Fine Tuning the Environmental Benefits Index to Achieve Cost Savings for the Conservation Reserve Program

by

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Thesis Abstract

The Conservation Reserve Program (CRP) is the largest conservation program in the United States and was established in 1985. Over time, the conservation objectives of the program have broadened to include wildlife habitat, air quality, and water quality. Changes to the enrollment mechanism were made to improve the economic efficiency of the program by implementing the Environmental Benefits Index (EBI). One of the ways farmers can increase their likelihood of being accepted into the CRP is offering a discount to the maximum rent payment for enrollment into the CRP. This study examines how farmer bidding behavior changes when the relative weighting of offering a rental payment discount increases in importance when determining which applicants are accepted into the CRP. The findings of this study indicate that a small change to the relative weighting does have an effect on farmers' willingness to offer a discount and thus improve the economic efficiency of the CRP.

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1. INTRODUCTION

The Conservation Reserve Program (CRP) is the largest conservation program in the United States. Given the size of the CRP, it is important to understand ways to improve the cost efficiency of the CRP by finding ways to lower the overall cost or increase the amount of land enrolled in the program. Improved cost efficiency allows existing financial resources allocated toward conservation programs to increase the area enrolled. Key to improving the cost effectiveness of the CRP is by better identifying farmer opportunity costs and reducing the amount of economic rents farmers can gain from participating in the CRP.

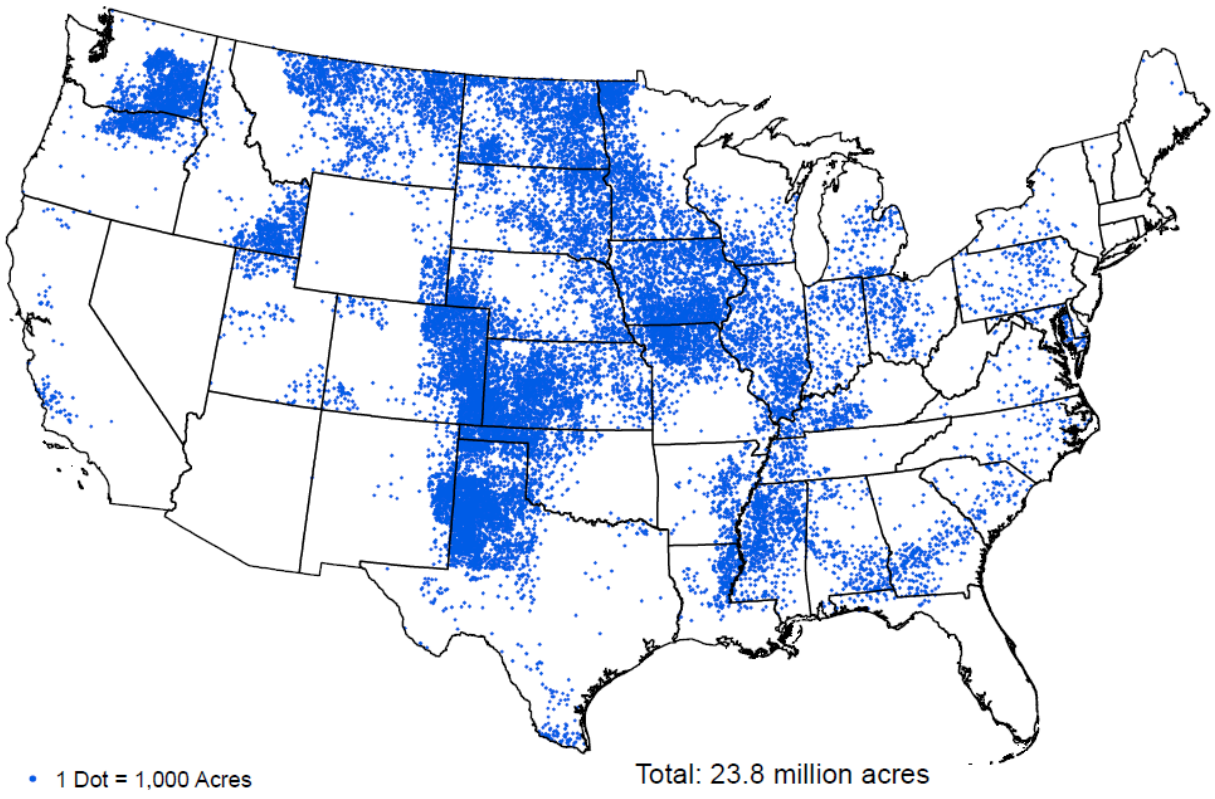

Figure 1: Map of CRP Enrollment as of March 2016.
Source: USDA Farm Service Agency (FSA).

The CRP is administered by the Farm Service Agency (FSA) which is part of the United States Department of Agriculture (USDA). The program allows farmers to voluntarily remove

their land from active agriculture production and convert their farmland into conservation lands in exchange for annual rent payments from the United States Federal Government. As of March 2016, the CRP had 23.8 million acres enrolled and annually pays out more than $1.7 billion per year (FSA 2016). Figure 1 shows where lands enrolled into the CRP are located throughout the United States.

To evaluate the bids that are submitted from across the country, the FSA uses the Environmental Benefit Index (EBI) to rank bids by land characteristics and it is used as the mechanism which determines which bids are accepted into the program during general sign-up periods (FSA 2012). Bids with an EBI score above a certain cutoff point are accepted into the program and EBI scores below the cutoff point are rejected. Currently, the EBI is based on six factors with the first five being environmental or location based and the sixth being based on cost (FSA 2012). As the goals of the CRP have changed, the EBI has been modified to reflect the changing priorities of the CRP (Hellerstein 2017).

This study seeks to improve the economic efficiency of the CRP and evaluate one aspect of the bidding mechanism to determine if small changes would cause farmers to better expresses their opportunity costs and improve the economic efficiency of the CRP. Kierwan et al. (2005) previously looked at how the offering of discounts affected the CRP's cost effectiveness in earlier sign-ups. This study seeks to expand on the work done by Kierwan et al. (2005), which examined general sign-ups 15, 16, 18, 20, and 26, by examining a farmer's motivation for offering a rental rate discount in exchange for an increased likelihood of being accepted into the CRP. In addition, this study looks at more recent general sign-ups 26, 39, 41, and 43.

Cattaneo et al. (2006) explored how relative changes to the relative weighing of different EBI components could impact the conservation goals of the program, but did not examine how

changes to the relative weighting of the cost portion of the EBI would impact the CRP. This study also examines how farmer bidding behavior may change because of an increase in the relative weight of the cost portion of the EBI.

The results of this study may provide policy makers with additional insight into the opportunity costs that farmers face when they elect to remove agricultural land from active production and place that land into a conservation program. By better understanding the motivations of farmers offering a discount, policy makers can make adjustment to the CRP's bidding mechanism that cause farmers to better express their opportunity cost. Thus, improving the economic efficiency of the CRP.

