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The Economic Impact of the Kentucky Green River Conservation Reserve Enhancement Program (CREP)

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Abstract

This study examines the impact of the Conservation Reserve Enhancement Program (CREP) on fourteen Kentucky counties. The CREP program is an advancement of the Conservation Reserve Program (CRP) which began nationally in 1985. The primary intention of both programs is to improve water quality and reduce soil erosion. Thus, in order to stimulate conservation efforts, farmers are given an opportunity to remove land from current production and still reap financial benefits. When CREP was introduced to Kentucky in 2002, the program provided far more lucrative incentives than the parent program. In 2007 CREP underwent an amendment process that broadened the definition of eligible land and enhanced financial benefits. Economic theory would suggest that, holding everything else constant, increasing financial benefits and initiating incentives should increase the acreage enrollment. My specific goal is to determine if the enhanced program has had the theoretically and statistically predicted positive affect on acreage enrollment. Preliminary results suggest that in fact there was a statistically significant increase in the mean number of acres enrolled in conservation programs in Kentucky after 2002. A complete economic analysis includes both costs and benefits, thus water quality and erosion data are needed. These data are not accessible because of the newness of the program, but will provide a great avenue for continual research.

Acknowledgements

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To my family, thank you for always supporting me and pushing me to achieve my fullest potential.

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Introduction

Kentucky has long since been regarded as a state rich in agriculture. In 2006, approximately 84,000 farms spanned across 13,840,000 acres of the Commonwealth of Kentucky. This sector contributed approximately 5 billion dollars to the state economy (USDA ERS, 2008). In view of the fact that such a large portion of our economic well being is attributed to one sector, it is important that we closely monitor all programs affecting those sectors. Two programs are the Conservation Reserve Enhancement Program (CREP) and its parent program, the Conservation Reserve Program (CRP). It is essential that measures are taken to evaluate and interpret the incentives and repercussions of these programs.

The Kentucky Green River CREP is the largest single conservation effort in the history of State of Kentucky (Warren County USDA FSA, 2008). In the 2007 fiscal year the grand total of estimated cumulative expenditures for the Kentucky Green River Conservation Reserve Enhancement Program totaled $740,946.86 (USDA FSA, 2007b). Much like that of the CRP, it is a conservation effort where land owners voluntarily remove land from active production, while still being compensated. The underlying goals of CREP are to protect the state's water supply, create secure habitats for endangered species and reduce soil erosion.

Economic theory would suggest that, holding all else constant, that an increase in financial incentives would increase acreage enrollment. Thus, my research is centered on two empirical questions. Is there a statistically significant increase in average acreage

enrollment of CREP versus the average acreage enrollment of CRP? Looking at farmer behavior, what factors have a statistically significant impact on acreage enrollment?

In the next sections you will find a review of similar land retirement programs from economic perspectives, a history of conservation reserve programs, a description of the data gathered and used, and explanation of results.

History

The United States government passed the Food Security Act of 1985 which included legislation that authorized the implementation of the Conservation Reserve Program (CRP). This piece of legislation was one of the first attempts to push conservation efforts beyond erosion control. Its goal was to improve soil and water quality (USDA ERS, 1997).

The United States Department of Agriculture (USDA) appointed the Farm Service Agency (FSA) as the administrative agent. The CRP was designed to target highly erodible land areas in order to provide a means of conservation that would greatly lessen the effects of farming. The original CRP contracts were voluntary 10 – 15 years land retirement agreements, in which the owner of the land discontinued previous crop production practices and complied strictly with the guidelines of the program. Originally eleven different practices fell within the locus of CRP. For the purpose of the CRP a practice can be defined as a specific method of farming, or way of tending the land. Many practices included introducing native grasses, hardwoods and buffers around sensitive water sources (USDA FSA, 2007 fact sheet). The nature of a land retirement

program is to allow land to sit for the length of the contract without the constant upkeep by farmers.

Owners received an annual rental payment, along with a maintenance fee each year for the length of the contract. The rental payment is designed to be equivalent to what the land would bring on an open rental market. The maintenance fee is a monetary amount intended to reimburse the land owner for any improvements or alterations that were made in order to prepare the land for the CRP enrollment. A cost-share program provided farmers with assistance for the cost associated with implementing these practices. For instance if the new practice was to plant native grasses and the cost associated for preparing the land and sowing the seed is $2,000, the farmer would receive a certain percentage of this cost. If the percentage were 10% the farmer would receive $200 from the program, after planting the grasses. This cost-share alleviates the high cost of certain seeds, and lessens the cost barrier. For each practice a different percentage would apply.

Incentives were offered periodically in association with certain farming practices. For example if Farmer A enrolls in the hardwood planting practice, beyond the annual rental payment and cost-share assistance for planting the hardwood trees, Farmer A would receive a certain monetary amount as an incentive. This incentive is typically a set amount, used to encourage farmers to participate in this practice. For illustration purposes, if Farmer A enrolls 1,000 acres in hardwood planting, his annual rental payment is $100 per acre, the cost of implementing hardwood trees is $3,500 at a 50%

cost-share and the incentive is $500. Farmer A's total monetary amount received is $102,250

The Food, Agriculture, Conservation, and Trade Act of 1990 allowed CRP to continue through 1995. It also allowed the program to include areas that were both on-site and off-site contributors to water quality deterioration. Under this act the Environmental Benefits Index (EBI) was created to rank the soil productivity along with their respective rental rate. The EBI takes into account wildlife, water quality, erosion, air quality and cost. Each category is ranked on a points system. A bid was the expected rental rate as determined by the EBI ranking (USDA FSA, 2007 CRP). For example the erosion component has a maximum possibility of 100, with a minimum of 0 points. If your soil contains highly erodible soil, it increases your ranking for a higher bid. For example if your soil has erosion points of 85, your chances of receiving a high bid are likely.

