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Self-Regulation and Social Welfare: The Political Economy of Corporate Environmentalism

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Self-Regulation and Social Welfare: The Political Economy of Corporate Environmentalism

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WORKING PAPER SERIES NO. 122

**Self-Regulation and Social Welfare:
The Political Economy of Corporate Environmentalism**

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Self-Regulation and Social Welfare: The Political Economy of Corporate Environmentalism

Abstract

We model self-regulation as a means of preempting government regulation when regulatory standards are a function of interest group pressures. As an exemplary case, we focus on corporate environmentalism, *i.e.* voluntary pollution abatement. If it is sufficiently costly for consumers to organize, firms can preempt consumer entry into the political process through voluntary abatement. Unlike standard entry deterrence models, however, here a strategy of overinvesting to raise the rival's welfare in the event of entry successfully deters entry. Interest group politics produce weaker pollution regulation than is socially optimal, and voluntary abatement may lead to even less pollution control than the political process. Nevertheless, when the costs of influencing policy are included, if self-regulation occurs it is a Pareto improvement.

I. INTRODUCTION

"While some of the environmental changes now emerging in corporate America are genuine and welcome, a good many are superficial, some are downright diversionary, and a few are being specifically designed to preempt more stringent public policies from emerging."

Brent Blackwelder
Acting President
Friends of the Earth¹

"In an effort to head off legal restrictions on privately traded derivatives, six of Wall Street's biggest securities firms have agreed to voluntarily tighten their controls on the most hotly contested aspects of their derivatives sales and trading."

Wall Street Journal
March 9, 1995²

"In today's society any industry as conspicuous as the major home appliance industry is continually faced with the threat of government regulation. In my opinion, the only way to avoid government regulation is to move faster than the government. The alternative to government regulation is judicious self-regulation."

Herbert Phillips
Technical Director
Association of Home Appliance Manufacturers³

To most economists, "regulation" means restraints imposed upon firms by government. In many cases, however, firms voluntarily restrain their own conduct; they "self-regulate." When self-regulation involves restrictions on quantity or sales territory, the terms "cartel" and "collusion" are applied and antitrust investigation may be expected. A large body of economic literature is devoted to identifying when such activities reduce social welfare.⁴ Other forms of self-regulation, however, have received less attention from scholars and antitrust authorities. Examples include establishment of financial exchanges, licensing of professionals, setting of safety standards, control of entertainment content, and voluntary pollution abatement.

Self-regulation may have a variety of motives. It may increase consumer demand by reducing uncertainty about product quality or ensuring interoperability of the products of different firms. It may enhance employee satisfaction by improving the safety or other quality aspects of the workplace. It may

also serve more strategic purposes, such as softening competition or preempting stricter government regulations.⁵

In this paper, we model self-regulation as a means of preempting government regulation, examining the conditions under which preemption is possible and, if it occurs, its welfare consequences. We present our analysis in the context of "corporate environmentalism," *i.e.* voluntary adoption of cleaner products or processes, but it should be clear from the above examples that the basic story has broader applicability.

Corporate environmentalism is on the rise.⁶ America's "Big Three" automobile manufacturers have established a Vehicle Recycling Partnership to set labeling standards on plastic automotive components, facilitating recycling. In some cases the logging industry has switched from clear-cutting technology to more environmentally friendly selective-cutting methods. The Chemical Manufacturers Association (CMA) has recently put forward a set of environmental principles—which they call "Responsible Care"—that more than 170 member companies have agreed to abide by. The list goes on.

While industry's self-imposed standards by definition exceed current regulations, they may fall short of those that would have been mandated in the absence of corporate environmentalism. The Big Three's plastics labeling program falls short of the German program of automotive disassembly and reuse. Selective cutting in old growth forests is more environmentally friendly than clear cutting, but many argue that such forests should not be cut at all. The CMA's "Responsible Care" program may be used as a rationale for refusing to adopt more stringent environmental practices; according to Barnard, at least one CMA member—Union Carbide—has already done just that.⁷ Such considerations raise the question of how social welfare is affected when self-regulation preempts government action. This concern is likely to become increasingly important, since as Walley and Whitehead (1994) point out, "win-win" situations—in which pollution prevention raises both corporate profits and consumer well-being—are increasingly difficult to find.⁸

We model self-regulation and social welfare in a three-stage game where Cournot oligopolists face the possibility of stricter pollution abatement regulations. Following Becker (1983), we model these regulations as arising from a political influence game between consumers and firms, with consumers favoring stricter abatement regulations than do firms.⁹ Following Stigler (1971) and Peltzman (1976), we assume it is costly for interested parties to organize themselves to enter the political process and to influence policymakers once involved in the political process. In the first stage of our game, symmetric firms choose (possibly zero) levels of voluntary abatement. In the second stage, identical consumers observe the voluntary abatement activity and determine whether to enter the influence game; if they do so, they and the firms exert pressure on government for their desired level of regulations, and an abatement policy is determined. In the third stage, firms play a Cournot production game.

From a methodological viewpoint, our analysis extends the economic theory of regulation in two directions.¹⁰ First, by adding an initial stage of voluntary actions by firms, we allow for the possibility of strategic self-regulation that preempts government action. As a result, we obtain some striking parallels and contrasts with the standard industrial organization literature, which typically takes regulation as either exogenously fixed or as a set of controls to be optimized. Second, by modeling explicitly the dimension of product quality (in this case, pollution abatement), we can address directly issues of regulatory efficiency discussed only informally by Becker.

The key to our analysis lies in how voluntary abatement affects the outcome of the influence game. We show that if the influence game is played, voluntary abatement leads to a reduction in mandatory abatement. This occurs because voluntary abatement reduces consumers' incentives to lobby¹¹ while strengthening firms' incentives. However, the rate of substitution between mandatory and voluntary abatement is less than one-for-one. Thus, if the influence game is sure to be played, voluntary abatement is unprofitable for firms because it increases the ultimate level of abatement firms will be required to undertake.

We identify a range of consumer organizing costs for which firms can preempt the influence game by engaging in voluntary pollution abatement. This range is strictly larger when firms can collude in their self-regulatory efforts, rather than engaging in non-cooperative preemption. On either side of the range, voluntary abatement efforts will be unprofitable. If organizing costs are low, consumers cannot be preempted and voluntary abatement becomes a costly expenditure with no strategic benefit. If organizing costs are high enough, consumers are blockaded from the political process and abatement becomes an unnecessary expenditure.

We show that interest group rivalry (the influence game) produces weaker pollution regulations than is socially optimal. Somewhat disturbingly, self-regulation may generate abatement levels even further from the social optimum. In the absence of an omniscient social planner, however, a more relevant question is how self-regulation affects the welfare of firms and consumers relative to what they would have received had no self-regulation occurred.

We find that when the costs of influencing policy are included, *if* voluntary abatement occurs then it represents a Pareto improvement over the status quo. More importantly, social welfare under preemption also Pareto-dominates that which would have arisen from the influence game, had it been played. Firms, of course, will only preempt if doing so raises profits, but might consumers be made worse off than if—in the absence of self-regulation—they had lobbied for stiffer standards? The answer would be yes if self-regulation weakened consumers' threat to invoke the influence game. However, as we noted above, when firms self-regulate they raise the ultimate level of abatement that would result from the influence game. Should consumers choose not to fight when they have this advantage, they must benefit from being preempted.