1.1. Overview of Conservation Reserve Program

The CRP started operation in 1986 with the passage of the Food Security Act of 1985. The original goal of the CRP was to reduce soil erosion from highly erodible farmland by retiring that land from agricultural production. A secondary goal was to reduce farm production to support crop prices (Shoemaker 1989). Starting in 1990 the goals of the CRP started to shift to include other conservation objectives such as increased wildlife habitat, water quality, and other areas of high conservation value (Osborn et al. 1995). Program funding and goals are modified and renewed by the United States Congress as part of what is commonly referred to as the "Farm Bill". With the passage of each Farm Bill, the CRP has been modified over time with the program's conservation objectives being changed and expanded. Some examples of these expansions include wetlands, wildlife habitat, and longleaf pine habitat. Table 1 provides a summary of the significant changes to the CRP that have occurred with the passage of the various Farm Bills since the CRP was established.

Table 1: Summary of significant changes to the CRP and the evolution of the enrollment mechanism.

Farm Bill	Significance	General Sign-up Covered	Years Covered	Important Aspects
The Food Security Act of 1985	Established the CRP with a focus on reducing soil erosion	1, 2, 3, 4, 5, 6, 7, 8 ,9	1986 - 1989	Maximum price paid was established by the MARR.
Food Agriculture, Conservation and Reform Act of 1990	Broadened the CRP's conservation goals to include water quality and inclusion of conservation priority area in addition to soil erosion. It also implemented the EBI as a scoring mechanism to rank bids.	10, 11, 12, 13	1991 - 1992	Replaced the MARR with the SRR which set a cap on the maximum rent payment available based on soil type.
Federal Agriculture Improvement and Reform Act of 1996	Added addition conservation priority areas and expanded those established by prior Farm Bills. It also added the cost component to the EBI.	15, 16, 18, 20	1997 - 2000	The cost component allowed farmers to bid at rates below the SRR to gain additional EBI points.
Farm Security and Rural Investment Act of 2002	Renewed the CRP and made minor adjustments to EBI.	26, 29, 33	2003 – 2006	Added EBI points for wildlife priority zones and EBI points for carbon sequestration.
Food, Conservation, and Energy Act of 2008	Renewed the CRP and made minor adjustments to EBI.	39, 41, 43	2010 - 2012	Removed EBI points awarded for not participating in cost-share.

Source: FSA (2013); Heimlich (2003); Hellerstein (2017); Osborn et al. (1995).

Initially, CRP bids were evaluated based on an erodibility index and the maximum acceptable rental rates (MARR). The MARR was calculated for multicounty areas that had similar soil erosion rates referred to as bid pools. Given the nature of the early CRP sign-ups, if a bid for inclusion into the CRP did not exceed the MARR it was accepted into the program (Osborn et al. 1995).

The Food Agriculture, Conservation and Reform Act of 1990 (1990 Farm Bill) called for expanding the scope of the CRP beyond soil erosion into broader conservation goals. This was primarily accomplished by adding the EBI to the enrollment process to rank various bids. In addition, the 1990 Farm Bill, replaced the MARR with soil specific rental rates (SRR) which are calculated based on the soil types located on the parcel of land offered for inclusion into the CRP

(Hellerstein 2017). On a particular parcel of land there may be several different soil types and the weighted average, based on the soil type, is used to calculate the maximum rental rate. In 1997 the CRP was again modified by adding a cost component to the EBI index that offered additional points for offering a discount to the SRR (Heimlich 2003). Since the Federal Agriculture Improvement and Reform Act of 1996 there have been only minor changes to the EBI index (Hellerstein 2017).

1.2. CRP General Sign-up Enrollment Process

General sign-ups for CRP enrollment occur at periodic intervals and with times set at the discretion of the FSA. Sign-ups are divided into general sign-ups and continuous sign-ups. This study will only be looking at general sign-up periods and specifically general sign-ups 26, 39, 41, and 42. To date there have been 49 sign-up periods with the most recent sign-up ending in February 2016. To enroll during a CRP general sign-up, a farmer will need to submit a bid to the FSA during a period of open enrollment (FSA 2012).

The open enrollment is determined by the FSA according to the number of acres allowed to be accepted into the program, which is set by government statute, and the remaining program funding, as determined by the most recent Farm Bill. Prior to the opening of the general enrollment period, the FSA will issue press releases regarding the general sign-up period to inform the public. In addition, local county FSA offices will notify the new media of the CRP general sign-up and mail letters to all owners and operators in the county notifying them of the CRP general sign-up (FSA 2018). During the period of open enrollment, a farmer will submit a bid by selecting a parcel of agricultural land that has been in active cultivation for four out of the previous six years (FSA 2018).

The bid that the farmer submits is often done in consultation with the local county FSA office. The local county FSA office can calculate an estimate of the EBI score that the bid will have and advise farmers who are submitting bids on ways to increase their EBI score (FSA 2018). Since most of the points awarded by the EBI are based on the location of the land being offered there are a limited number of actions that an applicant can take to increase the bids EBI score. The various environmental characteristics of that land, such as soil type and topography, and any actions the farmer offers to take to increase the conservation value of the land are then scored according to the details of the general sign-up the farmer is participating in (FSA 2012).

Cash rent payments are caped based on the weighted average of the soil type SRR located the parcel of land submitted for enrollment into the CRP. The FSA has calculated a SSR for each soil type located in each county or parish, a term for county in Louisiana. It is important to note that the SSR for a particular soil type, which often span multiple counties and states, are determined on a county by county basis and thus are different (Hellerstein 2017). The SRR is based on survey responses to the National Agricultural Statistics Service (NASS) which estimates the rental rate that a farmer would be expected to pay if the field was put into active cultivation (Hellerstein 2017).

The basic assumption is that the rent payment is the farmer's opportunity cost for taking the land out of agricultural production. The annual rental payment from the CRP would be similar to the rate the farmer would have received for renting the land to another farmer to produce an agricultural crop since the SRR is informed by relative soil type productivity and the survey results of the dryland rental rate for each county (FSA 2018). It can be reasonably assumed that higher rent payments would go to more productive crop land. Also, an applicant can seek, up to 50 percent of the cost of converting the agricultural land to conservation land in a

onetime payment. The cost share payment would be based on the expected costs to convert the land, as determined by the local county FSA office, not the costs that are incurred. Any cost overruns during the conversion would be paid by the farmer, but if the farmer was able to reduce the costs of conversion they would still only receive 50 percent reimbursement for the cost (FSA 2018).

To get a high EBI score, the farmer would need to place the most environmentally sensitive land up for bid and focus on the conservation practice that generates the most EBI points for a specific parcel of land. Most actions that an applicant can take to increase a bid's EBI score are predominately related to the cover type and the rent payment portion of the bid. To increase the EBI score related to the cover type, an applicant needs to propose a cover type that is more complex than planting the land in solid trees or solid grasses. For example, a more complex cover type would be to plant trees, but leave 10 to 20 percent of the land in some type of wildlife cover or to plant a mixture of hardwoods rather than planting the land in sold trees. In addition, the wildlife cover would need to be mixture of grasses, trees, shrubs, forbs, or legumes that are best suited for the wildlife in the local area (FSA 2012).

Once the open enrollment period for the general sign-up for the CRP has ended all submitted bids are analyzed and the Secretary of Agriculture will determine the cutoff EBI score (FSA 2012). All bids that have an EBI score higher than the cutoff point are enrolled into the CRP and those bids with EBI scores below the cutoff point are rejected. Once the land has been accepted into the program a contract is signed between the farmer and the FSA for a period of 10 or 15 years depending on the type of conservation that will be taking place. More typical conservation practices, such as planting loblolly pine, would be offered a 10-year contract while

more complex conservation practices, such as planting longleaf pine, will be offered 15-year contracts (FSA 2018).

