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7/23/07
3:30 pm

Crowding Out of Private Donations and Government Grants: Evidence from Environmental Charities

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July 2007

Abstract

A large literature examines the interaction of private and public funding of public goods and charities, much of it focusing on how public funding crowds out private funding: when governments increase funding of public goods, such as grants to charities, individuals may decrease voluntary contributions. This paper makes two contributions to this literature. First, the crowding out effect could also occur in the opposite direction: in response to a change in the level of voluntary private contributions to a charity, the government may alter its level of funding. I show in a static model how crowding out can manifest in both directions, and that the order of movement between the individuals and the government affects the equilibrium level of private and government contributions. Second, if there is asymmetric information about the quality of a public good, government funding may act as a signal about that quality. In this case, crowding in of private donations may be observed. I test for both of these phenomena using a large data set gathered from non-profit organizations' tax returns. To instrument for the level of private donations to certain environmental charities, I exploit public announcements regarding endangered species and toxic emissions. For some types of charities, I find evidence for both observations: government grants respond to the level of private donations, and government grants crowd in private donations.

I would like to thank the National Science Foundation Graduate Research Fellowship program for financial assistance, the National Center on Charitable Statistics for data, and Dean Corbae, Jason DeBacker, Don Fullerton, Shama Gamkhar, Dan Hamermesh, Matt Kotchen, Rob Williams, and seminar participants for helpful comments.

Public goods are often provided by both governments and individuals. Benevolent governments may provide public goods to overcome the market's failure; altruistic individuals may likewise do so. The interaction of these two sources of the provision of public goods ultimately affects the overall level of funding. In response to an increase in government spending on a public good or charity, altruistic individuals who care about the total level of the public good may reduce their contributions. Because of this "crowding-out" effect, a government choosing to increase funding to a charity by a given amount may actually increase the charity's revenues by only a fraction of that amount. Depending on who moves first, the same effect can occur in the opposite direction. If a government sees that private donations to a charity have risen, then it may reduce its public funds to that charity. Additionally, government funding may crowd in private donations if governments use grants as a signal of the quality of a public good. For both individuals and governments who are concerned about public goods, the impact of the potential crowding out and crowding in effects must be considered.

The literature on crowding out extends back at least to Warr (1982) and Roberts (1984), who show theoretically that an exogenous increase in government funding to charities can decrease private donations. In those models, the crowding out is exactly one-for-one, since the altruistic individuals care only about the total funding to the charity and not the source of funding. Empirical evidence, including Kingma (1989), finds that the crowding out effect is less than one-for-one. One explanation, provided by Andreoni (1989), is that individuals are "impure altruists" in that they receive a "warm glow" from their own giving, independent of the level of the public good.[1] Some studies find crowding *in* of government grants; Khanna and Sandler (2000) find this for charities in the UK, and Payne (2001) finds this for academic research institutions. Rose-Ackerman (1986) describes conditions under which government grants can crowd in private donation. For instance, matching grants are likely to spur an increase in donations. Grants may also come with mandated regulatory changes that make the charity more

[1] More recently, Dokko (2006) finds that changes in government donations to the National Endowment for the Arts after the 1994 Republican electoral victories crowded out private donations to arts groups, Gruber and Hungerman (2005) find that New Deal programs during the Great Depression crowded out church spending on social services, and Simmons and Emanuele (2004) find that government funding can crowd out individuals' donations of both money and time. See also Eckel et. al. (2005), Benzing and Andrews (2004), Andreoni and Payne (2003), and Payne (1998). Steinberg (1990) provides a survey of empirical analyses of charitable giving.

appealing to donors. If a charity exhibits economies of scale, then increased government revenue reduces the marginal cost of providing the service, making private donations more effective. Finally, grants may provide information, either explicitly through mandated reporting, or implicitly through the signal provided by the grant's acceptance. In a model of revenues of research universities, Payne (2001) shows that if government funding acts as a signal of institutional quality, then crowding in effects may dominate crowding out effects. A signaling model of contributions to charities is presented in Andreoni (1998). There, "seed money" from large donors increases others' donations by acting as a signal of the charity's quality. Evidence of this effect is found in a field experiment in List and Lucking-Reiley (2002).[2]

That literature focuses solely on how government spending affects individual giving. This paper also examines the opposite direction of causality: do private contributions to charities crowd out public funds? Because the direction of the effect depends on which party is the "first mover," I first model the interaction of government and individual donations to a public good. I assume that the government is benevolent and individuals are imperfectly altruistic: they care both about the total level of the public good and about their own contributions. The two groups can move simultaneously, resulting in a Nash equilibrium, or either party can move first, yielding a Stackelberg equilibrium. Adding asymmetric information about quality to the model yields the conclusion that government grants can act as signals of quality to donors and crowd in private donations. I then test the models using data on private and public contributions to environmental and social service charities. While social service charities are most commonly examined in the literature, here I also look at environmental charities in order to take advantage of public announcements regarding endangered species and toxic emissions that are used as instruments for private donations to charities.

This paper makes four contributions to the literature on crowding out and crowding in of charitable contributions. First, though numerous papers test whether government contributions crowd out private contributions, none can be found that either

[2] Landry et. al. (2006) also find some evidence that seed money increases others' contributions, but they find a stronger effect from being entered in a lottery for a cash prize when donating and from the physical attractiveness of the person asking for a contribution. Lange (2006) develops a model where the lottery prize money is provided by donors and thus acts similarly to seed money.

model or empirically test for crowding out in the opposite direction.[3] In fact, a negative correlation between government and private funding of charities could be evidence for either type of crowding out. Here, I test for both types separately and simultaneously by using instrumental variables to control for the endogeneity of the other side's contribution.[4] Second, I combine the crowding out literature with the literature on the signaling effects of large contributions. Government grants can act like seed grants in that they convey information to other donors about charity quality. Third, no study has examined crowding out and crowding in in the context of environmental public goods. By looking at data on environmental charities, I extend this literature into environmental policy. Fourth, instead of looking at only a few charities of a particular type, I use an extensive data set with more than 400,000 charities of all types.[5]

Initially, in a theoretical model with perfect information, I find that an exogenous increase in government funding to a public good causes a decrease in individuals' contributions, while an exogenous increase in individuals' contributions causes a decrease in government funding. This decrease in funding can be one-for-one under certain conditions. When both public and private funding are endogenous, the level of public good provision depends on the order in which the players move. When individuals are uncertain about the quality of the public good but governments are not, government grants can act as a signal to individuals of the quality. In this case, I show that the crowding out effect of increased funding can be countered by a crowding in effect from the signal. On net, either crowding out or crowding in of private donations is possible. Empirically, I look for evidence of crowding out or crowding in in both directions. For

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[3] Connolly (1997) studies the relationship between internal and external funding of research at universities using VAR methods. Thus, she generates impulse response functions for both types of funding, in response to an exogenous change in either type. Segal and Weisbrod (1998) use the same methodology to test for direction of causality between total contributions (government and private) and commercial revenues. However, neither paper looks at government and private funding as two separate categories.

[4] Knight (2002) studies the crowding out of state highway spending by federal grants. He develops a model where those federal grants are endogenous and determined by heterogeneous preferences for public goods. This explains the lack of evidence for crowding out in the data. After accounting for endogeneity by instrumenting for federal highway grants using data on the political power of state congressional delegations, he does find evidence of crowding out.

[5] Though they test for crowding out between program service revenue and all contributions, public and private, Segal and Weisbrod (1998) also find different results for different types of charities. Crowding out is found for housing, shelter, and arts charities, while crowding in is found for universities, technological institutes, and human services charities. Payne (2001) studies federal funding and private donations to universities and finds crowding in for research universities but crowding out for liberal arts colleges.

environmental charities, I find no evidence of a response of government grants to private donations or vice versa. However, for social service charities I find evidence that government grants crowd *in* private donations, and private donations crowd *out* government grants.

The presence of crowding in of contributions to charities is of concern to both governments and individuals who make these contributions. A government might choose an optimal level of provision of a charity or public good and adjust its funding to reach that level. Without accounting for the crowding in response by private donors, funding may exceed the optimal level. Likewise, if the level of private donations affects government support, then an individual's optimal level of giving ought to account for the reaction of government grants. Furthermore, though crowding out of private donations has been studied for social service organizations, the arts, and public radio, the effect is likely to be important in the growing but still unstudied area of environmental charities. How each type of funding affects the other type is crucial to understand if one wants to attain efficiency in the protection of environmental resources.

In the next section I present the theoretical model of crowding out. In section 2, I add uncertainty about the quality of the public good to the model, and present a signaling model which can lead to crowding in of government contributions. Section 3 describes the data, and section 4 presents the estimation results. Section 5 concludes.

I. Crowding out of Private and Government Contributions

The model presented here is a simple static equilibrium model of the amount of private and public giving to a charity or public good. Consider an economy with N individuals indexed by i. Each individual has an exogenous income allocation y_i is subject to a lump sum tax τ_i,[6] and chooses a voluntary contribution g_i to the public good. The individual gets utility from consumption, c_i, and from the level of the public

[6] The exogenous income and the lump sum tax mean that issues of the distortionary effects of taxation are not addressed by this model. Saez (2004) considers optimal tax policy in the presence of crowd out and tax distortions. The model here could easily be amended to include proportional taxes rather than lump sum, or it could include a parameter to represent a marginal cost of public funds that captures tax distortions.

good, G. The utility function is thus $U_i = U(c_i, G)$.[7] Suppose that $U_x > 0$, $U_{xx} < 0$ for $x = c, G$, and $U_{cG} > 0$, where U_x represents the derivative of the utility function with respect to the variable x. Also suppose that $U_x \to \infty$ as $x \to 0$, assuring an interior solution. The level of the public good is $G = \sum_{i=1}^{N} g_i + \tau_i$, so that private and public contributions to the public good are perfect substitutes in production.[8] The individual's budget constraint is $y_i \leq c_i + g_i + \tau_i$, and this constraint must bind. The individual thus makes a single choice of g_i to maximize $U(y_i - g_i - \tau_i, \sum_{i=1}^{N}(g_i + \tau_i))$.

