THE PRESENCE OF CONSERVATION RESERVE PROGRAM CONTRACTS AND THEIR EFFECT ON KANSAS AGRICULTURAL LAND VALUE

Dillon W. Garr
Graduate Research Assistant
Kansas State University
dillon.garr@gmail.com

Mykel Taylor
Assistant Professor
Kansas State University
mtaylor@ksu.edu

Selected Paper prepared for presentation at the Southern Agricultural Economics Association's

2016 Annual Meeting, San Antonio, Texas, February 6-9, 2016

The Conservation Reserve Program (CRP) was designed to compensate landowners and farmers for retiring environmentally sensitive ground rather than keeping it in crop production. CRP contracts require land to be reverted to natural cover and, in return, the government provides annual payments to the landowner. These contracts last from 10 to 15 years and opting out of the contract prior to expiration requires payments of significant fines. Therefore, when applying for a CRP contract, a landowner must weigh the benefits they receive 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.

When entering into a CRP contract, another consideration the landowner must make are the impacts on land value if they decide to sell their ground prior to the expiration of the contract. Will potential buyers prefer the consistent payments or prefer to have full flexibility of land use? The average CRP payment to landowners during the years 2005 to 2014 in Kansas was $45 per acre. This rate varies according the environmental sensitivity of the land and the year in which the contract is signed. If the profit potential on that land is greater than $45, then it is possible the existence of a CRP contract will depress the land's price if sold. However, if profitability is less than the CRP contract payment, then it may actually increase the value of the land. During this period, the profitability of farming averaged $18.35 per acre and ranged from a loss of $53 per acre to a gain of $50.50 per acre (KSFMRA 2015). The expectations for future profits from the land are likely to impact the willingness of buyers to bid on ground with a CRP contract.

While previous research has shown a negative average impact on land value from CRP contracts, it is not clear how differences in farm profitability over time affect the value of a contract. The objective of this study is to estimate the impact of an existing CRP contract on

Kansas farmland sold between 2005 and 2014. Land sales data containing descriptions of the land including location, productivity, accessibility, date of sale, and whether or not a CRP contract exists for any of the parcel are given. A hedonic regression model using these data will allow an estimate of the revealed demand for land characteristics, specifically the presence of a CRP contract that affects the usability of the land for a period of time.

Background and Literature Review

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" (United States Department of Agriculture). 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 specie 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 longer to grow and provide more environmental benefits. Therefore, in 1985, the 10 to 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 dichotomy, many studies have been conducted to observe whether or not having a CRP contract on a parcel of land up for sale affects the value of that land.

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.

While the above studies are important, their employed methods were meant to measure producer behavior as opposed to strictly land value changes. The simplest and most common way to analyze land value differences is to use a hedonic model. Taff and Weisberg (2007) did just that using observed farm sales with CRP contracts in Minnesota from 2002-2004. They implemented six different hedonic models with slightly varying data sets. Each data set used the log of price per acre as the regressand, but included or modified certain variables to compare the effects of certain traits. Using the six different hedonic models, they found a reduction in price per acre because of the presence of a CRP contract of between 8% and 15%. Taff and Weisberg conclude, rather strongly, that their analysis proves that 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 contracted lands to their own.

A similar analysis was conducted on agricultural land in North Dakota (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. 98 sales were found that met the established

criteria. Again, a hedonic model was employed using a dummy variable for the presence of CRP land. Also, included were dummy 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%.

As is evident, there are still many trains of thought regarding this issue. Some believe that because the government's willingness to pay to remove a piece of land from production can seemingly be exploited to obtain a windfall that CRP should increase the price of land. Others note that the lack of flexibility under CRP decreases the value of land.

Empirical Model

For this analysis, multiple OLS regression was used to create a hedonic model of land values. 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, we can interpret the value of the output coefficient measures as percent change in the price per acre given the implied condition. The model employed is as follows:

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

where $Size_i$ and $Size_i^2$ are the linear and quadratic terms for the size of parcel *i*, $NICrop_i$ is the percent of parcel *i* that is non-irrigated cropland, $IrrCrop_i$ is the percent of parcel *i* that is irrigated cropland, $Average_i$ and $Good_i$ are binary variables indicating average or good productivity, respectively, of parcel *i*, $Dirt_i$ and $Gravel_i$ are binary variables indicating the type of road that accesses parcel *i*, $Auction_i$ is a binary variable indicating if parcel *i* sold at a public auction, $Mineral_i$ is a binary variable indicating if the mineral rights of parcel *i* transferred with the land, CRP_i is a binary variable indicating if an existing 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, 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 impact of parcel size on sale price is expected to be negative, but with a positive sign on the quadratic size variable. This is because there tend to be more potential buyers for land when the parcel is smaller. This may be due to financing constraints that limit total price bids for larger parcels or possibly higher values for small acreages with options values for non-agricultural development. The percentage of non-irrigated land in a parcel will increase the value relative to pasture, but will decrease the value relative to irrigated land. The crop production on irrigated farmland is typically higher and has lower variability as compared to non-irrigated farmland. Pasture land has the lowest value due to the profitability of crop farming versus livestock production in Kansas.

Land rated as having good productivity is expected to command the highest price in the market, followed by average quality and poor quality ground, respectively. Road access affects the usability of land and hard-paved road access will positively affect land values as compared to

gravel, with dirt roads offering the lowest accessibility. The marketing channel used to sell land will affect sale price. Previous research has shown that land sold at auction will have a higher sale price as compared to land sold through a realtor or private treaty (Wilson, et. al. 2014). Mineral rights transferring with the land is expected to positively affect land values due to the potential value those mineral rights may offer if exploration yields a viable oil or gas well. Annual, quarterly, and county-level fixed effects are included in the model to control for a variety of factors that may affect land values. These factors include, but are not limited to, variation in rainfall across the state, proximity to urban areas, and the timing of crop sales following harvest.

CRP enters the model as both a stand-along variable and as an interaction term with the sale year. This is meant to measure both the average impact from the presence of a CRP contract and the variability across time on buyer's expectations of profitability from the land. The average net returns to wheat, corn, soybean, and grain sorghum enterprises in Kansas over the period 2004 to 2014 are presented in figure 1. The year-to-year variability demonstrates the short-run profitability and may affect buyer's willingness to bid for ground.

The general notion tends to be that land enrolled in CRP is of lower quality than average. This could potentially lead to a negative association between price and CRP that is driven by land quality. However, as noted above, in order to be eligible for the program, land must have been planted in 4 of the previous 6 years. Therefore, if this land is indeed lower quality it is still being farmed. Additionally, included in this analysis is a dummy variable matrix that shows whether the land was classified as poor, average, or good.

Data

The data were obtained from the Kansas Society of Farm Managers and Rural Appraisers annual sales records. These records include information on sale price, parcel size, cropland mix (i.e. non-irrigated cropland, irrigated cropland, pasture), productivity rating, road access, if the land sold at a public auction, whether or not the mineral rights transferred with the land, the existence of a CRP contract, and sale date. The full list of variables, definitions, and summary statistics are listed in table 1. The initial data set, from 2005-2014 consisted of over 12,000 observations. Observations that did not contain all required variables were eliminated as well as parcels under 40 acres in size. This was due to the strong possibility that small parcels of land may to be purchased for non-agricultural development. The number of observations with valid information for all included variables was 2,923 over the 10 year period.

Some of the observations included additional information on the CRP contracts which was not consistently reported for all the sales. For example, while the average parcel size is 171 acres, there are an average of 74 acres in CRP when a contract is present. The average CRP payment for these sales is $45 per acre and there area an average of 3.7 years remaining for these contracts. While there is considerable variability in these statistics across the individual parcels, average values indicate that buyers will face several years of reduced flexibility in land use.

Results

The coefficient estimates from the hedonic model are presented in table 2. The results presented in table 2 include coefficients of the binary variables following Kennedy's (1981) transformation to account for bias in a semi-logarithmic regression model. The majority of the land characteristic variables are statistically different from zero and have the expected sign.

The results indicate that a CRP contract decreases sales price by 11.2% on average. However, this impact varies considerable across the years examined in this study. For land sold in 2005, 2007, and 2009 through 2014, the impact is negative and ranges from -16.0% to -1.1% relative to land without CRP acres. In 2006 and 2008, land with a CRP contract actually sells for more the land without CRP acres with premiums of 4.1% and 11.9%, respectively. Predicted values for non-irrigated land with and without a CRP contract are presented in figure 2. The predicted values are adjusted according to Miller (1984) to account for bias in transforming the coefficients, which are estimated in logs, to predicted prices in levels.

