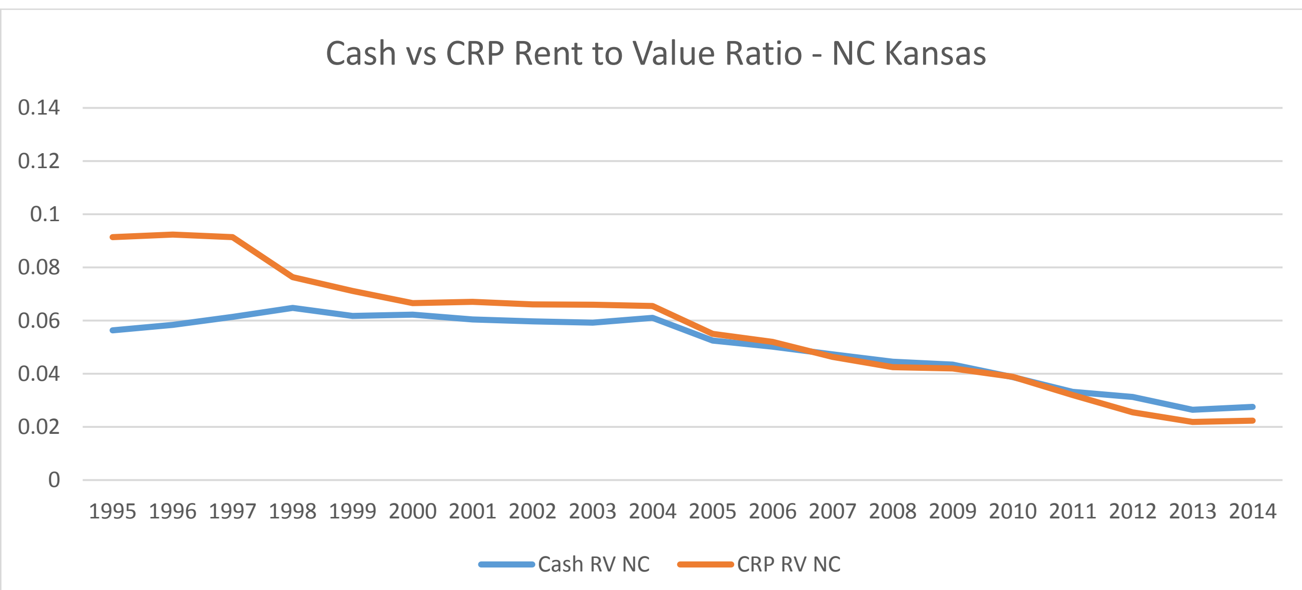


Total Effect of CRP on Land Value by Year

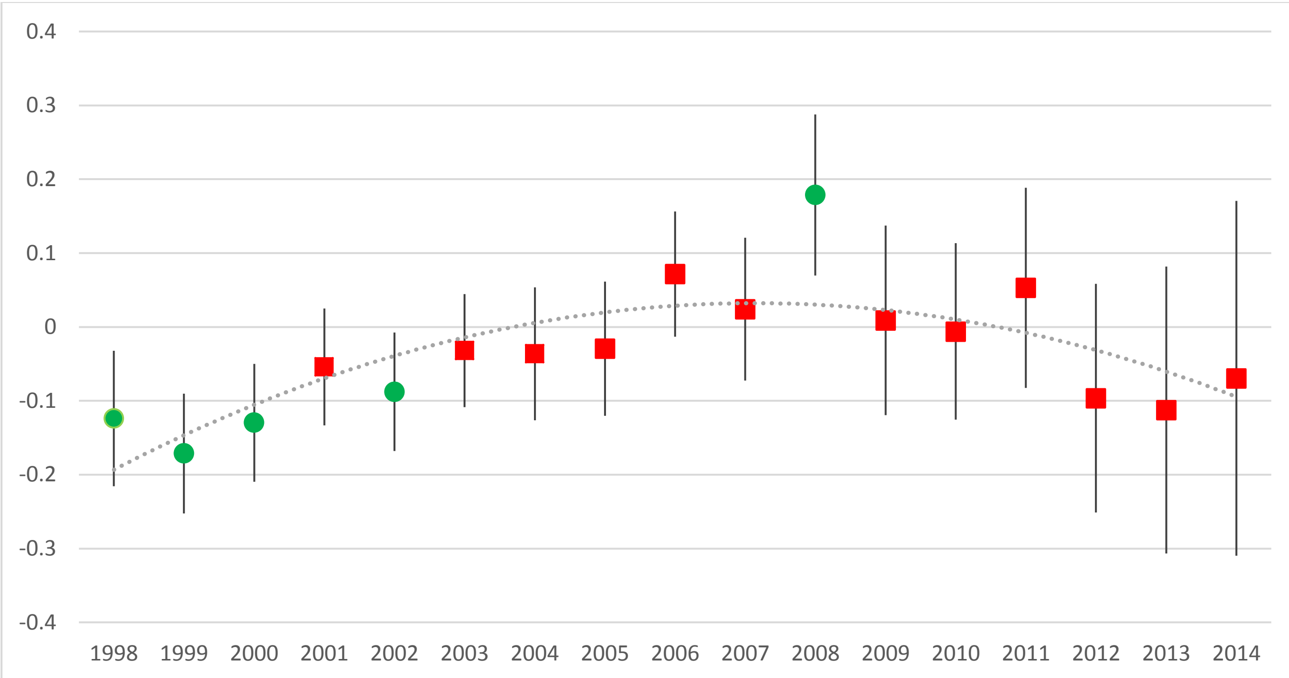
Year	Coefficient	Standard Error	P-Value	90% Confidence Interval	
1998	-0.1064	0.0550	0.053	-0.1969	-0.0159
1999	-0.1537	0.0521	0.003	-0.2394	-0.0680
2000	-0.1122	0.0497	0.024	-0.1939	-0.0305
2001	-0.0365	0.0503	0.468	-0.1194	0.0463
2002	-0.0702	0.0509	0.168	-0.1539	0.0135
2003	-0.0146	0.0475	0.759	-0.0927	0.0635
2004	-0.0187	0.0551	0.734	-0.1093	0.0718
2005	-0.0116	0.0595	0.845	-0.1096	0.0863
2006	0.0894	0.0590	0.130	-0.0076	0.1863
2007	0.0416	0.0619	0.502	-0.0603	0.1434
2008	0.1962	0.0719	0.006	0.0779	0.3144
2009	0.0265	0.0813	0.745	-0.1072	0.1602
2010	0.0115	0.0761	0.880	-0.1137	0.1367
2011	0.0706	0.0864	0.414	-0.0715	0.2127
2012	-0.0788	0.0964	0.414	-0.2374	0.0798
2013	-0.0951	0.1196	0.427	-0.2918	0.1017
2014	-0.0519	0.1483	0.726	-0.2958	0.1920

