The Political Economy of Refunded Emissions Payment Programs

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Abstract

Lobbying by pollution firms is commonly viewed as having a negative impact on the stringency of environmental policy. We ask whether lobbying instead can bring about *stricter* environmental policy, and how imperfect property rights affect the policy outcome. We study the effects on the equilibrium pollution tax of refunding all tax payments to the polluting firms. Relatively clean firms may be induced to lobby for a *higher* pollution levy. However, this incentive declines when the property rights over the accumulated funds are insecure.

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I. INTRODUCTION

Environmental policy reform often faces stiff resistance from industry lobby groups. This paper analyses whether such lobbying may be weakened, or even *used* to encourage more stringent environmental taxes. In particular, we focus on refunded emissions payment programs (REPs), where the pollution tax proceeds are refunded to the collective of tax-paying polluters in proportion to their output shares (Sterner and Höglund, 2000).[1] Firms cleaner than average thus receive refunds larger than their tax payments, possibly more than enough to compensate for abatement costs. It follows that relatively clean firms may lobby for a *higher* pollution tax rate. For example, the Swedish REP program resulted in a relatively high tax rate, 40 SEK/Kg (currently 5,500 USD/ton), and a substantial reduction of nitrogen oxide (NOx) emissions.[2,3]

It is of interest to study the applicability of REP programs for those economies, including many non-OECD countries, where environmental policy reforms have been particularly slow. One important difference between industrialized and developing and transition economies is the degree of property rights. The intensity and direction of lobbying on the pollution tax may be dependent on the probability of tax payment refunding to firms, i.e. the level of property rights (degree of ownership risk) over these funds.[4]

In this paper, we study the political economy forces underlying REP programs. How do relatively clean and polluting firms change their lobbying behavior when an REP program is introduced?[5] Are REP programs feasible when property rights are incomplete? These issues are novel in the literature.[6]

We employ a lobby group model pioneered by Grossman and Helpman (GH) (1994).[7] Assuming the existence of an REP program, we model lobbying of two types of firms with different abatement

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[1] Sweden launched an REP program in 1992 to encourage NOx abatement in large combustion furnaces within the energy paper and pulp, steel and other sectors.
[2] Similarly, in the U.S. a tradable performance standard was used to phase lead out of gasoline. Average emission intensities are determined and allowances allocated based on output (Fischer, 2003).
[3] Policymakers often favor special “green” funds to collect environmental taxes, also in the developing and transition economies. Frequently (e.g., the French NOx tax) they are used to help finance abatement investments, the local EPA, or monitoring and research (Sterner, 2003).
[4] Deacon (1994) and Bohn and Deacon (2000) study the effects of property rights (ownership risk) on natural resource use.
[5] Earmarking also changes incentives. For recent discussions of earmarking of pollution tax revenues, see Brett and Keen (2000) and Marsiliani and Renström (2000).
[6] Fischer (2003) studies abatement behavior in a Cournot duopoly when emissions are taxed and output subsidized, but omits lobbying and incomplete property rights.

technologies. Property rights over the generated funds may be incomplete. The analysis shows that an REP program changes firms' lobbying incentives, and relatively clean firms may lobby for a *higher* pollution tax. However, incomplete property rights over tax funds mitigate lobbying incentives created by REP programs. Moreover, with an REP program, pollution levels fall as property rights become more complete.

II. THE MODEL

A small open economy has two sectors. The "clean" sector produces a numeraire good z, and the polluting sector produces a good x. Polluting firms are of 2 different types i: low-pollution-intensity firms (L) and high-pollution-intensity firms (H). The differences in pollution intensity may stem from (exogenous) differences in pollution abatement technologies. The economy is populated by consumers (S), owners of low-polluting factors and owners of high-polluting factors. The population is given by N. We assume that ownership of the factors is highly concentrated such that the factor owners' population share is approximately 0. All individuals have labor income. Factor owners in addition have income from sector-specific factor ownership. The consumers suffer disutility from local pollution. An individual k has preferences given by $U^k = c^{zk} + u^k(c^{xk}) - \delta^S(\theta^L X^L + \theta^H X^H)$, where c^{zk} and c^{xk} are consumption of goods z and x, with world and domestic prices equal to 1 and p^*, respectively.[8,9] $u(c^{xk})$ is a strictly concave and differentiable sub-utility function. δ^S equals 1 for consumers, 0 otherwise. Production of x by the L and H firms is given by $X^L(X^H)$, $\theta^L(\theta^H)$ is the per-unit pollution damage function, where $\theta^L < \theta^H$. The government regulates pollution with a pollution tax $t \in T$, $T \subset \Re$, on each unit of pollution, and t is identical for all firms. Subscripts denote partial derivatives. Damage is a function of the per unit of output abatement quantity by firm i, A^i, i.e. $\theta^i = \theta^i(A)$, where $\theta^i_A < 0$, and $\theta^i_{AA} > 0$, $i = L, H$. An individual k spending Y^k consumes $c^x = d(p^*) = u_c^{-1}$ and $c^{zk} = Y^k - p^* d(p^*)$. The indirect utility function of a consumer is $V^S(p^*, Y^S) = Y^S + C(p^*) - (\theta^L X^L + \theta^H X^H)$, where $C(p^*) = u[d(p^*)] - p^* d(p^*)$ is her consumer surplus.