In 1996 the Federal Agriculture Improvement and Reform Act, once again extended the life of CRP. This amendment allowed CRP to continue through 2002, and simultaneously increased the enrollment eligibility to 36.4 million acres. This legislation also altered the ranking order within the EBI. For the first time wildlife habitat protection was included in the EBI, and given equal weight with soil and water quality restoration.

This act allowed the CRP to be offered on a continuous basis. Prior to this time the CRP had participated in a general sign up. This typically occurred once yearly. During this sign up potential CRP participants competed across the nation for rental rates,

based on their EBI ranking. The continuous sign up now offered potential CRP participants the opportunity to enroll year round. Under this sign up most participants receive a one time only, up front incentive to enroll.

In 1997 the FSA developed the Conservation Reserve Enhancement Program (CREP). Its purpose was to further the environmental objectives of the CRP. CREP is a partnership between federal, state and, occasionally, private contributors that is directly related to state conservation needs. CREP is a continuous enrollment program that too offers up front incentives for enrolling. CREP's set up is very similar to that of the CRP. CREP is a voluntary land retirement program that offers 10 to 15 year contracts for participants to discontinue previous farming practices and adopt the restrictions of CREP (USDA, 2006).

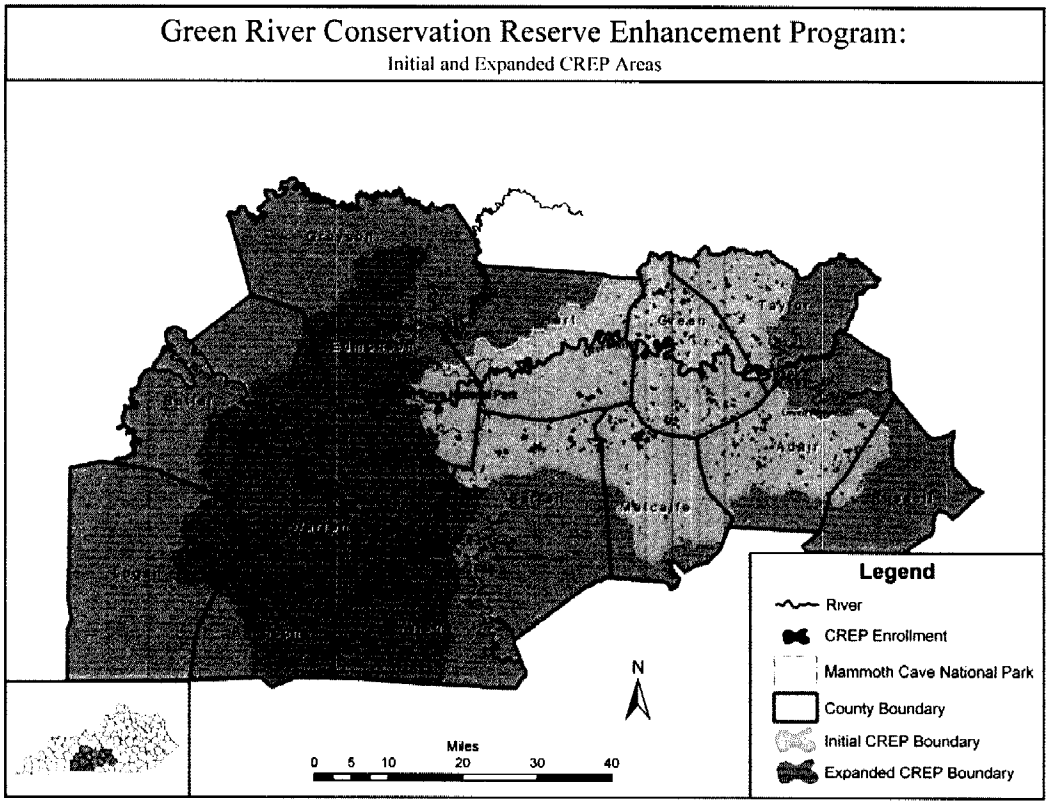
The primary difference between the two programs is that CREP is a partnership between state and federal governments. Therefore, not every state is a CREP participant. In August 2001 the USDA agreed with the Commonwealth of Kentucky to implement CREP, with specific interest in the Green River and Mammoth Cave land areas becoming known as the Kentucky Green River Conservation Reserve Program. This is the largest conservation program instituted in Kentucky history. The expected cost of this program will reach $105,000,000, with $85,000,000 allocated from the federal government, $17,000,000 from the state, and the Nature Conservancy (a private organization) to provide $5,000,000. The Commonwealth of Kentucky is responsible for funding all incentive opportunities, in addition (USDA FSA, 2007 fact sheet).

Originally, the target area for the KY Green River CREP consisted of the Green River watershed area. An area which contained 917,197 acres in eight counties: Adair, Barren, Edmonson, Green, Hart, Metcalfe, Russell and Taylor. This ecologically enhanced area is home to a variety of endangered species, and serves as the water supply for a large portion of south central Kentucky (Division of Conservation, 2007). As described earlier, the program's objectives are to reduce agriculture runoff, and alter current farming practices that would improve the water and soil quality of the river.

In 2006 an amendment to the KY Green River CREP was drafted. This amendment included increasing the area eligible for the program, increasing rental payments, and implementing a new practice into the program. In 2007 the amendment was approved. Currently the land area eligible for KY Green River CREP includes the original eight counties: Adair, Barren, Edmonson, Green, Hart, Metcalfe, Russell and Taylor plus the new additional counties: Allen, Butler, Grayson, Logan, Simpson and Warren. This additional land now protects an area of the Green River 30 miles down stream, increasing the eligible acreage to 946,101 (USDA FSA, 2007 annual report). Figure 1 illustrates the entire CREP region in Kentucky.