North Central Kansas

Rent-to-Value Ratio



Linear Combinations of CRP Coefficient and Interaction Terms

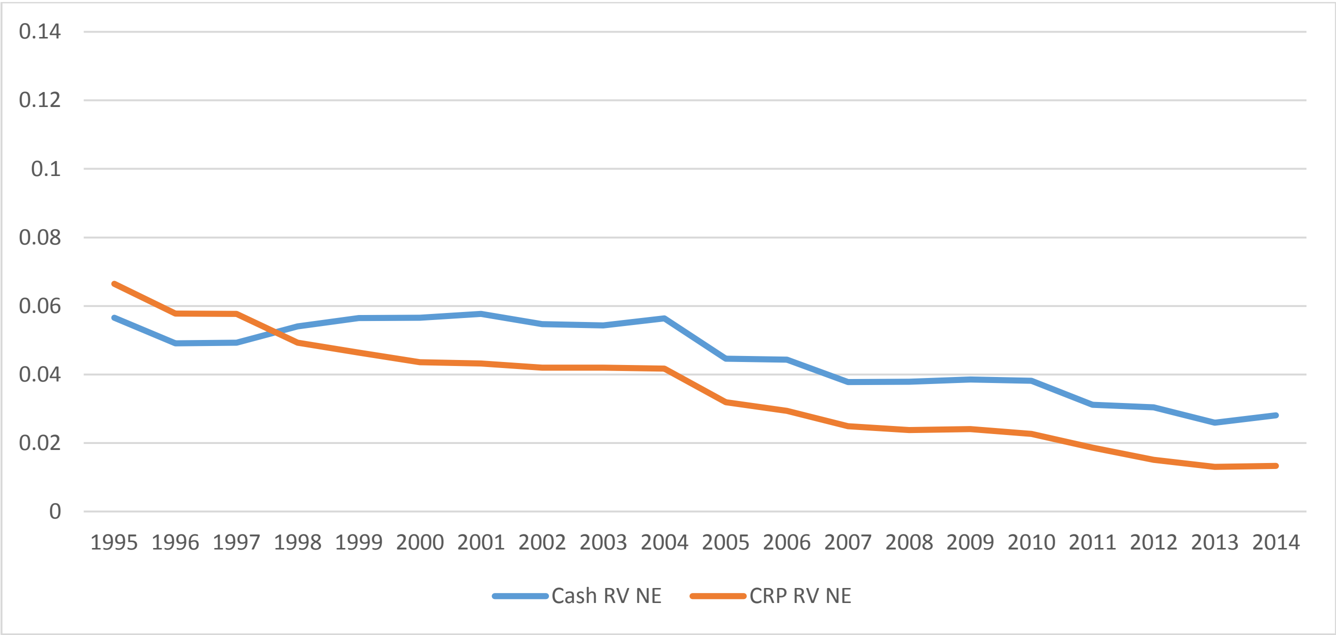


Total Effect of CRP on Land Value by Year

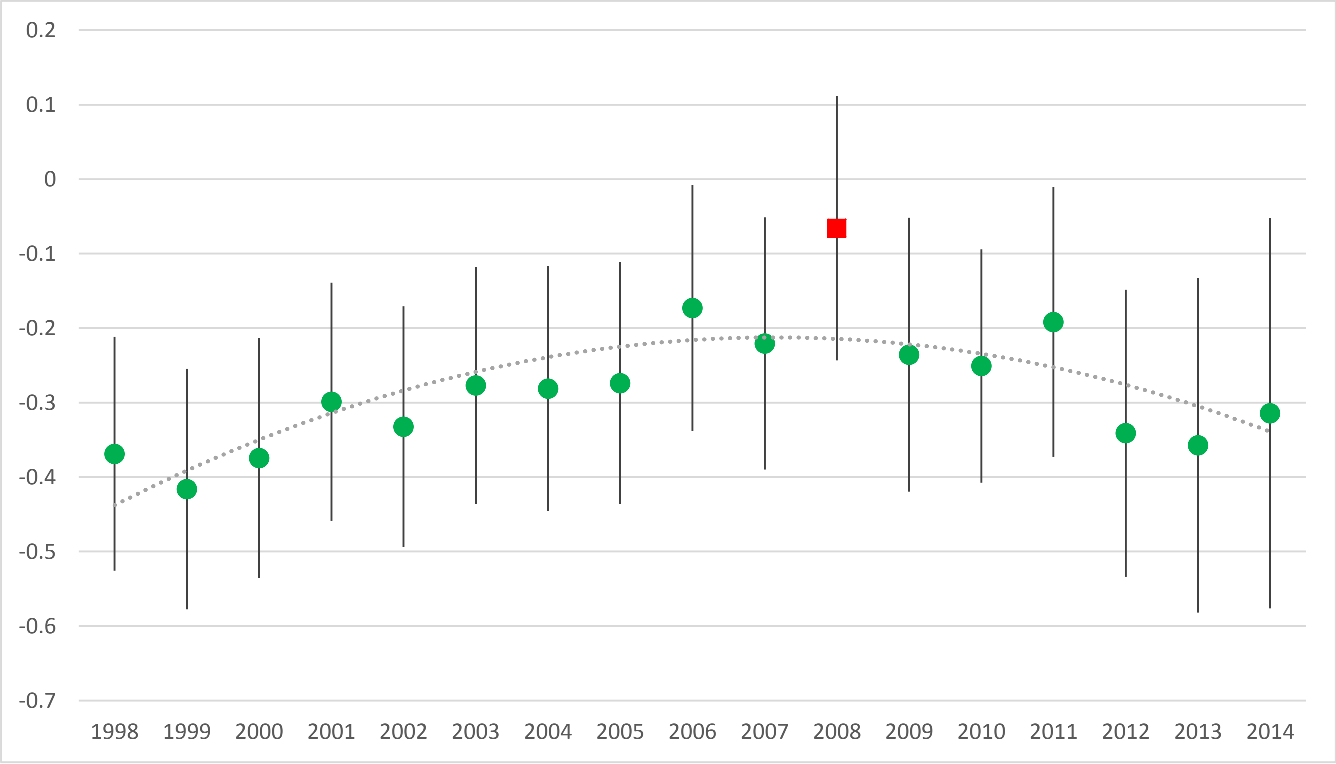
Year	Coefficient	Standard Error	P-Value	90% Confidence Interval	
1998	-0.1240	0.0557	0.026	-0.2156	-0.0324
1999	-0.1713	0.0493	0.001	-0.2524	-0.0902
2000	-0.1298	0.0484	0.007	-0.2094	-0.0501
2001	-0.0541	0.0482	0.262	-0.1334	0.0252
2002	-0.0878	0.0487	0.072	-0.1679	-0.0076
2003	-0.0321	0.0465	0.489	-0.1086	0.0443
2004	-0.0363	0.0547	0.507	-0.1263	0.0537
2005	-0.0292	0.0552	0.597	-0.1201	0.0616
2006	0.0718	0.0515	0.164	-0.0130	0.1566
2007	0.0240	0.0588	0.683	-0.0727	0.1207
2008	0.1786	0.0663	0.007	0.0695	0.2876
2009	0.0089	0.0780	0.909	-0.1194	0.1372
2010	-0.0061	0.0725	0.933	-0.1254	0.1133
2011	0.0530	0.0824	0.520	-0.0826	0.1886
2012	-0.0964	0.0942	0.306	-0.2513	0.0586
2013	-0.1126	0.1181	0.340	-0.3069	0.0816
2014	-0.0695	0.1461	0.634	-0.3098	0.1708

