(NON)COMPLIANCE WITH AGRICULTURAL CONSERVATION PROGRAMS:
THEORY AND EVIDENCE

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AAEA Annual Meeting, Chicago, August 2001

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*Corresponding author. The authors wish to thank Mitch Morehart for data assistance and, without implicating, Roger Claassen and Marca Weinberg for insightful comments and suggestions. This research was funded in part through a cooperative agreement with the United States Department of Agriculture. The views expressed in this manuscript are those of the authors and do not necessarily represent the views of the Economic Research Service or the United States Department of Agriculture.

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Abstract - This paper introduces enforcement costs and farmer noncompliance into the economic analysis of the USDA conservation program on highly erodible lands. A model of heterogeneous producers is developed to determine the economic causes of farmer noncompliance with the provisions of the conservation program. In addition, the paper determines the enforcement policy design that can induce conservation compliance and examines the effectiveness of the current enforcement policy in deterring producer noncompliance. The implications of the theoretical model are tested empirically with data provided by USDA. The analysis shows that farmer compliance with the provisions of the conservation program is not necessarily the natural outcome of self-interest and complete deterrence of noncompliance is not feasible with the current enforcement policy of the government. Both theoretical and empirical results indicate that the use of farm program payments as a leverage against noncompliance is not sufficient for inducing full producer compliance. Unless the government alters its policy on fines for fraudulent behavior, enforcement of conservation compliance will remain imperfect and some degree of noncompliance with the provisions of the program on highly erodible lands will continue to persist.

Keywords: Agricultural conservation programs, conservation compliance, enforcement, highly erodible lands.

The 1985 Food Security Act linked farm program payments to the conservation of soil and wetlands throughout the United States. The provisions of the Act stipulated that producer eligibility for farm program payments required certain on-farm resource conservation activities on highly erodible land or/and wetlands converted for agricultural production (Claassen). An implication of this policy was to bring the farm commodity programs in line with federal conservation programs, such as the Conservation Reserve Program, the Wetland Reserve Program, the Farmland Protection Program and the Wildlife Habitat Protection Program, where farmers are compensated through direct payments for conservation activities.

While the link of government payments to conservation activities purports to provide producers/ owners of highly erodible land with incentives to adopt (costly) conservation practices, farmer compliance with the provisions of the conservation program is by no means assured. Given the increased costs associated with the adoption of conservation activities, producers might find it optimal to not apply an approved conservation plan yet claim government payments they are not entitled to. And this noncompliance is not unknown to program enforcers. Since the inception of the conservation program over 11,000 producers have been cited for violations on approximately 281,000 acres with a total of nearly $16,000,000 in denied benefits (Claassen). Despite the incentives for, and the incidence of, noncompliant behavior by conservation program participants, this issue has not been analyzed systematically.

The objective of this paper is to introduce enforcement costs and farmer noncompliance into the economic analysis of agricultural conservation programs. Specifically, the paper examines the economic causes of farmer noncompliance with the provisions of the USDA conservation program on highly erodible lands. In addition, the paper focuses on the role of available policy tools (i.e. farm program payments, audits, and penalties) in inducing conservation compliance when enforcement is costly and examines the effectiveness of the current enforcement policy design in deterring noncompliance.

The hypotheses generated from the analytical model are tested empirically with data on costs of conservation practices, farmer noncompliance, audits and penalties provided by USDA. Although the research focuses on the conservation of highly erodible lands, the results of this study have implications for the larger group of conservation programs administered by the USDA.

While there are a number of studies on enforcement issues related to traditional farm programs (such as production quotas, deficiency payments, decoupled payments and export subsidies (Giannakas and Fulton 2000a, 2000b; Giannakas)), this paper represents the first attempt to theoretically and empirically analyze farmer noncompliance with the provisions of an agricultural program. An additional distinct feature of this study is that it relaxes the (conventional) assumption of producer homogeneity when analyzing farmer noncompliance with the conservation program. Instead, producers are postulated to differ in terms of age, education, experience, management skills, technology adopted, size and location of the farm, etc. The heterogeneity of producers in terms of production factors is a key component in the model and is critical to understanding the partial producer participation in the conservation program as well as non-compliance with program provisions on part (but not all) of the highly erodible land.

The rest of the paper is organized as follows. Section 2 develops the theoretical model and determines (*i*) the economic causes of producer noncompliance and (*ii*) the design of the enforcement policy that induces producers to comply with the provisions of the conservation program on highly erodible land. Section 3 examines the effectiveness of the existing enforcement policy in deterring producer noncompliance. The implications of the theoretical model are tested empirically in Section 4 while Section 5 summarizes and concludes the paper.

2. The Producer Problem

2.1. Participation in the Program

As mentioned previously, the introduction of the USDA program on highly erodible lands purports to induce producers/owners of highly erodible land to adopt conservation practices when employing this land in their production process. To provide producers with incentives to adopt (costly) conservation practices, the government has linked participation in the program with individual producer's eligibility to receive farm program payments. Specifically, for a producer to receive government payments corresponding to her production activity, she has to develop and submit a *plan of action* that indicates the conservation practices she intends to adopt (apply) on the highly erodible land she owns (Claassen). Approval of this plan by the USDA, entitles the producer to government payments associated with her farming activity. Of course, implicit in the provisions of the conservation program is a presumption that the farmer adopts the conservation practices described in the plan.

To illustrate the necessity of linking government payments to conservation practices by producers/owners of highly erodible land, consider first the case where eligibility for government payments is not contingent upon participation in the conservation program. Abstracting initially from the compliance issue (i.e., assuming producers adopt conservation practices specified in their approved production plan), the producer problem can be seen as the choice of whether to participate in the conservation program (by developing and receiving approval for a plan of action) or not.

As mentioned previously, producers are assumed to be differentiated in some fashion. Specifically, farmers are assumed to differ in the relative returns they receive from the use of the highly erodible land in the production process, which in turn stems from differences in such things as education, management skills, geography, etc. Let *a* denote the attribute that differentiates producers. A producer with attribute *a* has the following net returns function:

$\Pi_A = pQ_A^0 - c_A^0(Q) + \gamma a$	If develops plan and adopts approved production practice
$\Pi_{NA} = pQ_{NA}^0 - c_{NA}^0(Q) + \beta a$	If does not participate in the program

where *p* is the farm price of the output produced using the erodible land; Q_A^0 and Q_{NA}^0 are the quantities produced by the producer with differentiating attribute $a = 0$ with and without adoption of conservation practices, respectively; while $c_A^0(Q)$ and $c_{NA}^0(Q)$ denote the costs of production for this same producer under the two adoption scenarios examined here. The parameters γ and β are non-negative return premium factors associated with farm production with and without participation in the conservation program, respectively, while attribute *a* takes values between zero and one and captures producer heterogeneity in terms of costs of production. The terms γa and βa give the difference in net returns between producers with different values of the attribute *a* with and without adoption of conservation practices, respectively.

