Towson University
Department of Economics
Working Paper Series

Working Paper No. 2015-01

CREP: Cattle Receiving Enhanced Pastures? Investigating Landowner Response to Federal Incentives

by James Manley and Jason Mathias

January, 2015

© 2015 by Author. All rights reserved. Short sections of text, not to exceed two paragraphs, may be quoted without explicit permission provided that full credit, including © notice, is given to the source.

CREP: Cattle Receiving Enhanced Pastures? Investigating Landowner Response to Federal Incentives[1]

By James Manley[2] and Jason Mathias[3]

Abstract

Using enrollment data on the enhanced CRP's river buffer subprogram from 1998 to 2010 we find that participation incentives are larger for cattle pasture and that enrollments increase at a higher rate in counties with large amounts of cattle ranching. Counties producing cattle receive almost twice as much in up-front incentives, and the marginal effect of that incentive is also higher. This is probably due to the fact that cattle ranchers can use heavily subsidized "cost share" funding to improve their ranches. Accounting for the cattle effect also helps explain previous findings of apparent producer preference for up-front payments over a discounted stream of annual benefits. This preference is replicated but disappears when we control for cattle production.

JEL codes: H23, Q15, Q24, Q58

Keywords: agricultural economics, agricultural policy, Conservation Reserve Enhancement Program, Conservation Reserve Program, landowner incentives, subsidy response, cattle ranching

---

[1]Acknowledgements: this project was inspired by an investigation of Robert Wieland's work. Deep thanks to Dr. Jordan Suter for comments and suggestions and for sharing the data he collected with Gregory Poe and Nelson Bills. Thank you to all of the kind people from the USDA, FSA, and the Soil Conservation District of Carroll County, Maryland, especially Eric Hines, Susan Bollinger, Dr. Daniel Hellerstein, Eva Delp-Cole, and Thomas Lloyd. Finally, thanks to our many respondents at the NRCS including Thor Thorson in Oregon, Brad Duncan in Washington, and Roy Vick in North Carolina.

[2] Contact author. Department of Economics, Towson University, Towson, MD 21252 USA. Email jmanley@towson.edu.

[3] City of Baltimore. Reachable at jmathias6@gmail.com.

Introduction

The USDA's Conservation Reserve Program (CRP) pays rural landowners to accept restrictions on farming in environmentally sensitive areas. Its purpose is to "cost-effectively assist owners and operators in conserving and improving the nation's natural resource base" (FSA 2012). Landowners' accepting payments while refraining from raising crops adds about $3.5 billion per year to the US economy through reduced erosion, increased wildlife abundance, and improved water quality (Wu and Weber 2012). Since the program costs about $1.9 billion per year (FSA 2010), the program represents a substantial positive contribution to the welfare of US citizens.

In spite of the success of the program, CRP faces challenges such as a lower cap on the program's enrollment, attempts by some politicians to dismantle agri-environmental programs, existing restrictions on budget neutrality for some types of program development and higher costs of land enrollment imposed by rising food prices (Hagstrom 2012; Hellerstein 2010). While the cost-effectiveness of a policy is always important, these constraints further intensify the need for making the most of increasingly scarce resources.

An optimal policy would maximize the quality-adjusted amount of retired land per dollar invested. Market approaches such as auctions have failed to achieve desired results because there are not enough participants in the market: landowners with high quality land do not need to reveal the minimum payment they are willing to accept, instead using their market power to hold out for maximum offered benefits (Claassen 2009; Kirwan, Lubowski, and Roberts 2005). Thus, it is important to identify other factors affecting the willingness of landowners to supply land for these programs (see Claassen, Cattaneo and Johansson 2008 for a discussion).

Other papers have identified factors linked to program adoption, and have even identified some apparent inconsistencies in producer preferences. We offer a new explanation for this apparent inconsistency: previous studies ignored the difference between the features of the payments in cattle-producing and non-cattle-producing areas. Program rules provide government support for a larger variety of land improvements for cattle ranchers than they do for other types of agricultural producers. Because of this, cattle producers receive greater up-front incentives on average, and they are able to use government funds to improve their land in ways others are not.

Previous studies have grouped all areas together rather than identifying the different way that cattle production modifies incentive effects is missing part of the picture. As far as we know, we are the first to document such a factor that *moderates* incentive effectiveness.

We verify that the initial incentive including the cost share and the associated Signing Incentive Payment and Practice Incentive Payment (SIP and PIP) is significantly larger in cattle ranching counties than it is for other types of agricultural producers. We then investigate whether the marginal effect of incentives is larger in those places, and find that indeed it is.

This enables us to offer at least a partial explanation for Mortensen et al. (1989) and Suter et al.'s (2008) finding that up-front incentives are preferred to the discounted sum of annual payments. We find the same thing, but we see it disappear when we control for the marginal effect of incentives in highly cattle-producing areas.

We limit our examination to the market for one type of conservation practice. This paper focuses on the Conservation Reserve Enhancement Program (CREP), and more specifically on the riparian forest buffer establishment subprogram called CP22. CREP is an incentive-based volunteer program that is managed by the Farm Service Agency (FSA) and the Natural Resources Conservation Service (NRCS) in 33 states. It focuses on particularly environmentally sensitive areas; just about 2% of total CRP land is enrolled in CREP. Despite the relatively small acreage in question, CREP is very active in recruitment, accounting for 40% of CRP contracts in some years (Claassen, Cattaneo, and Johansson 2008).