The government is benevolent, maximizing a weighted utilitarian social welfare function: $W = \sum_{i=1}^{N} \gamma_i U(c_i, G)$. The coefficients γ_i represent the weight on each individual's utility in the social welfare function.[9] The government chooses the tax structure $\{\tau_i\}$ to maximize social welfare.

As previous literature on crowding out has considered government action (the tax schedule τ_i) exogenous, I start by considering that case in the next section below. Later, however, I also consider how government responds to an exogenous change in the level of private donations, and also how the two types of agents interact when both move endogenously.

A. Exogenous government action

First, suppose that the government sets its taxes exogenously and consider the response of individuals. Individual i's problem is: $\max_{g \geq 0_i} U(y_i - g_i - \tau_i, \sum_{j=1}^{N}(g_j + \tau_j))$. Individual i takes as given all other private contributions g_j. The first order condition for this maximization problem, assuming an interior solution, is $U_c = U_G$. The left hand

[7] This utility function does not include a "warm-glow" effect, as introduced in Andreoni (1989). Such a utility function would have g_i as an argument directly, rather than indirectly through its effect on the amount of the public good G.

[8] In Ferris and West (2003), the cost of providing the public good differs for public and private contributions. They use this cost-side explanation rather than Andreoni's (1989) utility-based explanation for the partial crowding out of public contributions that is found empirically.

[9] For recent uses of utilitarian, or Benthamite, social welfare functions, see e.g. Armenter (2007) or Eichner and Pethig (2006).

side of the first order condition is the marginal cost of an additional unit of private contribution, which is the foregone consumption from that unit of wealth, U_c. This is equated with the marginal benefit of an additional unit of private contribution, equal to the additional amount from the public good that is created from the individual's contribution, U_G. At a corner solution, where the individual optimizes by giving nothing to the public good, $U_c > U_G$, since the cost of giving the first dollar outweighs the benefit.

Crowding out is analyzed by evaluating $dg_i/d\tau_i$, or the change in private contribution resulting from a change in the forced level of government contribution from individual i. (This is a comparative static result for an agent's best-response function, not for a Nash equilibrium contribution.) This derivative is evaluated using the implicit function theorem on the first order condition for the interior solution:

$$\frac{dg_i}{d\tau_i} = -\frac{U_{cc} - 2U_{cG} + U_{GG}}{U_{cc} - 2U_{cG} + U_{GG}} = -1 .$$

Private contributions are perfectly one-for-one crowded out by the government's contribution.[10] This result is intuitive; individuals only care about the level of the public good and not about the source of its funding, so they are indifferent whether it is funded through their voluntary contributions or through their taxes.[11]

B. Exogenous Individual Action

The previous section assumes that the taxes are set exogenously and considers the response of individuals to a change in those taxes. This structure of the problem is most commonly seen in the empirical literature on crowding out. However, one may just as easily consider the government's response to a change in private donations to public goods. A large increase in private donations to a charity, due to perhaps a fundraising drive or a high-profile event highlighting the charity's need, may cause the government to reduce its giving to that charity compared to what it otherwise would have given them under the same conditions but without the increased private contributions.

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[10] This result is comparable Proposition 3 in Andreoni (1990).

[11] Allowing a warm glow effect makes this derivative more complicated. Under some additional assumptions about the utility function, it can be shown that $-1 < dg_i/d\tau_i < 0$, so that there is crowding out, but less than one-for-one.

To capture this other direction of crowding out, suppose that the actions of each individual are treated as exogenous by the government, who then sets the taxes $\{\tau_i\}$ to maximize social welfare. Suppose further that the government sets an identical nonnegative tax τ on every individual.[12] The government's problem is

$$\max_{\tau \geq 0} \sum_{i=1}^{N} \gamma_i U[y_i - g_i - \tau, \sum_{j=1}^{N}(g_j + \tau)],$$

where private giving g_i is exogenous. Assume an interior solution for τ. This yields the first order condition $\sum_{i=1}^{N} \gamma_i(-U_c + NU_G) = 0$. The social marginal cost of increasing the tax on individual i is the foregone value of consumption for that person. This equals the marginal benefit of increasing the tax, which is the value of the increase in the public good. This benefit accrues to each person's utility function, and hence it is summed over N. Use the implicit function theorem to calculate the change in the optimal tax in response to a change in private donations:

$$\frac{d\tau}{dg_i} = -\frac{\gamma_i(U_{cc} - NU_{cG}) + \sum_{j=1}^{N} \gamma_j(-U_{cG} + NU_{GG})}{\sum_{j=1}^{N} \gamma_j(U_{cc} - 2NU_{cG} + N^2 U_{GG})}.$$

Both the numerator and denominator of this expression are strictly negative, which means, with the negative sign at the front, this derivative is negative. Thus, private donations crowd out public spending. Furthermore, the absolute value of the denominator exceeds that of the numerator, so that the level of crowding out is less than one-for-one. However, this expression imposes that the tax rate must be the same for each individual, while private donations g_i may differ. If individual i increases her contribution by one dollar, then a decrease of one dollar in the tax τ would actually decrease the total amount of the public good by $(N - 1)$ dollars. A clearer way to see the magnitude of crowding out is by imposing homogeneity on all individuals, so that $y_i = y$ and $g_i = g$ for all i. In that case, the government's first order condition is $-U_c + NU_G = 0$, and $d\tau/dg = -1$. When each person's tax is identical and each person's private

[12] The most general form of the tax allows for the government to set a different tax for each individual. However, this generality makes the evaluation of derivatives difficult. To evaluate $d\tau_i/dg_i$ using the implicit function theorem, one must calculate the inverse of an $N \times N$ matrix (from the N first order conditions).

contribution is identical, then the government will perfectly crowd out any contributions made by individuals.

C. Equilibrium

The previous two sections have each considered a case where one side of the market acts exogenously. Now suppose that the actions of both the government and the individuals are endogenous.[13] Multiple equilibria arise from the fact that the players can move in different orders. First, suppose that all of the individuals and the government move simultaneously, resulting in a Nash equilibrium. Since both the government and each individual acts as though the other's action is fixed at the equilibrium level, the maximization problems and the first order conditions for each party are identical to the ones in the previous two sections. Thus, the first order conditions for an interior solution are a system of $N+1$ equations: $\sum_{i=1}^{N} \gamma_i(-U_c + NU_G) = 0$ for the government's problem (assuming again a single tax τ) and $U_c = U_G$ for each individual i.

The first order conditions can be solved to find an expression for τ and for $\{g_i\}$. Even with the simplification that the government sets only one tax, however, this is a large system of equations that is impossible to solve without parameterizing the utility function. By assuming homogeneity of individuals, though, an interesting result emerges. With identical individuals all making a contribution g, the government's first order condition simplifies to $U_c = NU_G$. These are the first order conditions for an interior solution, though. Without imposing that restriction, the first order Kuhn-Tucker conditions are $-U_c + U_G + \mu = 0$ and $-U_c + NU_G + \lambda = 0$, where μ is the Lagrange multiplier for the constraint that $g \geq 0$ and λ for the constraint that $\tau \geq 0$. Since both Lagrange multiplier must be nonnegative and the utility function is defined so that $U_G > 0$, it can be shown that the only feasible case is where $\mu > 0$ so that $g = 0$. So, individuals donate nothing and the government sets the tax level to maximize social welfare. Why does this corner solution always hold? Under homogeneity of individuals,

[13] This is similar to the contribution made by Knight (2002) to the federalism literature. He departs from the assumption of exogenous federal grants to states by supposing that they are determined in a political process, so that federal spending may help determine state spending, and vice versa. However, he does not study charitable giving.

there is no difference in utility between funding the public good through private donations g or through taxes τ. Thus, the government can set τ to achieve the first-best, totally compensating for the free rider problem. This is in general not possible when the two sources of funding for the public good are not perfect substitutes, for example, if there is a warm glow effect from private donations.

A second equilibrium concept occurs when the government is the first mover, followed by all individuals moving simultaneously, resulting in a Stackelberg equilibrium. The maximization problem and first order condition for each individual are the same as in section A, since individuals are second movers and take the government's and each other's actions as exogenous. The government, however, chooses both the tax and the individuals' private donations, subject to the individuals' maximizing behavior. The government's problem is thus

$$\max_{\tau \geq 0, g \geq 0_i} \sum_{i=1}^{N} \gamma_i U[y_i - g_i - \tau, \sum_{j=1}^{N}(g_j + \tau)] \text{ such that } -U_c + U_G + \mu_i = 0 \ \ \forall i,$$

where again μ_i is individual i's constraint that $g_i \geq 0$. The constraints are the first order conditions from all of the individuals' maximization problems. Because of the inequality constraints on both g and τ, the first order conditions for this problem are complicated and require the analysis of many cases. Assuming an interior solution for both the government's and individuals' problems and homogeneous individuals yields the following first order condition:

$$-U_c + NU_G + \lambda[U_{cc} - (N+1)U_{cG} + NU_{GG}] = 0$$

where λ is the Lagrange multiplier for the constraint. Though the government is choosing both τ and g subject to the constraint, the first order condition for each of these choice variables is identical. As above, that is because the two are perfect substitutes in utility when the government can choose both of them. The government thus is choosing the sum $\tau + g$, and it is not differentiating between the two sources of funding for G. In the first order condition, the first two terms on the left are identical to the first order condition from the government's problem when individual's private contributions are exogenous. Before, when just that first summation was set to zero, the interpretation was that the government should set the sum of marginal benefits equal to the sum of marginal costs. The second part of the equation, the parenthetical multiplied

by λ, comes from the government factoring in how its decision affects the individuals' optimal decisions. Only when this part equals zero does the government's choice of tax not become encumbered by individuals' decisions.