After the contract term has expired a farmer can reenroll land back into the CRP. When reenrolling land, the FSA looks at what the conditions of the land where before the conservation activities took place. For instance, if the land had been planted into a stand of loblolly pine then the original field conditions, before the planting of the loblolly pine, would be used to establish the environmental portion of the EBI (FSA 2018). However, because of changes to the EBI over time the farmer may have to take additional measures, such as opening the stand up for wildlife cover or taking other actions that would improve the EBI score for the land to again qualify for inclusion into the CRP.

When developing the conservation practices a farmer works with the Natural Resources Conservation Service (NRCS) to develop a conservation plan that is acceptable under the CRP (FSA 2018). To ensure compliance with the CRP contract the NRCS, FSA and various state agencies to inspect the property to ensure the agreed upon conservation practices are being implemented and ensure compliance with the signed contract. NRCS and various stage agencies (primarily state forestry agencies) will inspect properties to ensure that cover types are being established per the terms of the CRP contract (FSA 2018).

1.3. Description of Environmental Benefit Index

The EBI currently ranks offers from across the United States by evaluating a bid based on six factors with five of them being environmental and the sixth being based on cost. Each region and/or state of the country establishes how to measure the environmental factors based on the environmental characteristics of that region. Many of the environmental factors are assigned points by the NRCS which is responsible for determining the points to award for water quality,

air quality, and erosion based on the environmental characteristics of the region (FSA 2018). Most of the environmental factors are determined by the geographic location of the land being offered to the CRP and the farmer has limited to no options to increase this portion of the bids EBI score.

Table 2: Percentage of total EBI Points available for the main EBI Factors.

	26	39	41	43
Conservation Practice	29%	29%	29%	29%
Location	43%	43%	43%	43%
Cost	28%	28%	28%	28%

Source: Summarized from USDA Farm Service Agency (2013)

The EBI index score is determined by three main factors: 1) Conservation practice, 2) Location environmental factors, and 3) Cost factors. Table 2 provides the breakdown of each of the three main factors for the four general sign-ups analyzed as part of this study. Bidders to the CRP can increase their chances of being enrolled into the CRP, getting a higher EBI score, by selecting certain conservation practices and by lowering their rent request or not participating in cost sharing, EBI points stopped being awarded for not participating in cost sharing after general sign-up 39. The location environmental factors portion of the EBI index is based on the environmental characteristic of the land that is being offered and cannot be modified by the farmer. Often these characteristics are based on soil type, proximity to a body of water and proximity to major population centers.

Table 3: Breakdown of EBI categories by total points and the percentage of those points if awarded maximum points.

	Maximum Points Available				Point Weighting			
	26	**39**	**41**	**43**	**26**	**39**	**41**	**43**
N1 - Wildlife Benefits	**100**	**100**	**100**	**100**	**18%**	**18%**	**18%**	**18%**
Cover	50	50	50	50	9%	9%	9%	9%
Wildlife priority zone	30	30	30	30	6%	6%	6%	6%
Wildlife enhancements	20	20	20	20	4%	4%	4%	4%
N2 - Water Quality Benefits	**100**	**100**	**100**	**100**	**18%**	**18%**	**18%**	**18%**
Water quality area/zone	30	30	30	30	6%	6%	6%	6%
Ground water quality	25	25	25	25	5%	5%	5%	5%
Surface water quality	45	45	45	45	8%	8%	8%	8%
N3 - Soil Erosion Benefits	**100**	**100**	**100**	**100**	**18%**	**18%**	**18%**	**18%**
N4 - Enduring Benefits	**50**	**50**	**50**	**50**	**9%**	**9%**	**9%**	**9%**
N5 - Air Quality Benefits	**45**	**45**	**45**	**45**	**8%**	**8%**	**8%**	**8%**
Wind erodibility	25	25	25	25	5%	5%	5%	5%
Wind erosion soils	5	5	5	5	1%	1%	1%	1%
Air quality zone	5	5	5	5	1%	1%	1%	1%
Carbon sequestration	10	10	10	10	2%	2%	2%	2%
N6 - Cost Benefits	**150**	**150**	**150**	**150**	**28%**	**28%**	**28%**	**28%**
Rental payment Amount	125	125	125	125	23%	23%	23%	23%
Cost-share	10	0	0	0	2%	0%	0%	0%
Amount below maximum rent	15	25	25	25	3%	5%	5%	5%
Total EBI Points	**545**	**545**	**545**	**545**	**100%**	**100%**	**100%**	**100%**
EBI Cutoff	**269**	**200**	**221**	**209**				

Source: USDA Farm Service Agency (2013)

Table 3 breaks down the EBI index into the major EBI factors that make up the index and the relative weighting of each of those factors. The main EBI factors and the subfactors that make up the EBI for the 43rd general sign-up are described below (FSA 2012):

- Wildlife (0 to 100 points) – EBI points are awarded based on the parcel of land's ability to improve wildlife habitat, and the type of cover practice the farmer will implement if accepted into the program. The wildlife factor is divided into three sub-categories.
    - Wildlife Habitat Cover (0 to 50 points) – This sub-category awards points for cover types that provide benefit to wildlife. The cover types vary by region and are established by the USDA. Cover types that provide greater wildlife benefit

will receive more EBI points. For example, a simple stand of southern pines would receive 10 EBI points while establishing a Longleaf pine stand would receive 50 EBI points. As another example, a simple stand of southern pines, perhaps planted in an earlier CRP general sign-up and looking to re-enroll into the CRP, could increase the number of EBI points from 10 to 50 by creating openings within the stands of 10 percent to 20 percent that are planted with at least five native species of grasses, forbs, legumes, or shrubs.

- Wildlife Enhancement (0, 5, or 20 points) – This sub-category awards points for implementing practices that enhance the wildlife habitat. For example, 5 EBI points are awarded for establishing a food plot, while 20 points can be awarded for converting at least 51 percent of a monoculture forest stand to a mix of native species.
- Wildlife Priority Zones (0 or 30 points) – This sub-category awards points if at least 51 percent of the property is located within a wildlife priority zone. An example of a wildlife priority zones is the longleaf pine ecosystem.

- Water Quality Benefits from Reduced Erosion, Runoff and Leaching (0 to 100 points) – EBI points are awarded based on the parcel of land's ability to improve water quality through the reduction of soil erosion, nutrient runoff, and pollutants that enter the water. The water quality factor is divided into three sub-categories.
    - Location (0 or 30 points) – This sub-category is based on at least 51 percent of the land parcel offered being in an area that has been identified by the States as needing water quality protection.

- Groundwater quality (0 to 25 points) - This sub-category is based on the predominant soils leaching index which identifies soil types that have the potential to leach pesticides and fertilizers into ground water supplies. The number of points awarded are based on a combination of the soil leaching index and the nearby population that uses its groundwater for drinking.
- Surface water quality (0 to 45 points) – This sub-category evaluates the sediment load that could make its way to streams and the population of the nearby area. Points are awarded based on the lands water erosion potential and the land location relative to the stream and populated watershed.