The CP29 Marginal Pastureland Wildlife Habitat Buffer practice was introduced into CREP under this amendment. The CP29, also known as "the sinkhole program," creates a buffer 1,000 feet around a sinkhole. This land could be both past crop or pasture land. This was the first program of its kind. The ecological move behind this implementation was to protect the drainage basins that flowed into Mammoth Cave, Green River, Nolin River and southern Kentucky (USDA FSA, 2007 annual report).

Figure 1: CREP Map



(USDA FSA, 2007b)

Currently there are eighteen different practices within the KY Green River CREP. Each payment to farmers for these practices is calculated using a matrix. Reference matrices can be found in the appendix. Variables that effect payments include Crop History, Base Cost-Share, Practice Incentive Payment, Signing Incentive Payment, Soil Rental Rate Incentive, and Maintenance Payments.

Literature Review

The Conservation Reserve Enhancement Program (CREP), a voluntary land retirement program at a federal-state level, is not a new phenomenon. The United States Government instituted similar conservation programs in the 1930's Great Depression era (Heimlich, 2007). The implementation of these programs forced researchers to develop a method of evaluating their performance. In 1985 the Conservation Reserve Program (CRP), the parent program of CREP, originated under the Food Security Act. Economists immediately began studying its impact on the national economy, mainly by conducting cost-benefit analyses.

The Economic Research Service in their *Agricultural Resources and Environmental Indicators 1996-97*, observed that the total economic impact simply can not be derived from the sum of all individual components. CRP affects the economy in one of two ways, either by real effects or transfer effects. Real effects are those alterations that appear in relation to goods and services. Transfer effects are monetary exchanges that occur between branches of government. Real effects are not easily determined due to their nonmarket nature. This means that it is difficult to put a numerical value on such things as wildlife. Therefore, simply determining the net effect

of all actions is not accurate. Their method of calculation consisted of two formulas. The first is to evaluate the real changes in societal terms, mainly environmental quality improvements. The second is more focused on intra transfers, accounting for expenses, proceeds and savings. Both methodologies of analyzing the economic effects proved to be only partial, neither method taking into account all aspects of the multifaceted program.

Katherine Reichelderfer and William Boggess in 1988 analyzed the performance and cost effectiveness of the CRP in 1987 in relation to other farm programs. As described above, a bid system was implemented in 1986 to determine rental payments. Environmental factors, such as erosion levels and water quality, were each assigned a percentage value. All potential land was then evaluated using this criterion. Farmers were then placed in a bid system, with their rank reflecting the quality of land, according to the environmental factor criteria. Reichelderfer and Boggess's interpretation stems from the inter-reliance of variables. Specifically they examine the mutual dependence bid ranking and criteria selection. They suggest that depending upon the desired performance of the CRP; criterion is selected that affects the manner in which bids are entered into the ranking system. Consequently, the ranking of the bids determine the areas in which the desired performance is focused. Utility maximization, as a function of soil erosion, was used to determine the implicit effect of preferences. Their results suggest that in fact preferences do affect the manner in which criteria were included in the EBI.

Peter Feather, Daniel Hellerstein and LeRoy Hansen in 1999 evaluated the Conservation Reserve Program. Their purpose was to see if a correlation between the nonmarket benefits of CRP and outdoor recreations existed. In order to draw this conclusion, they first structured their research to discover the optimal level of CRP resulting in the greatest total benefit. They used the approach of quantifying the value society puts on achieving certain environmental goals. To calculate total benefits they considered three categories: water-based recreational activities, hunting, and wildlife observations. Subsequently, they divided the total benefits into two subcategories: public and private. These categories were analyzed with respect to their appropriate cost, either public or private. Their conclusion was that if CRP desired a more public oriented benefit, then their current method of appropriating resources was not efficient enough to reach an optimal level.

Edwin Young and Tim Osborn's economic assessment of the CRP in 1990, takes into account much more than monetary amounts to evaluate its effectiveness. Specifically, they examine the relationship between farm income, environmental benefits, food prices, and government expenditures. A complete economic analysis was performed including both measures of cost and benefits. They compared the explicit costs to the national economy, against the environmental and financial benefits of the program. They revealed that economic theory held true when removing large plots of land from current production. In fact this removal led to a decrease in the supply of commodities, causing an increase in the price of commodities. Then they observed that farmers began demanding higher rental payments to offset their increase in opportunity

costs. Their conclusion was a decline in the production of commodities which would damage international trade and led to a decrease in agribusiness economic activities. Overall they concluded that large environmental benefits resulted, however they were offset by a dramatic increase in the costs associated with the program.

Ralph Heimlich's analyzed land retirement programs in 2007. One point that distinguishes this work from others is that it acknowledges that most studies agree that farmers' gains are countered by consumers' losses, but he attempts to delve further into the argument. Heimlich began by examining the cost of land retirement programs; rental payments, cost-sharing, technical assistance and impacts on local communities. He then compared the cost to specific benefits; changes in agriculture markets, government expenditures, and overall market transactions. His conclusion was that presently the benefits of the program are outweighing the costs; however, certain inefficiencies in management could lead to a reversal in future years.

Most of the previous work to evaluate the economic impact of similar land retirement programs uses cost-benefit analysis to determine the total effect on the economy. In order to perform a complete cost-benefit analysis of the Kentucky Green River CREP, water and soil quality data are needed. In addition, one needs the value that each individual has placed on enrolling one acre into conservation programs. This information is unavailable at the present time due to the infancy of the program.

My research, which focuses mainly on farmer behavior, is the first of the Kentucky Green River CREP. My analysis examines specific factors in the macroeconomic environment of each county, as well as opportunity cost, incentives and

events specific to a given year, to determine which elements have a statistically significant impact on enrollment. First I determine if an increase in average acreage enrollment has in fact occurred with the implementation of CREP. Then I use regression analysis to isolate specific factors that impact this enrollment.