Another Stackelberg equilibrium is where the government sets the tax *after* all of the individuals have chosen their level of private contributions. In the first stage, all N individuals move simultaneously, and in the second stage the government moves. The government's maximization problem and first order condition are the same as in the case where individuals' actions are exogenous, since those actions are given at the time of the government decisions. The individuals must each choose a level of private contribution, factoring in how their contribution affects the government's choice of tax, holding constant all other individuals' contributions. Individual i's maximization problem is

$$\max_{g_i \geq 0, \tau \geq 0} U(y_i - g_i - \tau, \sum_{j=1}^{N}(g_j + \tau) \quad \text{such that} \quad \sum_{j=1}^{N} \gamma_j(-U_c + NU_G) = 0 .$$

The constraint is the first order condition of the government's optimization problem, assuming an interior solution. Individual i chooses τ subject to the constraint but can only affect τ insofar as g_i is changed. Letting the Lagrange multiplier of this constraint equal η_i, the first order conditions for individual i are:

$$-U_c + U_G + \eta_i[\gamma_i(U_{cc} - NU_{cG}) + \sum_{j=1}^{N} \gamma_j(-U_{cG} + NU_{GG})] = 0$$

$$-U_c + NU_G + \eta_i[\sum_{j=1}^{N} \gamma_j(U_{cc} - 2NU_{cG} + N^2 U_{GG})] = 0 .$$

The first two terms in the first equation $(-U_c + U_G)$ were found to sum to zero in the prior case where the tax was exogenous. The term with the Lagrange multiplier η_i shows how the individual's action impacts the government's tax. The first two terms in second equation $(-U_c + NU_G)$ would be set to zero if the individual were free to choose the optimal tax level, but the individual is constrained by the government's actions. Though the first order conditions are relatively easy to find, any further analysis of this equilibrium is impossible without assuming any form on the utility function.

Finally, I evaluate the social planner's problem, where each individual's level of private contribution and the tax are set simultaneously by one party. The maximization problem is

$$\max_{\{g_i\}\geq 0,\tau\geq 0} \sum_{i=1}^{N} \gamma_i U(y_i - g_i - \tau, N\tau + \sum_{k=1}^{N} g_k).$$

This yields the following set of first order conditions:

$$-\gamma_i U_c + \sum_{k=1}^{N} \gamma_k U_G + \lambda_i = 0$$

$$\sum_{k=1}^{N} \gamma_k (-U_c + NU_G) + \mu = 0,$$

where λ_i is the multiplier from the non-negativity constraint on g_i and μ is the multiplier from the non-negativity constraint on τ. At an interior solution, where these multipliers equal zero, the marginal cost of an additional dollar of g_i, which accrue only to individual i, are set to equal its marginal benefit, which accrues to all N individuals. This is shown in the first equation above. For τ, both the cost and benefits accrue to all individuals, since it is constrained to be the same for all individuals.

The first best solution thus depends on how each individual is weighted in the social welfare function, described by the γ_i parameters. In the special case where all individuals are identical, the problem becomes

$$\max_{g\geq 0,\tau\geq 0} U(y - g - \tau, N(\tau + g)).$$

Again, here g and τ are perfect substitutes, so government need only choose the sum $\tau + g$, or each individual's total contribution to G. This leads to the first order condition $U_c = NU_G$. The marginal cost to each individual, U_c, is set to equal the social marginal benefit, which accrues to all N individuals, NU_G.

II. Quality Signaling

In the prior section, both the government and individuals had perfect information. It is likely, however, that some uncertainty exists about the quality of a public good and how it affects individuals' utility functions. Furthermore, asymmetries between the government and individuals may exist concerning this uncertainty. Governments may have access to more information about the effects of a charity or public good, and they may be consequently more informed about its quality. I capture this information asymmetry in the model here and show how the government can use its tax policy to signal the unknown quality of the charity to the individuals. This signaling can lead to a

crowding in effect that works against the crowding out effect found earlier, if a higher tax rate signals a higher quality charity towards which individuals want to give more in donations.

To incorporate information asymmetries, suppose that the public good G can vary in quality, measured by the variable α. Let the individual's utility function be defined as $U(c_i,G;\alpha)$ where, as before, utility is increasing in both consumption, c, and the level of the public good, G. Also suppose that $dU/d\alpha > 0$ and $d^2U/dGd\alpha > 0$; that is, both total utility and the marginal utility of the public good increase with α. Under full information (if the individual knows the level of α), then an increase in α will induce individuals to donate more to the public good.

Suppose that individuals do not know the value of α, but the government does. The government cannot convey this information directly to individuals, but it can set a tax rate based on the value it observes. Individuals choose their level of private donations, g_i, simultaneously in response to the government's tax level. Let the government be the first mover. The game can thus be characterized by the following steps:

1. Nature chooses a value of the quality of the public good, α.
2. Government observes α and sets a tax τ applicable to all individuals.
3. Individuals simultaneously choose their level of private donations to the charity, g_i, observing τ but not α.

This game lends itself to being analyzed in the framework of a perfect Bayesian equilibrium (PBE), in a manner similar to that of the signaling model of Spence (1973). A PBE is defined by a set of strategies of the individuals $g_i(\tau)$ and of the government $\tau(\alpha)$, and a belief function of the individuals $\mu(\tau) \in [0,1]$ that gives the individuals' common probability assessment that $\alpha = \alpha_H$ given τ, such that the government's strategy is optimal given the individuals' strategies, the belief function is derived from the government's strategy using Bayes's rule when possible, and individuals' strategies constitute a Nash equilibrium of the simultaneous-move game in which the probability of $\alpha = \alpha_H$ is given by $\mu(\tau)$.[14]

[14] Payne (2001) provides a model where government grants can crowd in private donation by signaling quality. However, that model avoids dealing with Bayesian equilibria by supposing a reduced-form

To get clear analytical results from this model, I will make two specifications that simplify the model and reduce its generality. These specifications allow for the intuitive results about the signaling model to be directly demonstrated. First, suppose that only two values of the quality of the public good are possible, α_L and α_H, with $\alpha_L < \alpha_H$, and suppose that the probability of the public good being of high quality α_H equals $\lambda \in [0,1]$. Thus the government's strategies are described by defining the tax rate it sets given each of these two possibilities for public good quality.[15] Second, suppose that the utility function for individuals is defined as $U(c, G; \alpha) = \sqrt{c} + \alpha\sqrt{G}$. This parameterization allows for marginal utility of the public good to increase with α, as was assumed earlier. It will also allow for closed-form solutions to be found.[16] Individual i chooses a non-negative contribution level g_i to maximize his utility, given τ and all other contributions g_{-i}, such that $y_i \leq c_i + g_i + \tau$ and $G = g_i + g_{-i} + N\tau$.

The model can be solved backwards, starting with the individuals' responses to government policy. Since $\mu(\tau)$ is the individual's belief about the probability that $\alpha = \alpha_H$, let $E\alpha = \mu(\tau)\cdot\alpha_H + (1 - \mu(\tau))\cdot\alpha_L$. An individual's optimal choice of g_i is given by

$$g_i = \begin{cases} \dfrac{E\alpha^2(y_i - \tau) - g_{-i} - N\tau}{1 + E\alpha^2} \; if \quad E\alpha^2(y_i - \tau) \geq g_{-i} + N\tau \\ 0 \qquad\qquad\qquad\qquad o/w \end{cases}.$$

Whenever the external contributions to the public good ($g_{-i} + N\tau$) are sufficiently high, the individual chooses not to contribute anything himself. Imposing homogeneity on all N individuals, this solution becomes

$$g = \begin{cases} \dfrac{E\alpha^2 y}{N + E\alpha^2} - \tau \; if \quad E\alpha^2 y / N + E\alpha^2 \geq \tau \\ 0 \qquad\qquad\qquad\qquad o/w \end{cases}.$$

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function for the signal, where the level of government grants directly affects individuals' beliefs about the quality.

[15] This is a common simplification in the signaling literature, from Spence (1973) to Andreoni (2006).

[16] This functional form is used in Vesterlund (2003), who studies the signaling behavior of charities' fundraisers.

If $E\alpha$ is independent of τ, then this solution shows that there is one-for-one crowding out, so that the government's choice of the level of donation does not affect the total contribution to the public good. However, the tax level τ, when used as a signal of quality, can affect beliefs and thus $E\alpha$.

The government in this model can get the public good funded in two ways: directly, by imposing a tax on individuals, and indirectly, by signaling the quality of a public good and inducing individuals to voluntarily contribute. This is a key difference between this model and models of seed money contributions by private donors: while those donors may signal the quality of the charity, they may not tax individuals and force them to contribute. Thus, if the government is free to tax at any level it wants to fund the public good, there may be no need for any signaling, since the optimal provision of G can be attained wholly through taxation. In fact, in the parameterization of utility given above where individuals are identical and without any restrictions on the level of taxation, this is the case. The unique equilibrium is one where the government sets $\tau = \frac{\alpha^2 Ny}{1+\alpha^2 N}$, in response to either observed value of α. This tax level is high enough so that all individuals choose $g_i = 0$. Thus, contributions are always zero and there is no crowding out or crowding in.