- Erosion (0 to 100 points) – EBI points are awarded for this factor based on wind or water erosion potential of the land being offered. Points are calculated by using an erodibility index for both water and wind. The higher value erodibility index of water or wind is used with a greater number of points being awarded for higher index values.
- Enduring Benefits (0 to 50 points) – EBI points are awarded to this factor for utilizing cover types that are more likely to remain after the CRP contract period has expired. Primarily higher points are awarded for planting trees than for planting grasses.
- Air Quality Benefits from Reduced Wind Erosion (0 to 45 points) – EBI points are awarded to this factor based on improving air quality by reducing the amount of dust and particulates in the air caused by wind erosion and the cover types carbon sequestration ability. The air quality factor is divided into four sub-categories.
    - Wind Erosion Impacts (0 to 25 points) – This sub-category awards points based on the lands potential for wind erosion and the population that could be impacted

by the additional dust and particulates in the air from wind erosion. EBI points are calculated based on wind speed, wind direction, and duration of wind events.

- Wind Erosion Soils (0 or 5 points) – This sub-category awards EBI points if greater than 51 percent of the soil types on the parcel of land is on a list of soils susceptible to wind erosion and meaningfully impact the nonattainment of air quality standards. Typically, these soil types are composed of volcanic or organic materials that can be moved great distances by the wind.
- Air Quality Zones (0 or 5 points) – This sub-category awards EBI points based on at least 51 percent of the offered land parcel being located in an air quality zone that is in nonattainment of air quality standards. In addition, the land needs to have a weighted average wind erosion index equal to or greater than three.
- Carbon Sequestration (3 to 10 points) – This sub-category awards EBI points for utilizing cover practices that have greater carbon sequestration benefits. For example, planting trees awards 10 EBI points while establishing grasses awards 3 EBI points.

- Cost – EBI points are awarded to this factor based on the rental payment of the parcel. The cost factor is divided into two sub-categories.
  - Cost – This sub-category awards more EBI points to offers with lower rent payments. The number of EBI points awarded is not fully determined until after the end of the general sign-up.
  - Offer Less than Maximum Payment Rate (0 to 25 points) – This sub-category awards EBI points if a discount to the SRR is made by the farmer. Points are

awarded based the percentage below the SRR with 25 points being awarded for offers with a discount of 15 percent or greater.

2. PREVIOUS RESEARCH

2.1. Bidder Selection Methods in Conservation Programs

In free market economies most land is privately owned. Current markets typically do not create incentives for farmers and other landowners to conduct conservation related activities, often a public good, on their private property. This creates a market failure that can be mitigated through payments for environmental services (PES) from government programs or Non-Governmental Organizations (NGOs). Funding is often limited to pay for PES and an efficient way is needed to allocate funds to landowners. A conservation auction is useful in allocating those limited resources. The CRP was one of the first conservation programs to utilize a form of auction (Schilizzi 2017). However, when the CRP was first started there was little practical experience and limited research on how best to structure a conservation auction. This led to the first attempt at a conservation auction showing significant waste with evidence showing land values increasing as a result of the CRP payments being greater than a farmers opportunity cost (Shoemaker 1989).

LataczLohmann and VanderHamsvoort (1997) found that in situations where there is asymmetric information about the benefits and costs of enrolling land into a conservation program the auction method works best. The use of auctions, instead of fixed-rate payments, causes farmers to reveal information about his or her opportunity costs associated with removing the land from agricultural production and converting the land to a conservation purposes versus keeping the land in agricultural production. It is unlikely that the government or NGO has good information about a landowner's opportunity cost for enrolling their land in a conservation program. By having landowners better express their opportunity cost through an auction the landowner's ability to obtain excessive economic rents is reduced.

Cason and Gangadharan (2004) have shown that when bidders in a conservation program with multiple objective, such as the CRP, begin to learn more about the environmental benefits that the proposed conservation projects have the bidders will act strategically to increase their economic rents. This indicates that bidders increase their economic rents when they are better informed. Reichelderfer and Boggess (1988) found that after successive rounds of bidding, early in the CRP, the acceptance rate increased from 23% to 80% as farmers were able to adapt their bidding strategy to improve their chances of enrollment into the CRP. This finding is also supported by the findings of other studies (Shoemaker 1989, Reichelderfer and Boggess 1988, GAO 1989) that showed significant inefficiencies in early CRP sign-ups, before the implementation of the EBI.

Horowitz et al. (2009) looked at how best to design a conservation auction that reduces the economic rents by studying the Maryland Agricultural Land Preservation Foundation (MALPF) program. The basic issue of any conservation program is how to get landowners to undertake certain actions that do not, without compensation, provide an economic return to the land owner, but do have a value to society. According to Horowitz et al. (2009), the models that has been used to the greatest effect are competition based programs that require landowners to compete with other landowners to participate in a program with a fixed budget. In these types of programs, the landowner with the lowest cost bid, for the conservation outcome, will be accepted into the program and this will continue until the programs funds are exhausted. The CRP is one of these types of programs and other examples include the United Kingdom's Challenge Funds, the Auction for Landscape Recovery in Australia and the Grassland Pilot program in Germany (Horowitz et al. 2009).

Duke et al. (2013) summarized research on cost-effective conservation (CEC). CEC is a concept that combines both the benefits and costs of conservation. This can be looked through the lens of Benefit Targeting and Cost targeting. Benefit targeting ranks offers based on environmental benefits with the highest offers receiving funding until funding is depleted. Cost targeting ranks offers by cost only (Ferraro 2003) and the early CRP program being in this category.

2.2. Conservation Reserve Program Bidding Evolution

Originally the CRP placed emphasis on enrolling farmers into the program to mitigate the significant pollution problems caused by soil erosion. The focus on quickly enrolling farmers into the CRP reduced the cost effectiveness of the program during the first few years. The U.S. General Accounting Office (GAO 1989) issued a report indicating that the programs goals could have been obtained at significantly lower expense. The primary cause of the cost overruns was because an auction type system was not used. Instead, the early version of the CRP was more of an offer system with a single price offered to farmers over a relatively large region. The result were that in certain areas of the Southwest United States the CRP offered rental rates were twice the rental rates being paid for active farmland.

Smith (1995) published a study that looked at how money could have been saved in the early days of the CRP by having it utilize an auction type system rather than the offer system that was ultimately employed. It is also important to note that congress originally intended for the CRP to function with an auction type system (GAO 1989). Smith (1995) estimates that if the offered price would have been a maximum price for a region, instead of the price that was given to farmers, and farmers were paid an amount lower, based on the land's characteristics, the US government could have saved about $600 million. Shoemaker (1989) noted that as farmers

learned the bid caps that were used during the first several years of the CRP. This allowed farmers that signed up later to gain additional economic rents relative to those farmers who were the first to participate in the CRP.

The findings of Shoemaker (1989) and Smith (1995) indicate that in addition to targeting different conservation objectives, the changes to how farmers enroll into the CRP with the implementation of a type of conservation auction have had the effect of reducing the economic rents seen during the early days of the CRP. While these studies (Shoemaker 1989, Smith 1995) looked at earlier version of the CRP it indicates that any savings found from changing the relative weights of the cost portion of the CRP may be short lived as farmers are able to adjust their bidding behavior to increase their economic rents.

