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Getting the Most for Federal Dollars: Landowner Response to the Conservation Reserve Enhancement Program

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Getting the Most for Federal Dollars: Landowner Responsiveness to Conservation Incentives[1]

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Abstract

Previous research on landowner willingness to retire land into the Conservation Reserve Program (CRP) is based on cross-sectional data prior to 2002. Using enrollment data on a CRP subprogram from 1998 to 2010 we find that incentives matter more for pasture than cropland, and we find that counties producing cattle respond more strongly to current incentives. We also see an idiosyncratic lack of participation in Washington State. Finally, contrary to one recent study, we see that the discounted stream of payments matters to producers as much as up-front incentives. In counties producing few cattle, up-front incentives have virtually no effect.

JEL codes: H23, Q15, Q24, Q58

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

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Introduction

The USDA's Conservation Reserve Program (CRP) pays rural landowners to accept restrictions on farming in environmentally sensitive areas. 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, the CRP faces challenges going forward such as a lower cap on the program's maximum 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.

Specific program goals have varied over the years, from erosion prevention and wildlife habitat development to carbon sequestration. Due to the complexity of this evolving set of objectives it has been difficult to optimize participation, and over the years multiple changes to the programs have worked toward improving cost effectiveness. The Environmental Benefits Index was created and repeatedly updated in an attempt to quantify the value of land to be protected, and later the Conservation Reserve Enhancement Program was created to focus solely on land providing high levels of environmental benefits, such as edge-of-field and river buffers.

As a land renter, the government sets the price and landowners respond by choosing to keep farming or committing their land to the program for a period of time. An optimal policy would maximize the returns on investment by retiring the largest amount (or greatest quality) of environmentally sensitive 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 and indeed, identification of the factors influencing landowner decisions is an ongoing concern of the government and of researchers (see Claassen, Cattaneo and Johansson 2008 for a discussion).

As we analyze landowner decision-making, it is helpful to limit ourselves 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 recent years (Claassen, Cattaneo, and Johansson 2008).

Landowners' willingness to supply land might depend on many considerations. The first and most obvious is the direct opportunity cost: the lost value of production. Here the land's yield, the costs of production, and the potential for developing the land are important. Second, landowners must assess their less quantifiable costs, a complicated process that varies for each landowner. These costs may include the loss of a scenic view if trees are planted or if they do not like the look of the buffer. Also, river buffers may have unforeseen effects as wildlife colonize the buffers and may eat or otherwise ruin crops. Landowners' concerns may also affected by their age and the age of the next of kin or even grandchildren (Hines and Bollinger 2011).

The amount of land supplied depends also on the incentives. CREP currently has several incentives, but there is some variation by state and by the year the contract began. The three main incentives are 1) a sign on bonus, which is a set payment per acre; 2) an annual rental payment, based on the soil rental rate and an incentive rate; and 3) cost-sharing payments given at sign-up and/or after the buffer construction to reimburse part or all of the construction costs. The incentive rates vary over time based on policy changes, and some states also give additional incentives to the federal incentives (MDA 2009).

The cost-share may be used for more than simply planting trees or grasses, particularly on pastureland. For example, if a farmer has cattle that previously had access to a stream but may lose that access by joining CREP, the landowner may use the cost-share to build fencing, a cattle crossing and a watering trench (FSA 2012). Joining CREP would cover some or all of such start-up costs, though it may also require tens of thousands of dollars to be put up by the landowner (MDA 2009). In some states, the combination of Federal and state support covers all or even more than all of the startup costs. Thus, cost share incentives may be particularly noteworthy for enrollment.

Through understanding the effects of those quantifiable incentives and opportunity costs, policymakers may be able to more efficiently use funds to increase enrollment in CREP. With the goal of giving policymakers a more realistic approach for determining cost-effective incentives for CREP, our paper continues previous research of landowner responsiveness to incentives using actual enrollment data that includes policy changes and opportunity costs. Building on others' previous work, we use more data than has previously been brought to bear and are able to test a few hypotheses.