A more interesting and realistic case is where there is an interior solution, so that private donations do in fact respond to government contributions. Suppose that governments are restricted in the level of taxation that they can impose on individuals, so that $\tau < \tau_{max}$. This inequality may be forced on the government because of political considerations, or because of budget constraints from other types of government expenditure not included in the model. If τ_{max} is sufficiently low, then individuals will choose to make a positive contribution.[17] In this case, the solutions are in the interior solution section of the expression for g written above.[18]

For signaling to occur, there must be a separating equilibrium, where $\tau(\alpha_H) \neq \tau(\alpha_L)$. In a separating PBE, since individuals' beliefs must be derived from Bayes' rule, it

[17] The sufficient level for τ_{max} to ensure interior solutions is $\tau_{max} < \alpha^2 y/(N + \alpha^2)$.

[18] An alternative way of ensuring an interior solution for g_i is to add a warm glow effect to the utility function. Omitting the warm glow effect makes the model here easier to solve and still allows for the main predictions of the model.

must be the case that $\mu(\tau(\alpha_H)) = 1$ and $\mu(\tau(\alpha_L)) = 0$. That is, individuals are certain of the actual value of α once they observe the government's chosen tax level. Therefore, at the interior solutions, given the signals made by the government, $g(\alpha_H) = \alpha_H^2 y/(N + \alpha_H^2) - \tau(\alpha_H)$ and $g(\alpha_L) = \alpha_L^2 y/(N + \alpha_L^2) - \tau(\alpha_L)$. For this solution to be a PBE, it must be the case that, for each realization of α, the government's strategy is optimal given the responses of individuals. Government cannot have the incentive to deviate from its equilibrium strategy. Define social welfare, which the government is trying to maximize, as $W(\tau, g(E\alpha), \alpha)$, where the individuals' response to their beliefs about α is given by $g(E\alpha)$. The incentive constraints for the government are:

$$W(\tau(\alpha_L), g(\alpha_L), \alpha_H) < W(\tau(\alpha_H), g(\alpha_H), \alpha_H),$$
$$W(\tau(\alpha_H), g(\alpha_H), \alpha_L) < W(\tau(\alpha_L), g(\alpha_L), \alpha_L).$$

The first inequality states that, if the government observes α_H, it must be optimal for it to signal so with $\tau(\alpha_H)$ rather than signaling α_L with $\tau(\alpha_L)$. The second equality is the equivalent incentive constraint for when the government observes α_L.

Substituting in the individuals' response functions $g(\alpha)$ and the expression for social welfare, these two inequalities can be expressed in terms of deep parameters of the model: $\frac{1+\alpha_L\alpha_H}{1+\alpha_L^2} \le \sqrt{\frac{N+\alpha_H^2}{N+\alpha_L^2}} \le \frac{1+\alpha_H^2}{1+\alpha_L\alpha_H}$. This is a necessary condition for the separating equilibrium to be possible. Because at the interior solution there is one-for-one crowding out of the government's contribution to the public good, the government's choice of tax is absent from these inequalities. Thus they are not informative about what levels of the tax can support the separating equilibrium. In fact, any tax levels $\tau(\alpha_L)$ and $\tau(\alpha_H)$ are possible as long as $\tau(\alpha_H) \neq \tau(\alpha_L)$. However, it is logical to suppose that the tax level which signals the higher quality public good α_H exceeds the tax level for the low quality public good, or $\tau(\alpha_H) > \tau(\alpha_H)$.

Under this PBE, consider the level of individual contributions in response to different tax levels. Since the quality of the public good is binary, the two possible levels of contributions are: $g(\tau_L) = \alpha_L^2 y/(N + \alpha_L^2) - \tau_L$ and $g(\tau_H) = \alpha_H^2 y/(N + \alpha_H^2) - \tau_H$ (where τ_L and τ_H are shorthand for $\tau(\alpha_L)$ and $\tau(\alpha_H)$, respectively). Each equation demonstrates the crowding out effect that was shown earlier in the case of perfect certainty about quality. But as τ increases from τ_L to τ_H, crowding out need no longer

be one-for-one, and in fact crowding in is possible, depending on the model's parameters. A derivative cannot be evaluated because these changes are discrete, but consider a differential: $\frac{\Delta g}{\Delta \tau} = \frac{g(\tau_H) - g(\tau_L)}{\tau_H - \tau_L} = \frac{\alpha_H^2 y/(N + \alpha_H^2) - \alpha_L^2 y/(N + \alpha_L^2)}{\tau_H - \tau_L}$. The first two terms in the numerator net out to a positive value, since $\alpha_H > \alpha_L$. The expression $\tau_H - \tau_L > 0$. Thus, this differential is positive whenever $\alpha_H^2 y/(N + \alpha_H^2) - \alpha_L^2 y/(N + \alpha_L^2) > \tau_H - \tau_L$. If the difference in quality is sufficiently greater than the difference in the two tax signals, then the increase in the tax rate will lead to a net increase in private donations. Thus, crowding in of government grants is possible. The level of crowding in depends on the relative difference in the qualities of the public good and on the tax signals that hold in equilibrium. While an increase in the tax rate *ceteris paribus* will decrease private donations because of the crowding out effect, a higher tax rate signaling a higher quality public good will increase private donations because individuals believe the public good provides more utility. Which of these effects dominates is dependent on the parameters of the model, and is likely to differ for different types of public goods.

III. Data

The data on nonprofit environmental organizations comes from IRS tax returns filed by eligible organizations. These data are collected and distributed by the National Center for Charitable Statistics (NCCS) at the Urban Institute.[19] They are based on the Forms 990 or 990EZ that must be filed by certain 501(c)(3) nonprofit organizations. These forms must be filed by all eligible organizations, except for religious organizations and all those with less than $25,000 in gross receipts.[20] These data from 1998-2003 are contained in the Guidestar-NCCS National Nonprofit Research Database, which contains 1,388,480 observations from all charities which filed within those fiscal years.

[19] http://nccs.urban.org.

[20] The exclusion of religious organizations is likely significant, since they receive over half of all charitable giving in the United States (Ronsvalle and Ronsvalle, 2001). Religious organizations that receive the majority of their revenue from serving the general public are required to file Forms 990. These include the Sisters of Mercy hospital chain and Lutheran Social Services. About 15,000 such religious organizations were required to file in 2001. Examining donations to Presbyterian Church congregations, Hungerman (2005) finds that government provision of charitable services crowd out church donations by 20-38 cents on the dollar.

Organizations are classified in the dataset according to the National Taxonomy of Exempt Entities (NTEE), a system developed by the NCCS. The NTEE divides charities into 645 centile level codes, collapsible into 26 major groups and 10 major categories. I focus on charities classified into major groups C and D, representing "Environment" and "Animal-Related," respectively. Environmental charities are defined as those groups whose primary purpose is to preserve, protect and improve the environment. Animal-related charities are defined as private non-profit organizations whose primary purpose is to provide for the care, protection and control of wildlife and domestic animals that are a part of the living environment; to help people develop an understanding of their pets; and to train animals for purposes of showing.[21] Hereafter, I refer to all of these charities as environmental organizations.

I compare the results based on data from environmental organizations to results based on a set of other types of social service organizations. This set includes organizations that focus on: crime, employment, food and nutrition, housing, human services and community improvement.[22] This set of organizations, hereafter referred to as social service organizations, provides a basis to see how the environmental organizations differ.

The differences in charities' revenue sources can be seen in Figure 1, which divides up the average source of funding for each type of charity into several categories.[23]

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[21] Specifically, environmental charities include those involved in pollution control and abatement; conservation and development of natural resources; control or elimination of hazardous or toxic substances including pesticides; solid waste management; urban beautification and open spaces development; environmental education and outdoor survival; and botanical gardens and horticultural societies. Animal-related charities include organizations that develop and maintain fisheries resources and wildlife habitats to preserve and protect endangered species and other wildlife; humane societies; veterinary services; aquariums; and zoos.

[22] These are the organizations listed under the 1-digit NTEE codes of I, J, K, L, P and S. This is the same set of codes used by Andreoni and Payne (2003) for their set of social service organizations. Here, I separate environmental charities from the rest of the group. Andreoni and Payne (2003) also exclude some organizations that they describe as not directly providing services, while I include all 501(c)(3) organizations in those categories (see their fn 15).

[23] The first category is direct public support, which is the main category of donations from individuals. Second is indirect public support, comprised mainly of donations given to the charities collected by federated fundraising agencies, such as the United Way. The next category is government grants, which includes monies from federal, state, and local governments. Program service revenue is the money collected from the services that form the organizations exemption from tax. For example, a hospital would count as program service revenue all of its charges from medical services or room charges. Dues collected includes only the amount of dues received that are not contributions, for example the dues that go towards a subscription to a newsletter or some other benefit. Investment income includes dividends and interest on

The revenue sources for the two types of charities are dramatically different. Environmental charities receive half of their revenue from direct public support, including individual donations, while social service charities receive only 14% from this source. Government grants constitute a much smaller share of environmental charities' revenues (11%) than of social service charities' revenues (26%). Social service charities get about half of their revenue from program services; environmental charities receive only one-fifth of their revenues from this source.[24] The remaining sources of revenues are small for both types of charities, though environmental charities receive more in each of the remaining categories.