Figure 1 illustrates the (marginal) costs of production and output choices for producers with differentiating attribute $a = 0$ and $a = 1$ with and without adoption of conservation practices. The producer with $a = 0$ has higher production costs and, therefore, produces less output than the producer with $a = 1$ under both adoption scenarios considered herein (i.e., $c_A^0{}'(Q) > c_A^1{}'(Q)$, $c_{NA}^0{}'(Q) > c_{NA}^1{}'(Q)$, $Q_A^0 < Q_A^1$, and $Q_{NA}^0 < Q_{NA}^1$). A consequence of this is that less efficient producers will find it optimal to set aside greater part of their highly erodible land. The difference in returns when the two producers do not adopt the conservation technology equals β (i.e., $\beta = \left[pQ_{NA}^1 - c_{NA}^1(Q)\right] - \left[pQ_{NA}^0 - c_{NA}^0(Q)\right]$) while the parameter γ gives the difference in returns when both types of producers adopt the conservation practice (i.e., $\gamma = \left[pQ_A^1 - c_A^1(Q)\right] - \left[pQ_A^0 - c_A^0(Q)\right]$).

It is assumed that, while adoption of conservation practices on the highly erodible land increases the costs of production for all producers, it increases the production costs of the less efficient producers by relatively more. Since the cost of adoption declines with a, the divergence in the net returns arising from differences in producer efficiency increases with the adoption of conservation practices, i.e., $\gamma > \beta$.

A producer's choice of whether to participate in the conservation program or not is determined by the relationship between the returns under adoption of conservation practices *vis a vis* the returns when the farmer does not participate. Figure 2 illustrates the decisions of producers. The curve Π_{NA} graphs the net returns when farmers do not participate in the program while the curve Π_A depicts the net returns associated with the adoption of conservation practices for different levels of the differentiating attribute a. Since adoption of conservation practices results in increased costs for all producers, the curve Π_A lies underneath curve Π_{NA} and all farmers will find it optimal not to participate in the program.

To induce farmers to participate in the program, the government changed their payoff function by linking their eligibility for government payments, *GP*, to adoption of conservation practices. Assuming that farm program payments are a non-decreasing function of the level of production (and, thus, producer efficiency) so that $GP(a) = GP^0 + \theta a$ where $\theta \geq 0$, the net returns function of the producer with attribute a becomes:

$$\Pi'_A = pQ_A^0 - c_A^0(Q) + GP^0 + (\gamma + \theta)a$$ If develops plan and adopts approved production practice

$$\Pi_{NA} = pQ_{NA}^0 - c_{NA}^0(Q) + \beta a$$ If does not participate in the program

The introduction of *GP* into the payoff function of producers increases both the intercept and the slope of the Π_A curve. The relevant net returns curve is shown as the (dashed) Π'_A curve in Figure 2. Once again, the producers' choice on whether to participate in the conservation program or not depends on the relative returns under the two options. Specifically, the intersection of the net return curves Π'_A and Π_{NA} determines the level of the differentiating attribute that corresponds to the indifferent producer. The producer with attribute a_{NA} given by:

$$a_{NA} : \Pi'_{A} = \Pi_{NA} \Rightarrow a_{NA} = \frac{\left\lfloor pQ^{0}_{NA} - c^{0}_{NA}(Q)\right\rfloor - \left\lfloor pQ^{0}_{A} - c^{0}_{A}(Q)\right\rfloor - GP^{0}}{\gamma + \theta - \beta}$$

is indifferent between adopting and not adopting conservation practices – the net returns associated with the two options are the same. Producers "located" to the left of a_{NA} (i.e., producers with $a \in [0, a_{NA})$) will not participate in the program, while producers "located" to the right of a_{NA} (i.e., producers with $a \in (a_{NA}, 1]$) find it more profitable to adopt the conservation practices. When producers are uniformly distributed with respect to their differentiating attribute a, the level of a corresponding to the indifferent consumer, a_{NA}, also determines the portion of farmers that decide not to adopt conservation practices, s_{NA}. The portion of program participants, s_A, is given by 1- a_{NA}.[1]

Comparative statics results can easily be drawn from this model. More specifically, an increase in the cost associated with adoption of conservation practices shifts the Π'_{A} curve downwards and reduces farmer participation in the program, s_A, while an increase in the government payments linked to the adoption of conservation practices causes an upward shift of the Π'_{A} curve, increasing s_A. Obviously, if $GP^{0} \geq \left[pQ^{0}_{NA} - c^{0}_{NA}(Q)\right] - \left[pQ^{0}_{A} - c^{0}_{A}(Q)\right]$, all producers will adopt conservation practices (the curve Π'_{A} lies above Π_{NA} $\forall a$), while if $GP^{0} + \theta \leq \left[pQ^{0}_{NA} - c^{0}_{NA}(Q) + \beta\right] - \left[pQ^{0}_{A} - c^{0}_{A}(Q) + \gamma\right]$ no farmer will participate in the conservation program (the curve Π'_{A} lies below Π_{NA} $\forall a$).

In general, producers will participate in the conservation program on highly erodible lands when the government payments linked to program participation are greater than the costs of adopting the conservation practices. The greater is the size of government payments, the greater is the number of producers that will adopt conservation practices on their highly erodible land.

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[1] Note that the analysis considers those producers/owners of highly erodible land who find it profitable to farm (i.e., their net returns from farming are positive). Obviously there might have been farmers for whom the linkage of government payments to costly conservation practices resulted in their exit from farming.

2.2. Compliance with Program Provisions

Implicit in the previous analysis is the assumption that farmers comply completely with the provisions of the program on highly erodible lands, i.e., those developing and receiving approval for a plan of action, adopt the conservation practices required. However, given the increased costs associated with the adoption of conservation activities, producers might find it optimal to develop (and get approval for) a plan of action (so that they receive the government payments) but not actually implement this plan.