When the average profitability in the Kansas farm sector is compared to the predicted land values with and without CRP contracts a correlation appears. The first four years of the analysis period (2005 to 2008) were not especially profitable years for Kansas farmers. The average returns to farming, as measured by net returns to the four primary crop enterprises in the state, were $2.56 per acre and ranged from -$13.24 per acre to $34.92 per acre. However, the high net returns that began in 2008 turned out to be the beginning of a multi-year run of higher than normal profits for crop producers. The average net returns to profitability between 2008 and 2014 was $40.91 per acre. The worst year of the time period analyzed for profitability was 2014, with net returns averaging -$53.92 per acre.

It is difficult to know exactly how current farming conditions affect buyers' willingness to bid for cropland. However, the biggest discounts for CRP land were realized during some of the most profitable years for crop production. This suggests that while landowners who opt into a CRP contract consider the fixed payment to be worth at least the cost of forgoing crop production, potential buyers may come to vastly different conclusions depending on current market conditions affecting farm profitability.

Conclusion

Previous research has considered the question of how enrolling land in the CRP program affects the value of land. This study furthers the literature by analyzing how that impact varies over time, reflecting the opportunity cost of decreasing flexibility in land use. Results of the semi-log hedonic model indicate that an existing CRP contract reduces the value of land by 11% on a per acre basis. However, this estimate changes over time ranging from a reduction in land value of 16.0 percent to an increase of 11.9 percent for non-irrigated cropland. This variability in impact reflects how buyers value a fixed payment relative to being unable to farm the ground. In years of high profitability in farming, buyers apply a larger discount to parcels with CRP contracts than in periods of lower profitability.

The payment rates for CRP contracts are determined at the beginning of the contract period and do not fluctuate over the 10 or 15 year period of the contract. The results of this study suggest that altering this payment strategy such that CRP payments reflect current profitability of farming would reduce the discount in land value that occurs for parcels with CRP contracts. Matching the CRP payment to the opportunity cost of reduced land use flexibility may increase the appeal of the program to landowners who are not willing to forego high profits from crop farming.

References

Kennedy, P. 1981. “Estimation with Correctly Interpreted Dummy Variables in Semilogarithmic Equations.” *The American Economic Review*, 71(4):801.

Kirwan, B., Lubowski, R., and M. Roberts. 2005. “How Cost-Effective are Land Retirement Auctions? Estimating the Difference between Payments and Willingness to Accept in the Conservation Reserve Program.” *American Journal of Agricultural Economics*, 87(5):1239–1247.

Miller, D.M. 1984. “Reducing Transformation Bias in Curve Fitting.” *American Statistician*, 38:124-126.

Monson, M. 2009. “Valuation using hedonic pricing models.” *Cornell Real Estate Review*, (Vol. 7): 62-73.

Schmitz, N. and S. Shultz. 2008. “The Impact of the Conservation Reserve Program on the Sale Price of Agricultural Land.” *Journal of the American Society of Farm Mangers and Rural Appraisers*, 51-59.

Shoemaker, R. 1989. “Agricultural Land Values and Rents under the Conservation Reserve Program.” *Land Economics*. (May):131-137.

Taff, S.J. and S. Weisberg. 2007. “Compensated Short-Term Conservation Restrictions May Reduce Sale Prices.” *The Appraisal Journal*, (Winter):45-55.

United States Department of Agriculture. 2008. “Conservation Reserve Program and Conservation Reserve Enhancement Program.” United States Department of Agriculture, Washington, D.C.

Wilson, B., B. Schurle, M. Taylor, A. Featherstone, and G. Ibendahl. 2014. “Regression Estimates of Different Land Type Prices and Time Adjustments.” *Journal of the American Society of Farm Managers and Rural Appraisers*, pp. 192-203.