Our analysis has two implications for public policy. First, it lends support to an antitrust policy allowing industries to coordinate on voluntary abatement strategies. Second, it raises questions about government financing of consumer intervention into the political process: if consumer involvement

becomes *too* easy, firms may eschew voluntary abatement, with the result that both they and consumers are worse off than when consumer involvement was difficult.

Before proceeding, we briefly contrast our paper with related work in the literature. Despite the ubiquity of self-regulation, the phenomenon has received little attention from economists. Four informative case studies appear in Caves and Roberts (1975), covering appliance manufacture, farm machinery, computers, and entertainment.¹² Abolafia (1985) offers a helpful overview of the phenomenon of self-regulation and discusses three case studies of financial exchanges. Pirrong (1995) argues that self-regulation is an inefficient way to reduce monopoly power in financial markets. Ayres and Braithwaite (1992) argue that voluntary self-regulation is unlikely to be effective when it involves actions that increase firms' costs, and instead propose a process of negotiation between government and individual firms that they term "enforced self-regulation." Formal modeling is even less common. Arora and Gangopadhyay (1991) present a model where firms voluntarily reduce emissions of pollutants to attract "green" consumers. Bagnoli and Watts (1995) perform a similar analysis, and show that voluntary reductions generally cannot achieve the socially optimal level of abatement. Arora and Cason (1995), in an empirical analysis of voluntary reductions of toxics emissions, find that "large firms with substantial toxic releases in unconcentrated industries" are the most likely to undertake voluntary abatement, but find no evidence that firms are using voluntary abatement to attract "green" consumers. In a more strategic vein, Braeutigam and Quirk (1984) and Lyon (1991) analyze models wherein a regulated firm voluntarily reduces its price to avoid a rate review that would cut rates even further.

The paper that is closest in spirit to ours is Glazer and McMillan (1992). They model an unregulated monopolist threatened with the possibility that legislators will impose price regulation of a predetermined stringency. Whether regulation will be imposed is uncertain because legislators incur a cost of introducing new legislation, and prefer to free-ride on the efforts of their colleagues. Under certain assumptions the threat of regulation induces the firm to price below the unregulated monopoly level. Our

model differs from that of Glazer and McMillan in several important respects. We consider an oligopolistic industry in which consumers have both price and non-price (*e.g.*, pollution) concerns. We model explicitly the incentives of interest groups (producers and consumers) to expend resources on lobbying for their preferred policies, and allow the stringency of regulations to be determined endogenously. While we characterize the conditions under which preemption will occur, we also assess the social welfare implications of regulatory preemption, and address policy questions about appropriate antitrust treatment of self-regulation and about government subsidy of consumer intervention in the political process.

Our results are related to the literature on entry deterrence.¹³ In a sense, our oligopoly invests in pollution control to deter "entry" by consumers to the influence game. Unlike standard entry deterrence models, however, here the "fat cat" strategy—where investment raises the rival's welfare in the event entry occurs—is effective in preempting entry.¹⁴ The reason is that in ordinary deterrence games staying out yields the potential entrant a fixed reservation level of profits. Here, in contrast, consumers' utility of staying out of the influence game rises as firms invest. Welfare-enhancing preemption is possible because as voluntary abatement increases, consumers' utility of staying out rises faster than the utility of entering.¹⁵

The remainder of the paper is organized as follows. Section II presents the model. Section III analyzes the conduct of firms and of consumers, while section IV establishes welfare results and explores policy implications. Section V concludes and discusses directions for future research. All proofs are presented in the Appendix.

II. THE MODEL

In this section we present a three-stage model of voluntary pollution control. We view pollution control costs as continuous in nature, thus being amenable to traditional marginal analysis techniques.¹⁶

For simplicity, we assume symmetric firms and we do not discount payoffs over time. The sequence of moves in the model is as follows. First, firms choose a level (possibly zero) of voluntary pollution control that is assumed to be binding.¹⁷ For example, it could be built into the production technology, or firms could sell a conservation easement to an environmental group (e.g., the group buys the right to dictate a production technology to the firms, such as selective rather than clear-cut logging), or irrevocably link their image to voluntary abatement through advertising. Second, firms and consumers (who receive utility from the good but disutility from pollution) engage in interest-group rivalry for the purpose of influencing pollution control policy.¹⁸ Third, after pollution control policy has been determined, firms produce and sell output in a Cournot oligopoly. As is standard in multistage games, subgame perfection is achieved by solving the model in reverse chronological order. Hence the exposition below is presented from a backward-induction perspective.

Stage 3: Output Market Equilibrium

Production occurs in the last stage of the game following voluntary pollution control by firms and any additional mandatory pollution control generated from the political process. As in Besanko (1987), we consider a situation in which N^f identical firms engage in Cournot-style quantity rivalry in an industry featuring pollution externalities.¹⁹ Firm i chooses an output level q_i , and the firms face industry demand curve $P(Q)$, where $Q = \sum q_i$; we will also use the notation $Q_{-i} = \sum_{j \neq i} q_j$. Firms install a pollution control input, in the amount Z , which is the sum of a voluntary choice Z^v from stage 1 and mandatory control level Z^m from stage 2 of the game.²⁰ Firms are then confronted with per-unit output cost $c(Z)$ that is constant with regard to output, and a fixed capital cost $k(Z)$, both of which are increasing and convex in Z . In order to focus on the strategic aspects of voluntary abatement, we assume the costs of self-regulation and

government regulation are equal, and are only a function of Z . Given Q_{-i} , firm i 's problem is to

$$\max_{q_i} [P(Q_{-i} + q_i) - c(Z)]q_i - k(Z). \quad (1)$$

In the symmetric Cournot-Nash equilibrium, firms have equal outputs, defined by

$$q_i^* = -\frac{[P(Q^*) - c(Z)]}{P'(Q^*)}, \quad (2)$$

aggregate quantity traded is $Q^* = N^f q_i^*$, and the market clearing price is $P(Q^*)$. Henceforth we shall drop the subscript " i ," as in equilibrium all firms are identical. There should thus be no confusion in proceeding to use subscripts to indicate derivatives. Equilibrium earnings per firm, given Q^* , are $\pi^N(Z)$, where the superscript " N " indicates no influence costs are included at this stage. Note that our convexity assumptions on costs imply $\pi_Z^N = -c_Z q^* - k_Z < 0$ and $\pi_{ZZ}^N = -c_{ZZ} q^* - k_{ZZ} < 0$.

Stage 2: Influence Game

Following Becker (1983) we model pollution-control policy as the outcome of rival "influence inputs" being transformed through political institutions. For example, political institutions determine the extent of permissible lobbying activities and election campaign contributions, and tolerated forms of bribery such as revolving-door arrangements, junkets, and honoraria. In our influence game there are two interest groups, each made up of a number of identical agents. The interest groups differ in terms of their desired policy outcomes. These interest groups then engage in rivalry by investing resources in "pressure" activities that act as inputs in the policy production process.