In the next section we examine previous research, after which we describe the payment system followed by our data and modeling strategy. Next we analyze the data and present our results. Our results are summarized in the discussion and conclusion.

Previous Research

As a potential land renter the government sets the price it is willing to pay. Landowners respond by choosing to continue farming or committing their land to the program for a period of time. Landowners' willingness to supply land depends on their opportunity costs of enrolling their land in the program and the incentives associated with participation. From the creation of CRP and later CREP there have been multiple studies attempting to understand the incentives necessary to entice landowners to enroll in CRP/CREP and forgo revenue from crops or other opportunity costs.

The first body of research presents surveys done shortly after the CRP began. Esseks and Kraft (1988) found that a small rise in incentives and a restructuring to cash rather than commodity certificates would have increased enrollment. Hatley, Ervin, and Davis (1989) identified a number of socioeconomic characteristics that influenced producer participation, including age, tenure, occupation, education, and size of holdings. Mortensen et al. (1989) sought to identify characteristics of participants and assess the impact of CRP. They considered land attributes such as soil productivity, cost of cover establishment, and the reduced costs associated with decreased use of inputs on land that would not be cultivated.

Another group of analysts use contingent valuation (Cooper and Osborn, 1998; Kingsbury and Boggess, 1999; Lohr and Park, 1995; Purvis et al., 1989; Vanslembrouck et al. 2002, and Lynch, et al., 2002). Contingent value analysis poses hypothetical questions to landowners and uses the answers to estimate the effects on demand of variables that differ according to each landowner, such as age.

The third body of research is based on analyzing actual enrollment data, as is our analysis. Early efforts varied in their estimates of price elasticity (Konyar and Osborn, 1990; Parks and Kramer, 1997; and Parks and Schoor, 1997). The most recent, Suter et al. (2008), follows this approach.

Suter et al. (2008) examines willingness to accept payment to participate in the CP22 subprogram of CREP in six states with well-developed CREP programs and where much of the land is CP22 – that is, where riparian forest buffers predominate rather than a mix of riparian forest and riparian grass. Combining map layers showing land use with GIS data on rivers and streams, they calculate the amount of land eligible for program participation and use the percentage of eligible land actually enrolled in a given year as the dependent variable in a regression. They find that increasing the initial incentive, including both the cost share and the sign-on bonus, is five times more effective at increasing enrollment than increasing the annual payments (Suter et al. 2008).

As far as we know, no studies have yet identified moderating factors, i.e. interactions between variables. Also, remarkably little attention has been paid to the issue of cattle production, even though incentives for ranchers differ, as we show in the next section.

CREP Payment System

Participants are eligible to receive three types of incentives. The first is a sign on bonus, which is a set payment per acre. Second, an annual rental payment is assigned based on the soil rental rate and an incentive rate. Third, cost-sharing payments are given at sign-up and/or after the buffer construction to reimburse part or all of the costs associated with building the buffer as well as with any other land improvements necessary to allow the farm to continue production on land not committed to the program. Finally, some states supplement the Federal incentives (MDA 2009).

The sign on bonus consists of a few parts. Program participants receive a flat bonus of $100 per acre called the Signing Incentive Payment, or SIP, as well as a Practice Incentive Payment, or PIP, worth 40% of the total eligible cost of practice installation (FSA 2012). Finally, landowners are eligible for a cost share of up to 50% of eligible installation costs. The State of Maryland, for example, covers an additional 37.5% of installation costs so, when Federal and state incentives are accounted for, installing such features more than pays for itself (not to mention that Maryland pays an additional flat fee of $100 per acre as a "State Incentive Program.")

The second incentive is the annual payment. This payment is determined by multiplying a set number by the soil rental rate (SRR) of the parcel that is being removed from production. Ideally we would have parcel-level data on soil types; lacking that we calculate a weighted average land value by county and assume that parcels are representative of the county. We model this by estimating the county's SRR using NRCS data from the Soils Data Mart and multiplying the result by the incentive rate, given in the USDA data.

Cost-share payments are in many cases limited to reimbursement for costs associated with planting trees or grasses on the land that will be set aside. However, on pastureland, a variety of additional practices are eligible for reimbursement, and farmers seeking financial support for improving their land in certain ways may also find CREP to be a useful source of funding. For example if the establishment of a buffer zone around a river were to limit cattle's access to a stream, a rancher may use the cost-share to build fencing, a cattle crossing and a watering trench (FSA 2012). Joining CREP might be appealing if it covers some or all of these, though it may also require tens of thousands of dollars to be put up by the landowner (MDA 2009). Note that since the upfront payment is based on the cost of setting up the buffer, agricultural producers such as cattle ranchers for whom the buffer construction represents an improvement to the land in effect receive double payment: once for the improvement itself and once again through this cash incentive.