The CRP has utilized the EBI as a way to describe the ecological importance of a parcel of land for conservation. There has also been significant effort placed in fine tuning the EBI to improve the economic efficiency and improve the expression of farmers opportunity costs when enrolling in the CRP (Claassen et al. 2008). The EBI is actually a fairly poor environmental index, as described by ecologist, because it has been developed over time to try and make the CRP program's conservation goals more cost effective instead of describing the environmental effects (Ribaudo et al. 2001).

Kirwan et al. (2005) looked at how bidding behavior changed when the environmental factors of the EBI produced a high EBI score. The study discovered that farmers with low environmental factor EBI scores included a bid that provided a cash rent discount that was twice as large as those farmers who had high environmental EBI scores. The findings of this study, which looked at general sign-ups 15, 16, 18, 20, and 26, indicate that farmers with marginal bids look more closely at their opportunity cost when bidding to join the CRP. It also indicates that a

study looking into how best to reduce the cost portion of the EBI needs to pay special attention to farmers that are on the cusp of being included or rejected from CRP. Unfortunately, Kirwan et al. (2005) did not look at how changing the relative weights of the cost portion, or any other factor, of the EBI would affect farmers' bidding behavior, especially with respect to giving a discount on the cash rental rate.

There is also evidence that farmers that submit bids with high EBI scores as a result of the environmental portion of the EBI are receiving CRP rental payments that are in excess of their opportunity cost. The Kirwan et al. (2005) study also showed that these farmers do not include many additional conservation improvements to their land, such as increasing the amount of native plants that are part of the ground cover. Overall, farmers with high environmental EBI scores have no incentive to increase the conservation value of their application or to offer a discount in the cash rental rate because they are almost assured of being accepted into the CRP. However, Kirwan et al. (2005) also cautioned that the bidder may not be truly seeking additional economic profits, but could be truly expressing a higher opportunity cost for taking the land out of agricultural production and turning it into conservation land. The findings of Kirwan et al. (2005) may indicate the increasing the relative weighting of the portions of the EBI that would increase the conservation value of the proposed actions may also be needed to increase the quality of conservation. These findings also indicate that finding ways to increase to conservation effort of bidders with high EBI scores from the environmental factors may also be important for improving the overall ecological impact of the CRP.

Cattaneo et al. (2006) conducted a study where the EBI was looked at in great detail with significant focus applied to calculating the elasticity of the non-cost factors of the EBI. The goal was to examine how the EBI could be used to fine tune the conservation objectives by changing

how EBI points were awarded for different types of desired conservation outcomes. The findings indicate that when making changes to the relative weights of the EBI components small changes do not create significant changes to which parcels of land are accepted into the CRP. However, when there are large changes to the relative weights of the different EBI factors then there are changes in which bids are accepted and which are not. Cattaneo et al. (2006) establishes that looking at the elasticities of the EBI component factors can be done and has a meaningful way of evaluating how changes in the relative weights of the EBI can affect the program.

Cattaneo et al. (2006) found that small relative weight changes to EBI components targeted at the EBI components other than cost had the effect of changing the CRP's cost as a function of which bids were accepted and which bids were rejected from the CRP. This finding is interesting because it shows that the CRP's cost can be reduced or increased based on tweaks to the non-cost EBI factors. For policy makers it is important to understand that making changes to the CRP to encourage certain types of conservation practices may have the unintended consequence of increase the cost of the program or potentially reduce the cost of the CRP.

One of the shortcomings of Cattaneo et al. (2006) is that it did not focus on what changes to the relative weighting of the cost factor of the EBI would have. The stated reason for this was that the CRP is not "budget constrained" indicating that the investigators were not interested in reducing the cost of the program, rather they were more interested in adjusting which acres were included in the program and the ultimate environmental performance of the CRP.

Roberts and Lubowski (2007) conducted a study that examines what happens to land enrolled in the CRP after the contract expires. This is important to understand because the USDA would like to maintain the number of acres in the program in accordance with the most recent Farm Bill's guidance. This produces a significant hurdle because of the significant number of

acres that have contracts expiring and the need to either renew those contracts or get farmers who are not currently enrolled in the CRP to offer up their land. Roberts and Lubowski (2007) predicted that if all farmers who enrolled into the CRP in 1986 and 1987 had allowed their contract to expire by 1997 42 percent of the enrolled acres would not have been converted back into agricultural production. The explained reasons for only 42 percent of the land returning to agricultural production are that the cost of transitioning the cover crops back to a condition suitable for agricultural. This is especially true with regards to cover types that include the planting of trees. The findings indicate that the conservation benefits of the CRP, in certain cases, continue after land has left the CRP and is no longer being subsidized for conservation purposes.

Roberts and Lubowski (2007) study may indicate that in order to obtain the long-term conservation goals of the CRP, it may be beneficial to actually increase the cost of CRP rent payments in such a way to entice farmers to develop conservation plans that are costlier to convert back to agricultural production after the contract expires. This would imply that the conservation benefits to society continue after active participation in the CRP has ended. This may indicate that there is an opportunity to decrease the long-term costs of the CRP by increasing the cost of the CRP in the short term to encourage more sticky land conversation strategies.

Claassen et al. (2008) reported that CRP payments tend to be concentrated with retired farmers, landowners that generate their income from non-farm activities, and low income farmers and make up approximately 60% of CRP payments. In general, the CRP may be seen as a way for farmers with limited resources, time and income, to reduce labor requirements on the

farm and/or reduce risk from farming. This finding also implies that there may be an opportunity to increase the cost effectiveness as the opportunity cost of these farmers may be lower.

3. THEORY

The CRP is a type of payment for environmental service program that has characteristics of both a flat fee and a conservation auction selection system. Enrollment into the CRP program is determined by a bidding system that uses a benefit-cost index, the EBI, that considers environmental benefits and costs to target the highest impact participants. A flat fee is provided by the CRP's use of a SRR rental payment that places a maximum cap on what the CRP will pay a farmer based on the soil types present on the parcel of land being offered to the program. The conservation auction portion of the CRP is seen when the farmer voluntarily offers to accept a lower rental payment than the SRR, or maximum rent cap, that the parcel of land is qualified for. In addition, the farmer may also implement more involved, or costly, conservation practices. Both the discount from maximum rental payment and the more involved conservation practices allow the farmer to gain additional EBI points that provide a greater probability of being accepted into the program that is in addition to the flat fee offered.

Since the location based environmental factors of the EBI index cannot be modified by the applicant to increase their EBI score it will not be considered in this analysis. Farmers can select conservation practices that would increase the number of EBI points awarded, and it is reasonable to assume that there is a higher cost associated with certain conservation practices that are awarded higher points. However, it is difficult to calculate the cost differences between the different conservation practices to determine how farmer opportunity costs are expressed by applying one conservation practice over another.

Table 2 shows the relative percentage that each of the main EBI factors makes up of the total number of EBI points available. The assumption is made that each of the categories has been awarded the maximum number of points available for that category. As can be seen,

starting with general sign-up 26 and continuing through general sign-up 43, the percentage of points awarded solely based on the location and environmental characteristic of the land offered to the CRP is approximately 43 percent of the total EBI points. While the percentage of the total points that can be awarded based on conservation practice has been approximately 29 percent during those same signups. That leaves approximately 28 percent of potential EBI points being determined based an applicant's cost to the CRP program, rent payments or cost share payments. The majority of these points, 23 percent, are based on the value of rent payments and the remaining, 5 percent, is based on any discounts the farmer voluntarily provides. The points awarded for voluntarily offering to accept a lower cash rental payment are approximately 3 percent in general sign-ups 26 through 33 and approximately 5 percent after general sign-up 39, and the points awarded for not accepting cost share payments are approximately 2 percent in general sign-ups 26 through 33 and no points being awarded after general sign-up 39.