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[7] Damania (2001), and Fredriksson and Svensson (2003), among others, apply the GH model to environmental policy.
[8] Corner solutions may result with quasi-linear preferences. We assume interior solutions, however.
[9] Since p^* is exogenous we abstract from terms of trade effects that are not the focus of this paper.

Each individual has a unit of labor, thus the total labor endowment equals *N*. Both goods are produced with constant returns to scale technologies. Good *z* is produced by labor alone with an input-output coefficient equal to 1. With a labor supply large enough for a positive supply of *z*, the wage rate equals 1. Good *x* production requires labor and a sector-specific factor. Type *i* firms' net price equals $p^i = p^* - t\theta^i(A^i) - A^i$ (ignoring labor costs), and the specific factor reward is given by $\pi^i(p^i)$. The FOC with respect to abatement equals $\partial\pi^i/\partial A^i = -X^i(t\theta_A^i + 1) = 0$, which implies $-\theta_A^i = 1/t$, assuming sufficiently small firms (the effects on refunds of abatement decisions are ignored). The FOC yields $\partial A^i/\partial t = -\theta_A^i/(t\theta_{AA}^i) > 0$. Hotelling's Lemma gives the supply curve, $X^i(p^i) = \pi_p^i(p^i)$, where $X_p > 0$, $X_{pp} > 0$. Since $\theta^L < \theta^H$, $X^L > X^H$. Aggregate tax revenues equal $R(t) = t\left[\theta^L X^L(p^L) + \theta^H X^H(p^H)\right]$.

With an REP program, the generated tax revenues are returned to firms based on their relative output levels. However, in countries with incomplete property rights, the accumulated funds may partially be captured (unlawfully) by politicians or bureaucrats. We represent the degree of property rights by an exogenous parameter $0 \le \mu \le 1$, reflecting the share of funds returned to the polluting firms.[10] To focus on the pollution tax determination, all appropriated funds (a share $1-\mu$) are assumed wasted (e.g. captured by bureaucrats outside the model), and do not raise the welfare of any agents included in the model.[11]

H and *L* type firms may have diverging political interests, and are we assumed to organize into separate lobby groups that coordinate prospective political gifts (contributions) to the government. Consumers are unorganized (see Olson, 1965). In stage one lobby *i* offers the government a gift schedule $\Lambda^i(t)$, *i*=*L*,*H*, relating a monetary gift to a policy *t*. In the second stage, the government sets its optimal policy, given the lobbies' strategies, and collects the two lobbies' political gifts.[12]

Both lobbies ignore consumer surplus since its members receive a negligible share. The gross-of-contributions objective function of lobby *i* equals

[10] Alternative interpretations of μ are that its the probability that REP funds are refunded according to the law.

[11] Firms have full property rights over their own profits, which are not handled by the REP administrative system.

$$\Omega^i(t) \equiv \pi^i(p^i) + \mu R(t) X^i \Big/ \sum_{j=L,H} X^j. \tag{1}$$

The government values monetary gifts and aggregate social welfare,

$$G(t) \equiv \Lambda^L(t) + \Lambda^H(t) + a\Omega^A(t), \tag{2}$$

where aggregate social welfare equals

$$\Omega^A(t) \equiv \sum_i \pi^i(p) + l + C(p^*) - N\theta X(p), \tag{3}$$

i.e. aggregate factor rewards (refunds included), labor income, consumer surplus, and disutility from pollution. In (2), the parameter *a* is the government's weight on social welfare relative to political gifts.