Participation in CREP means that cattle ranchers may get government support for building a cattle-crossing or watering trench (FSA 2012). Between the PIP and the cost share, landowners recoup 90% of the cost of such installations, and in many states they receive more still. Also, since production of chickens and hogs in the US is dominated by feeding operations rather than pasture (Key & McBride 2007) these producers are ineligible and therefore might benefit less from CREP funding. Thus cost share funding may be more useful to cattle producers than to other types of agricultural producers, implying that counties with more pastureland may respond more to the up-front incentives.

Data Description

To analyze these issues, we take data from 184 counties in five states for each year from 1998 to 2010.[i] We follow Suter et al. (2008) in choosing to examine data from Maryland, North Carolina, Oregon, Virginia, and Washington because of those states' mature CREP programs and high concentration of riparian forest buffers (i.e. eligibility for CP22, the sub-program we analyze) within CREP.[ii]

The outcome we use is whether eligible land in a county was enrolled in the program in a given year. 19% of county/ years (393/2111) had enough enrollments that the total enrolled acreage was reported. (If fewer than eight producers enrolled land, the total was not reported due to privacy restrictions.)

The explanatory variables of interest are the two incentives to which landowners can respond: the annual rental payment and a one-time up-front payment, which itself consists of a few parts as described above. Our data from the USDA include cost share amounts and we account for SIP and PIP to get the initial incentive.

Since the annual rental payments depend on soil types, we calculate weighted averages of soil rental rates. We took the National Resources Conservation Service's Soil Data Mart's estimates of the amounts of each of a variety of soil types in a given county, and combined them with the value per acre of given soil types from the FSA and NRCS's joint Soils Data Management System. Thus, we calculate a weighted average soil rental rate in a given county. We calculate the present value of a 15 year stream of payments using a 3% discount rate. Note that we use SRR data from the entire county rather than just from participating acreage since the latter, as a self-selected area, might be biased.

Establishment costs are given in the USDA recipients' data. The amount a participating household receives up front is the cost share (1/2 of establishment costs) plus the PIP (i.e. another 40% of establishment costs) plus $100 per acre for the SIP. To calculate the total up-front receipts we multiply the cost share by 9/5 to add in the PIP, and finally add 100 for the SIP.

It is important to note here that the up-front payment is still not 100% of the cost share in some places, or at least it's not a lot different from it. In other words, it more or less balances out: it is the establishment costs plus maybe a little. If that investment serves no purpose to the landowner, it's money gone or, if they are fully compensated for their share of establishment costs, it may be something they are indifferent to. If that investment does serve a purpose to the landowner, constituting a land improvement, then it increases the appeal of participation in CREP. The CREP rules make it more likely for this to be valuable to cattle owners, as described above.

What factors might shift the supply curve? Variables were chosen based on previous studies as described above. Factors that might increase landowners' propensity to enroll their land include higher production expenses, higher taxes on agricultural products, and greater government expenditures of other types (the last two factors by increasing awareness of the government as a potential source of income). All of these variables come from the National Agricultural Statistics Service (NASS). "Government expenditures per acre" are total receipts from Federal farm programs in the county, divided by the total acres in the county that's on farms (according to the Agricultural Census). Counties that are more rural ought to be more likely to enroll, as development pressure should not affect their land values much. We use the USDA's 2003 Urban-Rural Continuum codes to check this.

Other opportunity costs are sure to play a role. We anticipate that investments already made in the land, such as irrigation, should make landowners less likely to enroll their land in the program. Also, owner-operated facilities are likely more reticent, since those leasing their land to tenants might be less personally invested in the production process and more interested in a guaranteed annual return. Finally, variables including total farmland per county, farm size, and average farm income have been suggested in past work, and we include them here without a clear expectation for effects they might have. All of these variables come from the NASS.

Current and anticipated prices are also highly relevant, so we gathered information on current and past prices of soy, corn, cattle, and wheat. Unfortunately these eight prices are highly correlated, which is not surprising given that many are substitutes in consumption as well as responsive to many of the same external conditions, from climate to national and international income shocks. To avoid multicollinearity we combined the eight prices into one using factor analysis. The first set of factor loadings puts positive weights on all prices, as we would expect, and so we use it.[iii]

Another variable of interest is the average age of the people in the county. One school of thought holds that older people might be more willing to enroll in CRP, perhaps keeping their land undeveloped for posterity either for environmental reasons or in hopes that the next generation might be more interested in farming. Alternatively, older farmers might be thinking of selling (or leasing) the farm to finance retirement while younger farmers might be thinking longer term (Lynch et al. 2002).

We also include state effects, and separately control for states' supplementary payments to CREP adopters. Maryland and Washington offer 37.5% of eligible costs, while North Carolina, Oregon, and Virginia offer 25%.

We considered many other variables but ultimately rejected them when they failed to show up as significant in any of our regressions. (Inclusion or exclusion does not materially affect our results.) We thought that counties with a higher percentage of educated people (data from the US census) might be more likely to enroll, again partly because of increased awareness of government programs and also potentially because of increased awareness of environmental issues. Alternatively, having higher opportunity costs to their time might mean that such farmers might choose to participate more so that they can take up other activities. Perhaps this bidirectionality of potential effects balanced out, leaving a net zero effect. Another possibility we considered was the number of acres already enrolled in the broader CRP. Again, analysis showed that this variable was not a significant predictor of program participation in any of our regressions, so it was dropped.