Previous EBI point cutoffs for inclusion into the CRP are publicly available from the FSA and have been relatively consistent from general sign-up to general sign-up. As a result, a farmer with a very high EBI score is unlikely to offer a discount because of their already high probability of being accepted into the program. This effect was previously reported by Kirwan et. al. (2005), which suggested that the number of farmers offering discounts is smaller when farmers have a greater likelihood of being accepted into a conservation program that utilizes a conservation scoring approach. As a result, this study focuses on the behavior of marginal applicants. In general sign-up 26, the maximum number of EBI points that an applicant can directly gain by offering a discount is 15 points and 10 points for not accepting a cost share from the program. While in general sign-ups 39, 41, and 43 there was a total of 25 EBI points that were available for offering a rent discount. In addition to gaining EBI points directly from lower

rental rates, the farmer also gains EBI points from the cost adjustment formula by simply having an overall lower rental rate. Assuming that a farmer offers a rental discount of $15 on a SRR of $100 per acre, the discount that awards the maximum number of EBI points, has an indirect impact of increase the cost portion EBI score by 10 points. Because of the 25 points available for directly offering a discount and not participating in cost share and an additional 10 points from the 15 percent lower rental rate, the dataset was rearranged so that only those applicants that were within 35 EBI points above and below the cutoff were included in the observations so that only marginal applications were analyzed. If the cutoff EBI score is 269, it is hypothesized that most farmers who lower their bids are those who have lands that had an EBI score between 234 and 304 (269 ± 35 the cost factor which is based on farmers' bids).

Figure 2: The Demand and Implied Supply of the CRP General Sign-up 26

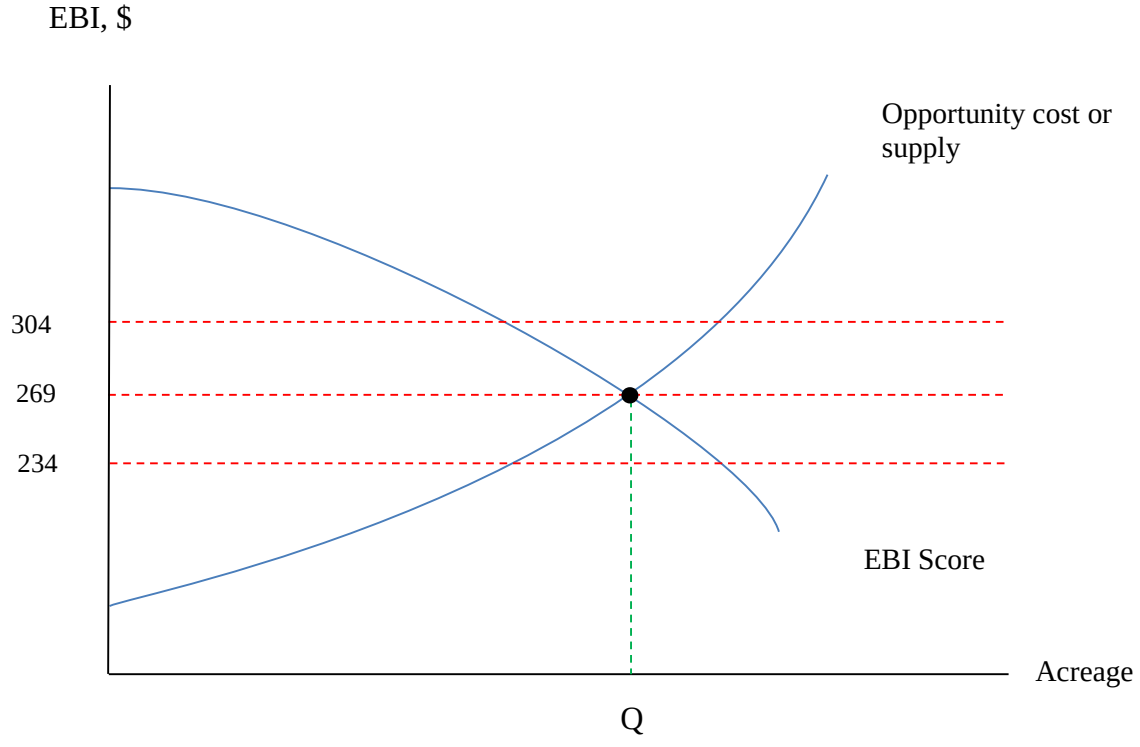

Figure 2 shows a supply and demand diagram that graphically demonstrates the theoretical basis for this study. The vertical axis of Figure 1 is the EBI score while the horizontal axis represents acreage enrolled into the CRP. As the amount of acres increases, the EBI score falls. So the EBI score is a downward sloping curve. Once the government decides a cutoff point in the EBI scores, 269 for general sign-up 26, the acreage under the CRP (Q) will be determined. Conversely, if the government decides the acreage is Q, then the cutoff EBI score is at 269.

There is a corresponding opportunity cost for farmers for every EBI score. Often land parcels with high EBI scores will have lower opportunity costs due to their lower agricultural productivity and be considered marginal agricultural land. For example, a parcel of highly erodible land will have a lower opportunity cost than another parcel of land with lower erodibility. As a result, the farmer's opportunity costs for enrolling in the CRP are generally (but not always) rising, as the EBI scores of their land decline. This upward sloping opportunity cost curve represents the supply curve for the CRP. In essence, the theory of this study is that by causing farmers to better express their opportunity costs they reduce their producer surplus and the government is able to increase their consumer surplus. In this case the supply is being provided by farmers taking their active farmland out of production and producing conservation, which is being demanded by the government.

It is expected that farmers with lower EBI scores will be more inclined to offer a discount to improve their bids chance of being accepted into the CRP. Also, farmers that are more familiar with the CRP because they are offering land that was previously enrolled into the CRP are more likely to offer a discount. Also, land that was previously enrolled in earlier general sign-ups may have been accepted with conservation practices that were less intensive than those required by the more recent general sign-up. It may be easier for that farmer to offer a discount than to

modify the conservation practice to increase the EBI score of the offer. It is also expected that older farmers will likely enroll into the program because they see it as a potential source of income during retirement while still maintaining their ownership of the land (Claassen et al. 2008).

A farmer's decision to offer a discount can be expressed by the following function.

$O = f(E, P, A, M, D)$

where:

O is the decision of the farmer to offer a discount and is characterized by a 0 if the farmer did not offer a discount and a 1 if the farmer did offer a discount.

E is the total number of EBI points that were awarded based on the N1, N2, N3, N4 and N5 categories and correspond to all the points awarded for the conservation practice and location environmental factors, that for the purpose of this analysis are used as a proxy for the measurement of the environmental benefits of land being enrolled into the CRP.