Costly monitoring and enforcement are required to induce producers who develop and receive approval for a plan of action, to adhere to the terms of the program and adopt (costly) conservation practices. The resource costs of monitoring and enforcement might result in enforcement that is imperfect which, in turn, creates economic incentives for noncompliance. Put in a different way, the possibility of noncompliance arises from an informational constraint, namely producers' actions cannot be directly observed; they can only be verified through costly auditing.

Assuming that producers/owners of highly erodible land know the penalty if they are found not complying with an approved conservation plan and the probability of being detected, their problem can be seen as the determination of whether to participate in the government program by developing (and getting approval for) a plan of action and, if so, whether to comply with the provisions of the program and implement the approved plan. Assuming neutrality towards risk, the net returns function of the producer with attribute *a* can be re-written as:

$$\Pi_A = pQ_A^0 - c_A^0(Q) + GP^0 + (\gamma + \theta)a$$

If develops plan and *adopts* approved production practice

$$\Pi_{NA} = pQ_{NA}^0 - c_{NA}^0(Q) + \beta a$$

If does not participate in the program

$$\Pi_{NA}^c = pQ_{NA}^0 - c_{NA}^0(Q) + GP^o - \delta(a)\rho + (\beta + \theta)a$$

If develops plan but *does not adopt* approved production practice

where δ is the probability that the producer will be audited (and detected if not complying with the conservation program) and ρ is the penalty in the event of detected noncompliance.

The audit probability takes values between zero and one (i.e., $\delta \in [0, 1]$) and is assumed to be a function of a base probability δ_0 that is constant across producers, and farm-specific characteristics that affect the audit probability (such as the number of variances issued previously) and are captured by the differentiating attribute a, i.e., $\delta = \delta_0 (1+a)$. Variances are issued when farmers who have developed and received approval for their plan of action, have in good faith (i.e., due to adverse weather or production conditions for instance) failed to fully implement the approved plan (Claassen). The issuance of a variance to a producer implies that this producer will be audited in subsequent time periods (Hyberg). Since the likelihood that conservation practices will be adopted increases with a (Figure 2), so does the likelihood that variances will be issued.[2] The audit probability δ is assumed to be a function of the costs associated with investigating producers and the resources available to program enforcers for monitoring conservation compliance.

Figure 3 graphs the net returns associated with adoption of conservation practices, Π_A, non-participation in the program, Π_{NA}, and noncompliance with program provisions, Π^c_{NA}, for different levels of the differentiating attribute a when the level of enforcement is greater than a critical level $(\delta_0\rho)^+$ (i.e., $\delta_0\rho > (\delta_0\rho)^+ \left(= \dfrac{\theta \Delta R^0 + (\gamma - \beta) GP^0}{\Delta R^0 - GP^0 + \gamma - \beta + \theta} \right)$ where $\Delta R^0 = \left[pQ^0_{NA} - c^0_{NA}(Q) \right] - \left[pQ^0_A - c^0_A(Q) \right]$). In this case, the Π_{NA} curve lies above the Π^c_{NA} and Π_A curves over some range of a making non-participation in the program optimal for some producers.

Specifically, the intersection of Π_A and Π_{NA} in Figure 3 determines the level of the differentiating attribute that corresponds to the producer who is indifferent between adopting and not adopting the conservation practices, a_{NA}, i.e.,

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[2] Given that adoption of conservation practices increases with a and a portion of adopting producers will face unexpected hardships, it follows that as the likelihood of adoption increases so does the likelihood of the issuance of variance (the absolute number of producers that adopt and receive variances increases).

$$a_{NA} : \Pi_A = \Pi_{NA} \Rightarrow a_{NA} = \frac{\Delta R^0 - GP^0}{\gamma + \theta - \beta}$$

Producers with $a \in [0, a_{NA})$ will prefer not to adopt conservation practices, while producers with $a \in (a_{NA}, 1]$ find it more profitable to participate in the program and adopt conservation practices on their highly erodible land. As mentioned previously, when producers are uniformly distributed with respect the differentiating attribute a, a_{NA} also gives the portion of farmers that do not adopt conservation practices, s_{NA}.

The portion of farmers who decide not to adopt conservation practices but masquerade as adopters in order to receive the government payments, s_{NA}^c, is determined by the intersection of the Π_{NA}^c and Π_{NA} curves in Figure 3 and equals:

$$s_{NA}^c = a_{NA}^c : \Pi_{NA}^c = \Pi_{NA} \Rightarrow s_{NA}^c = \frac{GP^0 - \delta_0 \rho}{\delta_0 \rho - \theta}$$

Comparative statics results can easily be drawn from this model. More specifically, an increase in the government payments linked to conservation practices increases the benefits from noncompliant behavior (i.e., shifts the Π_{NA}^c curve upwards) and increases the extent of noncompliance (i.e., $\frac{\partial s_{NA}^c}{\partial GP^0} > 0$ and $\frac{\partial s_{NA}^c}{\partial \theta} > 0$). In addition, this increase in government payments raises the returns to adoption of conservation practices (i.e., shifts the Π_A curve upwards) and increases the number of farmers that actually adopt conservation practices (i.e., $\frac{\partial s_A}{\partial GP^0} > 0$ and $\frac{\partial s_A}{\partial \theta} > 0$). Obviously, since the increase in government payments increases both s_{NA}^c and s_A, it reduces the portion of honest non adopters (i.e., producers that do not participate in the program), $s_{NA}^h \left(= s_{NA} - s_{NA}^c\right)$, by an equal amount.

Similarly, an increase in (any of) the enforcement parameters (i.e., audit probability and penalties) increases the expected penalty for noncompliant behavior (i.e., shifts the Π_{NA}^{c} curve downwards while rotating it rightwards) and reduces the amount of noncompliance (i.e., $\frac{\partial s_{NA}^{c}}{\partial \delta_0} < 0$ and $\frac{\partial s_{NA}^{c}}{\partial \rho} < 0$). Noncompliance will be completely deterred when the expected penalty exceeds the government payments linked to the adoption of conservation practices for all producers (i.e., when the curve Π_{NA}^{c} lies underneath curve Π_{NA} $\forall a$).