Others have identified the relative importance of incentives in general and that of the initial payments relative to the annual rent payment in particular, but as far as we know ours is the first to examine factors moderating responsiveness to incentives. Also, we are able to test the roles of farmer age, crop prices, and production expenditures using data on revealed rather than stated preferences, and using more data than has been previously brought to bear on the topic.

In the next section we examine previous research, after which we describe the payment system, and 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

From the creation of CRP and later CREP there have been multiple studies attempting to understand the incentives necessary for a landowner to be willing to enroll in CRP/CREP and forgo revenue from crops or other opportunity costs.

The first body of research is comprised of contingent value analysis (Cooper and Osborn, 1998; Kingsbury and Boggess, 1999; Lohr and Park, 1995; 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. However the contingent value studies suffer from the same problems as any contingent value analysis in their susceptibility to hypothetical bias as well as their inability to estimate not only the probability of program participation but also the area farmers might choose to enroll.

The second 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. As explanatory variables, they extract from the USDA NASS (National Agricultural Statistics Service)'s 1997 agricultural census information on cattle per acre, average farm income, farm size, and the share of land that is irrigated (representing sunk costs associated with potentially higher opportunity costs from the more productive land) and an indicator for the share of owner-operators in the area (as opposed to absentee landlords). From other sources they include an indicator for development pressure, a measure of property taxes, the amount of land already enrolled, and the FSA payroll per farm in each county.

For their analysis, they regress the share of land enrolled in a given year on various parts of the CREP incentives offered, including the annual payments available and one time incentive rates (which include the sign on bonus and cost share), as well as the other measures of opportunity costs listed above. They find that increasing the initial incentives, 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).

CREP Payment System

The annual payment for participating in CREP including CP22, the program we measure, is determined by multiplying a set number by the soil rental rate (SRR) of the parcel that is being removed from production. 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.

The up-front payment is slightly more complicated. 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. Many states provide further incentives. 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 "eligible" costs upon which all of these incentives are based are limited for the CRP program in general but in the case of CP22, the forested riparian barriers, a much wider variety of practices are eligible for cost sharing if the land is currently pasture. For example, in many cases fencing is not eligible, but fencing to protect a riparian buffer from livestock is eligible, as is establishing an alternate water source for livestock. Between the PIP and the cost share, landowners recoup 90% of the cost of such installations, and in many states they receive more still. Thus, we expect counties with more pastureland to respond more to the up-front incentives.

Data Description

To analyze these issues, we take county data from 184 counties in five states 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] Our results are directly comparable to theirs because we use some of the same data: they generated and were kind enough to share GIS-derived estimates of the number of acres eligible to participate in the program in each county. Our research updates and expands upon theirs by using more recent data from a longer time period (from 1998 through 2010) and adding new variables to give a more recent and more complete analysis of the response of enrollment to changing incentives.

The outcome of interest is the share of eligible land in a county that is enrolled in the program in a given year. 19% of county/ years (392/2058) had enough enrollments that the total acreage was reported. This acreage is the numerator, and the denominator is the number of acres eligible for the program as determined by Suter et al.'s (2008) data analysis.[iii] They combined map-coded land use data with rivers, streams, and watershed boundary data and used GIS to calculate the area of land that would support buffers as allowed by each state's standards.

Our data are at the county level, and we use soil rental rates created as the average of value per acre of given soil types from FSA and NRCS's joint Soils Data Management System as weighted by the amount of each soil type in a given county, taken from the National Resources Conservation Service's Soil Data Mart. Combining these we can get a weighted average soil rental rate for each county, and based on this we can predict the annual rental rate offered by the government for land 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, not just from participating acreage, since the latter might be biased.

There are two incentives to which landowners can respond: the annual rental payment and a one-time up-front payment, including a sign-up bonus, installation, and cost share payments, all associated with establishment of the buffer. In some cases the state government will add an additional amount to the up-front payment. Our data from the USDA include cost share amounts and we account for SIP and PIP to get the initial incentive. State incentives are also publicly available, so we include them separately.