P is a variable that is 0 for land that was previously not enrolled in the CRP and 1 for land that was previously enrolled into the CRP

A is the average cash rental payment for the county of the applicant for the year prior to the sign-up.

M is the maximum rental payment that could have been awarded based on the weighted averages of the SRR found on the offered property.

D represents the average demographics of the farmers in the county of the bid, specifically the average age of the farmers in a county.

The amount of discount that a farmer offers can be expressed in the following equation.

$Disc = f(E, P, A, M, D)$

where:

Disc is the amount, in dollars per acre, of discount the farmer is offering from the maximum rent available.

E is the total number of EBI points that were awarded based on the N1, N2, N3, N4 and N5 categories and correspond to all the points awarded for the conservation practice and location environmental factors, that for the purpose of this analysis are used as a proxy for the measurement of the environmental benefits of land being enrolled into the CRP.

P is a variable that is 0 for land that was previously not enrolled into the CRP and a 1 for land that was previously enrolled into the CRP.

A is the average cash rental payment for the county of the applicant for the year prior to the sign-up.

M is the maximum rental payment that could have been awarded based on the weighted averages of the SRR found on the offered property.

D represents the average demographics of the farmers in the county of the bid, specifically the average age of the farmers in a county

A two-stage selectivity model was used to estimate the model. A probit model is used to estimate how factors drive a farmer's willingness to offer a discount in the first stage of the model. In the second stage, OLS methods are used on the residual observations of those farmers that offered a discount to analyze factors influencing the size of the discount offered. This analysis gives insight into which factors drive the size of the discount that farmers offering a discount are willing to provide.

It is expected that by increasing the relative weights of the EBI points awarded for offering discounts, farmers will be more inclined to offer a discount to gain enrollment into the

CRP. An increase in the relative amount of EBI points awarded for rent discounts can lead to the average cost per acre of the program being reduced. To understand the magnitude of how increasing the relative weight of the cost portion of the EBI could improve the CRP's cost efficiency a simple simulation was used. The simulation assumes a doubling of the number of potential EBI points awarded for offering a discount, from 25 points to 50 points. This is then applied by increasing the weighted average per acre discount by the increase in relative weight, 12.6%. While this is a simple simulation, it helps to demonstrate the magnitude of a change in the relative weighting of the cost portion of the EBI could have by indicating the amount of money that could be saved by the CRP or the number of additional acres that could be enrolled into the program.

4. DATA

Data used for this research comes from three sources. The first source is the CRP bid file received from the USDA. This dataset contains all individual bid offers for enrollment, those accepted and rejected by the CRP, for general sign-up 26, 39, 41, and 43. General sign-up 26 occurred in 2003, general sign-up 39 occurred in 2010, general sign-up 41 occurred in 2011, and general sign-up 43 occurred in 2012. The dataset contains the number of acres offered to the CRP, the number of acres that were previously enrolled into the CRP, the amount of cash rental payments requested, the maximum rate available for the offer, and a breakdown of the EBI score by category (N1, N2, N3, N4, N5).

A second data source is from the USDA's National Agricultural Statistics Service (NASS) Census of Agriculture survey. The Census of Agriculture is a survey of farmers conducted every five years asking economic questions about the farmers' farm operation. Specifically, the analysis in this study used the county wide average for farm size, number of conservation acres per farm, and the average farmer age for each county in which land was offered into CRP for the four datasets. County data was matched to the specific offer provided in the CRP bid file. The data was collected from the most recent survey before the general sign-up. The survey years used by this study were 2002 for general sign-up 26 and 2007 for general sign-ups 39, 41 and 43.

A third data source is from the USDA's NASS Cash Rents Survey. The Cash Rents Survey provides county-level estimates of the cash rent paid by farmers for irrigated cropland, non-irrigated cropland, and pasture on an annual basis. This data was used to estimate the county average rent to compare the offered CRP rent payments. The used for each of the general sign-ups analyzed in this study was from the year before the CRP general sign-up period.

5. RESULTS

Table 4: Results of Sign-up 26 two-stage selectivity model

Variable	Probit (Offer discount) model				Discount offered	
	Coefficient	t-ratio	Marginal Effect	t-ratio	Coefficient	t-ratio
Maximum payment	0.031	60.93	0.9%	69.75	0.396	26.41
Tot. Env. EBI Points	-0.019	54.53	-0.5%	60.32	-0.232	25.24
Prev. enrolled into CRP	0.198	12.94	5.9%	12.73	1.575	8.65
County Avg. Cons. Payments	0.000	2.00	0.0%	2.00	-0.021	4.50
Avg. County Farmer Age	0.017	8.73	0.5%	8.75	0.178	8.21
Avg. County Farm Size	0.000	0.50	0.0%	0.50	0.000	0.54
R2 Adjusted	0.229				0.401	
Lambda					11.604	

The results of the two-stage selectivity model for general sign-ups 26 is presented in Table 4 above while the results of general sign-ups 39, 41, and 43 are presented in Tables 6 through Table 8 in the Tables and Figures section.

The probit model fit relatively well considering the large number of observations in the sample with an adjusted R^2 of 0.229 for sign-up 26, 0.261 for sign-up 39, 0.284 for sign-up 41, and 0.264 for sign-up 43. The selectivity model showed an adjusted R^2 of 0.401 for sign-up 26, 0.662 for sign-up 39, 0.587 for sign-up 41, and 0.620 for sign-up 43. In the probit model for each of the four sign-ups analyzed the maximum CRP payment, and county average farmer age were positive and significant at the 1% level. While the total number of environmental EBI points was negative and significant at the 1% level. The previous enrolment in the CRP was significant at the 1% level in sign-ups 26, 39, and 41, but was only significant at the 5% level in sign-up 43. The average county farm size and county average conservation payments were not significant in any of the four data sets analyzed.

Farmers that were previously enrolled in the CRP showed the highest likelihood of offering a cash rent discount. All else being equal, a 1% increase in the number of previously enrolled CRP applicants would result in an increase in the probability of offering a cash rent discount of 5.9% in sign-up 26, 5.1% in sign-up 39, 7.0% in sign-up 41, and 4.4% in sign-up 43. Also, farmers that offer land that has a high maximum rental payment also showed that, all else equal, a 1% increase in the maximum land rent payment would increase the probability of offering a discount by 0.9% in sign-up 26, 0.8% in sign-up 39, 0.7% in sign-up 41, and 0.7% in sign-up 43. The average age of farmers in the county also plays a part in that a 1% increase in the average age of the farmer in the county increases the probability of offering a discount by 0.5% in sign-up 26, 0.9% in sign-up 39, 1.1% in sign-up 41, and 1.3% in sign-up 43. There are also indications that farmers with higher environmental EBI scores are less likely to offer a discount, with a 1% increase in total environmental EBI points decrease the probability of offering a discount by 0.5% in sign-up 26, 0.9% in sign-up 39, 0.9% in sign-up 41, and 0.9% in sign-up 43.

The average discount offered by those who chose to offer a discount was $8.74 per acre in sign-up 26, $9.89 per acre in sign-up 39, $7.52 per acre in sign-up 41, and $8.80 per acre in sign-up 43. Results of the OLS regression shows farmers who were previously enrolled in the CRP offered a discount of $1.56 per acre in sign-up 26, $1.37 per acre in sign-up 39, $1.43 per acre in sign-up 41, and $0.78 per acre in sign-up 43.