Data Description

The United States Department of Agriculture's Farm Service Agency (FSA), is responsible for overseeing the development and maintenance of both the CRP and CREP. It is also liable for keeping records of the involvement in each program. The data used in this study is directly taken from the data collected by the USDA and FSA offices on both a federal and local level.

The KY Green River Conservation Reserve Program has only been in existence since 2001, with the first enrollments beginning in 2002. Therefore, data specifically for CREP is only available beginning in the year 2002. These data were taken from the USDA Farm Service Agency's Conservation Reserve Enhancement Program Reports. This data varies in relationship with when CREP was introduced on a county level. For example Logan County, KY did not become a CREP participant until 2008, whereas Hart County, KY was an original participant of CREP. For Logan County, KY CREP data exists only for 2008, and Hart County, KY from 2002-2008.

CRP on the other hand began in 1985. Kentucky, however, did not begin keeping thorough records of enrollment until 1996. The data records from 1996 through 1997 did not contain enough complete information to be included in this study. These data

were taken from the USDA Farm Service Agency's Conservation Reserve Program Reports. On a CRP basis, for this analysis, data collection begins in 1998.

In 2002 the Farm Security and Rural Investment Act introduced a privacy regulation to federal agriculture documents. The act prohibits information from being disclosed in cases where the number of participants is so minute, that the public could infer detailed information pertaining to individual farmers. In reference to my data collection, there are years in which information is not available due to the 2002 Farm Security and Rural Investment Act. In those instances, it is assumed that the number enrolled is less than four contracts, but greater than zero contracts.

The data for this study consists of data on a county level as well as a time-series basis, generating a panel data set. The counties included are the original eight counties and the recently added six counties. The time period included dates from the first records in 1998 to the most present records of 2008. Since the information collected spans across time and counties I am able to calculate statistics for both years and counties, simultaneously.

In order to examine CRP acres and CREP acres separately the two were included as individual variables. On a yearly basis, it is apparent that the average CREP acres exceed that of CRP acres enrolled by over 500 acres. See Table 1 for more information. Although the average acres enrolled for CREP is larger than that of CRP acres, the standard deviation of the two is reversed. This indicates that although the average of all CREP acres is higher the enrollment is more dispersed than for that of CRP. In other words the distribution is more spread out, including both very high and very low

Table 1: Descriptive Statistics – full sample

Variable	Mean	Median	Std Dev	Min	Max	n
Total CRP	627.842	241.75	889.492	5.1	4340.9	60
Total CREP	1128.88	470.35	1720.53	25.1	8121.6	50
Total Both	1001.22	444	1492	33.9	8121.6	94
Rental Rate	106.47	102.745	41.6383	42.96	239	94
Maintenance	53.0462	65	35.706	0	122	65
Incentive	32.5591	38	35.0036	0	118	93
Corn Value	286.426	258.96	99.1018	139.26	709.3	154
Soybean Value	225.53	226.05	80.9304	53.13	460.1	154
Hay Value	169.952	170.215	32.7113	99.825	259.91	154
Burley Value	420.056	427.946	157.349	0	801.034	154

amounts. This suggest that CRP acres have been more concentrated over time; however the data indicate that CREP began relatively low and is now increasing greatly.

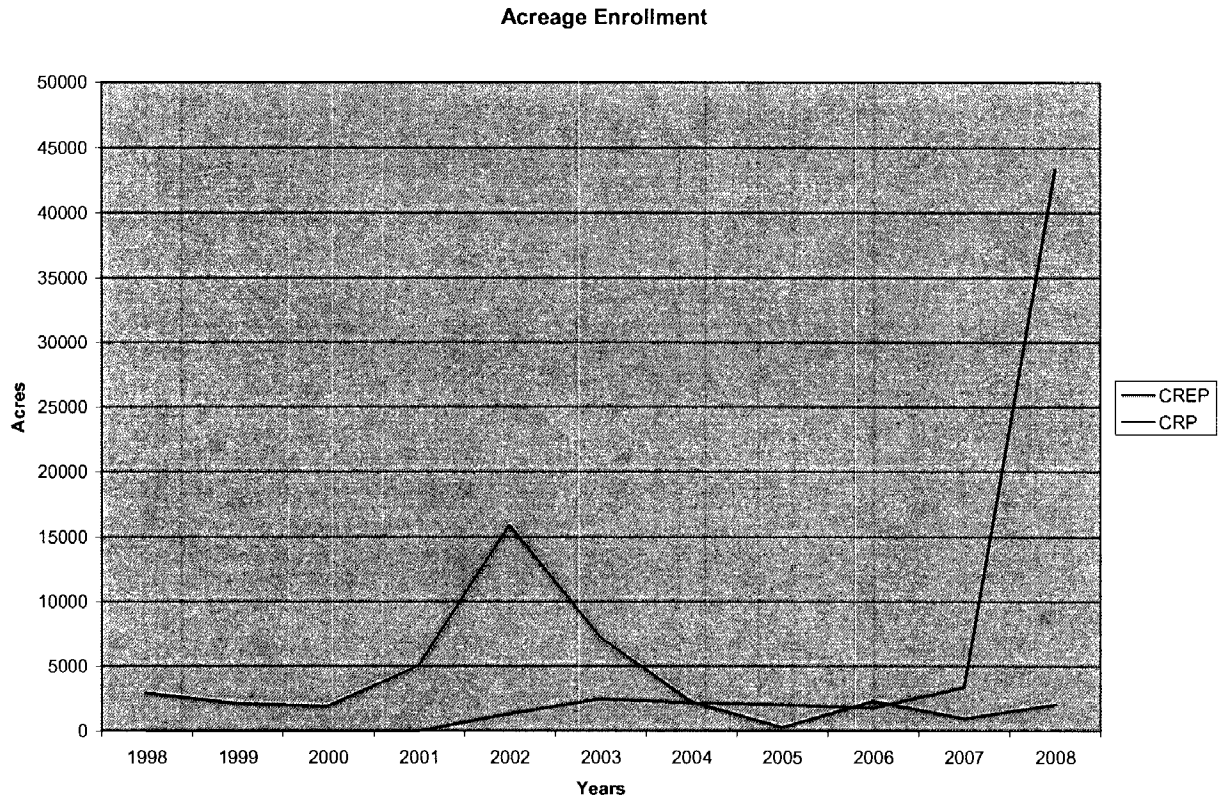
By combining CRP and CREP acres for each year I am able to examine total acres enrolled. Figure 2 shows the total acreage enrollment for both CRP and CREP over the ten year time span. It is apparent that the CRP enrollment peaked just after the introduction of CREP. Soon after the initial introduction CREP, levels began increasing. In the 2005 – 2006 time range CRP acres briefly spiked, exceeding that of CREP acres. This can be attributed to the fact that the original eight county area was the only area eligible for CREP enrollment in that time period. See Figure 1 for county eligibility borders. After the amendment in 2006, a drastic increase can be seen in the CREP enrollment.