The subgame perfect Nash equilibrium in the well-known model by GH is found using two necessary conditions: (i) $t^\circ = \arg\max_t \sum_i \Lambda^{i^\circ}(t) + a\Omega^A(t)$ on T; (ii) $t^\circ = \arg\max_t [\Omega^j(t) - \Lambda^{j^\circ}(t)] + [\sum_i \Lambda^{i^\circ}(t) + a\Omega^A(t)]$ on T, for all *j*. Using conditions (i)-(ii) (see GH), the equilibrium pollution tax characterization equals

$$\sum_i \frac{\partial \Omega^i(t^\circ)}{\partial t} + a\frac{\partial \Omega^A(t^\circ)}{\partial t} = 0. \tag{4}$$

Differentiation of (1) and (2) with respect to *t* yields the effect of the pollution tax on *L* and *H* firms,

$$\frac{\partial \Omega^L(t)}{\partial t} = \underbrace{-\theta^L X^L}_{A} + \mu\left(\underbrace{\frac{dR}{dt}\frac{X^L}{X^L + X^H}}_{B} + \underbrace{\frac{R\gamma^L}{\left(X^L + X^H\right)^2}}_{C}\right), \tag{5}$$

$$\frac{\partial \Omega^H(t)}{\partial t} = \underbrace{-\theta^H X^H}_{D} + \mu\left(\underbrace{\frac{dR}{dt}\frac{X^H}{X^L + X^H}}_{E} + \underbrace{\frac{R\gamma^H}{\left(X^L + X^H\right)^2}}_{F}\right), \tag{6}$$

where $\gamma^j \equiv \theta^i X^j \left(\partial X^i / \partial p^i\right) - \theta^j X^i \left(\partial X^j / \partial p^j\right),\ \ j = L, H$. Note that $\gamma^L = -\gamma^H$. We make an assumption on the relative slopes of the supply functions of the two firms. **Assumption 1:** $\left(\partial X^L / \partial p^L\right) \le \left(\partial X^H / \partial p^H\right)$. From Assumption 1 it follows that $\gamma^L > 0$ and $\gamma^H < 0$. To simplify the exposition we also assume the following. **Assumption 2:** The equilibrium tax rate is on the left-hand side of the Laffer curve: $dR/dt > 0$.

[12] Neither the lobby groups, nor the government, are assumed to renege on their promises in the second stage.

Eqns. (5)-(6) show that the direct negative effect on both lobbies of *t* (terms *A* and *D*) is muted by the effect of REP refunding (terms *B*, *C*, *E*, and *F*). The positive term *B* reflects the change in refunds, given the output share of *L* firms. Term positive term *C* is the effect on refunds, taking into account the increase in the *L* firm's output share. If (5) is negative (positive), the *L* firm favors a lower (greater) pollution tax. Eqn. (6) has a similar interpretation as (5). However, note that since $X^H < X^L$, term *E* in (6) is smaller than term *B* in (5). Moreover, while term *F* is negative, term *C* is positive. Thus, terms *E* and *F* imply that the *H* firm is relatively more adversely affected by *t* under the REP program than the *L* firm.

Next, the effect of the pollution tax on social welfare equals:

$$\frac{\partial \Omega^A(t)}{\partial t} = -\theta^L X^L - \theta^H X^H + \mu \frac{dR}{dt} - \left(\frac{\partial \theta^L}{\partial A^L} \frac{\partial A^L}{\partial t} X^L + \frac{\partial \theta^H}{\partial A^H} \frac{\partial A^H}{\partial t} X^H - \theta^{L^2} \frac{\partial X^L}{\partial p^L} - \theta^{H^2} \frac{\partial X^H}{\partial p^H} \right). \quad (7)$$

Substituting (5)-(7) into (4) yields an explicit expression for the equilibrium characterization:

$$(\lambda^L + a)\overbrace{\left[-\theta^L X^L + \mu \left(\frac{dR}{dt} \frac{X^L}{X^L + X^H} + \frac{R\gamma^L}{\left(X^L + X^H\right)^2} \right) \right]}^{\underset{(?)}{A}} + (\lambda^H + a)\overbrace{\left[-\theta^H X^H + \mu \left(\frac{dR}{dt} \frac{X^H}{X^L + X^H} + \frac{R\gamma^H}{\left(X^L + X^H\right)^2} \right) \right]}^{\underset{(-)}{B}}$$

$$+ a \underbrace{\left(\theta^{L^2} \frac{\partial X^L}{\partial p^L} + \theta^{H^2} \frac{\partial X^H}{\partial p^H} - \frac{\partial \theta^L}{\partial A^L} \frac{\partial A^L}{\partial t} X^L - \frac{\partial \theta^H}{\partial A^H} \frac{\partial A^H}{\partial t} X^H \right)}_{\underset{(+)}{C}} = 0, \quad (8)$$

where λ^i, $i = L, H$, indicate lobby *i*'s political pressure. (8) reflects the three major forces on the pollution tax. Term *A* (*B*) reflects the political influence of the *L* (*H*) firm lobby. Term *C* is the welfare effect of the pollution tax on consumers. Since the welfare term *C* is unambiguously positive, the *sum* of terms *A* and *B* is negative. Since from (5) and (6) the effect of a tax increase is more negative for the *H* lobby, term *B* must be negative, i.e. the *H* lobby seeks a lower tax rate. However, term *A* may be positive.[13] Thus, with an

[13] Note that since $\gamma^H \equiv -\gamma^L$, the last partial terms in terms *A* and *B* cancel out. Thus, in the aggregate only the effect on total generated revenues determines the political pressure created by the REP program.