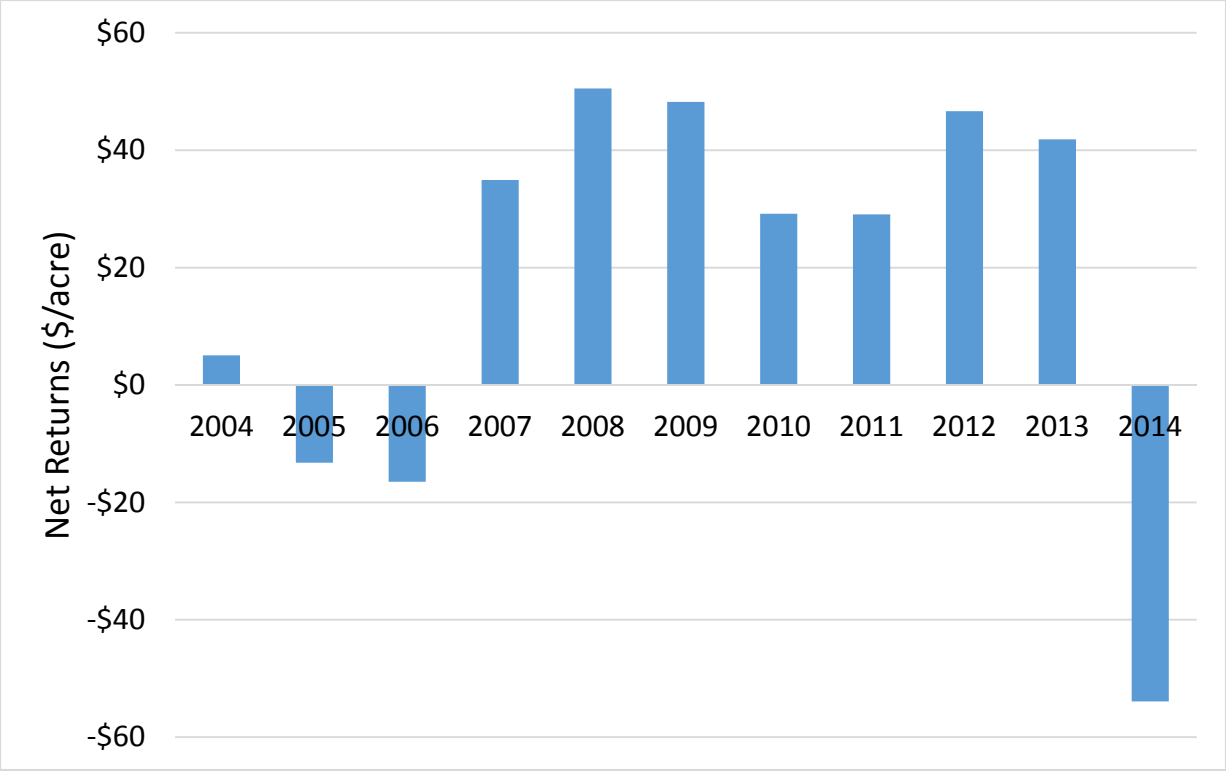

Figure 1. Net returns to wheat, corn, soybean, and grain sorghum enterprises in Kansas.

Figure 2. Predicted values of non-irrigated land with and without CRP contract.

Table 1. Summary Statistics of Model Data

Variable	Definition	Mean	Standard Deviation	Minimum	Maximum
Price	Price per acre of parcel	1,586.58	1,286.70	127	26,000
ln(Price)	Natural log of price per acre	7.15	0.63	4.84	10.17
Size	Parcel size in acres	171.08	230.81	40	9,735
$Size^2$	Parcel size squared	82,527	1,619,231	1,600	94,800,000
Crop_Perc	Percent of parcel in non-irrigated cropland	0.65	0.37	0	1
IrrCrop_Perc	Percent of parcel in irrigated cropland	0.05	0.18	0	1
Average	Binary variable equal to 1 if parcel productivity rated as "average", 0 otherwise	0.73	0.44	0	1
Good	Binary variable equal to 1 if parcel productivity rated as "good", 0 otherwise	0.22	0.42	0	1
Dirt	Binary variable equal to 1 if road access is dirt, 0 otherwise	0.12	0.33	0	1
Gravel	Binary variable equal to 1 if road access is gravel, 0 otherwise	0.69	0.46	0	1
Auction	Binary variable equal to 1 if parcel sold at public auction, 0 otherwise	0.25	0.44	0	1
Mineral	Binary variable equal to 1 if mineral rights transferred with parcel, 0 otherwise	0.85	0.35	0	1
CRP	Binary variable equal to 1 if parcel has current CRP contract, 0 otherwise	0.06	0.24	0	1
CRP_Y2005	Interaction term between CRP and Y2005	0.01	0.11	0	1
CRP_Y2006	Interaction term between CRP and Y2006	0.01	0.11	0	1
CRP_Y2007	Interaction term between CRP and Y2007	0.01	0.10	0	1
CRP_Y2008	Interaction term between CRP and Y2008	0.01	0.08	0	1
CRP_Y2009	Interaction term between CRP and Y2009	0.01	0.07	0	1

Table 1. Summary Statistics of Model Data, cont.