The rental rate variable, the average rental rate, is determined by the FSA as the average of all rental payments made to enrollees during each time period.[1] By examining the distribution of the average rental rates, I am able to conclude that the mean or average of the rental rates is 106.47. The standard deviation is 41.64, suggesting that the rental rate does have fluctuations.

As per the implementation of CREP in 2002, incentives were introduced as a portion of the legislation. Therefore, incentives are only positive after 2002. Because incentives were not applicable before CREP, zeros are calculated as the incentive rates

[1] All price variables, including rental rate and crop values, have been adjusted for inflation using the base year 1982-1984 Consumer Price Index.

Figure 2: Enrollment Graph



for all non-CREP areas. Thus, the minimum is $0 and the maximum is $118. For more information see Table 1.

To gain a better understanding of events occurring in the macro economic environment of each county during the time span, I used the unemployment rate as published annually by the Bureau of Labor Statistics. This rate is a non-farm, not seasonally adjusted rate. Assuming that the previous year's economic activities are a predictor factor for the enrollment of a given year, the unemployment rates were lagged by one year. For example the unemployment rate in 1997 was used as a predictor in the 1998 acreage enrollment.

A measure of opportunity cost must also be analyzed in order to account for alternatives to the set-aside programs. Kentucky's four primary crops are corn, soybeans, hay and tobacco. In order to account for the value of each of the above listed crops across both county and time, I used price data (USDA EMIS, 2008) for the state of Kentucky. Because of the efficiency of the commodity markets, there is only very slight variation across regions. Therefore a state estimate is an accurate measure of commodity price for a given year. According to (USDA NASS, 2008) I used the yields for each crop per county and year. I then multiplied the price for the given year by the yield for the specific county and year to determine the value the specific crop has in that given county per year. Because previous crop prices serve as a predictor of the next year's prices, it is necessary to lag the prices to determine the correct value. For instance, the crop prices for 2002 were a predictor factor in the enrollment for 2003.

Because of the voluntary nature of this program, the data I have collected is only the data pertaining to those choosing to enroll in the conservation programs. However, because of the manner of collecting data, the data for those not choosing to enroll is nonexistent. Therefore, I realize that my data and as a result, my analysis may contain a self-selection bias. Lack of self-selection bias is extremely vital to the accuracy of statistical research because it examines the effect of membership within a division or program, when inclusion in the sample is not determined randomly but rather is based on individual choice (James, 2004). Specific to my study, it may be that farmers are persuaded to enroll in conservation program based on the lucrative financial incentives or by personal inclination. Thus, these particular individual characteristic about each enrollee is unable to be disentangled from the given results, which could affect the willingness of enrollment per individual. More extensive econometric modeling is needed to fully test and correct for self selection bias in this study.

Means Test

The following hypotheses were tested using a one-sided t-test assuming unequal variances:

$$H_0 : AverageTotalCREPAcres \leq AverageTotalCRPAcres$$
$$H_A : AverageTotalCREPAcres > AverageTotalCRPAcres$$

The numerical results to this test can be found in Table 3. The results indicate a t-stat of 1.8622 and a p-value of 0.03339 which suggests that we can reject the null hypothesis at a 5% level of significance. Thus, I reject the null hypothesis and conclude

Table 3: Means Test

t-Test: Two-Sample Assuming Unequal Variances

	Total CREP	*Total CRP*
Mean	1128.88	627.842
Variance	2960215	791196
Observations	50	60
Hypothesized Mean Difference	0	
df	70	
t Stat	1.8622	
P(T<=t) one-tail	0.03339	
t Critical one-tail	1.66691	

that there is a statistically significant increase in the average total acres enrolled in CREP versus average total acres enrolled in CRP.

Regression Analysis

A regression analysis was performed to obtain a more complete understanding of the determinants of farmer behavior. The following is my linear regression model being used to predict the total acres enrolled in either program in each county, i, over time, t:

$$Acres_{it} = \beta_0 + \beta_1 RR_{it} + \beta_2 UNEMP_{it} + \beta_3 CVALUE_{it} + \sum_{c=4}^{17} \beta_c County + \sum_{t=18}^{25} \beta_y Year + \varepsilon_{it},$$

where Acres is total acres enrolled in both programs in each county per year, RR is the average rental rate in each county and year, UNEMP is the unemployment rate in each county and year, and CVALUE is the corn value in each county and year.

County fixed effects are dummy variables that are specific to each county in the data set. Green County was excluded from the equation to be used as a reference point. The purpose of these fixed effects is to account for activities or events taking place specific to a location. For example changes in local governments are specific to location. Therefore, these effects on enrollment would be included under the county fixed effect variable. This variable is very important because it picks up on the factors not included elsewhere in the model.