In our model, one interest group is made up of the N^f firms whose costs are increased by additional pollution-control restraints, while the other is made up of N^c consumers who purchase the good produced by the firms and who also have disutility over pollution emitted by the firms. All individuals and

firms allocate influence inputs noncooperatively.²¹ Firms, if they enter the influence game, always attempt to influence policy makers to reduce mandatory pollution control (the per-firm resources they allocate for this purpose are referred to by the variable l).²² While consumers care about their consumer surplus from buying the good produced by firms, and thus oppose higher prices, they also have disutility over pollution. Thus it is possible for firms to choose a level of voluntary abatement sufficiently high that consumers would actually prefer less than the voluntary level of pollution control. This is never profitable for firms, however, as they could achieve the same result without incurring the costs of political influence. As a consequence, we are left with a situation in which consumers—if they enter the political process—always allocate resources (in the amount of m per person) to influence policy makers to choose more pollution control.

Following Stigler and Peltzman, we assume that consumers wishing to influence the process of policy formation must bear in the aggregate a fixed cost $F(N^c)$; each of the identical consumers then bears a cost $f(N^c) = F(N^c)/N^c$ if the consumer group enters the influence game.²³ In the present context, individuals must inform themselves of the implications of pollution control for their well-being,²⁴ and of the efficacy of various feasible policy remedies. Individuals of similar interests must then coordinate on a mutual lobbying strategy. We will refer to these various costs collectively as organizing costs. Firms face similar tasks, which again make organizing costly. However, firms' organizing costs are typically less than those of consumers, since assessing the costs of regulation to the firm is usually much easier than assessing the health and aesthetic benefits to consumers, and the number of firms in an industry is typically very small relative to the number of consumers. Without loss of generality, then, we normalize firms' cost of organizing to zero.

Since the N^f firms are identical, aggregate firm resources allocated to political pressure are $L = N^f l$. Similarly, the N^c consumers devote $M = N^c m$ aggregate resources to pressure activities if they choose to incur the fixed cost of entering the political process. These aggregate resources are transformed

into influence through a process that features diminishing marginal returns. For example, each additional dollar generates a smaller increase in lobbyist effectiveness than the previous dollar spent: policy makers have a finite amount of time and resources to devote to a particular issue. The amount of influence generated by a given group's lobbying expenditures is represented by the function $I(\cdot)$, which takes on positive values as a function of m and (symmetrically) negative values as a function of l . That is, $I(0) = 0$, $I(L) < 0$, $I_L < 0$, and since this process experiences diminishing marginal returns $I_{LL} > 0$; similarly, $I(M) > 0$, $I_M > 0$, and $I_{MM} < 0$.

We adopt a neutrality assumption that negative influence $I(L)$ and positive influence $I(M)$ determine policy in an equally-weighted way. In particular, neutrality means that mandatory pollution control $Z^M[I(L)+I(M)]$ is a function of the unweighted sum of $I(L)$ and $I(M)$. (Then $Z[I(L)+I(M)] = Z^V + Z^M[I(L)+I(M)]$ is also a function of the sum of the influence inputs.) We assume $Z_I > 0$ and $Z_{II} < 0$.

(We will often suppress the dependence of Z on influence for notational ease.) Our convexity assumption means that it becomes increasingly difficult for one interest group to move a policy maker in one particular direction, as the policy maker can generally be expected to have constituencies with diverse needs and interests that he must also serve. Clearly, $Z_I = Z_I I_I < 0$. We shall also assume that

$$Z_{II} = (Z_I I_I)^2 + Z_I I_{II} > 0, \text{ so the returns from lobbying are diminishing; similar assumptions are made for}$$

consumers.

Consider a representative firm's optimization problem in the influence game. Given the influence choices of the other parties, it must choose influence input l to maximize:

$$\pi^N(Z[I(L)+I(M)]) - I. \quad (3)$$

Note that $\pi^N(Z)$ in equation (3) has already been optimized with regard to q , and so reflects the equilibrium output vector from the oligopoly output game. Thus, while resources invested in influencing Z^M have a direct effect on $\pi^N(Z)$ through unit cost $c(Z)$, from the envelope theorem their indirect effect on profit through q^* is zero. A firm's optimal choice of I is given by the following equation:

$$\pi_Z^N Z_I I_I = 1. \quad (4)$$

Since all firms are identical, equation (4) determines $I(L^*)$, where $*$ denotes an equilibrium value.

Consumers are utility maximizers, and choose their per-person lobbying expenditures m independently. Utility falls as the price of the good rises and as the total amount of pollution in the environment increases. Since firms are symmetric, we let $d = f(Z, q)$ be the total environmental degradation caused by an individual firm, and $D = D(N^f, Z, q)$ be the total amount of degradation. Recognizing that q^* is chosen by firms in stage 3 and that the number of firms is fixed, we suppress the dependence of D on q and N^f , and the total welfare of a consumer²⁵ is then

$$U^N(P(Z), D(Z)) - m. \quad (5)$$

A consumer's optimal choice of m is given by the following equation:

$$[U_P^N P_Z + U_D^N D_Z] Z_I I_m = 1. \quad (6)$$

We adopt the shorthand notation $U^N(Z) \equiv U^N(P(Z), D(Z))$ and write

$$U_Z^N = \frac{dU^N}{dZ} = \left[\frac{\partial U^N}{\partial P} \frac{\partial P}{\partial Z} + \frac{\partial U^N}{\partial D} \frac{\partial D}{\partial Z} \right] \quad (7)$$

and we assume $U_{ZZ}^N < 0$; note that U_Z^N is initially positive, but declines and so can become negative.

Then (6) can be rewritten as $U_Z^N Z_I I_m = 1$. As with firms, the N^c consumers are identical, so equation

(6) determines $I(M^*)$, where $*$ again denotes an equilibrium value.

Equations (4) and (6) generate reaction functions for firms and consumers in the influence game. Recognizing that the firms' lobbying decisions depend on Z^v , let $l(m, Z^v)$ and $m(l, Z^v)$ represent the reaction function of a firm and consumer respectively. It is straightforward to show that the reaction functions are upward sloping, indicating that lobbying expenditures are strategic complements.

Stage 1: Voluntary Pollution Control

Prior to the interest group rivalry process that generates pollution-control policy, firms can choose a level (possibly zero) of voluntary pollution control. Firms are assumed to be capable of anticipating the implications of voluntary pollution control for both the outcome of the policy formation process and for oligopoly equilibrium profits. In what follows, we often write $Z(Z^v)$ to emphasize the dependence of the ultimate level of pollution control on the firms' initial choice of Z^v . Similarly, we write $l^*(Z^v)$ and $m^*(Z^v)$, suppressing the dependence of the equilibrium lobbying levels on the rival's lobbying level. We assume that $Z(0) > 0$, which avoids the uninteresting case in which the external costs of pollution to consumers are too small to generate any legislative requirements for pollution control. Firms thus choose Z^v to maximize the following equilibrium profit function:

$$\pi^f(Z^v) = \pi^N(Z(Z^v)) - l^*(Z^v) \quad (8)$$

where the superscript I indicates that profits are measured net of influence costs. We also denote consumer utility, net of influence costs, by $U^I(Z^V) = U^N(Z(Z^V)) - m^*(Z^V)$.

III. CONDUCT OF FIRMS AND CONSUMERS

In this section, we analyze the behavior of firms and consumers in the model presented above. We are particularly interested in the question of when voluntary abatement is profitable. We begin by establishing how the choice of Z^V affects $\pi^I(Z^V)$, both directly, and indirectly through $Z(Z^V)$ and $l^*(Z^V)$.