Northeast Kansas

Rent-to-Value Ratios



Linear Combinations of CRP Coefficient and Interaction Terms

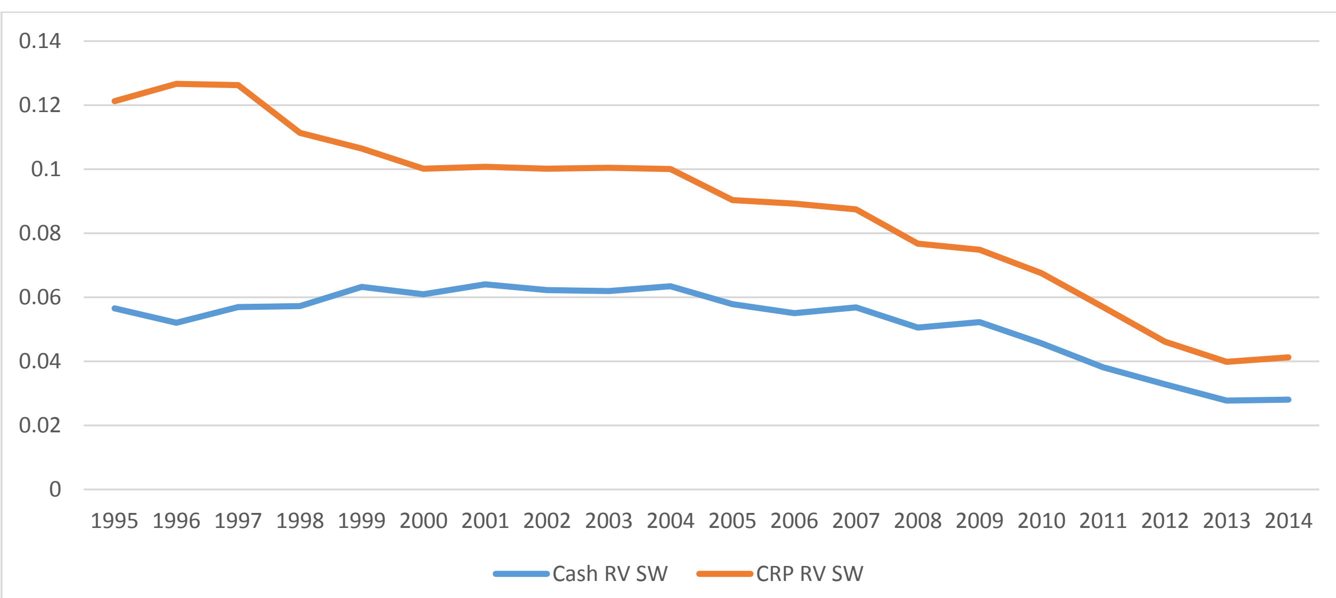


Total Effect of CRP on Land Value by Year

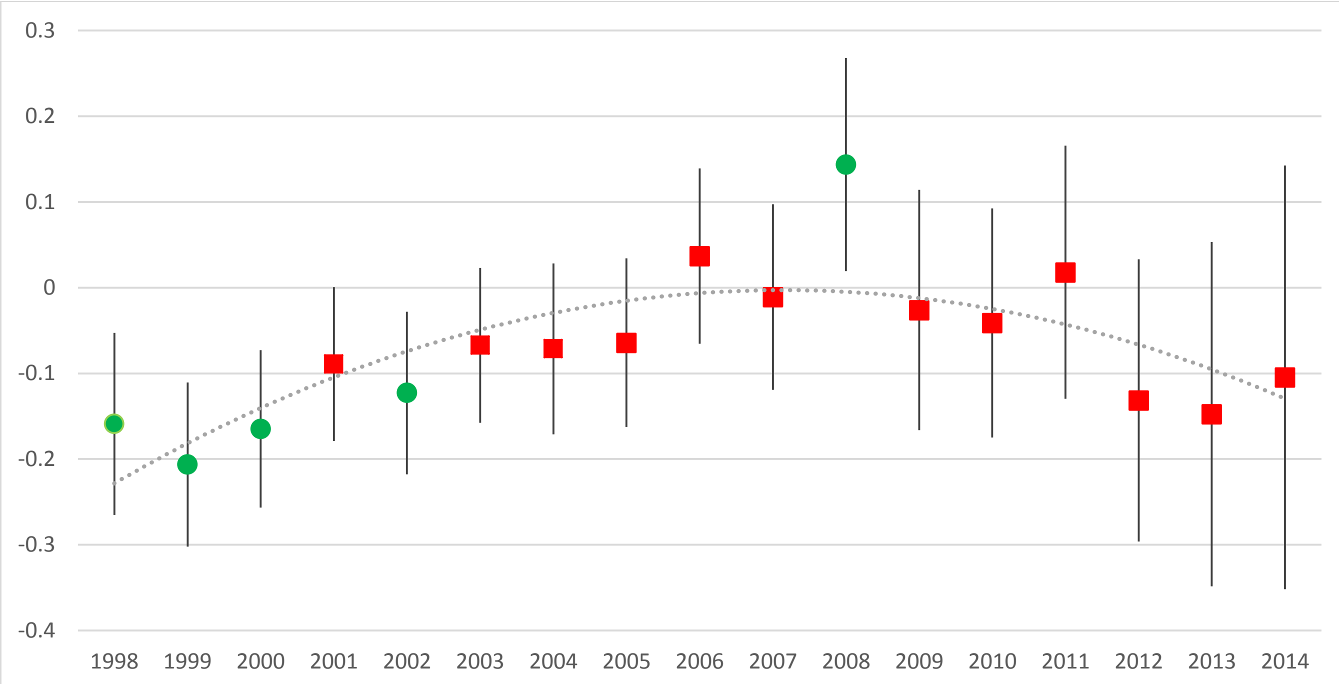
Year	Coefficient	Standard Error	P-Value	90% Confidence Interval	
1998	-0.3686	0.0955	0.000	-0.5257	-0.2115
1999	-0.4159	0.0982	0.000	-0.5774	-0.2544
2000	-0.3744	0.0979	0.000	-0.5353	-0.2134
2001	-0.2987	0.0972	0.002	-0.4586	-0.1389
2002	-0.3324	0.0982	0.001	-0.4939	-0.1709
2003	-0.2768	0.0966	0.004	-0.4356	-0.1179
2004	-0.2809	0.1000	0.005	-0.4454	-0.1165
2005	-0.2738	0.0987	0.006	-0.4362	-0.1115
2006	-0.1728	0.1003	0.085	-0.3379	-0.0078
2007	-0.2206	0.1029	0.032	-0.3898	-0.0514
2008	-0.0660	0.1078	0.540	-0.2434	0.1114
2009	-0.2357	0.1118	0.035	-0.4196	-0.0518
2010	-0.2507	0.0952	0.008	-0.4073	-0.0941
2011	-0.1916	0.1101	0.082	-0.3728	-0.0105
2012	-0.3410	0.1171	0.004	-0.5336	-0.1484
2013	-0.3573	0.1365	0.009	-0.5818	-0.1327
2014	-0.3141	0.1593	0.049	-0.5763	-0.0520