Table 1 presents revenues aggregated into four main categories. As a measure of private donations, I combine direct public support, indirect public support, and dues. Government grants and program service revenue have their own categories, and the remaining revenues are classified as "other." The top panel of Table 1 lists statistics for environmental organizations, the bottom panel for social service organizations. The number of environmental organizations is about one-fifteenth the number of social service organizations. On average, environmental organizations receive less total revenue than social service organizations ($978,000 vs. $1,716,000). Of this revenue, though, they receive a great deal more from private donations, and less from government grants and program service revenue. Finally, the mean values are all much higher than the median values, and even the 75th percentile values, suggesting a data set that is skewed towards high-revenue firms. These statistics suggest that the revenue sources for environmental charities are quite different than those of social service charities.

Trends in these values are presented in Figure 2. The top panel is for environmental charities; the bottom panel for social service charities. The values presented are the average per charity value of government grants and private donations in constant 2002 dollars. Just as shown in Table 2 for 2002 only, environmental charities receive more from private donations than from government grants, while social service charities receive more from government grants in all years.

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savings and cash accounts; rents and sales include net revenue from rents and from sales of securities, inventory, or other assets. Finally, the last category includes all other revenue, including from special events such as dinners, raffles, or door-to-door sales of merchandise.

[24] Segal and Weisbrod (1998) test for crowding out between all donations, including private and government grants, and program service revenue.

The presence of crowding out in either direction implies that spikes in government grants would be accompanied by dips in private donations, and vice versa. For social service charities, no such pattern emerges, since both values appear to be increasing. However, environmental charities exhibit this pattern. After 2001, a dip in private donations is accompanied by an increase in government grants.[25] This is merely suggestive, so I turn to regression analysis to identify the presence of a crowding out effect.

IV. Econometrics

The models lend themselves to two different empirical tests. First, government grants can cause either crowding in or crowding out private donations to charities, depending upon which effect dominates. Second, private donations can crowd out government grants. While numerous papers have tested for causality in the first direction, no paper has examined causality in the opposite direction. Also, I test for these predictions separately in environmental charities and social service charities. While other papers have looked at social service charities and some other categories of charities, no paper has specifically tested for crowding out effects in environmental charities.

Because of the two predictions, I run two separate regressions, one in which the level of private donations to a charity is the dependent variable and the level of government grants is an independent variable, and one with those two variables reversed. The level of private donations is defined as in Table 1 above: the sum of direct public support, indirect public support, and dues. I also add control variables to the regressions. At the charity level, these are the level of program service revenues and all other revenues. Furthermore, I include a number of state-year level variables to control for economic, demographic, and political conditions. These are the unemployment rate, average household income, total population, fraction of the population 65 or older, the fraction of a state's US Congress and Senate delegations that are Democrats, and a dummy for whether the state governor is a Democrat. Political and economic variables

[25] The dip in private donations to environmental charities approximately coincides with the early 2000s recession. The fact that a similar dip is not visible in private donations to social service charities may indicate that donations to environmental charities are more income elastic than donations to social service charities.

may have important effects on the levels of both private and public contributions to charities. A state with a higher proportion of Democrats in power is likely to be composed of more liberal citizens who may be more willing to provide financial support for environmental charities. Likewise, Democratic congresses may be more willing to approve higher levels of funding for these groups. If so, leaving out political proxies causes an upward bias on the coefficient of interest. Finally, because I have six years of data from thousands of organizations, I am able to control for organization-specific unobservable effects using panel data econometric methods. The Hausman specification test rejects the assumption that the unobservable effect is uncorrelated with the other regressors, so a fixed-effects model is employed rather than a random-effects model.[26]

The large data set, containing entries from all 501(c)(3) nonprofit charities that filed with the IRS between 1998 and 2003, allows for very disaggregated analyses but also presents problems with messy data. Froelich et. al. (2000) discuss the adequacy and reliability of the data from IRS Form 990. While it is believed that the IRS reporting requirements are not treated with much importance by the charities, Froelich et. al. find that the reported data are fairly consistent with more detailed audit information, especially in the basic categories of contribution, programming, and fundraising. Still, I undertake measures to clean the data. Some charities report revenues by category (e.g. private donations, government grants) that do not add up to the reported level of total revenues. Likewise, for some charities the expenditures do not add up correctly. I eliminate all of these charities from the data set (about 20% of observations from the social service charity data set and 30% from the environmental charity data set). Though the data are a panel, it is a very unbalanced one. To compensate, I include in the regressions only those charities which appear for all six years (about 40% of the charities).[27]

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[26] The model here does not consider the behavior of the charity in response to changes in government grants, like the fundraising models of Andreoni (1998), Andreoni and Payne (2003), and Rose-Ackerman (1987). However, I include fundraising expenditures to control for a charity's efficiency in converting revenues to charitable services (see Khanna and Sandler 2000).

[27] To examine how limiting the sample in this way may create a bias from sample selection, the summary statistics from Table 1 can be replicated after limiting the sample to those charities which pass the screenings described above. The mean values of the financial variables are all fairly close to the values in the full sample. However, large differences are present in the median and 75th percentile values of the financial variables. Those values for the limited sample are approximately two to three times as high as those in the full sample. While the data in the full sample are quite skewed, the limited sample data are

Estimates are likely to suffer from endogeneity bias. Charities jointly determine the amount of private donations and government grants that they solicit. Unobservable effects may lead to an increase in both of these simultaneously, biasing the coefficient estimates upwards. For example, an exogenous event may increase the need for a particular charity, which would increase that charity's private donations and government grants. Alternatively, endogeneity could bias the estimates downwards. A restructuring of the charity or of its nonprofit status could cause it to reallocate its funding between donations and grants, which would create a negative correlation between these two values not due to crowding out.

Instrumental variables regression is used to correct the endogeneity bias. This requires two separate sets of instruments: one to instrument for the level of government grants in the determination of private donations and one for the level of private donations in the determination of government grants. The literature provides numerous examples of the first set of instruments, since this direction of crowding out has been tested before. One such set of instruments consists of state-level measures of government transfers to individuals from SSI programs.[28] This represents the overall level of transfers and government giving in a state a particular year. Some states may be more "generous" in their giving, and these instruments should pick that up.[29] I also use the average level of government grants in a state in a year as a predictor.

As an instrument for the level of private donations, I use a measure of the price of a dollar of charitable donation based on the state's income tax and rules for allowing deductions of those contributions. From NBER's Taxsim program, I have the state and federal average marginal tax rate for each state and year in the sample.[30] I also have an indicator as to whether or not the state allows a deduction of charitable contributions for state income tax, as are allowed for federal taxes. From this, I construct a price of giving to charity. I expect that as this price increases, giving to charities in that state decreases,

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even more so. Thus, it appears that limiting the data in the above way tends to eliminate the smaller charities while keeping the larger ones. Performing econometric analyses on this limited sample may overemphasize the effect from larger charities.

[28] Khanna and Sandler (2004), Andreoni and Payne (2003), and Payne (1998) use similar instruments.

[29] Though the basic level of SSI benefits is set at the federal level, many states choose to supplement that value. I also used the level of OASDI benefits as instruments, but adding those had no effect on the results, and they were only available for four out of six years in the sample.

[30] See www.nber.org/~taxsim.

controlling for income, demographic, and political factors.[31] A second instrument for private donations is the fraction of a charity's expenditures devoted to fundraising. The more a charity spends on fundraising the higher its expected level of private donations.

The results for these instrumental variables, fixed effects model regressions are presented in Tables 2 and 3. Table 2 presents the results from regressions where private donations are the dependent variable and government grants are the regressor; Table 3 presents the results from regressions where these are reversed. The top panel in each table represents the regressions using environmental charities, and the bottom panel represents the regression using social service charities. Each panel of Table 2 has seven columns, one for each regression model employed. In the first column are the base case results, using the instruments described.

The coefficient of interest in the regressions in Table 2 is that of government grants. The theory is indeterminate about the sign of this coefficient. Absent government signaling of charity quality, it should be negative, indicating crowding out. Signaling can cause crowding in, making the coefficient positive. Table 2 indicates different results for environmental and social service charities. In the first column, the coefficient for environmental charities is insignificant, and the coefficient for the social service charities is positive. This is evidence for crowding in rather than crowding out, consistent with results found by Khanna and Sandler (2000) and Payne (2001). The two other categories of revenue, program service revenues and other revenues, are significantly positively correlated with private donations.

The model of crowding out depends on either governments or individuals being able to respond to the level of giving from the other. Thus, an effect of timing might not be captured entirely in this static model. Therefore, I also use lagged instruments in the first stage in column 2, and lagged values of the endogenous regressor in column 3. These changes do not alter the results by much.

It is possible that the effect of crowding out or crowding in as well as the other control variables and instruments are only applicable to a subset of the charities, for three reasons. First, while some of the controls and instruments are at the state-year level, not

[31] Randolph (1995), Auten, Sieg, and Clotfelter (1998) and Stuntz (2006) all find that the tax deduction significantly affects the amount of giving. Andreoni (2005) reviews this literature.

all of the charities operate only in the state in which they are registered. Many are national organizations that accept donations and possibly government grants from other states. For these charities, the instruments are unlikely to be good predictors. Though I cannot know for certain which organizations are national and which are local, column 4 excludes those whose names begin with "National," "American," or "North American." I also exclude organizations classified as support organizations under the NTEE taxonomy.[32] These organizations do not directly provide services but support organizations or individuals who do provide services through management and technical assistance, fundraising, and public policy analysis. Second, many of the charities receive no government grants throughout the entire six-year sample period, and many receive no private donations throughout the period. Such charities are likely not to receive such funding forms at all, even in response to a change in the other funding source, and thus I also exclude them from the regressions in later columns (5 and 7). Third, Table 1 indicates a great deal of skewness in the data. It is possible that the relatively few organizations with very large revenues behave differently and swamp the effects of the majority. Column 6 therefore eliminates from the regression those charities in the top decile of expenditures.