Taking the partial derivative of equation (8) with respect to Z^V , and substituting in for π_Z^N yields

$$\frac{d\pi^I}{dZ^V} = [-c_Z q^* - k_Z] \left[1 + \frac{dZ^M}{dZ^V} \right] - \frac{dl^*}{dZ^V}, \quad (9)$$

which in turn depends on

$$\frac{dZ^M}{dZ^V} = Z_I \left[I_l \frac{dl^*}{dZ^V} + I_m \frac{dm^*}{dZ^V} \right] \quad (10)$$

Our concern is to determine when equation (9) has a positive sign. Propositions 1 and 2 address this question, first for the (counterfactual) case where consumers can organize costlessly and then for the case where organization is costly. Prior to Proposition 1, however, we present a lemma showing how the level of pressure by consumers and firms responds to voluntary abatement.

Lemma: *If the influence game is played, the equilibrium level of resources each firm (consumer) devotes to lobbying is positively (negatively) related to the level of voluntary abatement, i.e. $dl^*/dZ^v > 0$ and $dm^*/dZ^v < 0$. Thus, when voluntary abatement increases, the equilibrium level of mandatory abatement is reduced.*

Figure 1 illustrates the change in consumer and firm reaction functions in response to an increase in voluntary abatement. Functions superscripted with a 0 represent reaction functions when the level of voluntary abatement is zero, while those represented with a + superscript are reaction functions resulting from a positive level of voluntary abatement. With positive voluntary abatement, a consumer's reaction function shifts downward, reflecting a reduced marginal value of further emissions control. At the same time, a firm's reaction function shifts outward, reflecting a higher marginal cost of further control. Note, however, that a firm's reaction curve rotates about the origin because—regardless of the level of voluntary abatement—its optimal response to a zero level of lobbying expenditures from consumers is to do likewise. This reflects the constraint that firms are not allowed to become “dirtier”. Consumers do not face this constraint, and in our model they will lobby even if firms do not.

Since voluntary abatement induces firms to expend more lobbying resources, it cannot be profitable unless the total level of abatement falls. In proposition 1, however, we show that in the absence of fixed organizing costs for consumers, the level of *total* abatement increases despite the fact that the level of *mandatory* abatement falls.

Proposition 1: *If consumers can organize costlessly, voluntary pollution control is never profitable.*

Although voluntary abatement leads to a reduction in mandatory abatement, the reduction is less than one-for-one. The lemma shows that with voluntary abatement, consumers devote fewer resources to

influence, implying that the marginal influence from a dollar spent by consumers (I_I) is high. It also shows that when firms undertake voluntary abatement, the net influence $I(M) + I(L)$ is lower at the new equilibrium. Diminishing returns to influence means that after voluntary abatement, the marginal impact of additional influence (Z_I) is greater than it would be in the absence of voluntary abatement. Consequently, with voluntary abatement, the impact on pollution control of the marginal dollar spent by consumers ($Z_I I_I$) is increased. First-order condition (6) requires that $U_Z^N Z_I I_I = 1$, so the marginal benefit

of abatement U_Z^N must fall, which can only happen if voluntary abatement increases total Z . As a corollary, when consumers can organize costlessly they will always enter the political process, and firms will not voluntarily engage in abatement activities – it is not profitable. The question remains, however, whether voluntary abatement activities can be profitable when consumers are confronted with fixed costs of entering the political influence process. We turn now to this issue.

U.S. antitrust law makes illegal all collusive attempts to restrict sales quantity or raise price. To the best of our knowledge, however, these laws do not preclude firms from choosing cooperative levels of voluntary pollution abatement, and in fact, firms often use trade associations to self-regulate via uniform product and production standards. Proposition 2 establishes conditions under which firms' profits can be enhanced by cooperative voluntary pollution abatement that preempts mandatory controls.

Proposition 2: *There exists a range of consumer fixed costs of organizing on which a perfectly collusive oligopoly chooses a positive level of voluntary abatement and thereby preempts consumer intervention in the regulatory process. Let $[f_{Z^*}, f_{blockade}]$ be this range. Then $f_{Z^*} > 0$, and for*

$f_{Z_{\max}^V} < f(N^c) < f_{\text{blockade}}$ the firm's choice of Z^V is decreasing in $f(N^c)$; for $f(N^c) > f_{\text{blockade}}$, consumer

intervention is "blockaded," i.e. preempted with $Z^V = 0$.

An example of preemption is given in Figure 2. The figure illustrates both industry profit and consumer utility as functions of the level of voluntary abatement. The right hand side of the figure exhibits the range of feasible choices of voluntary abatement for the industry, namely $[0, Z_{\max}^V]$. If firms

undertake no voluntary abatement, they earn $\pi'(0)$; as shown in Proposition 1, this is the firms' optimal

level of self-regulation if consumer political action cannot be prevented. Preemption—if successful—is

profitable as long as $\pi^N(Z^V) \geq \pi'(0)$, which is true for $Z^V \leq Z_{\max}^V$. If the industry could preempt the

influence game at a level $Z^V > Z_{\max}^V$ it would prefer not to make such a choice,

i.e. $\pi'(0) > \pi^N(Z) \quad \forall Z > Z_{\max}^V$.

The left-hand side of figure 2 illustrates the effect of $f(N^c)$ and Z^V on the representative consumer's decision to enter the influence game. Should the consumer choose *not* to engage in the influence game, he receives utility level $U^N(Z^V)$. The same consumer receives $U^I(Z^V)$ should he choose to engage in the influence game; we define this utility as *net* of lobbying dollars $m(Z^V)$, but *gross* of the fixed costs, $f(N^c)$, associated with the influence game.

We assume that if $Z^V = 0$ consumers—in the absence of organizing costs—will lobby for abatement, i.e., $U^I(0) > U^N(0)$. In addition, for large enough Z^V , $U^I(Z^V) < U^N(Z^V)$, and consumers prefer not to enter the influence game, even if it is costless to do so. To see this, recall that voluntary abatement does not perfectly substitute for mandatory abatement, so there must exist some fixed point $Z^* = Z(Z^*)$, such that the influence game leaves Z^* unchanged. If the firms voluntarily abate to this level, the influence game—if initiated—will only result in lobbying dollars wasted for both firms and consumers. Since $m(Z^*) > 0$, $U^N(Z^*) > U^I(Z^*) = U^N(Z^*) - m(Z^*)$.²⁶

Increasing consumer organizing costs shift downward the net utility, $U^I(Z^V) - f(N^C)$, consumers obtain from entering the influence game. Suppose firms undertake the maximum profitable level of voluntary abatement Z_{\max}^V . Then let $f_{Z_{\max}^V}$ be the fixed cost at which consumers—given Z_{\max}^V —are

just indifferent between entering the influence game and staying out. For $f(N^C) < f_{Z_{\max}^V}$, the industry will

find it more profitable to choose $Z^V = 0$, and engage in the influence game. If fixed costs increase further,

say to $f_{\bar{Z}}$ the industry must select $Z^V = \bar{Z}$ in order to preempt the influence game. If fixed costs are

large enough, i.e. $f(N^C) \geq f_{\text{blockade}}$, consumers will decide not to lobby even if $Z^V = 0$; in this case we

say that entry is blockaded. The relationship between the industry's optimal choice of Z^V and the level of fixed costs faced by consumers is given in figure 3.

While firms may be able to preempt collusively, it is not obvious that preemption is possible when firms must select voluntary abatement levels noncooperatively. The following proposition addresses this issue. While a continuum of asymmetric preemption equilibria exist, we choose to focus on symmetric

equilibria for simplicity and clarity.