Southwest Kansas

Rent-to-Value Ratios



Linear Combinations of CRP Coefficient and Interaction Terms

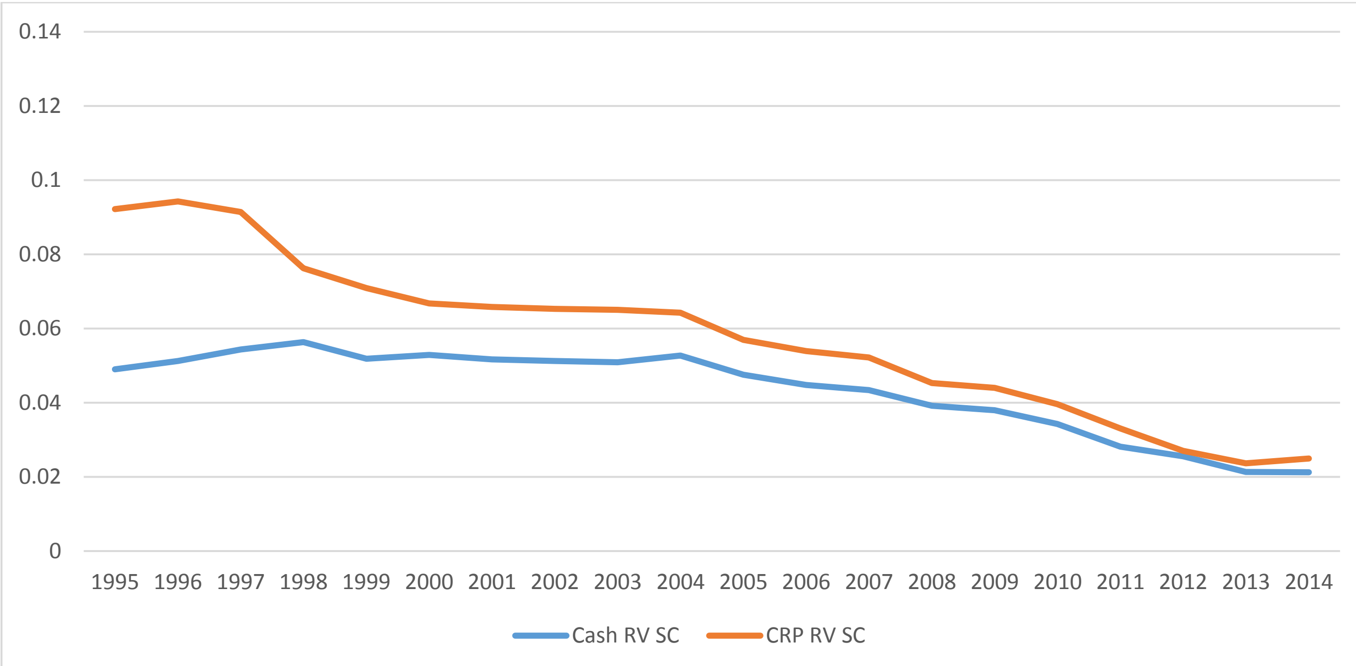


Total Effect of CRP on Land Value by Year

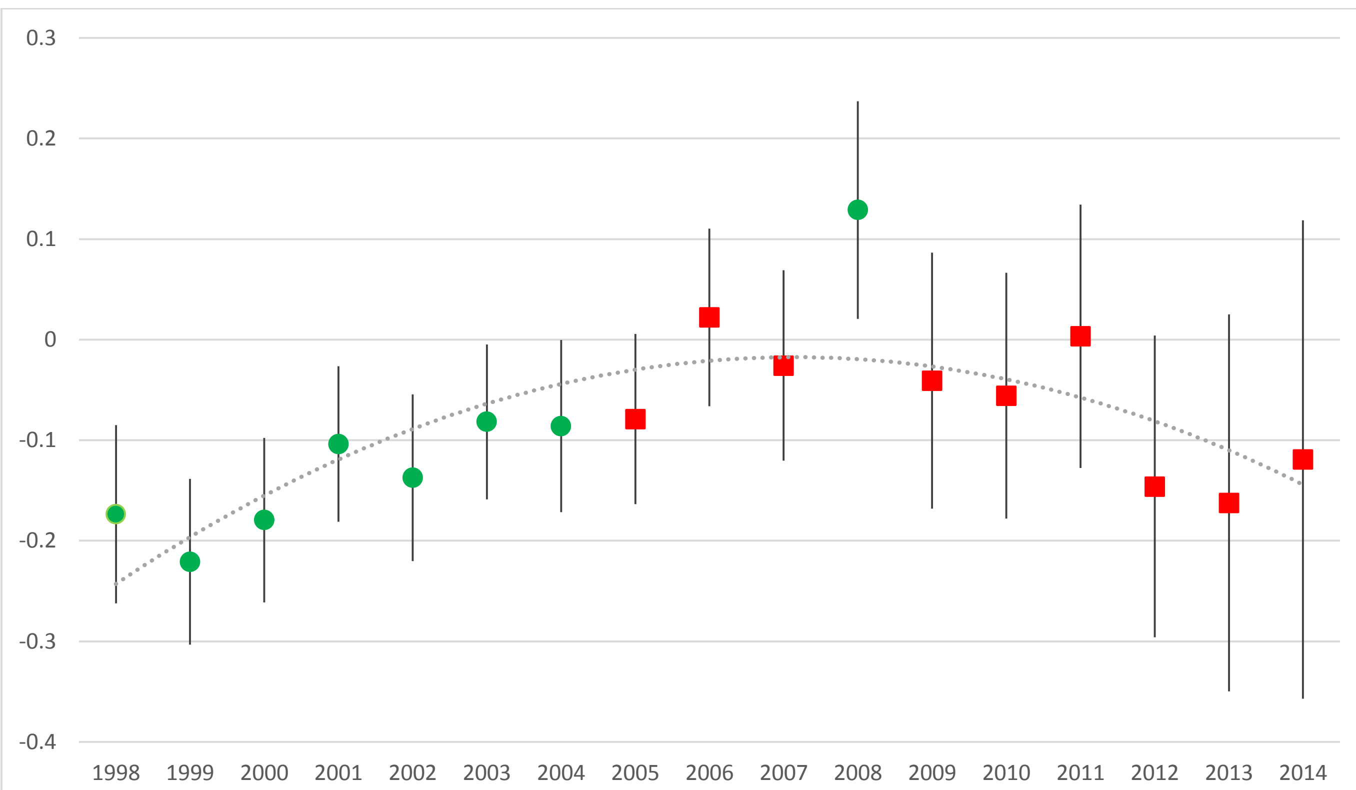
Year	Coefficient	Standard Error	P-Value	90% Confidence Interval	
1998	-0.1590	0.0645	0.014	-0.2651	-0.0529
1999	-0.2063	0.0581	0.000	-0.3020	-0.1107
2000	-0.1648	0.0559	0.003	-0.2568	-0.0728
2001	-0.0892	0.0546	0.103	-0.1790	0.0007
2002	-0.1228	0.0576	0.033	-0.2176	-0.0280
2003	-0.0672	0.0549	0.221	-0.1576	0.0232
2004	-0.0714	0.0606	0.239	-0.1711	0.0284
2005	-0.0643	0.0598	0.283	-0.1627	0.0341
2006	0.0367	0.0622	0.555	-0.0656	0.1390
2007	-0.0111	0.0658	0.867	-0.1193	0.0972
2008	0.1435	0.0755	0.057	0.0193	0.2678
2009	-0.0261	0.0852	0.759	-0.1663	0.1140
2010	-0.0411	0.0812	0.613	-0.1747	0.0925
2011	0.0180	0.0898	0.841	-0.1297	0.1657
2012	-0.1314	0.1001	0.189	-0.2961	0.0333
2013	-0.1477	0.1221	0.226	-0.3485	0.0531
2014	-0.1046	0.1503	0.487	-0.3518	0.1427