Thus, two portions of the incentive are established, an annual and a one-time component, the latter based upon the cost share, but what other factors might shift the supply curve? Variables were chosen based on previous studies and as suggested by workers active in the field. Factors that might increase landowners' propensity to enroll their land include higher production expenses, higher taxes on agricultural products, the number of acres already in CRP, 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). Similarly, 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. Counties that are more rural ought to be more likely to enroll, as development pressure does not much affect their land values. 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. Higher prices for production goods such as wheat, cattle, and soybeans should likewise keep producers away, while higher prices for input goods such as corn (for cattle production) should encourage adoption. Also, owner-operated facilities are likely more reticent, since those leasing their land to tenants might be both more interested in a guaranteed annual return and less personally invested in the production process. Finally, variables including total farmland per state, farm size, average farm income, and average taxes 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.

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 put their hand into the 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 the farm to finance retirement while younger farmers might be thinking longer term (Lynch et al. 2002).

Finally, a key area of contrast is the presence of pastureland. NASS lists livestock 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. The cost share is likely to matter more for pasture owners, since more practices are authorized when cattle are present. To test this we created an indicator for total cattle sales of less than $1 per acre. 173 of 2058 (8%) of our observations fell into this category.

Econometric Model

For consistency we use a model similar to Suter et al. (2008):

$$P_{i22} = \beta_0 + \beta_a X'_{ia} + B_c X'_{ic} + \beta_y X'_{iy} + u_i$$

P_{i22} is the proportion of eligible riparian acres enrolled in CP22 each county in a given year. X_{ia}, X_{ic}, and X_{iy}, represent factors affecting decisions in the given year. a represents opportunity costs, c represents county level factors, and y represents incentives offered, all for county i. β_0 is the intercept while β_a, β_c, and β_y represent the coefficients on those variables. Again for consistency we use the Tobit estimator Suter et al. (2008) used to address the large number of zeros in the dependent variable.

The number of CP22 acres enrolled for each year was provided by the USDA from the CRP contract files. In many cases, only one or two contracts were signed in a given county in a given year, and in these cases the number of acres is not reported. Lacking information, these are included as zeros in our analysis. The number of eligible acres is calculated by Suter et al. (2008) as described above, and we divide the number of acres enrolled by the proportion of eligible acres enrolled as the dependent variable. Still, 392 of 2058, some 19% of county/ years had measured levels of enrollment. We use the set of explanatory variables described above, including a system of dummy variables to indicate states.

These five states are split into only two groups as far as state level incentives: Maryland and Washington offer an additional 37.5% of eligible costs, while North Carolina, Oregon, and Virginia offer 25%. Accordingly, we are forced to have a "double baseline" for our state variables, eliminating two so that the indicator for state will function and another so that the "high state incentive" variable will function. We choose the adjacent Maryland and Virginia for the baseline.

Finally, to test the hypothesis that counties producing little or no cattle will have a different response to incentives, we run a second regression interacting the "no cattle sales" dummy with the up-front payment. We tried including this dummy variable directly as well as with the interaction, but when we include the indicator directly it is insignificant (p-value > 0.96) and all other results are virtually identical, so in the interest of brevity we include only the former results.

Results

Table 2 lists the regression results, and a quick look through reveals that the coefficients have the expected signs. Higher incentives increase participation, and higher opportunity costs, such as investments in irrigation, owner-operated farms, urban access, and the share of college degrees in the county are negatively correlated with program participation (though this last variable, the prevalence of college education, is not statistically significant). The time trend shows decreasing participation.

The two regressions are designed to test the interaction between cattle production and the role of the up-front incentive. Since more cost sharing is available for practices designed to protect buffers from cattle, we anticipated that areas with more land dedicated to pasture might see a greater response to up-front incentives. Indeed this is what we see: while up-front incentives matter overall, the effect of incentives is much less in areas in which no cattle production occurs. In areas where there is no cattle production the point estimate of the total effect of up-front incentives is an order of magnitude smaller and the combined coefficient has a p-value of 0.91, which to us implies that it is essentially zero. (As described above, we also tried including an indicator variable for a lack of cattle production, and this indicator variable was statistically insignificant.)