Proposition 3: *Symmetric preemption by a noncooperative oligopoly is possible for*

$$f(N^c) \in [f_{z_{NC}}^v, f_{blockade}], \text{ where } f_{z_{NC}}^v < f_{z_{max}}^v.$$

When the firms cannot coordinate on voluntary abatement, free-riding occurs. At the collusive level of voluntary abatement, any given firm prefers to eschew voluntary abatement and allow the influence game to occur. By so doing, it enjoys at no cost the reduced level of mandatory abatement made possible by its rivals' voluntary abatement activities. As a result, the collusive level of voluntary abatement cannot be sustained as a non-cooperative equilibrium.

The threat of mandatory abatement in the second stage of the game will still support an equilibrium with some degree of non-cooperative preemption. For small enough voluntary abatement levels, firm i is willing to match or exceed the levels undertaken by the other firms, assuming its action will preempt consumers. Thus preemption will still occur for large consumer fixed costs, but there are some low levels of $f(N^c)$ for which preemption would have occurred collusively but not non-cooperatively, i.e.

$$f_{z_{NC}}^v < f_{z_{max}}^v. \text{ Our results in Proposition 3 contrast sharply with those of Gilbert and Vives (1986) and}$$

Donnenfeld and Weber (1995), who find that oligopolies have incentives to provide excessive levels of output or quality when engaging in entry deterrence. The key difference is that in those models, firms derive private benefits from contributing to the "public good" of entry deterrence, while in our model contributions carry private costs but not private benefits.

One might think that as the number of firms, N^f , increases, growing free-rider problems would

make preemption more difficult. In our model, however, whether preemption occurs depends upon two factors: 1) the firms' ability to coordinate sufficient voluntary abatement ("supply"), and 2) the level of voluntary abatement required to preempt consumer entry into the political process ("demand"). The "supply" of preemption falls with N^f , since free-rider problems plainly worsen. The "demand" for preemption, however, depends on the mandatory abatement level determined in the influence game, which may either rise or fall with the number of firms. Put another way, if the influence game does occur, aggregate lobbying activity by firms and by consumers is ambiguously affected by N^f .²⁷ The empirical work of Arora and Cason (1995) suggests that the "demand" effect dominates, since they find voluntary abatement is more likely to occur in unconcentrated industries.

To sum up, the results of this section show that firms will not engage in preemptive pollution abatement when consumers can mobilize costlessly. In this case, since voluntary and mandatory abatement are imperfect substitutes, preemption is unprofitable. On the other hand, if it is sufficiently costly for consumers to organize themselves, firms can profitably preempt, taking advantage of the wedge that organization cost drives between voluntary and mandatory abatement. The threshold level of consumer organizing costs at which preemption becomes profitable is higher when firms act non-cooperatively than when they coordinate on voluntary abatement.

IV. WELFARE IMPLICATIONS

In this section, we assess welfare from two perspectives. First, we establish a benchmark for the socially optimal amount of pollution control and compare it against the outcome of the influence game; we then examine whether self-regulation results in a move toward the social optimum. Second, we examine the more limited, but perhaps more important, question of whether voluntary pollution control Pareto-dominates the outcome of the influence process when there is no voluntary abatement.

A welfare maximizing social regulator would choose Z to maximize

$$N^f \pi^N(Z) + N^c U(Z) \quad (11)$$

yielding

$$\frac{\pi_Z^N}{U_Z} = -\frac{N^c}{N^f} \quad (12)$$

On the other hand, equations (4) and (6) imply that the equilibrium of the influence game is characterized by²⁸

$$\frac{\pi_Z^N}{U_Z} = \frac{I_m}{I_l} \quad (13)$$

The social optimum, given by (12), differs in two ways from the equilibrium of the influence game. First, the welfare maximum weights firms and consumers equally. As a result, equation (12) does not include the relative impact of lobbying expenditures, unlike the equilibrium result shown in (13). Because the effectiveness of lobbying is subject to diminishing returns, the group that spends more on lobbying will be worse off in the influence game than in the welfare maximum. Second, the welfare maximum reflects the relative number of firms and consumers (as can be seen in the right-hand side of (12)), but the equilibrium result does not.²⁹ The reason for the second difference is that the influence game reflects our assumption that all players make their influence decisions non-cooperatively. Thus, each consumer or firm equates the last dollar of lobbying expenditures to his own individual marginal benefit from a change in the level of abatement. The effects of that marginal expenditure on other parties are ignored, however, so free-rider effects distort the equilibrium away from the welfare maximum. Free-rider problems increase with the number of members in an interest group, so relative to the welfare maximum, the influence game is biased toward the group with the smaller number of members.

It is important to note that both effects—diminishing returns to lobbying and free-rider problems—

work against consumer interests. We focus on the case where without voluntary abatement consumer involvement leads to some regulatory requirement for pollution control, *i.e.* consumers in the aggregate devote more resources to lobbying than do firms. Because of diminishing returns to lobbying, the influence game is worse for consumers than is the welfare maximum. In addition, we assume there are more consumers than firms, so consumers face worse free-rider problems, further reducing consumer welfare in the influence game. We state the foregoing observations as Proposition 4.

Proposition 4: *If an industry has more consumers than firms, and will in equilibrium face some regulatory requirements for pollution control, the political influence game generates less abatement than is socially optimal.*

It is indeterminate in general whether self-regulation moves the level of pollution control closer to the socially optimal level. Proposition 2 guarantees the existence of a preemptive level of abatement if $f(N^c)$ is large enough. As $f(N^c)$ tends toward f_{blockade} , this preemptive level goes to zero, and consequently will be *lower* than the total abatement that would result from the influence game alone. Conversely, when $f(N^c)$ is low, firms may self-regulate to a level *beyond* what would result from the influence game in order to economize on lobbying costs.

A more meaningful question, however, is whether voluntary abatement improves welfare relative to what it would have been with no voluntary abatement; this issue is addressed in Proposition 5.

Proposition 5: *If preemption occurs, both consumer welfare and profits are increased, relative to their levels were government regulation imposed in the absence of voluntary abatement.*

If the industry chooses to preempt, then preemption must be profitable. It is less obvious that

consumers are better off; it is not enough simply to show that consumers are better off at $Z = Z^v$ than at $Z = 0$. It is necessary to establish that consumers are better off than they would have been if no voluntary abatement had taken place and they had lobbied for standards $Z(0)$ that might have been stricter than Z^v . The argument proceeds in two steps. First, observe that as long as consumers enter the influence game, they are always better off when firms have engaged in voluntary abatement. This is so because total abatement increases with Z^v , as shown in Proposition 2, and consumers' lobbying expenditures decrease with Z^v , as shown in the Lemma. Together the two effects must raise consumer welfare. Second, observe that if the firm preempts, it chooses a voluntary abatement level Z^v such that consumers are just indifferent between entering the influence game to obtain $Z(Z^v)$, and avoiding the influence game altogether. However, the preceding point shows that consumers prefer the influence game with $Z^v > 0$ to the influence game with $Z^v = 0$. Thus, if consumers allow themselves to be preempted by some $Z^v > 0$, they must be better off than they would have been had they fought to impose standards on an industry with no voluntary abatement.