South Central Kansas

Rent-to-Value Ratios



Linear Combinations of CRP Coefficient and Interaction Terms

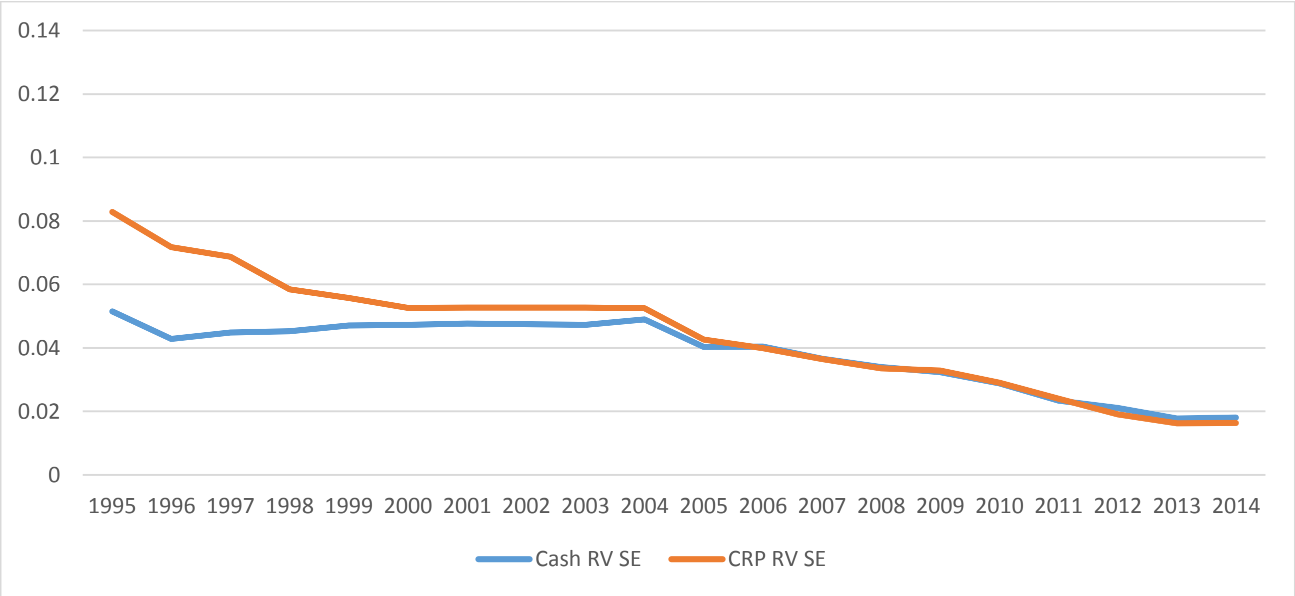


Total Effect of CRP on Land Value by Year

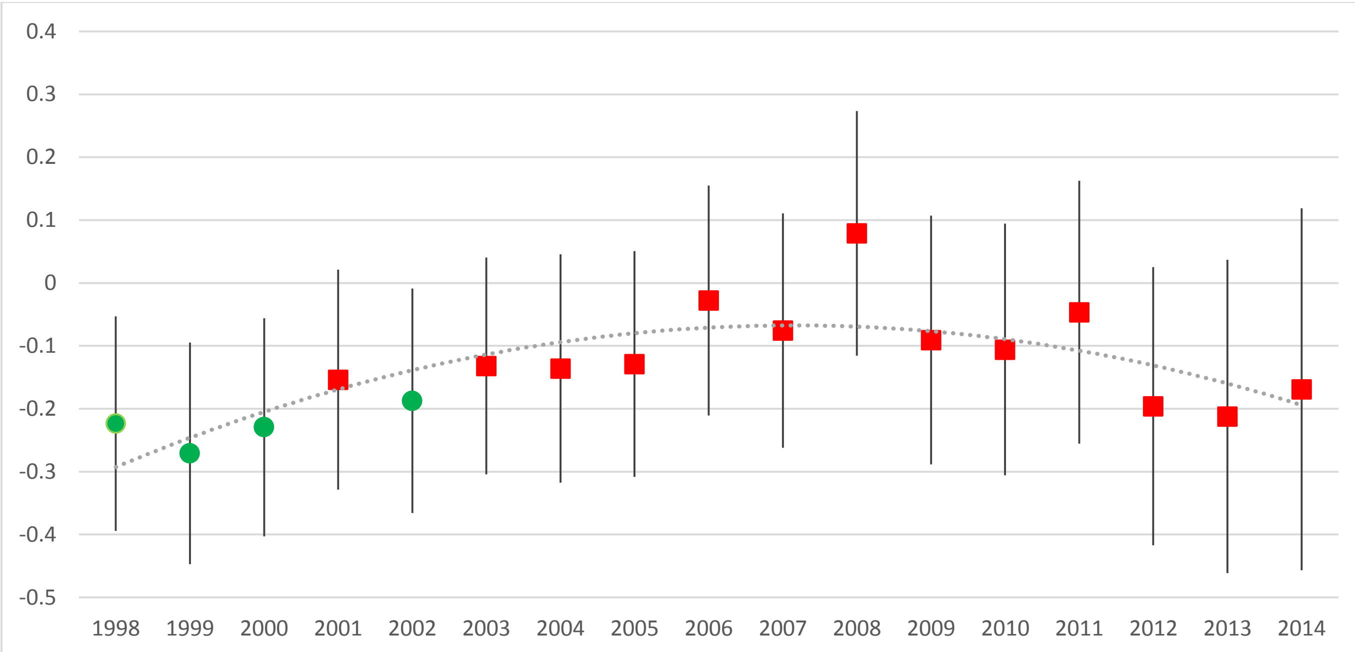
Year	Coefficient	Standard Error	P-Value	90% Confidence Interval	
1998	-0.1736	0.0538	0.001	-0.2622	-0.0851
1999	-0.2209	0.0501	0.000	-0.3033	-0.1386
2000	-0.1794	0.0497	0.000	-0.2611	-0.0977
2001	-0.1038	0.0470	0.027	-0.1812	-0.0264
2002	-0.1374	0.0504	0.006	-0.2203	-0.0545
2003	-0.0818	0.0468	0.080	-0.1587	-0.0049
2004	-0.0860	0.0521	0.099	-0.1716	-0.0003
2005	-0.0789	0.0514	0.125	-0.1635	0.0057
2006	0.0221	0.0537	0.680	-0.0663	0.1105
2007	-0.0257	0.0575	0.655	-0.1202	0.0689
2008	0.1289	0.0658	0.050	0.0207	0.2371
2009	-0.0407	0.0774	0.598	-0.1680	0.0865
2010	-0.0557	0.0742	0.453	-0.1778	0.0664
2011	0.0034	0.0796	0.966	-0.1276	0.1343
2012	-0.1460	0.0912	0.110	-0.2961	0.0041
2013	-0.1623	0.1139	0.154	-0.3496	0.0250