For environmental charities, in only one of these latter regressions is a significant coefficient for the main regressor found, but all of the coefficients are positive. For social service charities, limiting the sample in this way changes only the magnitude of the coefficient, and it remains significantly positive. Overall, Table 2 suggests that a dollar increase in government grants to a charity increases the charity's private donations by about 30 to 60 cents for social service charities. For environmental charities, no effect is found.

Table 3 presents the regressions in the opposite direction, where the level of government grants is the dependent variable and the level of private donations is the endogenous regressor. The instruments used for private donations are the price of a dollar of charitable donation and the fraction of a charity's expenses devoted to fundraising. Column 1 is the base case, columns 2 and 3 are with lagged regressors and instruments, and columns 4-7 limit the sample size as described above. For

[32] These are organizations whose last two digits of the NTEE centile code are less than 20.

environmental charities, the coefficient of interest is not significantly different from zero in any of the columns. For social service charities, this coefficient is negative in all of the columns. It is not significantly negative in columns 2 and 3, where the regressors are lagged one period, while it is significant at the 5% level in columns 1 and 4 and at the 1% level in columns 5-7. The coefficient magnitudes indicate that a one dollar increase in private donations to a charity decreases the charity's government grants by 10 to 40 cents.

These results are from separate regressions for each direction of causality. Efficiency may be gained by estimating the equations simultaneously. Using three-stage least squares (3SLS) is a readily available method of doing so. The advantage of 3SLS over equation-by-equation 2SLS is that the correlation among the error terms is captured with the simultaneous estimation method. However, though losing efficiency, 2SLS is better able to handle the panel nature of the data. Each of the regressions described above uses a fixed effects methodology to account for the unobserved charity-specific effect, an option not included in standard statistical software packages for 3SLS. To account for the charity-specific effect with 3SLS, I can simply add a dummy variable for each charity, which yields results identical to fixed effects regressions. Unfortunately, the large number of charities in the data set makes this option conflict with the computational limits of statistical software packages. If I look at only a small subset of the total number of charities, one that does not exceed the computational limits, then the results from 3SLS do not differ much from the results from 2SLS. This suggests that implementing 3SLS on the entire sample will yield results similar to those presented in Tables 2 and 3.

Though I cannot analyze the entire sample using 3SLS, I can disaggregate the sample and run separate regressions for each category of charity. As categorized by the NTEE, the environmental charity sample contains charities from 40 different types of organizations; the social service sample contains 145 different charity types. I run both the 2SLS and 3SLS regression on each type of charity separately. Because many categories contain only a small number of charities, most of these individual regressions result in coefficients of interest that are not significantly different from zero. For the categories with the largest number of charities, though, the results are consistent with what is shown in Tables 2 and 3. For environmental charities, almost all of the

regressions result in insignificant results. For social service charities, regressions from the largest categories of charities show that, in those categories, government grants crowd *in* private donations while private donations crowd *out* government grants. In the 3SLS regressions of the effect of government grants on private donations, 67 categories of charities show crowding in, while 52 show crowding out. Ten show significant levels of crowding in, and only five show significant crowding out. In the opposite direction, the effect of private donations on government grants, there is more evidence for crowding out than crowding in. 68 categories of charities show crowding out (four are significant), while only 51 show crowding in (two are significant).

Disaggregating the analysis into different charity categories above uses the same set of controls and instruments for each category of charity. In Tables 4 and 5, I select a particular category of charity and use instruments specific to that category to better identify the effect of private donations on government grants. The first instrument used here is the number of species listed as threatened or endangered under the Endangered Species Act (ESA), in a state-year. Listing a species is an early step in the process under the ESA. By listing a species, it becomes illegal to hunt or otherwise harm that species, but no governmental action is taken until possibly a critical habitat for the species is chosen. As of 1998, only 40% of listed species had designated critical habitat.[33] Therefore, listing a species is expected to have no direct effect on government grants to charities that deal with endangered species. However, having a new species listed nearby is likely to promote individuals to donate to charities that deal with that issue. Since the ESA is widely reported in the media individuals are likely to be aware of the new listings.[34] The instruments used are a count of the number of species listed as either endangered or threatened in each state in each year.

The NTEE classification system category "D31" covers charities that deal with "Protection of Endangered Species." Because only a few of these charities (14) appear in the data set in all six years, I also include charities from category "D30": Wildlife Preservation and Protection. These charities are also likely to be impacted by announcements of the listing of endangered species. The results from these regressions

[33] Brown and Shogren (1998).
[34] Hendrickson (2005).

appear in Table 4. Though the new instrument is expected to identify the effect of private donations on government grants, none of the coefficients on that regressor are significant. This may partly be due to the fact that so few charities fall into this category, especially in the columns that exclude the broader "D30" designation.

In Table 5, I use a different instrument for private donations that applies to a specific set of charities. The Toxics Release Inventory (TRI) is an EPA-sponsored program that publicly releases information on toxic chemicals emitted by individual plants. Businesses and government agencies self-report emissions, which are available on the EPA website.[35] The reported level of emissions does not relate to any regulatory power; they are reported simply to inform the public and allow individuals to make more informed decisions about how pollution impacts their health.[36] Because of this, reported TRI emissions are likely to impact private donations to charities that deal with industrial pollution but are unlikely to affect government behavior directly.[37] The NTEE category "C20" covers charities dedicated to "Pollution Abatement and Control"; in Table 5 the sample is limited to that subset. As with all of the regressions where the level of government grants is the dependent variable, few of the coefficients are significant. However, in columns 3 and 4, the coefficient of interest is of the expected sign (negative) and is close to being significant at the usual levels.

V. Conclusion

The effect of crowding out of private donations by government contributions, proposed in Warr (1982) and Roberts (1984), and extended to include a warm glow effect in Andreoni (1989, 1990), has had numerous empirical investigations. Many studies, including Kingma (1989) and Payne (1998) find significant evidence of partial crowding out. Other papers, including Khanna and Sandler (2000) and Payne (2001), find some evidence of crowding in of private donations. Though their results differ, most of these papers have several things in common: they use a relatively small sample of charities,

[35] http://www.epa.gov/tri/.
[36] Bui and Mayer (2003) test if changes in reported TRI emissions affect neighborhood house prices; they find no correlation.
[37] An alternative instrument might be to look at the county level attainment status of National Ambient Air Quality Standards.

they look at social service charities only, and they test for crowding out or crowding in only in one direction.

Here I extend that literature by looking at a large data set that includes most charities that file Form 990 with the IRS, which includes all non-religious charities with at least $25,000 in gross receipts. Because I attempt to instrument for private donations by announcements regarding endangered species and toxic emissions, I look separately at environmental and animal related charities, in addition to social service charities. The first main contribution is the theoretical and empirical examination of crowding out in the "opposite direction": private donations crowding out government grants. Theoretically, I show that the crowding out effect depends on whether the government or individuals make their contributions first. The second main contribution is showing that government grants can act as signals for charity quality, leading to crowding in. Empirically, I find evidence for both of these effects, but only among social service charities, not environmental charities.

This paper uses data from various types of public goods, but the results are important to environmental issues in particular. Both the regressions and the summary statistics show that, compared to social service charities, environmental charities behave in significantly different ways when it comes to finances. They get a lower fraction of their funding from government grants and a higher fraction of their funding from private donations. While the evidence presented here shows a significant relationship between government and private funding of social service charities, no such relationship is found for environmental charities. Since environmental charities behave so much differently than other types of charities, it is errant to extrapolate results found from other charities to environmental charities.

One reason for the insignificant results for environmental charities may be that by looking only at data from charities, I am unable to capture any other types of crowding out behavior that may be unrelated to the charities. For example, in response to an increase in government grants to environmental charities, individuals may not alter their contributions to charities, but instead alter their level of volunteering or recycling.[38]

[38] Simmons and Emanuele (2004) find that government grants crowd out donations of both money and time.

Similarly, governments may respond to an increase in private donations by decreasing funding to the EPA or other environmental activities besides the particular charity affected. This would bias downward my estimates of crowding out.

In addition, the only data I have on government contributions to these public goods are through grants made to nonprofit charities. Governments also provide public goods in other ways. According to White House audits, the total amount of federal grants to environmental charities in 2004 was $143 million, whereas the 2005 EPA budget totaled $7.8 billion. Much of the EPA's spending went to grants paid to states and tribal governments, which may in turn have used that federal money to pay grants to environmental charities. But it is clear that at least some and perhaps a large fraction of the money that government uses to provide environmental and social service public goods are provided in other ways besides grants to charities. How this effect may bias the results is unclear. If grants to charities are a constant fraction of government spending on public goods, then no bias exists, since the increase that I see in the data in government grants to charities corresponds to an increase in actual government provision of public goods. However, if the government substitutes nonprofit grants for other spending on public goods (so that when I see an increase in grants in the data, the actual government provision of public goods may have stayed constant or decreased), then the results may be biased.