For comparison we tried including instead an indicator for zero poultry production and its interaction with up-front payment. 369 counties, or 18% of the sample spread across all five states, fall into this category. When we run the regressions interacting the up-front payment with this indicator, we see no impact. Specifically, the marginal impact of up-front payments in the areas producing no poultry was reduced by about 1/5, a statistically insignificant amount, whether we included the interaction only or the interaction and the indicator both. (When the indicator itself is included, it is insignificant with a p-value of over 0.8.) In both cases the total effect of up-front payments was significant at the 1% level for both poultry-producing and non-poultry producing areas.

Next, we notice that the dummy variable indicating location in Washington state is strongly negative, indicating that counties there enroll a smaller share of agriculturally productive acres in CP22 than do counties in Virginia or North Carolina. This is surprising since Washington and Maryland provide 50% higher reimbursement rates for eligible costs (37.5% vs. 25%) than the other three states in our data. Clearly some other factors are at work, and we speculate on them below.

Finally we investigated whether our data, covering the same area over a longer period of time than that used by Suter et al. (2008), would yield a similar finding, that up-front incentives matter more than long-term incentives. In fact we find that the two are statistically indistinguishable: a t-test for difference failed with a p-value of 0.83.

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 more 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. This eligibility is 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. Since crop producers are ineligible for this cost sharing they stand to benefit much less. Our analysis shows that 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.

This characteristic of the program is clearly by design, and it is most likely appropriate. 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. However, protecting streams from crop fertilizers and pesticides is also a worthy goal, and perhaps the incentives could be better balanced, particularly in areas that have high animal populations that may not be kept outdoors, such as poultry. Currently incentives are more effective for areas with cattle production than for areas with poultry production. In the latter areas, the abundance of readily available fertilizer may lead to overapplication, in which case buffers might be extraordinarily useful.

We also see an idiosyncratic lack of participation in the state of Washington, where in spite of early access to the program, high state-provided incentives, and Federal per-acre incentives among the top 5 in the country, enrollment remains low. One report (Born and Bassok 2008) concludes that in the state, the offered rents are too low, that smaller plots are unlikely to enroll because of onerous administrative requirements and excessive demands for minimum buffer width, and that "cultural differences between program administrators… and farmers" may be a factor. These issues notwithstanding, enrollment in the larger CRP program has done well (FSA 2010) but a relatively low share of acreage eligible for CREP has been enrolled (Smith 2000, FSA 2010). Another possibility is that Washington's cattle industry includes denser facilities: as of 2009, it was the only state of the five we examine that has large capacity cattle feedlots (NASS 2010)[iv]. Another possibility is that apples and other fruit crops, the state's #1 form of agriculture in terms of value production, have a low supply elasticity, so producers are unwilling to fallow their land. However, this does not explain Washington's relatively high level of participation in CRP.

Finally, contrary to Suter et al. (2008), we do not find that up-front incentives have a greater effect on enrollment than do annual payments. Every test comparing these coefficients came back insignificant. One possibility is that responses simply have changed over time. Also, we controlled differently than they did for additional incentives such as SIP, PIP, and state incentives. Third, they had more information than we were able to acquire on the cost of improvements made by participating farms. If we included this, we might see the same results. On the other hand, improvement costs could be seen as investments in the producers' own land. In this case, "costs" are not really money lost, and reimbursement represents a pure gain. From this perspective, such "costs" should not be subtracted at all, and perhaps excluding them would result in an assessment of more similar incentive effects.

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.