Proposition 5 has two main policy implications. First, it supports allowing industry to coordinate on a choice of pollution limits. As Proposition 3 indicates, in some situations firms acting non-cooperatively will choose not to engage in voluntary abatement, but would do so if they could coordinate their actions. Furthermore, Proposition 5 shows that welfare would be enhanced by such coordination. In the context of our model, antitrust prosecution of "collusion" in this area will reduce welfare.

A second implication of our analysis is that government should not necessarily subsidize consumer involvement in the regulatory process. State regulatory agencies have increasingly taken to funding branches with names like "Division of Ratepayer Advocates" or "Office of Consumer Counsel" to intervene in utility rate cases. These actions appear designed to offset the high costs to consumers of intervening in the regulatory process, and indeed our analysis shows that such subsidies can shift the policy regime from one of no government regulation (because consumer organizing costs are too high) to one of

preemption. On the other hand, our results also indicate that these efforts may unintentionally make consumers worse off by substituting government regulation for less costly industry self-regulation. The fixed cost of organizing implicitly commits consumers to an "acceptable" level of self-regulation beyond which they will not enter the political process. If organizing costs fall too low, this commitment is eroded and firms find preemption unprofitable; by Proposition 5 this makes consumers worse off.

Our analysis also identifies a linkage between the effects of antitrust and regulatory policy. Granting industry the right to collude on pollution control lowers the threshold of consumer organizing costs below which self-regulation becomes unprofitable. Thus, for any given $f(N^c)$, antitrust policy allowing such cooperation reduces the danger that regulatory subsidization of consumer political action will undermine self-regulation.

V. CONCLUSIONS AND EXTENSIONS

We have developed a model in which firms can use self-regulation as an imperfect substitute for government-imposed regulations. We find that when consumers can costlessly enter the political process, firms cannot preempt stricter regulations through voluntary efforts. However, when consumers are confronted with a fixed cost of entry into the political process (e.g., costs of acquiring information on the mechanics of a pollution externality and the identity of the emitters), this fixed cost drives a wedge between the utility consumers gain from voluntary controls, and the utility from mandatory controls *net* of the cost of participating in the political process. In particular, firms can match the net utility consumers can expect in the political equilibrium with a *lower* level of voluntary controls. These voluntary controls can thus preempt the political process since all parties are made at least weakly better off. Note that the model requires that voluntary controls have commitment value; if firms can unilaterally reduce the level of voluntary controls at later stages of the model, consumers will anticipate this and voluntary controls will no

longer have their preemptive capacity.

Our model is testable when one can identify the conditions under which consumers' informational and organizational costs are large, and voluntary efforts have commitment value. Consumer entry costs will be high when information costs are high. This may occur because the mechanics of the externality have not been previously established, either theoretically or empirically, or because they are complex or controversial. Even if these mechanics are well understood, the cost of obtaining accurate data about emission levels may be prohibitive. In either case, when information costs are high, our model predicts that a sufficient reduction in these costs will induce voluntary abatement. A striking example of this phenomenon was set in motion when Congress reauthorized Superfund in 1986. Title III of the legislation required companies to report their emissions of over 300 toxic chemicals, thereby dramatically lowering consumer information costs. By 1992, over 1200 companies had undertaken voluntary abatement, resulting in a 40% reduction (nearly 600 million pounds) in the emissions of 17 key pollutants.³⁰

There are many potentially interesting extensions of our model. One of these arises when capital costs are not fully recoverable. In this case, a sunk-cost investment can be used as an instrument to limit forced pollution control. The firms may be able to commit to a technology with an upper bound of pollution control capability. Exceeding that level of pollution control ex post creates a discontinuous drop in the value of the firms, as they must scrap the sunk-cost technology and invest in a new capital stock with a higher pollution-control capacity. Preemption thus may be more prevalent in industries where such sunk costs characterize the production technology.

Other extensions appear interesting as well. In a model with asymmetric firms, large firms might undertake voluntary abatement while smaller firms choose to take a free ride on their rivals' efforts. Private information about benefits and costs of abatement also would be worth examining. Asymmetric influence functions or an explicit representation of voting behavior could be included. Finally, an analysis of the incentives of incumbent firms to lobby for tighter regulations for purposes of entry deterrence³¹ or

predation may be worthwhile. Bartel and Thomas (1987) argue that many environmental regulations serve as predatory devices, but they provide an incomplete assessment, since they ignore the (potentially beneficial) effects of regulations on consumers. Our framework, in which consumers play a crucial role, may shed new light on this subject.

APPENDIX

Proof of Lemma: Recall from our earlier assumptions and analysis that $\pi_z < 0$, $Z_l < 0$, $Z_u > 0$ and $U_z < 0$, $Z_m > 0$, $U_m > 0$, $Z_{mm} < 0$; U_z is positive throughout the relevant range of Z . Thus totally differentiating (4) and (6)

and gathering terms yields $\frac{dl^*}{dZ^V} = \frac{-\pi_{ZZ}Z_l}{\pi_{ZZ}Z_l^2 + \pi_{ZZ}Z_{ll}} > 0$ and $\frac{dm^*}{dZ^V} = \frac{-U_z Z_m}{U_{ZZ}Z_m^2 + U_z Z_{mm}}$. If consumer influence

is reduced and firm influence is increased, the amount of mandatory abatement must fall.

Q.E.D.

Proof of Proposition 1: From the previous lemma we know that firms will increase their lobbying expenditures following a voluntary abatement. For voluntary abatement to be unprofitable, it is sufficient to show that total abatement rises following a positive level of voluntary abatement. From equation 13 we know that the equilibrium

level of total abatement resulting from the influence game is characterized by $\pi_z^{N\alpha}/U_z^\alpha = I_m^\alpha/I_l^\alpha$, where the

superscript α indicates whether voluntary abatement occurs. Let $\alpha = 0$ denote the equilibrium values of the

variables above when firms undertake no voluntary abatement. Now choose some $Z^V > 0$, and let $\alpha = +$ denote

the equilibrium values associated with this positive level of voluntary abatement. From the lemma above, and

diminishing returns to influence, we know that $I_m^*/I_l^* < I_m^0/I_l^0$. Consequently $\pi_z^{N*}/U_z^* < \pi_z^0/U_z^0$, and this

implies that $Z(Z^V) > Z(0)$.

Q.E.D.

Proof of Proposition 2: We first establish that feasible preemption exists. Note that the firms can always preempt consumers by choosing a level of voluntary abatement that will yield consumers the same utility they would receive from engaging in the influence game, i.e. Z^V such that $U^N(Z^V) = \max_{Z^V} U^I(Z^V) - f(N^c)$. Note that in what

follows we drop the functional dependence of f on N to avoid excessive notation. To show that Z^V exists as a feasible choice, we need to show that $\pi^N(Z^V) > \pi^N(Z(0)) - l(0) = \pi^I(0)$. That is, it is more profitable to engage in preemption than not to engage in preemption and enter the influence game. It is clear that for sufficiently large f such a Z^V exists since for sufficiently large f , $U^I(0) - f = U^N(0)$ and $\pi^N(0) > \pi^I(0)$. Call this level of fixed cost $f_{blockade}$, since at this

level consumers will not enter the influence game even if the firm undertakes no clean up.