Year fixed effects are included in the model under very similar circumstances as the county fixed effects. This variable takes into consideration those events specific to a particular time frame. For instance a drought or severe weather would effect enrollment but only for a specific time period. This variable is very important because it

captures those factors not included in the model that are specific to a precise year. Year represents the 9 years in the time fixed effects which are included in the regression with 2002 being omitted. The descriptive statistics for these variables can be found in Table 2.[2]

In generating this model, I possessed certain expectations of how the variables should behave. The rental rate variable I expected to have a positive coefficient, suggesting that an increase in the dollar value of the rental rate would result in an increase in the acres enrolled. I also expected the p-value to be small, suggesting that in fact the rental rate variable does have a statistically significant impact on acreage enrollment.

I too anticipated the unemployment variable to be positive; suggesting that for every increase in the unemployment rate farmers would enroll more acreage in the program. This thought reflects instability in the economy, shown by the increase in the unemployment rate. Assuming farmers would look for a lower risk investment in a downturn of the economy, they would enroll more acres to generate a secure income for the future.

The corn value was used, in place of the other crop values, because it is the only crop that showed a statistically significant effect on acreage enrollment. In using an ordinary least squares regression equation, it is important to omit variables that are not contributing theoretical and statistical significance to the model. The soybean, hay, and

[2] Many other potential explanatory variables were considered, but due to the lack of accessibility they were not included in the modeling. These include farm income, average age of farmer, and primary occupation of farm owner.

Table 2: Descriptive Statistics – regression sample[3]

Variable	Mean	Std Dev	Min	Max	n
Total Acres	609.7100000	763.1046557	33.900000	4340.90	80
Rental Rate	51.6831903	14.2827460	23.3478261	92.7579365	80
Unemployment	6.0575000	1.8728422	3.5000000	17.90000	80
Corn Value	153.5195267	36.7313918	83.5894358	266.5773810	80
Adair	0.0625	0.2435887	0	1	80
Allen	0.025	0.1571100	0	1	80
Barren	0.1	0.3018928	0	1	80
Butler	0.125	0.3328055	0	1	80
Edmonson	0.05	0.2193200	0	1	80
Grayson	0.1	0.3018928	0	1	80
Green	0.075	0.2650531	0	1	80
Hart	0.0875	0.2843491	0	1	80
Logan	0.125	0.3328055	0	1	80
Metcalfe	0.0625	0.2435887	0	1	80
Russell	0.025	0.1571100	0	1	80
Simpson	0.05	0.2193200	0	1	80
Taylor	0.75	0.2650531	0	1	80
Warren	0.0375	0.1911822	0	1	80
dum1998	0.125	0.3328055	0	1	80
dum1999	0.0625	0.2435887	0	1	80
dum2000	0.0625	0.2435887	0	1	80
dum2001	0.0625	0.2435887	0	1	80
dum2002	0.0875	0.2543491	0	1	80
dum2003	0.1	0.3018928	0	1	80
dum2004	0.1375	0.3465472	0	1	80
dum2005	0.1	0.3018928	0	1	80
dum2006	0.1375	0.3465472	0	1	80
dum2007	0.125	0.3325055	0	1	80

[3] Descriptive statistics for regression sample model 2, n = 70, are very similar to the descriptive statistics for regression sample model 1, n = 80.

burley tobacco value variables were highly insignificant with p-values of 0.7337, 0.3779, and 0.9762, respectively. Due to the small sample size, I dropped these variables to gain degrees of freedom for my model. I predict that the corn value variable will have a negative coefficient, suggesting that for every dollar increase in the corn value a corresponding decrease will result in acreage enrollment. This would indicate that as the opportunity cost increases, farmers would be less likely to enroll acreage.

After developing the regression model, I discovered an interesting change in the effect depending upon the time frame used.[4] Therefore, I used two different manipulations of the time period: (1) 1998-2007 with n = 80 and (2) 1998-2006 with n = 70. This was done to examine the effect of the additional counties as well as the changes to the original program brought on by the 2006 amendment. The results for model one is found in Table 4. The adjusted R-squared of the first model is 0.4233, meaning that this model accounts for 42.33% of the variation in the data. The variable of primary interest is the rental rate. I discovered that it has a highly statistically significant impact on enrollment in acres with a p-value of 0.0241 in the first model. The coefficient implies that for every one dollar increase in rental rate, the enrollment increases by 24.acres. Elasticity of enrollment, in this context, is the responsiveness of

[4] Heteroskedasticity is the effect generated on the error term, by omission of an important variable. If an important variable has been omitted and not included in the other independent variables, the effect is incorporated by the error term (Studenmund, 2001). My model tested negative for heteroskedasticity, using the White's test with a p-value of 0.27. Therefore, I fail to reject the null hypothesis that the error terms are heteroskedastic.

A multicollinearity, or perfect correlation between independent variables, check was also performed, using bivariate correlation analysis. No variables proved to be significantly correlated, indicating that no variables are accounting for the same movement in the data (Studenmund, 2001).