Finally, a key area of contrast is the presence of pastureland. NASS lists cattle sales per county, and we divided this by the size of the county to get sales per acre as an indicator of the presence of cattle. To compare against cattle, we created measures for chicken sales per acre as well. We use indicators for being in the each quintile of sales of the given type of animal. Sample statistics for all variables can be found in Table 1.

Summary Statistics

The cost share is likely to matter more for pasture owners, since more practices are authorized for cost share support when cattle are present (such as fencing, cattle crossings, watering trenches, etc.). Table 2 shows the amount of cost share received per acre, by the quintile of cattle sales per acre. As you can see, participating farms in counties in the top quintile of cattle sales accounted for 422 (20%) of the 2111 observations in the category. These counties average around $2569 per acre in up-front CP22 payments, while in the other areas the total is about half, at $1328. A t-test comparing the amount of cost share awarded per acre in the high cattle areas showed that the difference is highly significant, with a t-statistic above sixteen (p-value < 0.0001). Note, though, that the amount of cost share also has a high variance. Some producers are managing to extract more help from the government.

Among top cattle producers, the annual payments are lower. The discounted sum of total payments averages about $1407 for areas outside the top cattle producing areas, while in those areas the payments average under $1177. (A t-test finds that this significance too is different with a p-value < 0.0001.) On balance, these areas enrolled at rates that differ only nominally. 22% of the top quintile of cattle producing areas had enrollment, while 18% of other areas did. A t-test shows that the p-value for testing the difference is 0.085.

While the pattern of support is different for top cattle farming counties, we still might expect that the marginal effect of a dollar in the up-front payment is the same across cattle producing and non-cattle-producing areas. We turn to regression analysis to investigate whether the up-front payment has a higher marginal effect on participation in these areas.

Econometric Model

Ideally we would to estimate the effects of a variety of factors on enrollments:

$$Y_{22} = \beta_0 + \beta_{cs} X_{cs} + \beta_a X_a + \beta_z X_z + u \qquad (1)$$

Y_{22} is the share of eligible riparian acres enrolled in CP22 each county in a given year. X_{cs} represents the up-front payment, including the cost-share incentive, PIP, and SIP. X_a represents that portion of the incentive to be paid as an annual installment, while X_z, is a vector of other factors affecting decisions in the given year, including education, age, livestock sales per acre, etc., as listed in the previous section and as summarized in Table 1.

To investigate whether cattle production modifies this production process, we expand equation (1) in two ways. First, we add a system of indicators for being in each quintile of cattle sales per acre. Second, we interact these indicators with the cost share, expecting that counties with more cattle sales per acre will be more responsive to the cost share as they are allowed to direct that payment toward a greater variety of improvements to their land. As a result our estimated equation takes the form

$$Y_{22} = \beta_0 + \beta_{cs} X_{cs} + \beta_a X_a + \beta_z X_z + \beta_G R_G + \beta_{csG} X_{cs} R_G + u$$

where R_G is a vector of dummy variables indicating "groups": quintiles of cattle sales per acre. The associated regression coefficients, β_G, show the marginal impact on the share of eligible county land enrolled in the program associated with being in different quintiles of cattle sales per acre. The vector of interaction coefficients, β_{csG}, shows the changing effects of the cost share incentive on enrollment across cattle sales quintiles.

Unfortunately the data on enrollments have a few difficult characteristics. First, a county-year is not a homogeneous entity that every year decides what portion of its eligible land to enroll in the program. A county is composed of heterogeneous individuals owning various plots of land; enrollment of 1000 acres in one area may represent just one landowner's willingness to participate, while 100 acres in another may represent dozens of people accepting the incentives. (This is still true if we look at the proportion of eligible land enrolled instead of simply area.) Thus, looking at the number of acres enrolled may not speak to the degree to which the incentives are appealing. Second, the data feature a large number of zeroes. Of 2111 county-years, just 393 (19%) enrolled acreage into CP22.

For these reasons our preferred specification is to use a binary logit regression, looking to see what predicts whether a positive level of acreage was enrolled during a given county-year. Our preferred specification is a logit with random effects at the state level.

We test the robustness of our results using a falsification test. Since most chicken are produced in intensive facilities rather than outdoors, we use chicken production as a falsifier. If we observe that the areas producing the most chicken are responsive to the up-front payment in ways similar to the areas producing the most cattle, this would call into question our alternative hypothesis (i.e. our contention that cattle producers experience differential returns to participation).[4] We observe that the indicator for a county's being in the top quintile of chicken sales per acre is not correlated with that for cattle sales- the correlation is 0.01.

Results

Table 3 lists the regression results. The first column shows that all coefficients have the expected signs. Higher incentives of both types- annual and up-front- significantly increase participation. Higher opportunity costs such as investments in irrigation, owner-operated farms, urban access, and crop prices are negatively correlated with program participation. Familiarity with government as proxied by total government expenditures per acre in the area is linked with higher enrollment, while higher tax burdens impose a slight negative effect on enrollment. The first column also shows that the quintile with the most cattle sales per acre is more likely to participate. Areas with more agricultural acreage are more likely to see some participation, and areas with larger farms participate more.