On the other hand, if the level of enforcement is such that $\delta_0\rho \leq (\delta_0\rho)^{+}$ all farmers that do not adopt conservation practices will find it optimal to masquerade as adopters and claim the government payments (i.e., the Π_{NA} curve lies underneath Π_{NA}^{c} and/or Π_A curves $\forall a$ and the share of honest non adopters, s_{NA}^{h}, falls to zero (Figure 4)).

Not only does reduced enforcement increase the share of non-adopters that masquerade as adopters, it also provides economic incentives that turn previous adopters of conservation practices to noncompliance. Specifically, when enforcement is relatively low (i.e., when $\delta_0\rho < (\delta_0\rho)^{+}$) producers with $a \in (a_{NA},\ a_{NA}^{c'}]$ find it optimal not to comply with the provisions of the program (see Figure 4). In this case, the portion of farmers in noncompliance increases to:

$$s_{NA}^{c'} = a_{NA}^{c'} : \Pi_{NA}^{c'} = \Pi_A \Rightarrow s_{NA}^{c'} = \frac{\left\lfloor pQ_{NA}^{0} - c_{NA}^{0}(Q)\right\rfloor - \left\lfloor pQ_{A}^{0} - c_{A}^{0}(Q)\right\rfloor - \delta_0\rho}{\gamma - \beta + \delta_0\rho}$$

Obviously, the lower is the level of enforcement, the greater is the extent of noncompliance, and the lower is the portion of farmers that adopt conservation practices. Adoption of conservation practices also falls with an increase in the cost of adoption, i.e., the greater is the cost of adopting conservation practices, the lower is the level of conservation compliance.

The results on farmer noncompliance with the provisions of the conservation program on highly erodible lands can be summarized in the following three propositions:

Proposition 1: For farmer noncompliance to be completely deterred, the expected penalty should exceed the government payments linked to the adoption of conservation practices.

Proposition 2: The extent of noncompliance increases with the size of government payments and the costs of adopting conservation practices and falls with an increase in the level of enforcement (i.e., an increase in audit frequency and/or the penalties associated with detected noncompliance).

Proposition 3: A lax enforcement of the conservation program will increase the number of farmers that do not comply with the provisions of the program – it will increase the number of non-adopters that claim eligibility to government payments and it might also induce adopters of conservation practices to turn to noncompliance.

3. The Government Problem – Enforcement of Conservation Compliance

The analysis in the previous section suggests that the individual producer's decision to not comply with the provisions of the conservation program on highly erodible lands as well as the extent of noncompliance depend on the amount of government payments linked to conservation behavior, GP, the audit probability, δ, and the penalties for detected noncompliance, ρ. Since both the policy variable GP and the enforcement parameters δ and ρ are endogenous to the government at large, the question that naturally arises is "why does farmer noncompliance occur?"

Even though the size of farm program payments is exogenous to the agency responsible for conservation programs,[3] *Proposition 1* indicates that producer noncompliance can be completely deterred when the expected costs associated with noncompliant behavior exceed the benefits of noncompliance (i.e., the government payments). Thus, with government payments being exogenous, all that is required for noncompliance to be completely deterred is a level of audits and penalties to ensure that:

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[3] The level of farm program payments is determined by the Congress. In the case of the conservation program on highly erodible lands, conservation compliance is determined by the USDA Natural Resource Conservation Service, while the USDA Farm Service Agency is responsible for determining farmer eligibility for government payments (GAO).

$$\delta(a)\rho \geq GP(a)$$

In this case, the expected costs outweigh the benefits of noncompliance (the Π_{NA}^{c} curve lies underneath Π_{NA} and/or Π_{A} curves $\forall a$) and noncompliant behavior is effectively deterred.

Interestingly, since both audits and penalties are inversely related to the amount of noncompliance (i.e., $\frac{\partial s_{NA}^{c}}{\partial \delta_0} < 0$ and $\frac{\partial s_{NA}^{c}}{\partial \rho} < 0$), when the establishment of penalties is costless, policy enforcers can achieve the (any) desired level of enforcement by substituting costly monitoring with costless fines. This trade-off reduces the enforcement costs of the program and maintains conservation compliance so far as $\rho \geq \frac{GP(a)}{\delta(a)}$. At the limit, enforcement of conservation compliance can be costless through the imposition of enormous (infinite) fines and no monitoring (Becker's "optimal fine" result).

While economically efficient, this enforcement policy is not particularly appealing, however. Infinite penalties (the government taking over the farmer's assets? life in prison? decapitation?) for farmers who dot adopt conservation practices yet claim farm program payments (that prior to the enactment of the conservation program would receive anyway) are neither feasible nor costless or just. The imposition of disproportionate fines would likely offend the public sense of justice – "the punishment does not fit the crime" (Carr-Hill and Stern; Stern; Stigler; Shavell; Cowell).

This line of reasoning might explain the existing limit on the penalties for farmers found not complying with the conservation program on highly erodible lands. The penalty for detected noncompliance equals the government payments, i.e., producers who are found to be noncompliant lose their government payments. While this might seem like a "fair" enforcement policy since "the punishment fits the crime" ("exactly" we would add), it is not fully effective as far as enforcement of compliance is concerned. The reason is that, unless *every single producer* is investigated (i.e., unless δ = 1 for all producers), when the penalty equals the government payments (i.e., when $\rho = GP(a)$), the benefits from noncompliant behavior exceed the expected costs (i.e., $\delta(a)\rho < GP(a)$), and there will always be economic incentives for noncompliance (the relevant net returns curve Π_{NA}^{c} will lie above the Π_{NA} and Π_{A} curves over some range of a and s_{NA}^{c} will be positive).

The question then becomes "how extensive will this noncompliance be?" Substituting $GP(a)$ for ρ and repeating the analysis in Section 2.2 shows that when penalties equal government payments the extent of noncompliance depends on the audit probability. While a value of $\delta(a) = 1$ would eliminate any economic incentive for noncompliance, investigating every producer would entail a massive disbursement of resources that would most likely violate the budget constraint of any governmental agency.[4]

Presuming that the objective of the agency responsible for the enforcement of conservation compliance is deterrence of farmer noncompliance, when $\rho = GP(a)$, the optimal audit frequency will be determined by the resource costs of monitoring producers and the available budget to program enforcers. Specifically, the optimal number of audits falls with an increase in the resource costs of monitoring farmer compliance and/or a reduction in the available budget. The lower is the audit frequency, the lower is the expected cost of noncompliant behavior, and the greater is the extent of noncompliance. When the base audit probability falls below a critical level $\delta_0^{\mp}\left(=\frac{\left[pQ_{NA}^{0}-c_{NA}(Q)+\beta\right]-\left[pQ_{A}^{0}-c_{A}(Q)+\gamma\right]}{2\left(GP^{0}+\theta\right)}\right)$, all farmers will find it optimal to not comply with the program (the relevant Π_{NA}^{c} curve lies above curve Π_{A} $\forall a$) and adoption of conservation practices falls to zero ($s_A = 0$).