Table 4: Summary of Regression Model 1

Variable	Coefficient	Standard Error	t-value	p-value
Intercept	-1778.95679	1059.62988	-1.68	0.0990
RR	24.79295	10.68010	2.32	0.0241
UNEMP	-91.00442	52.84306	-1.72	0.0908
CVALUE	7.63618	3.86022	1.98	0.05300
Adair	285.54307	402.05655	0.71	0.4806
Allen	-245.34290	599.28971	-0.41	0.6839
Barren	-160.73278	344.07473	-0.47	0.6423
Butler	219.01448	357.46834	0.61	0.5427
Edmonson	301.97366	466.95589	0.65	0.5206
Grayson	1639.85937	402.24680	4.08	0.0002
Hart	-99.11912	326.92263	-0.30	0.7629
Logan	327.72834	390.97587	0.84	0.4056
Metcalfe	-15.97565	385.12459	-0.04	0.9671
Russell	435.21691	577.17365	-0.75	0.4541
Simpson	-617.28056	477.44964	-1.29	0.2016
Taylor	-243.05588	345.04481	-0.70	0.4842
Warren	-465.33605	521.00141	-0.89	0.3757
dum1998	1438.60670	367.96960	3.91	0.0003
dum1999	629.05560	401.61362	1.57	0.1231
dum2000	604.13278	401.44946	1.50	0.1382
dum2001	993.96073	409.66573	2.43	0.0186
dum2003	-200.07525	316.49395	-0.63	0.5299
dum2004	347.68426	361.44367	0.96	0.3404
dum2005	-112.04452	326.02235	-0.34	0.7324
dum2006	338.44398	314.72766	1.08	0.2870
dum2007	-589.13045	450.77540	-1.31	0.1968
Adjusted R-Square	0.4233			

farmers to a change in rental rates. The elasticity of enrollment is 2.10; suggesting that in fact enrollment is elastic and farmers are responsive to changes in rental rates. The unemployment rate is also statistically significant with a p-value of 0.0241 in the first model. The coefficient suggests that for every one point increase in the unemployment rate, enrollment decreases by 91 acres. The value of corn is also statistically significant with a respective p-value of 0.053. The coefficient suggests that for every one dollar increase in the value of corn, enrollment increases by 7.64 acres.

While very few counties and very few years are statistically significant at an individual level. The "year" fixed effects are statistically significant as a whole with a p-value of 0.0003 and the "county" fixed effects are statistically significant as a whole with a p-value of 0.0001. Therefore, I am also rejecting the assumption or null hypothesis that the betas on each set of those variables are equal to each other and subsequently equal to zero. This indicates that in fact both specific time and location play a significant role in acreage enrollment. This means that there are particular events or activities specific to each area over time that can not be accounted for in other variables, which "year" and "county" are referencing. In order decrease the use of these variables, in future empirical research additional data is needed over both the time-series and at a county level. These additional variables could possibly disentangle specific effects from those related to location and time.

The results for the second model are found in Table 5. In the second model the adjusted R-squared is 0.4204, indicating that this model accounts for 42.04% of the variation found in the data. I found that the rental rate is no longer statistically

Table 5: Summary of Regression Model 2

Variable	Coefficient	Standard Error	t-value	p-value
Intercept	-754.34756	1271.97670	-0.59	0.5561
RR	13.05434	13.46875	0.97	0.3376
UNEMP	-110.59251	57.62903	-1.92	0.0613
CVALUE	7.57171	4.42353	1.71	0.0938
Adair	108.66074	466.88750	0.23	0.8170
Allen	-650.45397	672.26450	-0.97	0.3384
Barren	-312.60634	401.28061	-0.78	0.4400
Butler	92.13379	398.63991	0.23	0.8183
Edmonson	48.23748	512.27632	0.09	0.9254
Grayson	1467.70702	444.69726	3.30	0.0019
Hart	-298.00844	368.55589	-0.81	0.4230
Logan	111.91355	460.03828	0.24	0.8089
Metcalfe	-235.44683	448.44879	-0.53	0.6021
Russell	-7.85687	810.85875	-0.01	0.9923
Simpson	-919.33506	538.21806	-1.71	0.0945
Taylor	-362.93524	393.38132	-0.92	0.3611
Warren	-727.82860	576.20089	-1.26	0.2130
dum1998	1229.51489	410.85467	2.99	0.0045
dum1999	385.91842	445.62003	0.87	0.3911
dum2000	396.96448	441.29980	0.90	0.3732
dum2001	786.73461	450.85085	1.74	0.0878
dum2003	-209.98638	332.99725	-0.63	0.5315
dum2004	239.55219	395.15731	0.61	0.5474
dum2005	-167.84077	345.58740	-0.49	0.6296
dum2006	208.85561	340.73918	0.61	0.5430
Adjusted R-Square	0.4204			

significant with a p-value of 0.3376. Although both unemployment rates and corn values remain statistically significant with respective p-values of 0.0613 and 0.0938. The coefficient for unemployment suggests that as unemployment increases by one point, enrollment decreases 110.59 acres. The coefficient for corn value suggests that as corn values increase by one dollar, that enrollment increases by 7.57 acres.

Conclusions

According to the variation of the two models, certain conclusions can be drawn. In the 1998 – 2007 time frame, it is evident that rental rates are a very strong indicator of acreage enrollment. This reinforces the economic theory, if everything else constant, when financial incentives increase, in this model rental rates, then enrollment should increase. The lack of significance in the 1998 – 2006 time frame, first suggests that there is something taking place in the last year, 2007, that is altering the marginal benefit of enrolling additional acres. This special occurrence could in fact be due to the amendment to CREP beginning in 2007 or additional factors not being captured by the 2007 fixed effect in the model. In order to further investigate this occurrence additional empirical research is needed, using data from years after this study, post 2007 data.

The unemployment rate variable did not behave as anticipated in either model. My expectations assumed a positive correlation with increasing unemployment rate and increasing future risk. However, the negative coefficient suggests a completely different phenomenon. Due to the fact that many Kentucky farmers are part-time farmers, in fact according to the USDA National Agriculture Statistics Service's 2002 *Census of Agriculture*, approximately 45.76% or 39,602 farmers classified themselves as a part-

time farmer. This means that they own and operate a farm, but they also hold another full or part-time job in a non-farm industry. As the unemployment rate increases, it suggests that these individuals have either lost or are in fear of losing their non-farm occupations. Thus, now they must rely more heavily on their farming operation to make up for the loss in external salary. If farmers are making the assumption that they currently need or will need in the near future, their land for their own production or consumption purposes, they will be less likely to enroll additional acreage in a long term, 10-15 year, conservation contract. Thus, this would account for the decrease in acreage enrollment with an increase in the non-farm not-seasonally adjusted unemployment rate.