Regression 2 (the right column in Table 3) is designed to test the interaction between cattle production and the role of the up-front incentive. The negative sign on the up-front incentive and the negative signs on the higher cattle sales quintiles must be interpreted in light of the interactions below. The former reflects the issue described above: a share of the up-front "incentive" just represents a payback for the establishment costs of the conservation measures, which are less valuable to crop farmers. Toward the bottom of the table, we see the anticipated greater response to up-front incentives among those with higher levels of cattle sales: while up-front incentives matter overall, the effect of incentives is much stronger in the top quintiles of

[4] We also tried using an indicator for the top quartile of hog production. Results were similar to those with chicken, so again in the interest of brevity we omit this result.

cattle production. So both the size of the up-front incentive and the degree to which it constitutes an incentive are larger in cattle-producing areas. The latter, the negative coefficients on the indicators for cattle sales, show that the interaction between cattle production and the up-front incentives are the key to understanding the higher participation rates among counties producing more cattle.

Rather than looking at the regressions coefficient by coefficient, it may be easier to see the information synthesized graphically. Figure 1 shows the marginal effects of the initial incentive on program participation. It combines the various coefficients and in addition it shows the comparable estimates for when we group the data into quintiles of chicken production rather than cattle production. In the case of chicken, we see some variation across quintiles, but there is little change in the effectiveness of the up-front payment. As we move to the top three quintiles of cattle sales per acre, though, the marginal response to the up-front payment moves from negative to positive. This may be attributable to the fact that the up-front payment is covering costs associated with improving the value of the land for the more cattle-oriented areas, while the investments in other areas may be less valuable outside the immediate context of promoting conservation.

In each regression we tested whether the coefficient on the discounted sum of annual payments is the same as the coefficient on the up-front incentive. In the first column (the results of the regression run without interactions) the annual payment and the up-front payment are not statistically distinguishable. In the regression with interactions, the two are starkly different on average, but as before a more complete assessment requires considering the level of cattle sales. The marginal values including full set of quintile effects are shown in Figure 2. For the first two quintiles, i.e. the areas with the lowest levels of cattle sales, the annual incentive has a much larger marginal effect on participation, while for the latter three quintiles, the effects of the two are equal or slightly in favor of the up-front incentive. This is consistent with the up-front payment being as valuable as a cash payment even though it actually represents a reimbursement for costs incurred, as described above, since the costs in question are associated with land improvements valued by the ranchers.

Thus, the two incentives initially appear to be different, but when we separate out the interacted effects of cattle sales per acre on the initial incentive, the coefficients get closer together and cease to significantly defer by any commonly used level of significance.

Discussion

The CRP and CREP have been highly effective investments, returning almost double what they cost (Wu and Weber 2012). This research has identified a few quirks in the incentive structure, and perhaps optimizing this system of payments could result in an even higher return.

As it stands, the current incentive system offers something different to those who would enroll pasture. The handbook describing how incentives are to be awarded details specific areas in which cattle farmers can be reimbursed for a larger set of expenses. Thus, producers wishing to develop their land in a certain way can find support from this program in order to do so, a benefit that other potential participants cannot receive. This enticement is further magnified by the fact that Federal "cost sharing" provides the basis for more than just reimbursement: it determines the amount producers receive from Practice Incentive Payment as well as the state systems. Since each provides a multiple of these "eligible costs" back to producers as an additional incentive, the implementation expense becomes a multiplier for other, up-front cash incentives. Since crop producers are ineligible for this cost sharing they stand to benefit much less. The data do in fact reflect this discrepancy, as in non-cattle producing areas the amount of the cost share does not affect the proportion of eligible acres enrolled in CREP's CP22 program.

Overall, counties in the top quartile of cattle sales participate in CP22 at the same rate as others: the rate of participation is not significantly different. However, this is in spite of a shifted set of incentives. We showed above that counties in the top quartile of cattle sales per acre receive significantly more up-front incentives than producers in other areas. At the same time, annual incentive payments in these counties are lower than in others ($t > 10$, $p(t) < 0.0001$). It is unclear what the means for the quality of the land being preserved.

The incentive structure of the program is clearly by design, and it is does accomplish some important aims. Hubbard et al. (2004) note that, "Watersheds with concentrated livestock populations have been shown to discharge as much as 5 to 10 times more nutrients than watersheds in cropland or forestry." Certainly the establishment of forest buffers and the associated fencing and water troughs to protect streams from cattle and other animal populations is something that ought to be incentivized. Perhaps if the annual payments in highly cattle-producing areas were more on a par with other areas, takeup would be higher rather than at the same level (where it is now).

On the other hand, protecting streams from crop fertilizers and pesticides is also a worthy goal, and perhaps the incentives could be better balanced. Cropland may also suffer more negative externalities from a buffer, including increased access by (crop-stealing) wildlife and/or higher irrigation costs. Cattle may experience positive benefits from the shade provided by a buffer and possibly benefit from protective fencing built as part of the buffer. If these effects dominate, we would expect to see more cropland enroll if incentives are homogenized. On the other hand, cattle need to be watered and they want to keep cool, so keeping them out of a stream has costs as well.

Finally, following Suter et al. (2008), we note that indeed initial regression results show that up-front incentives are preferred to a discounted stream of annual payments. However, after controlling for the interaction between up-front incentives and cattle production, we find that the distinction disappears. We conclude that it does not appear that up-front incentives have a greater effect on enrollment than do annual payments.