2014	-0.1192	0.1446	0.410	-0.3570	0.1187

Southeast Kansas

Rent-to-Value Ratios



Linear Combinations of CRP Coefficient and Interaction Terms



Total Effect of CRP on Land Value by Year

Year	Coefficient	Standard Error	P-Value	90% Confidence Interval	
1998	-0.2235	0.1037	0.031	-0.3940	-0.0530
1999	-0.2708	0.1070	0.011	-0.4468	-0.0948
2000	-0.2293	0.1054	0.030	-0.4027	-0.0559
2001	-0.1537	0.1063	0.148	-0.3285	0.0211
2002	-0.1873	0.1085	0.084	-0.3658	-0.0088
2003	-0.1317	0.1048	0.209	-0.3041	0.0407
2004	-0.1359	0.1104	0.219	-0.3175	0.0458
2005	-0.1288	0.1090	0.238	-0.3081	0.0506
2006	-0.0278	0.1110	0.803	-0.2103	0.1548
2007	-0.0756	0.1132	0.504	-0.2618	0.1106
2008	0.0790	0.1181	0.503	-0.1153	0.2734
2009	-0.0906	0.1203	0.451	-0.2885	0.1072
2010	-0.1056	0.1215	0.385	-0.3054	0.0942
2011	-0.0465	0.1270	0.714	-0.2555	0.1625
2012	-0.1959	0.1345	0.145	-0.4172	0.0254
2013	-0.2122	0.1515	0.161	-0.4614	0.0371
2014	-0.1691	0.1750	0.334	-0.4569	0.1188