Note that there is a maximum level of voluntary cleanup, Z_{\max}^V , that the firm will be willing to undertake,

where $\pi^N(Z_{\max}^V) = \pi^I(0)$. The relevant comparison point on the right-hand side of the equality is zero cleanup

because $d\pi/dZ^V < 0$. Thus, as shown in Proposition 1, if consumer participation cannot be stopped, firms will

undertake no voluntary cleanup. Since π^V is also declining in Z^V , any level of voluntary cleanup beyond Z_{\max}^V will

not be profitable.

Next we focus on the minimum level of Z^V required to preempt consumers. This level is given by

$U^N(Z_{\min}^V) = U^I(Z_{\min}^V) - f$. Consequently we write $Z_{\min}^V(f)$ as a function of the level of consumer fixed costs.

To avoid the uninteresting case where firms preempt consumers even when consumers can costlessly enter the

political process, we assume $Z_{\min}^V(0) > Z_{\max}^V$.

It remains to be shown that $Z_{\min}^V(f)$ is decreasing in f . This result follows from two observations. First

$U^N(Z^V)$ is independent of f , and second $U^I(Z^V) - f$ is strictly decreasing in f . Now consider two levels of f , with $f_A < f_B$

$< f_{\text{blockade}}$. Then $U^I(0) - f_B > U^N(0)$, because consumers cannot be preempted by a zero level of voluntary

abatement. Now define $\theta_B(Z^V) = U^I(Z^V) - f_B - U^N(Z^V)$, a continuous function. Then $\theta_B(0) > 0$. Recall

that $Z_{\min}^V(f_A)$ is defined such that $U^I(Z_{\min}^V(f_A)) - f_A = U^N(Z_{\min}^V(f_A))$. Thus, since $f_B > f_A$, $\theta_B(Z_{\min}^V(f_A)) < 0$.

By Bolzano's Theorem, there exists a $\hat{Z} \in (0, Z_{\min}^V(f_A))$ such that $\theta_B(\hat{Z}) = 0$. By the definition of $\theta_B(Z^V)$,

we see that $\hat{Z} = Z_{\min}^V(f_B)$. Therefore, $Z_{\min}^V(f_B) < Z_{\min}^V(f_A)$.

Q.E.D.

Proof of Proposition 3: Let $\pi^N(Z_{-i}^V; Z_i^V)$ be firm i 's profit when the influence game is preempted, all firms but i

abate to (scalar) level Z_{-i}^V and firm i abates to level Z_i^V . Similarly let $\pi^I(Z_{-i}^V; Z_i^V)$ and $I^*(Z_{-i}^V; Z_i^V)$ be firm

i 's profit when the influence game is played and its optimal lobbying expenditure, given the aforementioned voluntary

abatement levels. The maximum symmetric collusive level of voluntary abatement, denoted Z_{\max}^{VIC} is defined by

$$\pi^N(Z_{\max}^{VIC}; Z_{\max}^{VIC}) = \pi^I(0; 0). \quad \text{On the other hand, the maximum non-cooperative level of voluntary abatement,}$$

denoted Z_{\max}^{VINC} , is defined by $\pi^N(Z_{\max}^{VINC}; Z_{\max}^{VINC}) = \pi^I(Z_{\max}^{VINC}; 0)$. Two things must be shown. First, non-

cooperative voluntary abatement is possible. Note that there exists Z_i such that

$$\pi^N(0; Z_i) \geq \pi^I(0; 0) = \pi^N(0; 0) - I^*(0; 0). \quad \text{This is easy to see, assuming } I^*(0; 0) > 0: \text{ there must exist some small}$$

Z_i that is profitable if it successfully preempts, since the firm is thereby spared the lobbying cost $I^*(0; 0)$. From the

continuity of $\pi^N(Z_{-i}^V; Z_i^V)$, similar results hold for small Z_{-i}^V . Thus, some noncooperative preemption is

possible for sufficiently high levels of consumer fixed costs. Second, it must be shown that $Z_{\max}^{VINC} < Z_{\max}^{VIC}$.

Consider firm i 's best response when all other firms play Z_{\max}^{VIC} , which is determined by

$$\pi^N(Z_{\max}^{VIC}; Z_i) = \pi^I(Z_{\max}^{VIC}; 0). \quad \text{Note that } \pi^N(Z_{-i}^V; Z_i^V) \text{ passes through } \pi^N(Z_i^V) \text{ but is rotated clockwise. Note}$$

also that $\pi^I(Z_{\max}^{VIC}; 0) > \pi^I(0; 0)$, so it cannot be a best response for firm i to select $Z_i = Z_{\max}^{VIC}$. Instead, since

$$d\pi^N(Z_{-i}^V; Z_i^V)/dZ_i < 0, \quad \text{firm } i\text{'s best response requires } Z_{\max}^{VINC} < Z_{\max}^{VIC}. \quad \text{Thus, the maximum level of non-}$$

cooperative voluntary abatement is lower than the maximum collusive level. As a result, there are some values of the consumer fixed cost f for which collusive preemption is possible but non-cooperative preemption is impossible. Q.E.D.

Proof of Proposition 5: If the firms preempt, they choose Z^V so that

$$U^N(Z^V) = U^N(Z(Z^V)) - m^*(Z^V) - f(N^c).$$

Note that the Lemma shows that $m^*(Z^V) < m^*(0)$, and that Proposition 2 shows that $Z(Z^V) > Z(0)$, so $U^N(Z(Z^V)) > U^N(Z(0))$. Therefore

$$U^N(Z^V) = U^N(Z(Z^V)) - m^*(Z^V) - f(N^c) > U^N(Z(0)) - m^*(0) - f(N^c).$$

Q.E.D.

BIBLIOGRAPHY

- Abolafia, Mitchel Y. "Self-Regulation as Market Maintenance," in Roger G. Noll, editor, *Regulatory Policy and the Social Sciences*, Berkeley, CA: University of California Press, 1985.
- Arora, Seema and Tim Cason. "An Experiment in Voluntary Environmental Regulation: Participation in EPA's 33/50 Program," *Journal of Environmental Economics and Management*, v. 28, 1995, pp. 271-286.
- Arora, S. and Gangopadhyay, S., "Toward a Theoretical model of Emissions Control," University of Southern California, Mimeo, 1991.
- Ayres, Ian and John Braithwaite, *Responsive Regulation: Transcending the Deregulation Debate*, New York: Oxford University Press, 1992.
- Bagnoli, Mark and Susan G. Watts. "Ecolabeling: The Private Provision of a Public Good," mimeo, Indiana University, May 1995.
- Barnard, Jayne W., "Exxon Collides with the Valdez Principles," *Business and Society Review*, 1990, pp. 32-35.
- Bartel, Ann P. and Lacy Glenn Thomas. "Predation through Regulation: The Wage and Profit Effects of the Occupational Safety and Health Administration and the Environmental Protection Agency," *Journal of Law and Economics*, v. 30, 1987, pp. 239-264.
- Becker, Gary S., "A Theory of Competition Among Pressure Groups for Political Influence," *The Quarterly Journal of Economics*, August 1983.
- Besanko, David, "Performance versus Design Standards in the Regulation of Pollution," *Journal of Public Economics*, v. 34, 1987, pp. 19-44.
- Braeutigam, Ronald R. and James P. Quirk, "Demand Uncertainty and the Regulated Firm," *International Economic Review*, v. 25, (1984), pp. 45-60.
- Cairncross, Francis, *Costing the Earth*, Harvard Business School Press, Cambridge, Massachusetts, 1992.
- Caves, Richard E. and Marc J. Roberts, editors, *Regulating the Product: Quality and Variety*, Cambridge, MA: Ballinger Publishing Company, 1975.
- Dean, Thomas J. and Robert L. Brown. "Pollution Regulation as a Barrier to New Firm Entry: Initial Evidence and Implications for Future Research," *Academy of Management Journal*, forthcoming.
- Donnenfeld, Shabtai and Shlomo Weber. "Limit Qualities and Entry Deterrence," *RAND Journal of Economics*, v. 26, no. 1, Spring 1995, pp. 113-130.