The finding that participants value the incentives equally speaks to the appropriateness of discounting. Farmers' decision-making is therefore consistent with economic assessment of what is "rational," and they do seem to consider both the short and long-term. Thus, the current balance between up-front and annual incentives seems effective in its use of Federal dollars to entice CREP program participation, though the value of the establishment costs to the producer may vary.

The conclusions we draw are necessarily limited to those few areas for which we had data, and findings may not be easily extrapolated to other states. The study areas were chosen as areas with mature programs with commitments to this type of conservation practice, so newer participants in particular may not respond similarly.

Further research might consider other factors that amplify or dampen the appeal of incentives. Consideration of interacting producer and incentive characteristics might improve program targeting and cost effectiveness. Also, if data on emissions could be compiled, a direct comparison of incentives to potential emissions would likely yield means for further optimization. Surely those of all political persuasions can agree that maximizing the return on Federal dollars is a worthy goal for future research.

Literature Cited

Claassen, Roger. 2009. “Cost-effective Conservation Programs: The Role of Economics.” *Journal of Soil and Water Conservation* 64 (2: March/ April): 53A-54A.

Claassen, Roger, Andrea Cattaneo, and Robert Johansson. 2008. “Cost-effective Design of Agri-Environmental Payment Programs: U.S. Experience in Theory and Practice.” *Ecological Economics* 65: 737-752.

Cooper, Joseph and Osborn, C. Tim. 1998. “The Effect of Rental Rates on the Extension of Conservation Reserve Program Contracts.” *American Journal of Agricultural Economics*.80 (February): 184-194.

Esseks, J. Dixon, and Steven E. Kraft. 1988. “Why Eligible Landowners Did Not Participate in the First Four Sign-ups of the Conservation Reserve Program.” *Journal of Soil and Water Conservation* (May-June): 251-256.

Farm Service Agency (FSA). 2010. “Conservation Reserve Program: Annual Summary and Enrollment Statistics.” FY 2010. 48 pp.

Farm Service Agency (FSA). 2011. “Conservation Reserve Enhancement Program – Maryland.” USDA FSA Fact Sheet. March. 2 pp.

Farm Service Agency (FSA). 2012. Agricultural Resource Conservation Program Handbook 2-CRP Revision 5. Last updated July 11, 2012. 904 pp.

Hagstrom, Jerry. 2012. “House Passes Disaster Assistance.” *Agweek* August 2. 1pp. Downloaded from http://www.agweek.com/event/article/id/20001/ on August 4, 2012.

Hellerstein, Daniel. 2010. “Challenges Facing USDA’s Conservation Reserve Program.” *Amber Waves* 8 (2, June): 28-33.

Hubbard, R.K., G. L. Newton, and G. M. Hill. 2004. “Water Quality and the Grazing Animal,” *Journal of Animal Science* 82 (13, supplemental): E255-E263.

Key, Nigel, and William McBride. "The changing economics of US hog production." USDA-ERS Economic Research Report 52 (2007). 45 pp.

Kingsbury, Leigh and Boggess, William. 1999. “An Economic Analysis of Riparian Landowners’

Willingness to Participate in Oregon's Conservation Reserve Enhancement Program." Selected Paper for the Annual Meeting of American Agricultural Economics Association. August, 1999.

Kirwin, B., Lubowski, R., Roberts, M., 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: 1239–1247.

Konyar, K.,and Osborn, C. Tim. 1990. "A National-Level Economic Analysis of Conservation Reserve Program Participation: A Discrete Choice Approach." *The Journal of Agricultural Economics Research.* 42.2:5-12. 1990.

Lohr, L., and Park. T.A., 1995. "Utility Consistent Discrete-Continuous Choices in Soil Conservation." *Land Economics.* 71:474-490. November.

[MDA]. CREP update 2009. "Maryland's Conservation Reserve Enhancement Program." Maryland Department of Agriculture. 2009.

Mortensen, T. L., Leistritz, F. L., Leitch, J. A., Coon, R. C., & Ekstrom, B. L. 1989. Landowner characteristics and the economic impact of the Conservation Reserve Program in North Dakota. *Journal of Soil and Water Conservation*, 44(5), 494-497.

Lynch, Lori, Hardie, Ian, and Parker, Doug. 2002. "Analyzing Agricultural Landowner's Willingness to Install Streamside Buffers." WP02-02. The University of Maryland, College Park Department of Agricultural and Resource Economics.

[NASS] National Agricultural Statistics Service, 2010. "Cattle on Feed." Downloaded on October 21, 2012 from http://usda01.library.cornell.edu/usda/nass/CattOnFe//2010s/2010/CattOnFe-12-17-2010.pdf

Parks, P.J., and Kramer, R.A. 1995. "A policy Simulation of Wetlands Reserve Program." *Journal of Environmental Economics and Management.* 28: 223-240. March.

Parks, P.J., and Schorr, J.P. 1997. "Sustaining Open Space Benefits in the Northeast: An Evaluation of the Conservation Reserve Program." *Journal of Environmental Economics and Management.* 32: 85-94. January, 1997.