Proposition 4: Government payments have both a direct and an indirect effect on farmer noncompliance with the provisions of the conservation program on highly erodible lands. Specifically, an increase in government payments increases the economic incentives for noncompliance by increasing the benefits associated with it (direct effect). At the same time, the increase in government payments reduces the incentives to not comply by increasing the expected penalty for noncompliance (indirect effect). Given, however, that penalties are weighted by the audit probability (which is less than one) when expected costs are calculated, the direct effect of government payments on producer behavior dominates, i.e., an increase in government payments will increase both benefits and expected costs to noncompliance

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[4] At the end of the day, even if these resources were available, it is most likely that the government would find it optimal to devote them to the deterrence of more socially harmful criminal offenses than farmers masquerading as adopters of conservation practices to receive government payments.

> but it will increase the benefits by relatively more. The difference in the magnitude of these changes is determined by the size of the audit probability. The lower is the audit probability, the greater are the net expected gains from noncompliant behavior, and the greater the extent of noncompliance is expected to be.

Given that the audit probability is less than one for most producers and the equality of penalties with government payments, a message of the theoretical model developed in this paper is that the lack of full compliance with the provisions of the conservation program should come as no surprise.

Proposition 5: Unless the government increases the fines associated with fraudulent (noncompliant) behavior over and above the farm program payments, enforcement of conservation compliance will remain imperfect and farmer noncompliance with the provisions of the program on highly erodible lands will continue to persist.

These results are supported by the empirical analysis in the following section.

4. Empirical Application

In this section we test the hypotheses derived above. To conduct the empirical analysis we rely on state level data from the USDA Farm Service Agency 1997 Status Review Results (SRR) as well as on data from the USDA 1997 Agricultural and Resource Management Survey (ARMS). Due to issues of confidentiality, observations on individual behavior are not available. The SRR provides audit data including incidence of noncompliance, enforcement effort, number of audits and variances issued. The ARMS data provides data on farm program participation and payments. According to the SRR data, approximately 50,000 farmers were audited in 1997 and over 48,000 were found to be actively applying an approved conservation plan. From the ARMS data we see that roughly 750,000 farmers received government payments during that year totaling nearly $6 billion.

The audit data groups the observations on individual behavior to the state level. That is, we observe in the data the number of audited individuals who choose to comply or not. Fortunately, this organization of the data allows us to test the hypotheses derived from the theoretical model of this paper. Additionally, in certain states the statistical weighting procedure used at USDA to estimate state level statistics required that certain states be aggregated to insure reliable estimates (see Dubman, p.14). Table 1 provides a listing of those states that were aggregated. The region-specific cost of conservation compliance estimates provided in Barbarika and Dicks are used to explain some of the variation in noncompliance across states (see Table 2). Although these conservation cost were estimated prior to implementation of the conservation program on highly erodible land, they still provide relative cost differences across regions that can act as a proxy for current differences in the cost of adopting conservation practices. Overall, the data set is limited to 34 observations.

Two empirical models are estimated. The first model is the enforcement decision model, which is based on the theoretical framework developed earlier, and can be expressed as:

$$\delta_i = \alpha_1 \text{effort}_i + \alpha_2 \text{var}_i + \alpha_3 \text{penalty} + \varepsilon_i$$

where the audit probability (δ) depends upon the enforcement effort (effort), which is measured as the number of hours spent conducting audits, the number of variances issued (var) and the penalties for noncompliance. The subscript *i* denotes the *i*th state while ε_i are identical and independently distributed error terms. The variance term is problematic in that the variances issued in the previous year determine the current year's audit probability and the only available variances are for the same year as the audit probability. In light of this situation we also estimate a variant of this model excluding the variance term.

The second model is the noncompliance decision model, which follows from the theoretical findings, and can be written as:

$$\%nc_i = b_o + b_1 [1 - \delta_i] \text{payment}_i + b_2 \text{concost}_i + \upsilon_i$$

This model captures the relationship between the share of farmers who decide to not comply (%*nc*) with the regional cost of conservation compliance (concost) and the net benefits from government payments (payment). The latter corresponds to the program payments less the expected penalty for noncompliance (the product of payments withheld and the audit probability), or simply [1-δ] payment. υ_i are identical and independently distributed error terms. To avoid issues of multicollinearity and endogeneity we substitute the estimated enforcement model for δ in the noncompliance decision model. Given that we have two sets of estimates for the enforcement model, we estimate the noncompliance decision model for each of the estimated audit probability models.

A grouped data maximum likelihood function is used to estimate these models. The likelihood function is written as:

$$ln\,L = \sum_i n_i\,[\,P_i\, ln\,F(\,\Gamma' x_i\,) + (\,1 - P_i\,)\,ln(\,1 - F(\,\Gamma' x_i\,))]$$

where n_i is a weight that typically represents the sample population in location i (Greene, p. 654), P_i is the proportional dependent variable, F is the normal probability distribution and $\Gamma = \alpha, b$ for the enforcement and noncompliance models, respectively.

In the case of the enforcement decision model, the dependent variable (P_i) is the audit probability, which is derived by dividing the number of audits in a state by the total number of farms receiving payments. The number of farms receiving payments in a state is used as the weight in the likelihood function employed in the enforcement decision model estimation. In the noncompliance decision model, the dependent variable is the rate of noncompliance that is derived by dividing the total number of farmers not complying with the provisions of the conservation program by the total number of audited farms. In this situation, it is the number of audits for each state that is used as the weight in the likelihood function.

The estimation of the enforcement decision model allows us to test three hypotheses. *First*, does the budget constraint bind so that the enforcement agency must trade-off enforcement cost with the total number of audits (i.e., the more effort (time) required in auditing a producer, the more costly is the audit and the lower is the audit probability), $\alpha_1 < 0$? *Second*, is the audit probability lower in those states with larger government payments (penalties), $\alpha_2 < 0$? This hypothesis addresses the inverse relationship between costly monitoring and costless fines described in Section 3. *Third*, is the audit probability higher in those states with greater numbers of issued variances, $\alpha_3 > 0$? This hypothesis tests the claim that the issuance of a variance increases the probability of an audit by program enforcers.