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Figure. Counties in sample

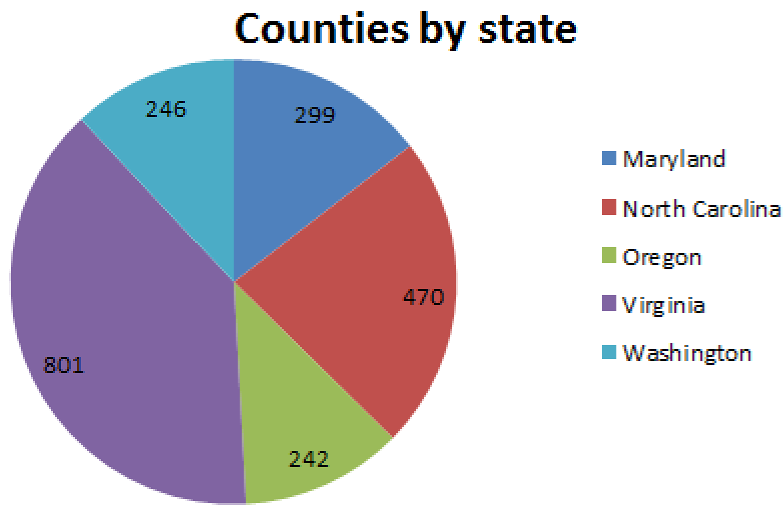

Table 1. Sample Statistics

Variable	Mean	Std. Dev.	Min	Max
Annual payment (present value, in $thousands)	1.35	0.62	0.3	3.5
Up-front payment ($thousands /acre)	1.58	1.52	0.1	22.2
State % cost share	28.3	5.5	25	37.5
Livestock sales ($thousands /acre)	0.28	0.60	0	8.74
Mean acres per farm	0.10	0.20	0.002	2.33
Share of land irrigated	0.27	0.25	0	0.995
Average Farm Income ($thousands /acre)	30.5	49.1	-49	508
Share owner operated	0.71	0.17	0	1
Average age	57.1	2.1	50.2	64.4
% with Bachelor's	20.7	10.2	4.8	58.4
Rural/ Urban code	4	2.6	1	9
Average Taxes ($/acre)	18	37.5	0	1400
CRP acres	0.008	0.03	0	0.22
Total Expenses ($/acre)	0.6	1.74	0	73.89
Total Gov. Payments per acre	10.6	11.3	0	129.6
County sells less than one head of cattle per acre	0.08		0	1

Table 2. Regression results

Variable	Coefficient (SE)	Coefficient (SE)
Annual payment (present value)	0.008 (0.004)*	0.007 (0.004)*
Up-front payment	0.007 (0.001)***	0.008 (0.001)***
Up-front, in areas without cattle sales		-0.006 (0.004)*
State-provided up-front payment	0.003 (0.000)***	0.003 (0.000)***
Livestock sales per acre	0.003 (0.004)	0.003 (0.004)
Acres of farmland	0.013 (0.009)	0.010 (0.009)
Share of land irrigated	-0.028 (0.013)**	-0.027 (0.013)**
Average Farm Income	0.000 (0.000)	0.000 (0.000)
Share of farmland owned by operator	-0.037 (0.012)***	-0.035 (0.012)***
Average age in county	-0.002 (0.001)*	-0.002 (0.001)
Share of population with Bachelor's degrees	-0.000 (0.000)	-0.000 (0.000)
Rural/ Urban code	0.003 (0.001)***	0.003 (0.001)***
Average taxes paid	-0.000 (0.006)	-0.000 (0.000)
Acres in CRP	0.063 (0.092)	0.083 (0.094)
Year after 1997	-0.005 (0.000)***	-0.005 (0.001)***
Total expenses	0.001 (0.002)	0.001 (0.003)
Total government expenditures per acre	0.001 (0.000)***	0.001 (0.000)***
North Carolina indicator	-0.000 (0.006)	-0.001 (0.006)
Oregon indicator	-0.009 (0.010)	-0.011 (0.010)
Washington indicator	-0.044 (0.009)***	-0.044 (0.009)***

N = 2058. * = significant at the 10% level; ** = significant at the 5% level; *** = significant at the 1% level.
Tests of the entire regression show significance at less than the 0.0001 level.

Endnotes

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[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] We repeated the analysis, decrementing the eligible acres by the number of acres enrolled in previous years. This has the effect of proportionally increasing each regression coefficient by 25-50%. Additionally, the average age variable, formerly significant at the 10% level, drops down to a p-value of 0.105. No other p-value change enough to affect the number of asterisks indicated in Table 2.
[iv] Oregon is one of several states lumped into the "Other States" category, implying that a smaller number of large capacity production areas exist there as well.