Purvis, Amy, John P. Hoehn, Vernon L. Sorenson, and Francis J. Pierce. 1989. "Farmers' Response to a Filter Strip Program: Results from a Contingent Valuation Survey." *Journal of Soil and Water Conservation* (September-October): 501-504.

Suter, Jordan F., Gregory L. Poe, and Nelson L. Bills. 2008. “Do Landowners Respond to Land Retirement Incentives? Evidence from the Conservation Reserve Enhancement Program.” *Land Economics* 84(1, February) 17-30.

Vanslembrouck, Isabel, Guido Van Huylenbroeck, and Wim Verbeke. 2002. "Determinants of the willingness of Belgian farmers to participate in agri-environmental measures," Journal of Agricultural Economics 53 (3, November): 489-511.

Wu, Junjie, and Bruce Weber. 2012. “Implications of a Reduced Conservation Reserve Program,” Council on Food, Agriculture, and Resource Economics Conservation Crossroads in Agriculture Series. Downloaded from http://www.cfare.org/conservationcrossroads/Wu-Weber_Final.pdf on August 3, 2012. 16 pp.

Table 1. Sample Statistics

Variable	Mean	Std. Dev.	Min	Max
Annual payment (present value, in $thousands)	1.4	0.62	0.30	3.5
Up-front payment ($thousands /acre)	1.6	1.5	0.10	22
State % cost share	28	5.5	25	37.5
Livestock sales ($thousands /acre)	0.27	0.59	0	8.7
Mean acres per farm (thousands)	0.098	0.20	0.002	2.3
Share of land irrigated	0.22	0.20	0	0.995
Average Farm Income ($thousands /acre)	0.03	0.05	-0.49	0.51
Share owner operated	0.71	0.17	0	1
Average age	57	2.1	50.2	64.4
Rural/ Urban code	4.05	2.58	1	9
Average Taxes ($/acre)	18.8	37.8	0	1441
Total Expenses ($1000/acre)	0.62	1.75	0	73.89
Total Gov. Payments ($/acre)	10.8	12.4	0	0.16
Price index (from principal components)	0.13	1.01	-1.06	1.87
Year after 1997	7.87	3.30	1	13
County in top quartile for cattle sales	0.25		0	1
County in top quartile for chicken sales	0.25		0	1
Share of county/ years enrolling positive acreage	0.19		0	1
County is Maryland	0.14		0	1
…North Carolina	0.23		0	1
…Oregon	0.13		0	1
…Virginia	0.38		0	1
…Washington	0.13		0	1

N = 2111. Unit of observation is county-year, i.e. a given county in a given year.

Table 2. Cost Share and Annual Payments by Cattle Sales Quintiles

Cattle Sales Quintile	Cost Share $thousands/acre		Annual Payment Discounted sum		% enroll in CP22	
	Mean	SD	Mean	SD	Mean	N
1	1.078	1.048	1.661	0.524	0.279	423
2	1.218	1.034	1.493	0.465	0.187	422
3	1.238	1.114	1.429	0.594	0.118	422
4	1.781	1.174	1.046	0.517	0.130	422
5	2.569	2.234	1.177	0.738	0.216	422
Total	1.576	1.502	1.361	0.616	0.186	2111

Table 3. Regression results: Effects on probability of participation in CP22

Explanatory variable	No interactions	With Interactions
Annual Paymt, discounted sum	0.515 (0.148)***	0.458 (0.153)***
Up-front payment	0.610 (0.079)***	-0.532 (0.227)**
Quintile: lowest cattle sales	0.000 (0.000)	0.000 (0.000)
Quintile: second lowest cattle	-0.211 (0.202)	0.027 (0.323)
Quintile: middle cattle sales	-0.267 (0.249)	-1.518 (0.386)***
Quintile: second highest cattle	-0.090 (0.255)	-2.204 (0.437)***
Quintile: highest cattle sales	0.601 (0.243)**	-1.530 (0.460)***
Cattle sales group 1 X cost share		0.000 (0.000)
Cattle sales group 2 X cost share		-0.129 (0.285)
Cattle sales 3 (mid) X cost share		1.219 (0.271)***
Cattle sales group 4 X cost share		1.527 (0.255)***
Cattle sales 5 (max) X cost share		1.377 (0.247)***
State-provided cost share sup.	0.045 (0.081)	0.074 (0.057)
Livestock sales per acre	-0.132 (0.198)	-0.301 (0.218)
Agricultural acres in county	1.308 (0.275)***	1.469 (0.285)***
Median acres per farm in county	0.775 (0.329)**	0.448 (0.342)
Share of farmland irrigated	-1.147 (0.484)**	-2.063 (0.517)***
Cash farm income per operator	1.958 (1.690)	2.918 (1.820)
Share owner-operated	-0.984 (0.434)**	-0.995 (0.460)**
Average age of owner	-0.059 (0.042)	-0.047 (0.044)
Rural-urban codes	0.056 (0.030)*	0.058 (0.032)*
Average tax expenses per farm	-0.015	-0.023

	(0.009)*	(0.010)**
Production expenses	0.262	0.402
	(0.194)	(0.212)*
Gov. expenditures per acre	0.026	0.034
	(0.006)***	(0.007)***
Prime factorization of ag. Prices	-0.597	-0.604
	(0.163)***	(0.169)***
Year (1997=0)	-0.076	-0.073
	(0.048)	(0.050)
Constant	-0.745	-0.822
	(3.392)	(2.973)
	2,111	2,111