In the noncompliance decision model, two additional hypotheses can be tested. *First*, is the rate of noncompliance higher in those states with greater net benefits from noncompliant behavior, $b_1 > 0$? This hypothesis test allows us to verify the findings stated in Propositions 2 and 4. *Second*, is the rate of noncompliance higher in those states with higher costs of conservation compliance, $b_2 > 0$? This hypothesis test is based on the derived theoretical result stated in Proposition 2.

Tables 3 and 4 list the estimation results. The data supports the implications of the theoretical model since all the hypothesized coefficients are consistent in sign with the theoretical results and statistically significant at the 0.001 level of significance. Specifically, the empirical analysis shows that the audit probability increases with the number of variances issued and falls with an increase in the cost per audit and the size of the penalty. The empirical relationship between audit frequency and variances issued should be treated carefully however, given the earlier caveat. In addition, the empirical results support the theoretical findings that the incidence of noncompliance is an increasing function of government payments. Finally, the empirical analysis verifies the contention that the extent of noncompliance increases with the cost associated with the adoption of conservation practices.

5. Summary and Concluding Remarks

The introduction of the USDA program on highly erodible lands purports to induce producers/owners of highly erodible land to adopt conservation practices when employing this land in their production process. To provide producers with incentives to adopt (costly) conservation practices, the government has linked participation in the program with individual producer’s eligibility to receiving farm program payments.

While the linkage of government payments to conservation activities induces adoption of conservation practices, it also creates economic incentives for some producers to develop the plan of action required for the receipt of government payments, but to not actually comply with the terms of the policy (i.e., to not adopt the required conservation practices).

Theoretical and empirical results suggest that both the producers' decision to not comply as well as the extent of noncompliance depend on the size of government payments linked to farmer participation in the program, the costs associated with the adoption of conservation activities, and the enforcement policy of the government. Specifically, the greater is the size of government payments and/or the higher are the costs of adopting conservation practices, the greater are the economic incentives for, and the extent of, noncompliance. Put in a different way, while an increase in government payments will increase adoption of conservation practices it will also increase the number of producers who do not adopt conservation practices yet claim government payments they are not entitled to. The number of producers who do not comply with the provisions of conservation practices also increases with a reduction in the probability that noncompliant behavior will be detected and with a decrease in the penalties for detected noncompliance. When the level of enforcement becomes relatively low, there are also economic incentives for farmers that have previously adopted conservation practices to switch to noncompliance.

For noncompliance to be completely deterred, the combination of enforcement parameters (i.e., audit probability and penalties) should be such that the expected penalty exceeds the benefits from noncompliant behavior (i.e., the government payments linked to conservation behavior) for all producers. Any enforcement policy that fails to meet this criterion will fail in achieving full compliance.

The government enforcement policy on highly erodible lands certainly falls into this category. What makes the government policy ineffective in completely deterring noncompliance is the fact that penalties for detected noncompliant behavior equal the benefits, i.e., producers who are audited and found to be noncompliant with the conservation program lose their government payments. Given that penalties are weighted by the audit probability when expected costs to noncompliance are calculated, the expected costs do not exceed the benefits creating economic incentives for some producers to not comply with the provisions of the conservation program on highly erodible land.

With penalties set equal to benefits from noncompliant behavior, the net producer gains from, and the extent of, noncompliance on highly erodible lands depend on the audit probability which, in turn, is determined by the resource costs of monitoring farmer compliance and the available budget to program enforcers. Specifically, the greater are the monitoring costs and/or the lower are the resources available to program enforcers, the lower the audit probability is expected to be. And the lower is the audit frequency, the greater is the extent of noncompliance.

In this context, given the relatively low audit probability faced by producers/owners of highly erodible land, the incidence of producer noncompliance with the provisions of the conservation program should come as no surprise. A message of this paper is that unless the government (Congress) changes its policy to increase the fines associated with fraudulent behavior over and above the farm program payments, enforcement of conservation compliance will remain imperfect and some degree of farmer noncompliance with the provisions of the program on highly erodible lands will continue to persist.

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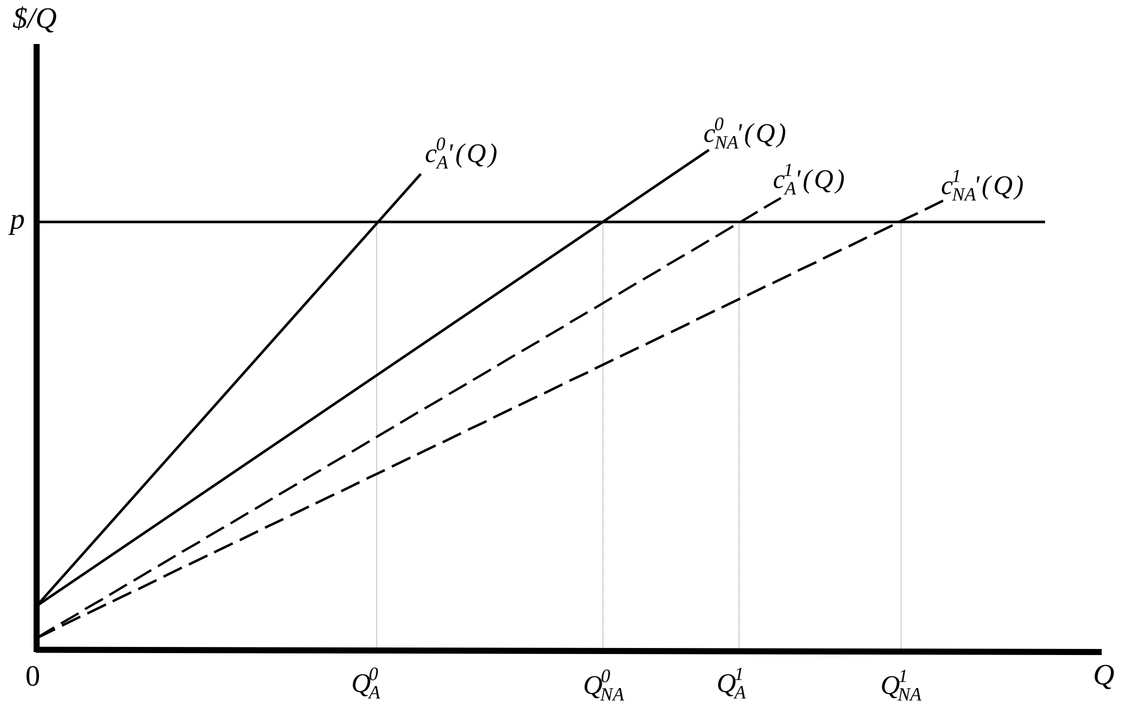