REP program, heavier pollution taxation may have two proponents: (i) the consumers (weighted by *a* by the government) who unambiguously benefit from a cleaner environment; (ii) if term *A* is positive, the *L* lobby (weighted by $(1+a)$ by the government) seeks a *higher* pollution tax, because it benefits sufficiently from the refunds to even outweigh its abatement costs. Potentially, an REP program thus creates a powerful constituency *in support of* a higher pollution tax. In this case, *L* firm lobbying neutralizes the lobbying efforts of the *H* firms, and the effect is a greater pollution tax in the political equilibrium. We thus have found that:

Result 1: *In equilibrium, firms with relatively low pollution intensity may lobby for a higher tax rate*.

We now compare (8) with the equilibrium pollution tax without an REP program. Tax revenues are now assumed distributed equally to all individuals (standard in the literature). We maintain $0 \le \mu \le 1,$ and both firms still lobby separately (for expositional purposes). The equilibrium characterization equals

$$\underbrace{-(\lambda^L + a)\theta^L X^L - (\lambda^H + a)\theta^H X^H}_{A} + a\left(\mu\frac{dR}{dt} + \theta^{L^2}\frac{\partial X^L}{\partial p^L} + \theta^{H^2}\frac{\partial X^H}{\partial p^H} - \frac{\partial \theta^L}{\partial A^L}\frac{\partial A^L}{\partial t}X^L - \frac{\partial \theta^H}{\partial A^H}\frac{\partial A^H}{\partial t}X^H\right) = 0. \quad (9)$$

Eqn. (9) suggests that without REP, both firms exert a compact resistance to the pollution tax as reflected by the unambiguously negative political pressure from the two lobbies, represented by term *A*. Instead, the consumers now benefit from the tax revenues. However, their weight in the government's maximization is only *a*, lower than the $(1+a)$ weight on revenues allocated by the government under the REP scheme. This applies particularly to those economies where special interests dominate to the detriment of general welfare, i.e. where *a* is low (see Fredriksson and Svensson, 2003). A comparison of (8) and (9) yields:

Result 2: *An REP program reduces the aggregate downward political lobbying on the pollution tax by the polluting firms*.

We now return to the REP program, in order to study the effect of incomplete property rights on the functioning of such a program.

Result 3: *In equilibrium, the pollution tax is increasing with the degree of property rights over tax revenues*.

Proof: Differentiation of (8) with respect to μ yields, after simplifications,

$$\frac{dt^{\circ}}{d\mu} = -\frac{(1+a)(dR/dt)}{D}, \qquad (10)$$

where D is the SOC of the government's maximization in (8), and is required to be negative. (10) is positive under Assumption 2. *Q.E.D.*

As property rights over the REP funds become less secure, the equilibrium pollution tax falls. This is due to the greater incentive to lobby against the pollution tax as a lower share of the collected funds are returned to the firms.[14] Result 3 implies the following.

Result 4: *In equilibrium, aggregate pollution emissions are decreasing with the level of property rights*.

Proof: Aggregate emissions are given by $(\theta^L X^L + \theta^H X^H)$. Differentiation yields

$$\frac{d(\theta^L X^L + \theta^H X^H)}{d\mu} = \left(\frac{\partial \theta^L}{\partial t} X^L - \theta^{L^2} X^L + \frac{\partial \theta^H}{\partial t} X^H - \theta^{H^2} X^H \right) \frac{dt^{\circ}}{d\mu}, \qquad (11)$$

which is negative under Assumption 2. *Q.E.D.*

Since REP programs are dependent on firm lobbying, environmental quality will suffer if such lobbying is reduced due to incomplete property rights.

III. CONCLUSION

Refunded emissions payment (REP) programs create new political incentives for firms and the government. In the aggregate, firm lobbying for a lower pollution tax is reduced, and relatively clean firms may even lobby for a *greater* pollution tax. However, these political economy effects are muted in countries with incomplete property rights. Incomplete property rights cause environmental quality to decline because polluting firm lobbying incentives are reduced.

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[14] This suggests that international organizations such as the World Bank, e.g., may have a role to play in strengthening the legal regime prior to the introduction of REP programs in developing and transition economies.

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