Table 5: Results of simulation of General sign-ups 26, 39, 41, and 43.

General Sign-up	Original Avg. Per Acre Discount	Simulated Avg. Per Acre Discount	Cost Savings (USD millions)	Additional Acres Possible
26	$2.28	$2.57	$0.6	10,759
39	$3.63	$4.09	$2.1	46,261
41	$3.18	$3.59	$1.2	25,881
43	$3.00	$3.38	$1.5	30,283

Results of the simulation are presented in Table 5. In sign-up 26, the simulation increased the average per acre discount from $2.28 per acre to $2.57 per acre, a per acre increase of $0.29. The resulting cost savings were $0.6 million or an increase of approximately 10,759 acres. In sign-up 39, the simulation increased the average per acre discount from $3.63 per acre to $4.09 per acre, a per acre increase of $0.46. The resulting cost savings were $2.1 million or an increase of approximately 46,261acres. In sign-up 41, the simulation increased the average per acre discount from $3.18 per acre to $3.59 per acre, a per acre increase of $0.41. The resulting cost savings were $1.2 million or an increase of approximately 25,881 acres. In sign-up 43, the simulation increased the average per acre discount from $3.00 per acre to $3.38 per acre, a per acre increase of $0.38. The resulting cost savings were $1.5 million or an increase of approximately 30,283 acres.

6. CONCLUSIONS

The results of the two-stage selection analysis showed the single most important factor influencing a farmer's decision to offer a discount when bidding in the CRP is if they have participated in the CRP previously and are reenrolling their land into the program. This is not surprising given that offering a discount to the SRR is the easiest way for farmers to increase their EBI score with the least amount of effort. Other ways to increase their EBI score, such as adding a more complex conservation practices, requires more effort that offering to take lower annual rent payments.

It is also interesting that the average farmer age by county showed significance, though muted in a farmer's willingness to offer a discount. This may indicate that farmers nearing retirement may have a lower opportunity cost and look at conservation programs to generate income in retirement or reduce the amount of labor required to maintain the farm during retirement while continuing to own land to pass on to future generations. This finding is consist with the findings of Claassen et al. (2008). It is important to note that this analysis would be greatly enhanced by having more demographic information, specifically age, for each bidder in one of the general sign-ups rather than simply relying on county wide averages. However, due to privacy concerns this information was not made available by the USDA.

The simulation indicates that by increasing the relative significance of the cost portion of the EBI index savings can be achieved. The additional savings from increasing the relative weighting of the cost portion of the index is consistent with the findings of Cattaneo et al. (2006) that showed an increase in the relative weighting of the environmental portions of the EBI index produced more environmental benefits from the factor that saw its relative weight increase.

While the overall savings indicated by the simulation may be small relative to the total size of the CRP, the simulation is indicative of how savings may be achieved. Once again, this is consistent with the findings of Cattaneo et al. (2006) that smaller changes in relative weightings produce minor changes in farmers providing the ecological benefit targeted, while larger increases to the relative weightings produce more significant changes. The small savings may also indicate that methods other than changing the relative weightings of the EBI cost factor may have a greater impact in improving the economic efficiency of the CRP. Potential changes to the method of bidding into the CRP, such as multiple rounds of offers would be one such opportunity for further consideration. While the primary limiting factor of the CRP is acres enrolled in the program rather than cost, it is important to improve the cost efficiency of a program by structuring the bidding mechanism in such a way to that excess economic rents are reduced.

However, it is important to note that increasing the economic efficiency of the CRP may lead to less emphasis on conservation goals as part of the selection criteria for enrollment into the CRP. Policy makers may be forced to choose one conservation goal over another to better target the CRP and reduce the overall impact to conservation caused by less focused goals. Policy makers need to take care in developing changes to the bidding mechanism of the CRP less they ultimately reduce the conservation performance of the program.

Policy makers have several tools at their disposal to target enrollment in conservation programs to meet desired ecological and conservation outcomes. Improving the cost efficiency of a conservation program is an important component as financial resources of governments and NGOs are not unlimited. However, conservation programs are ultimately attempting to address a

market failure resulting from externalities not being priced into goods and services and perfect cost efficiency may not be achievable.

This study has addressed one way to improve the cost efficiency of the CRP by better targeting farmers opportunity costs. Increasing the relatively weighting of the cost portion of the EBI may be a way for policy makers to improve the cost efficiency of the CRP. The CRP has been functioning since 1985 and has continued to be renewed and modified as government conservation priorities have changed. Finding ways to improve the CRP's economic efficiency and allow less funds to be used or more acres to be enrolled will help to ensure that the CRP continues to play its role as the largest conservation program in the United States through shifting government spending priorities.

7. TABLES AND FIGURES:

Table 6: Results of two-stage selectivity model for General Sign-up 39

Variable	Probit (Offer discount) model				Discount offered	
	Coefficient	t-ratio	Marginal Effect	t-ratio	Coefficient	t-ratio
Maximum payment	0.029	20.84	0.8%	22.47	0.173	11.27
Tot. Env. EBI Points	-0.033	36.37	-0.9%	48.28	-0.118	7.44
Prev. enrolled into CRP	0.180	5.06	5.1%	5.08	1.369	5.75
County Avg. Cons. Payments	-0.005	3.73	-0.2%	3.74	-0.025	2.88
Avg. County Farmer Age	0.032	9.27	0.9%	9.40	0.176	8.63
Avg. County Farm Size	0.000	7.67	0.0%	7.75	0.000	1.60
R2 Adjusted	0.261				0.662	
Lambda					-1.524	-1.69

Table 7: Results of two-stage selectivity model for General Sign-up 41

Variable	Probit (Offer discount) model				Discount offered	
	Coefficient	t-ratio	Marginal Effect	t-ratio	Coefficient	t-ratio
Maximum payment	0.026	22.04	0.7%	23.27	0.221	20.95
Tot. Env. EBI Points	-0.034	50.05	-0.9%	74.86	-0.184	15.39
Prev. enrolled into CRP	0.256	7.65	7.0%	7.77	1.425	6.89
County Avg. Cons. Payments	0.002	1.35	0.0%	1.35	-0.017	2.49
Avg. County Farmer Age	0.040	15.82	1.1%	16.29	0.152	11.62
Avg. County Farm Size	0.000	2.00	0.0%	2.00	0.000	1.95
R2 Adjusted	0.284				0.587	
Lambda					4.271	6.59

Table 8: Results of two-stage selectivity model for General Sign-up 43

Variable	Probit (Offer discount) model				Discount offered	
	Coefficient	t-ratio	Marginal Effect	t-ratio	Coefficient	t-ratio
Maximum payment	0.024	20.51	0.7%	21.70	0.260	22.86
Tot. Env. EBI Points	-0.208	44.08	-0.9%	63.15	-0.198	14.23
Prev. enrolled into CRP	0.153	4.05	4.4%	4.07	0.775	3.34
County Avg. Cons. Payments	-0.002	1.58	0.0%	1.58	0.032	5.19
Avg. County Farmer Age	0.044	14.08	1.3%	14.46	0.207	11.49
Avg. County Farm Size	0.000	0.42	0.0%	0.42	0.000	0.23
R2 Adjusted	0.264				0.620	
Lambda					3.727	4.51

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