Figure 1. Production decisions and welfare for producers with *a* = 0 and *a* = 1

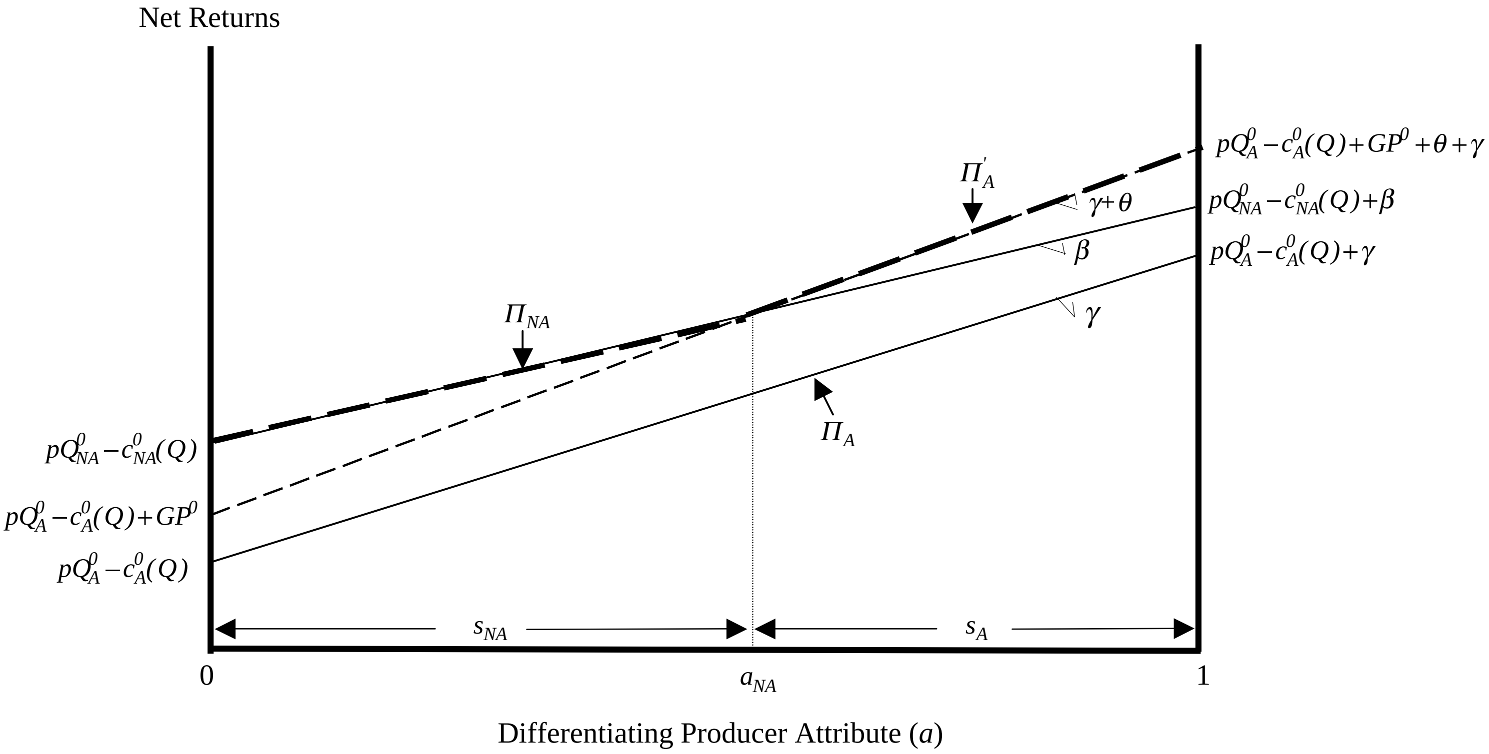

Figure 2. Production decisions and participation in the conservation program

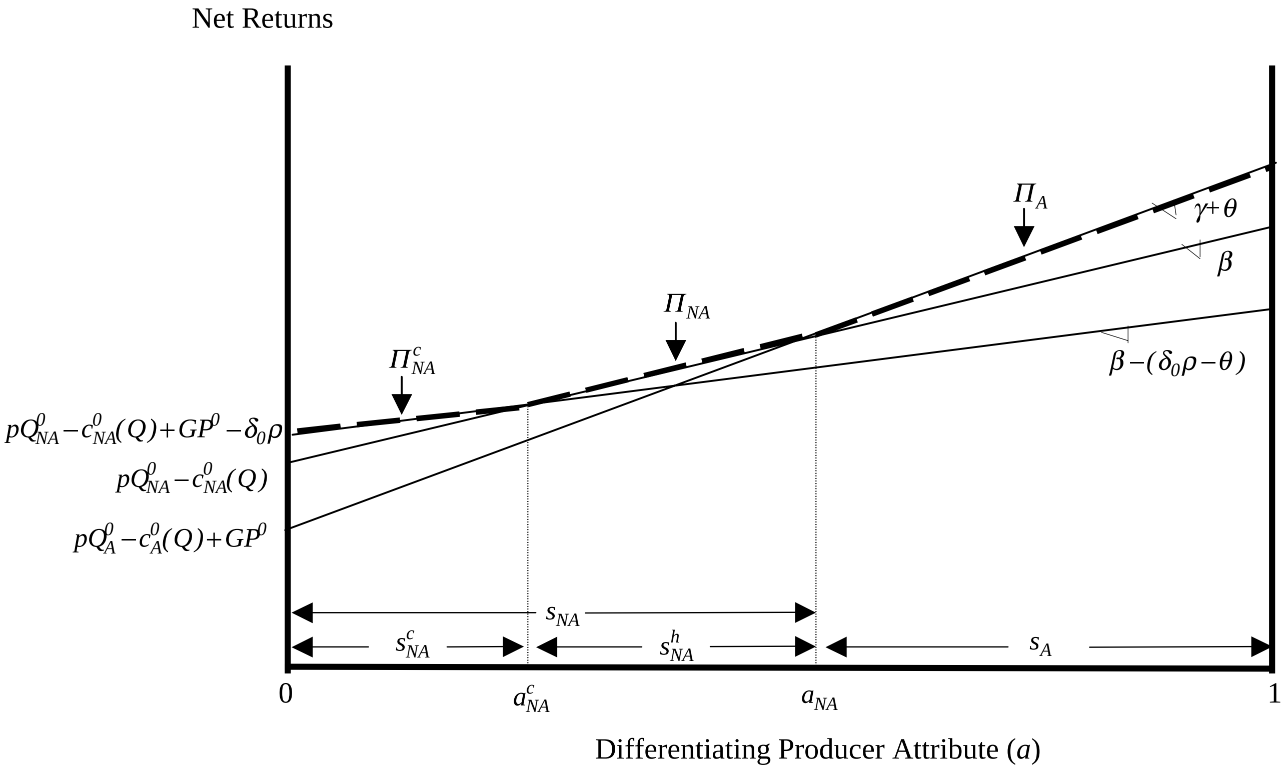

Figure 3. Production and compliance decisions when $\delta_0\rho > (\delta_0\rho)^+$

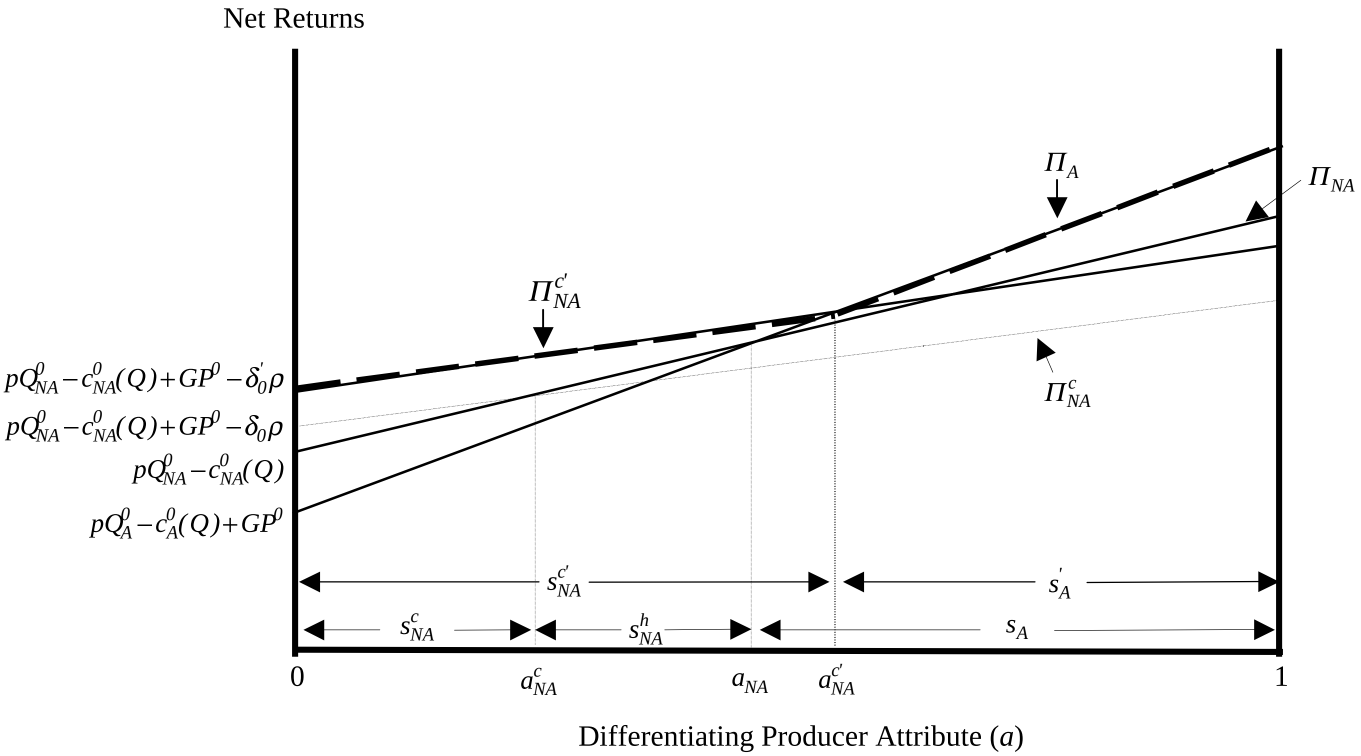

Figure 4. Production and compliance decisions when $\delta_0\rho \leq (\delta_0\rho)^+$

Table 1. State Aggregates

Group Name	
West	AZ,NM,NV,UT
New England	CT,MA,ME,NH,RI,VT
Mid-Atlantic	DE,MD,NJ,WV
Delta	AR,LA
Southeast	FL,GA
Mountain	CO,WY

Table 2. Regional Cost of Conservation Compliance

Region	**Average Cost/Acre**
Northeast	2.206977
Appalachia	1.05119
Southeast	1.142759
Delta	0.848039
Corn Belt	0.243977
Lake States	0.241617
Northern Plains	0.129595
Southern Plains	0.318854
Mountain	0.182493
Pacific	0.791463

Table 3. Estimation Results for Enforcement Decision Model

δ	α	α
Penalty	-2.2 x 10^{-9}** (-100.81)	-2.23 x 10^{-9}** (-102.26)
Enforcement Cost	-0.0002092** (-174.44)	-0.0001415** (-133.16)
Variance	0.006188 (132.19)	
Chi^2	592658.84	577335.82

** 0.001 significance level, z-statistic in parenthesis.

Table 4. Estimation Results for the Noncompliance Decision Model

%nc	***b***	b^{nv}
Constant	-2.652089** (-53.45)	-2.962514 ** (-44.60)
Conservation Cost	0.2041343** (4.97)	00309986 ** (7.89))
Net benefits	1.81 x 10^{-10}** (4.39)	8.61 x 10^{-11}* (3.10)
Chi^2	78.95	84.75

* 0.002 significance level
Note: the third column labeled b^{nv} presents the estimated coefficients when the estimated enforcement decision model without a variance term is used.