It is clear that environmental charities and social service charities differ. As environmental issues, especially those related to climate change, grow in importance, the resources devoted to these issues will grow, and the nature of the interaction between public and private funding of environmental public goods is likely to change. There is currently much emphasis on expanding public-private partnerships in helping the environment.[39] This paper is an important first step in analyzing the interaction between those two sources of environmental protection. It is limited in that it only examines environmental non-profit charities, and how private donations and government grants to those charities are related. As other avenues for providing environmental public goods

[39] Massachusetts in 2003 created the Office of Public Private Partnerships within the Executive Office of Environmental Affairs to coordinate such efforts. The Bush Administration has long favored a voluntary approach to environmental regulation, where governments and private firms collaborate on achieving environmental goals.

grow, more questions arise as to the method that these goods shall be provided. Knowing how public and private funding of public goods are related is essential to their optimal provision.

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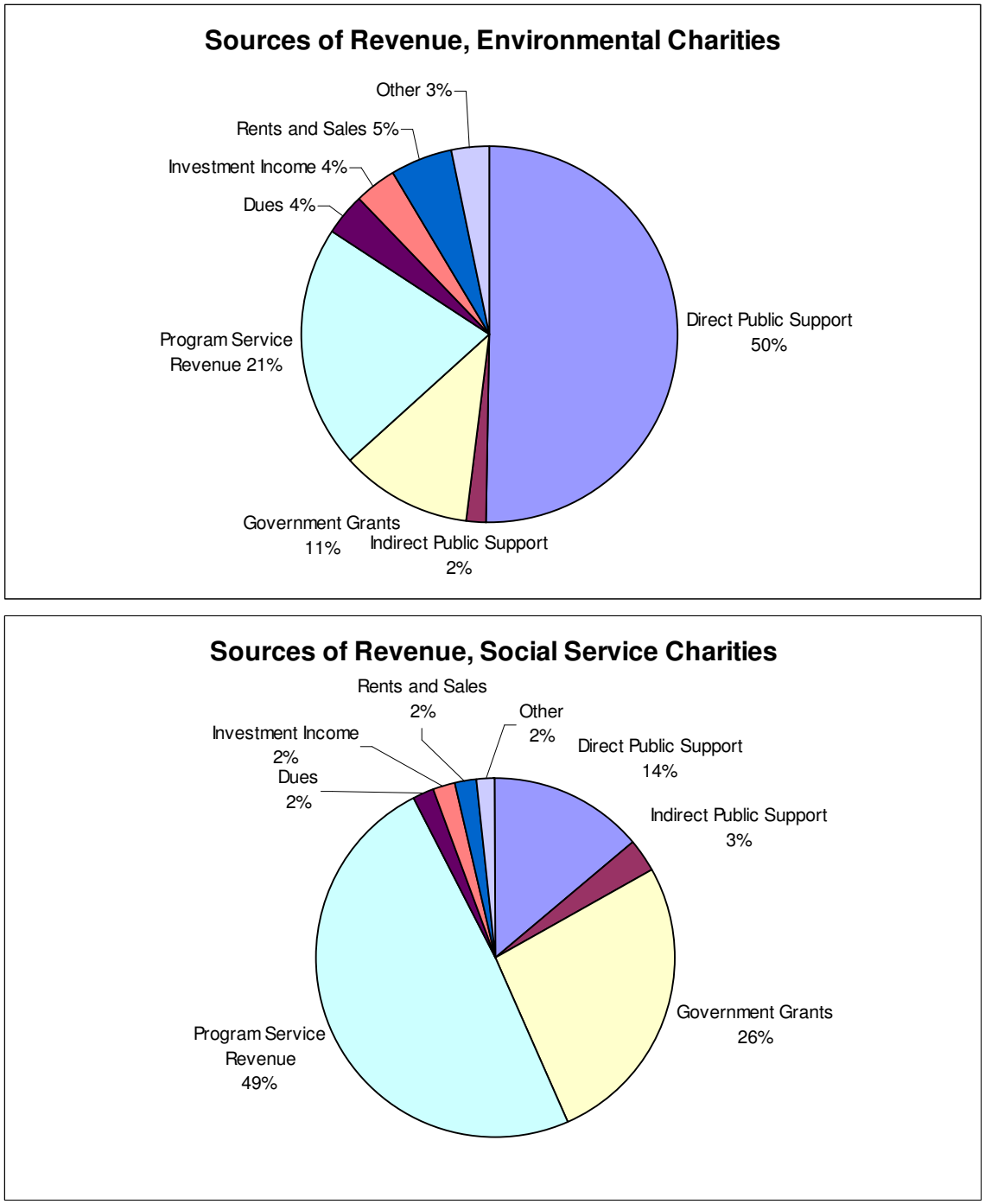
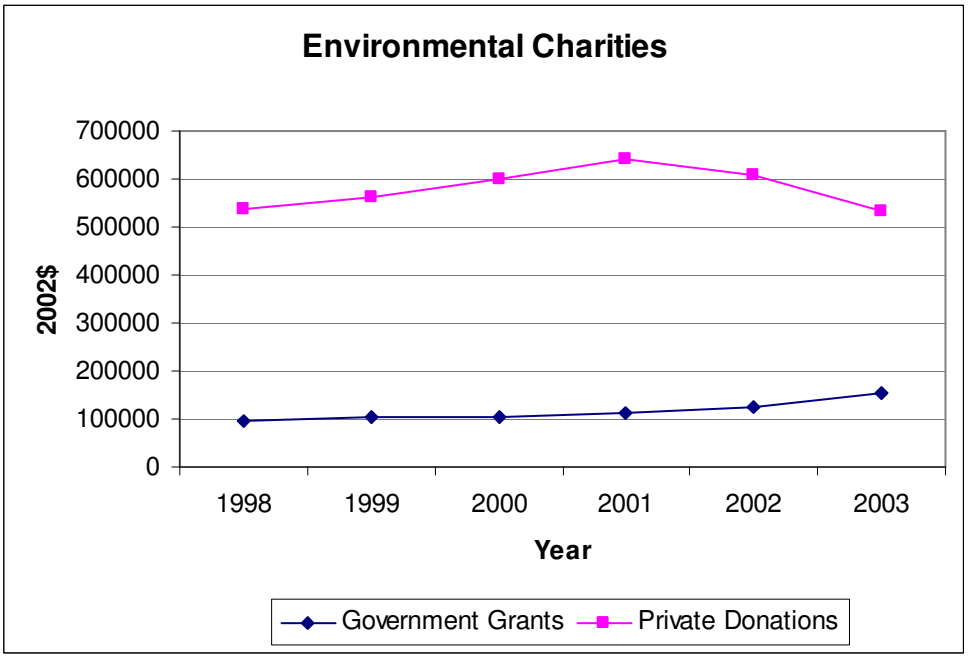
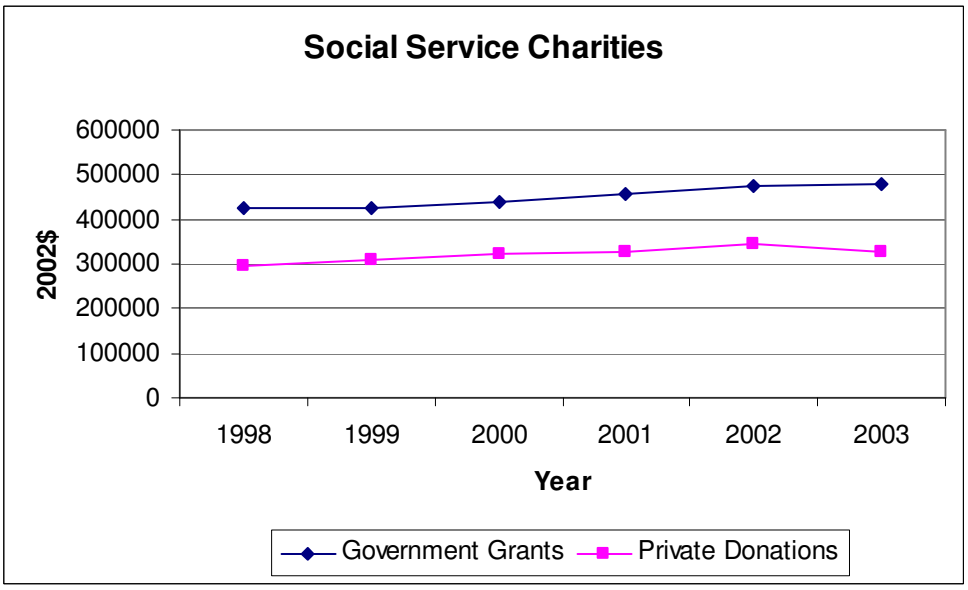
Figure 1



Notes: Environmental charities include those in NTEE codes C (Environment) and D (Animal-related). Social service charities include those in NTEE codes I (Crime and Legal-related), J (Employment), K (Food, Agriculture, and Nutrition), L (Housing and Shelter), P (Human Services), and S (Community Improvement and Capacity Building). Investment income includes interest and dividends; rents and sales includes securities and inventory; other includes special events revenues.

Figure 2





Notes: Environmental and Social Service charities are defined as in Figure 1. All dollar values are deflated by CPI.

Table 1

Summary Statistics – Charity Revenues						
	Number of Observations	Number of Organizations	Mean ($1,000s)	Standard deviation ($1,000s)	Median ($1,000s)	75th percentile ($1,000s)
Environmental Organizations	50,111	12,741				
Private Donations			543	6230	46	186
Government Grants			112	1074	0	0
Program Service Revenue			204	2654	1	48
Other Revenue			106	1542	6	30
Social Service Organizations	391,574	89,806				
Private Donations			322	4510	22	145
Government Grants			452	3243	0	103
Program Service Revenue			845	8774	34	303
Other Revenue			79	975	5	30

Notes: Data are averaged over 1998-2003 in constant 2002 dollars. Private donations include direct and indirect public support and dues. Other revenue includes interest, rents and sales.