All regressions are logit models with random effects imposed at the state level. * p<0.1; ** p<0.05; *** p<0.01

Figure 1. Effects of Initial Payment on Program Participation, by Cattle Sales per Acre Quintiles

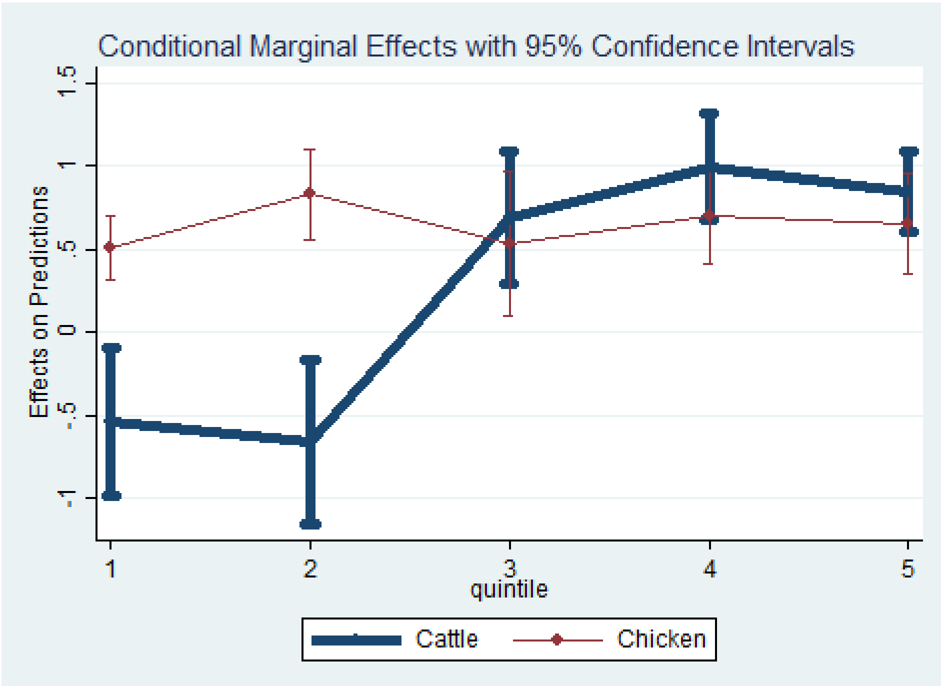
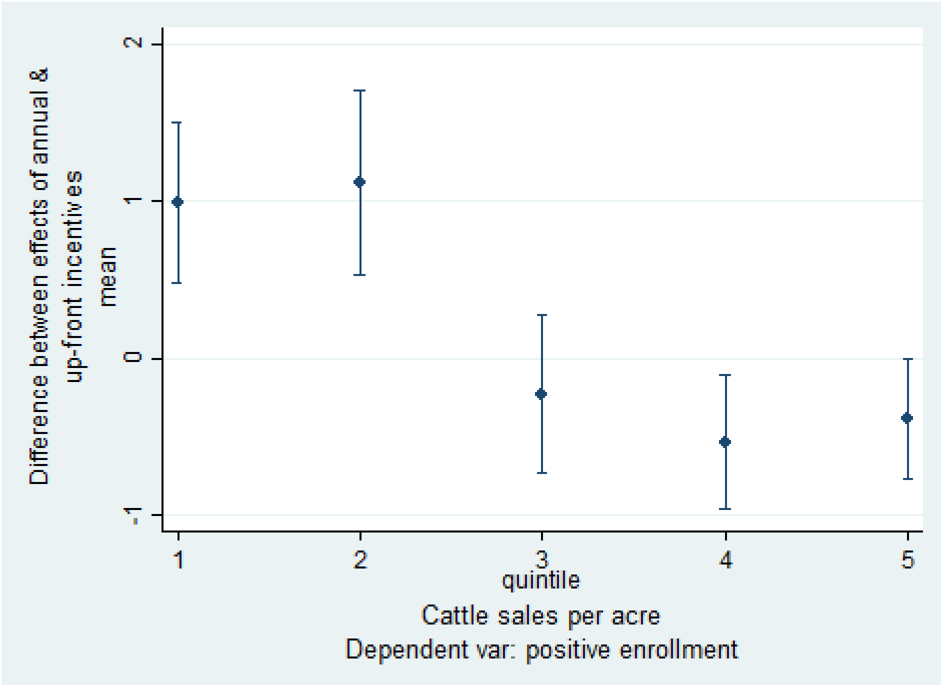


Figure 2. Difference between Effects of Initial Payment and Annual Incentive on Program Participation, by Cattle Sales per Acre Quintiles



Endnotes

[i] We have fewer observations for 1998-2000 as a result of missing data.
[ii] Five of Suter et al.'s 218 counties are from New York. We lacked data for variables in some of Suter's counties and could not include them.
[iii] Instead of the combined price produced using factor analysis, we repeated our analysis using current soy prices. We chose soy prices because they showed the highest correlation with all of the other prices. Results obtained from using the current soy prices were not materially different from the results shown.