Variable	Definition	Mean	Standard Deviation	Minimum	Maximum
CRP_Y2010	Interaction term between CRP and Y2010	0.01	0.07	0	1
CRP_Y2011	Interaction term between CRP and Y2011	0.00	0.07	0	1
CRP_Y2012	Interaction term between CRP and Y2012	0.00	0.06	0	1
CRP_Y2013	Interaction term between CRP and Y2013	0.00	0.04	0	1
CRP_Y2014	Interaction term between CRP and Y2014	0.00	0.04	0	1
Q1	Binary variable equal to 1 if parcel sold in first quarter, 0 otherwise	0.30	0.46	0	1
Q2	Binary variable equal to 1 if parcel sold in second quarter, 0 otherwise	0.27	0.45	0	1
Q3	Binary variable equal to 1 if parcel sold in third quarter, 0 otherwise	0.20	0.40	0	1
Q4	Binary variable equal to 1 if parcel sold in fourth quarter, 0 otherwise	0.22	0.42	0	1
Y2005	Binary variable equal to 1 if parcel sold in 2005, 0 otherwise	0.17	0.37	0	1
Y2006	Binary variable equal to 1 if parcel sold in 2006, 0 otherwise	0.15	0.36	0	1
Y2007	Binary variable equal to 1 if parcel sold in 2006, 0 otherwise	0.14	0.34	0	1
Y2008	Binary variable equal to 1 if parcel sold in 2007, 0 otherwise	0.10	0.30	0	1
Y2009	Binary variable equal to 1 if parcel sold in 2008, 0 otherwise	0.07	0.25	0	1
Y2010	Binary variable equal to 1 if parcel sold in 2009, 0 otherwise	0.11	0.32	0	1

Table 1. Summary Statistics of Model Data, cont.

Variable	Definition	Mean	Standard Deviation	Minimum	Maximum
Y2011	Binary variable equal to 1 if parcel sold in 2010, 0 otherwise	0.08	0.28	0	1
Y2012	Binary variable equal to 1 if parcel sold in 2011, 0 otherwise	0.08	0.27	0	1
Y2013	Binary variable equal to 1 if parcel sold in 2012, 0 otherwise	0.06	0.23	0	1
Y2014	Binary variable equal to 1 if parcel sold in 2013, 0 otherwise	0.04	0.19	0	1
County1 - County104	Binary variables denoting parcel location in one of 104 Kansas Counties	0.01	0.08	0	1

Number of Observations = 2,923

Table 2. Results of the Hedonic Regression Model

Variable	Coefficient	Standard Error	P-Value	Transformed Coefficient
Size	-2.925E-04	5.940E-05	0.000	--
$Size^2$	4.150E-08	1.480E-08	0.005	--
Crop_Perc	0.334	0.019	0.000	--
IrrCrop_Perc	0.627	0.034	0.000	--
Average	0.121	0.035	0.000	0.128
Good	0.283	0.038	0.000	0.327
Dirt	-0.100	0.026	0.000	-0.096
Gravel	-0.059	0.016	0.000	-0.057
Auction	0.043	0.015	0.003	0.044
Mineral	0.084	0.024	0.000	0.087
CRP	-0.112	0.054	0.038	-0.107
CRP_Y2006	0.152	0.080	0.058	0.161
CRP_Y2007	0.038	0.083	0.645	0.035
CRP_Y2008	0.225	0.092	0.015	0.247
CRP_Y2009	0.065	0.103	0.526	0.062
CRP_Y2010	0.058	0.094	0.536	0.055
CRP_Y2011	0.071	0.099	0.469	0.069
CRP_Y2012	-0.062	0.128	0.629	-0.068
CRP_Y2013	-0.038	0.155	0.806	-0.049
CRP_Y2014	0.101	0.172	0.558	0.090
Q2	0.033	0.016	0.040	0.033
Q3	0.072	0.018	0.000	0.074
Q4	0.118	0.017	0.000	0.125
Y2006	0.047	0.023	0.047	0.047
Y2007	0.093	0.024	0.000	0.097
Y2008	0.277	0.025	0.000	0.318
Y2009	0.330	0.032	0.000	0.391
Y2010	0.408	0.025	0.000	0.503
Y2011	0.531	0.027	0.000	0.701
Y2012	0.785	0.028	0.000	1.191
Y2013	0.964	0.033	0.000	1.620
Y2014	1.079	0.033	0.000	1.939
Constant	6.321	0.322	0.000	--
R^2	0.730			

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