The corn value variable was also not as anticipated. I expected the corn value to indicate that as corn value or opportunity costs increase, economic theory would predict that holding everything else constant, enrollment should decrease. Perhaps economic theory does hold true, but I did not hold other factors constant. Other simultaneous changes are taking place in the farming industry that is not accounted for in this model. For example, the rising cost of farm production is not addressed in this model. In further empirical research, this could in fact prove to hold a correlation with corn values, which lead to a decrease in acreage enrollment, as theory predicts. Furthermore, the concept of simultaneity could have an effect on the regression output. Simultaneity is the causation between variables that are co-dependent (Studenmund, 2001). Simply put this is a circular reference. An action in one variable is the result of another variable, which is linked with the cause of the first variable. In reference to this study, the

removal of land from the production of corn will result in a decrease in the supply of corn, thus increasing the price of corn. Therefore, it is unknown whether the removal of land is leading to the increase in corn prices or if the increase in corn prices is leading to a decrease in the land available for corn production.

My study has been successful in proving that in fact there is a statistically significant increase in the number of acres enrolled in CREP versus that of CRP enrollment. My analysis also proved successfully in isolating certain factors that are vital in predicting farmer behavior in relation to acreage enrollment, such as rental rates, unemployment rates, opportunity cost, year and county fixed effects.

I hope that my research has imparted an understanding of the conservation programs and farmer behavior that was previously unexplored. Farmer behavior is essential in predicting implications of proposed government policy changes. For instance if the rental rate was increased by $50, holding all other factors constant, the average expected enrollment would increase by 1,239.5 acres in 1998 - 2007. This information is extremely important to those agencies responsible for enforcing such changes. It is also vital that other participants in the agriculture industry understand what motivates farmers to enroll in such programs. This comprehension will lessen the contention between those in favor of conservation programs, and those opposing them.

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Appendices

Terms

Cost-share program – a percentage reimbursement to the farmer for the cost associated with implementing the specified conservation practice

Hardwood – a broad leaf tree with a high density

Maintenance fee – is a monetary amount intended to reimburse the land owner for any improvements or alterations that were made in order to prepare the land for the CRP enrollment

Native grasses – grasses that were previously indigenous to a specific area but have been replaced by other crops

Practice – a specific method of farming, or way of tending land

Rental payment – a payment to the farmer for the use of their land for the program's use, designed to be equivalent to what the land would bring on an open rental market.

Riparian Buffers – an area surrounding and protecting a sensitive environmental area

Payment Matrices

(USDA FSA, 2007b)

Federal CREP									
Practice Code	**Practice Description**	**Land Eligibility**	**Crop History**	**Base C/S**	**PIP**	**SIP** Acres X Full Years (not>10 yrs) X $1	**SRR Incentive (ac/yr) % x SRR)**	**Maintenance Payment** ac/yr	**Maintenance w/fence //and water** ac/yr
CP1	Introduced Grasses and Legumes	HEL	Yes	50%			50%	$4	
CP2	Native Grasses	HEL	Yes	50%			75%	$4	
CP3	Tree Planting	HEL	Yes	50%			100%	$4	
CP3A	Hardwood Tree Planting	HEL	Yes	50%			100%	$4	
CP4B	Permanent Wildlife Habitat Corridors	HEL	Yes	50%			75%	$4	
CP4D	Permanent Wildlife Habitat	HEL	Yes	50%			75%	$4	
CP8A	Permanent Grass Waterways	NA	Yes	50%	40%	X	75%	$4	
CP9	Shallow Water Areas for Wildlife	NA	Yes	50%	40%		75%	$4	
CP10	Grass Cover-already established	HEL	Yes	0			50%	$4	
CP11	Tree Cover –already established	HEL	Yes	0			50%	$4	
CP12	Wildlife Food Plots	HEL	Yes	0			50%	N	
CP15A	Contour Grass Strips	NA	Yes	50%	40%		50%	$4	
CP21	Filter Strips	NA	Yes	50%	40%	X	75%	$4	$8//$9
CP22	Riparian Buffers	NA	Yes or MP	50%	40%	X	100%	$6	$8//$9
CP23	Wetland Restoration	Wetland	Yes	50%	**	**	100%	$4	
CP23A	Wetland Restoration Non-Floodplain	NHE	Yes	50%	**	**	100%	$4	
CP25	Rare and Declining Habitat	HEL	Yes	50%			100%	$4	
CP29	Marginal Pastureland Wildlife Habitat Buffer	NA	MP	50%	40%	X	100%	$4	$8/$9

(USDA FSA, 2007b)

Green River CREP

State CREP Cost Share/Incentive Matrix

State Practice Code	Federal Practice Code or Practice Description	State Cost Share Rate	State Incentive Rate	State Incentive Rate w/ Easement Option
KREP1	CP1	25%	25%	75% *
	CP2	25%	25%	75% *
	CP3	25%	25%	75% *
	CP3A	25%	25%	75% *
KCREP2	CP8A	25%	25%	75% *
	CP15A	25%	25%	75% *
	CP21	25%	25%	75% *
	CP22	25%	25%	75% *
	CP29	25%	25%	75% *
KCREP3	Livestock Water System	25%	25%	75% *
KCREP4	Fence	25%	25%	75% *
KCREP5	Stream Crossing	25%	25%	75% *

* Incentive available if permanent easement is offered on noted practice, and in watershed of federal contract

- Cost share and incentive payments combined cannot exceed $7,500 per practice per state fiscal year.
- Each applicant or operation is limited to $20,000 total per state fiscal year, not to exceed $40,000 in any two consecutive program years.