Table 2

The Determinants of Private Donations [a]							
Environmental Charities	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Government Grants [b]	.265 (.177)	.209 (.476)	.148 (.204)	.427** (.145)	.122 (.107)	1.40 (1.41)	.439 (.730)
Program Service Revenue	.207** (.0188)	.215** (.0206)	.213** (.0203)	.169** (.0229)	.254** (.0269)	.0881 (.126)	.150 (.116)
Other Revenue	.0829** (.0164)	.120** (.0179)	.112** (.0182)	.129** (.0189)	.150** (.0241)	.144** (.0321)	.0590 (.0446)
F-test on significance of instruments in first stage regression (p-value)	22.07 (.000)	1.31 (.270)	14.64 (.000)	28.66 (.000)	27.42 (.000)	2.47 (.0603)	2.37 (.0682)
Number of Observations	16585	13823	13823	14349	7982	13407	5632
Number of Charities	2766	2766	2766	2400	1331	2389	1009
R^2	.0962	.107	.108	.0826	.1695	.0088	.0594
Social Service Charities	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Government Grants [b]	.423** (.0517)	.406** (.0853)	.377** (.0814)	.382** (.0488)	.287** (.0390)	.628** (.0753)	.327** (.0451)
Program Service Revenue	.0767** (.00963)	.0765** (.0156)	.0257** (.00533)	.0701** (.00848)	.104** (.0139)	.0879** (.0144)	.0894** (.0141)
Other Revenue	.00610 (.00457)	.0160** (.00512)	.0146** (.00498)	.00853 (.00473)	.00504 (.00748)	.0102* (.00466)	.0547** (.00715)
F-test on significance of instruments in first stage regression (p-value)	114.1 (.000)	42.34 (.000)	32.18 (.000)	113.32 (.000)	140.75 (.000)	96.73 (.000)	115.88 (.000)
Number of Observations	174209	145219	145219	162855	90238	151568	72616
Number of Charities	29096	29092	29092	27238	15053	26210	12654
R^2	.0150	.0165	.0159	.0187	.0310	.0045	.0126
For Both Types of Charities							
Lagged Instruments?	No	Yes	Yes	No	No	No	No
Lagged Endogenous Regressor?	No	No	Yes	No	No	No	No
Exclude National & Support Organizations?	No	No	No	Yes	No	No	Yes
Exclude Charities w/o Grants or Donations?	No	No	No	No	Yes	No	Yes
Exclude Top 10% of Revenue?	No	No	No	No	No	Yes	Yes

[a] Data are from 1998-2003 and only include those organizations that are in the panel for all six years and whose reported categorical revenues sum up to reported total revenues, and likewise for expenses. State-year level controls include population, per capita income, unemployment rate, fraction of individuals older than 65, number of Democratic senators, fraction of US House delegation Democratic, and an indicator for whether the governor is a Democrat.

[b] Instruments for government grants are the state-year average value of grants to charities, the state-year total payments paid to individuals through SSI, and the state-year payments paid to individuals through SSI for the aged.

Table 3

The Determinants of Government Grants [a]							
Environmental Charities	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Private Donations [b]	.228 (.130)	.212 (.162)	.200 (.201)	.177 (.153)	.213 (.494)	-.0911 (.116)	-.627 (1.07)
Program Service Revenue	.00480 (.0309)	.0113 (.0381)	-.00040 (0.0381)	.0377 (.0400)	.0494 (.111)	-.0946** (.0138)	-.122 (.0730)
Other Revenue	-.0102 (.0592)	.00653 (.0731)	-.0237 (.0462)	.0125 (.0865)	.0554 (.171)	.0110 (.0160)	.00310 (.0343)
F-test on significance of instruments in first stage regression (p-value)	6.19 (.0021)	0.17 (.841)	5.92 (.0027)	5.05 (.0064)	3.95 (.0193)	11.09 (.000)	17.15 (.000)
Number of Observations	16585	13823	13823	14349	7982	13407	5632
Number of Charities	2766	2766	2766	2400	1331	2389	1009
R^2	.0343	.0384	.0337	.0435	.0842	.0123	.000
Social Service Charities	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Private Donations [b]	-.203* (.0909)	-.0762 (.142)	-.0457 (.0894)	-.182* (.0810)	-.482** (.140)	-.135** (.0451)	-.254** (.0704)
Program Service Revenue	-.278** (.00306)	-.281** (.00386)	-.279** (.00230)	-.281** (.00278)	-.465** (.00487)	-.281** (.00406)	-.441 (.00654)
Other Revenue	-.0290 (.00553)	-.0306** (.00650)	-.0289** (.00515)	-.0239** (.00559)	-.0312** (.0107)	-.0121** (.00393)	.00214 (.00837)
F-test on significance of instruments in first stage regression (p-value)	71.38 (.000)	26.78 (.000)	65.34 (.000)	99.57 (.000)	42.9 (.000)	182.4 (.000)	144.4 (.000)
Number of Observations	174209	145219	145219	162855	90238	151568	72616
Number of Charities	29096	29092	29092	27238	15053	26210	12654
R^2	.0041	.0042	.0042	.0063	.0082	.0013	.0217
For Both Types of Charities							
Lagged Instruments?	No	Yes	Yes	No	No	No	No
Lagged Endogenous Regressor?	No	No	Yes	No	No	No	No
Exclude National & Support Organizations?	No	No	No	Yes	No	No	Yes
Exclude Charities w/o Grants or Donations?	No	No	No	No	Yes	No	Yes
Exclude Top 10% of Revenue?	No	No	No	No	No	Yes	Yes

[a] Data are from 1998-2003 and only include those organizations that are in the panel for all six years and whose reported categorical revenues sum up to reported total revenues, and likewise for expenses. State-year level controls include population, per capita income, unemployment rate, fraction of individuals older than 65, number of Democratic senators, fraction of US House delegation Democratic, and an indicator for whether the governor is a Democrat.

[b] Instruments for private donations are the calculated private cost of donations, based upon the state plus federal income tax rate and whether states allow charitable deductions, and the fraction of a charity's revenue devoted to fundraising.

Table 4

The Determinants of Government Grants, Wildlife/Endangered Species Charities [a]								
Environmental Charities	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Private Donations [b]	.347 (.263)	.610 (.626)	-.740 (2.41)	-.0683 (.222)	.527 (.375)	.567 (.407)	.971 (1.14)	.000954 (.338)
Program Service Revenue	.198 (.205)	-.108 (.366)	.428 (1.12)	.307 (.295)	-.114 (.118)	-.128 (.131)	-.00745 (.165)	-.353* (.165)
Other Revenue	.0527 (.0919)	.186 (.194)	-.173 (.506)	-.327 (.348)	-.124 (.0662)	-.128 (.0707)	-1.11* (.466)	.308 (.439)
F-test on significance of instruments in first stage regression (p-value)	.83 (.511)	.98 (.4265)	1.49 (.2583)	.41 (.794)	1.22 (.303)	1.39 (.236)	.28 (.888)	.48 (.747)
Number of Observations	84	78	36	25	480	462	204	144
Number of Charities	14	13	6	6	80	77	34	28
R^2	.127	.0643	.0463	.1787	.266	.262	.432	.0854
Category "D30" included?	No	No	No	No	Yes	Yes	Yes	Yes
Exclude National Organizations?	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Exclude Charities w/o Grants or Donations?	No	No	Yes	Yes	No	No	Yes	Yes
Exclude Top 10% of Revenue?	No	No	No	Yes	No	No	No	Yes

[a] Data are from 1998-2003 and only include those organizations that are in the panel for all six years and whose reported categorical revenues sum up to reported total revenues, and likewise for expenses. Only charities in categories D30 and D31 are included. State-year controls are identical to those in Tables 2 and 3.

[b] Instruments for private donations are the price of donations, the fraction of expenses given to fundraising, and the number of species listed as endangered or threatened in a given state that year.

Table 5

The Determinants of Government Grants, Pollution Abatement and Control Charities [a]				
Environmental Charities	**(1)**	**(2)**	**(3)**	**(4)**
Private Donations [b]	.191 (.408)	.115 (.399)	-.253 (.604)	-.931 (.614)
Program Service Revenue	.0643 (.0485)	.0677 (.0483)	-.0239 (.302)	-.0527 (.156)
Other Revenue	.179 (.213)	.196 (.213)	.903* (.372)	.627 (.775)
F-test on significance of instruments in first stage regression (p-value)	1.31 (.271)	1.30 (.275)	.55 (.651)	.27 (.848)
Number of Observations	444	432	228	170
Number of Charities	74	72	38	32
R^2	.0008	.0086	.168	.193
Exclude National Organizations?	No	Yes	Yes	Yes
Exclude Charities w/o Grants or Donations?	No	No	Yes	Yes
Exclude Top 10% of Revenue?	No	No	No	Yes

[a] Data are from 1998-2003 and only include those organizations that are in the panel for all six years and whose reported categorical revenues sum up to reported total revenues, and likewise for expenses. Only charities in category C20 are included. State-year controls are identical to those in Tables 2 and 3.

[b] Instruments for private donations are the price of donations, the fraction of expenses given to fundraising, and the total emissions reported in the TRI from sources in that state that year.