- Gilbert, Richard and Xavier Vives. "Entry Deterrence and the Free Rider Problem," *Review of Economic Studies*, v. 53, 1986, pp. 71-83.
- Glazer, Amihai and Henry McMillan, "Pricing by the Firm under Regulatory Threat," *Quarterly Journal of Economics*, August 1992, pp. 1089-1099.
- Hemphill, Thomas A., "Corporate Environmentalism and Self-Regulation: Keeping Enforcement Agencies at Bay," *Journal of Environmental Regulation*, Winter 1993/94.
- Hunt, Michael S., "Trade Associations and Self-Regulation: Major Home Appliances," in Richard E. Caves and Marc J. Roberts, editors, *Regulating the Product: Quality and Variety*, Cambridge, MA: Ballinger Publishing Company, 1975.
- Kaserman, David L. and John W. Mayo, *Government and Business: The Economics of Antitrust and Regulation*, Fort Worth, TX: The Dryden Press, 1995.
- Lyon, Thomas P., "Regulation with 20-20 Hindsight: Heads I Win, Tails You Lose?," *RAND Journal of Economics*, v. 22, 1991, pp. 581-595.
- Peltzman, Sam, "Toward a More General Theory of Regulation," *Journal of Law and Economics*, v. 19, 1976, pp. 211-248.
- Pirrong, Stephen Craig, "The Self-Regulation of Commodity Exchanges: The Case of Market Manipulation," *Journal of Law and Economics*, v. 38, 1995, pp. 141-206.
- Porter, Michael, "America's Green Strategy," *Scientific American*, April, 1991.
- Smart, Bruce, *Beyond Compliance: A New Industry View of the Environment*, Washington, D.C.: World Resources Institute, 1992.
- Stigler, George, "The Theory of Economic Regulation," *Bell Journal of Economics and Management Science*, v. 2, 1971, pp. 3-21.
- Tirole, Jean, *The Theory of Industrial Organization*, Cambridge, MA: The MIT Press, 1989.
- U.S. Environmental Protection Agency, "EPA's Voluntary Programs: A Summary List Prepared by The 33/50 Program," Washington, DC, June 1994.
- Walley, Noah and Bradley Whitehead, "It's Not Easy Being Green," *Harvard Business Review*, May-June, 1994.

Endnotes

1. Smart (1992), p. 200.
2. *Wall Street Journal*, March 9, 1995, p. C1.
3. Quoted in Hunt (1975), page 45.
4. Kaserman and Mayo (1995) provide a good overview of this research.
5. If self-regulation is more cost-effective than government regulation, firms might self-regulate even if doing so has no impact on the ultimate level of restraint required.
6. For a survey of corporate environmental programs, see Smart (1992). The idea that "pollution prevention pays" has been widely promoted in the popular and trade press. For example, Cairncross (1992) notes that firms may engage in the production of "green" products to serve a high margin market niche, and that a reputation for cleanliness may ease the burden of plant location. Michael Porter's influential article in *Scientific American* (1991) argued that American companies that adopt greener production processes may enhance their competitiveness in world markets. Hemphill (1993) points to another motive for pollution prevention: courts often treat more leniently environmental offenders that have established their own in-house audit and compliance programs.
7. Barnard (1990), p. 35.
8. Many of the opportunities for painless Pareto-improvements have already been implemented. For example, 3M's "Pollution Prevention Pays" program has reduced the company's emissions by over 1 billion pounds since 1975, and has saved 3M roughly \$500 million in the process. Walley and Whitehead argue, however, that many recent corporate environmental initiatives have had negative effects on company profits, suggesting that most companies now face sharply rising costs should cleanup standards be further increased. They cite (p. 46) the following example: "A major North American chemical company...was enjoying an internal rate of return of 55% on employee-generated environmental initiatives...But when those impressive returns were added to the internal rate of return on *all* corporate environmental projects, the return dropped to a negative 16%."
9. One could also devise a somewhat more complex model that subdivides consumers according to their relative disutilities for price increases and for environmental degradation. Even so, there will always be one consumer group with the strongest preference for environmental protection, whose interests are most strongly opposed to those of the firms; other consumer groups will fall somewhere on the spectrum between these two extremes. Consider, for example, a group of consumers who are concerned about price but not about pollution. The interests of these consumers are aligned with those of the firms when it comes to investments in pollution control, since installation of the technology both raises price and reduces profits. Because all consumer groups will on balance align with either the firms (lobbying for weaker regulations) or environmentalists (lobbying for stronger regulations), including additional consumer groups would complicate the modeling but seems unlikely to generate substantial new insights.
10. Although there is a vast literature on the economics of regulation, we take the "economic theory of regulation" to mean the strand of the literature associated with the work of Stigler (1971), Peltzman (1976) and Becker (1983).
11. We often use the term "lobby" as a shorthand for the array of actions interest groups can take to obtain political influence, which includes campaign contributions, direct lobbying, political advertising, revolving-door arrangements, junkets, and honoraria.
12. Hunt's chapter on appliance manufacture is particularly relevant to our concerns, and argues persuasively that the industry's voluntary safety standards were successful in preempting government regulation.
13. See Tirole (1989) for a good overview.

14. Tirole (1989), section 8.3, presents a taxonomy of business strategies based upon animal analogies such as the "fat cat effect" and the "puppy dog ploy."
15. Note also that, unlike Gilbert and Vives (1986) or Donnenfeld and Weber (1995), our oligopolists never have an incentive to engage in excessive (i.e., Pareto-dominated levels of) entry deterrence, since individual firms do not obtain private benefits from voluntary abatement.
16. This could mean, for example, that possible short-run technological constraints on pollution control are not binding within the range relevant to the analysis.
17. If the technology is not binding, it has no commitment value and thus no strategic effect.
18. Note that since voluntary pollution control is binding, policy cannot result in lower levels of pollution control.
19. By assuming homogeneous products, we in effect assume that consumers cannot observe the emissions of an individual firm, though they may be able to observe aggregate environmental damage (e.g., air quality in the Los Angeles basin or water quality in the Great Lakes). Our model thus gives firms weaker incentives for individual abatement actions than the models of Arora and Gangopadhyay (1991) or Bagnoli and Watts (1995), which emphasize demand shift effects. The bias of our model against voluntary action highlights the strength of the welfare results we obtain.
20. Because the firms are symmetric, the level of Z determined in stages 1 and 2 of the game is the same for all firms and we treat it as a scalar; we avoid vector notation for notational simplicity.
21. While environmental groups and trade associations may coordinate the collection of funds from members, we emphasize the fact that the financial contributions of members are made individually and on a non-cooperative basis.
22. Because firms are symmetric and there is no possibility of entry, it is not profitable to lobby for stricter regulations as a means of raising rivals' costs.
23. Stigler (1971) and Peltzman (1976) present a theory that shows the effects of fixed organizing costs on the effectiveness of pressure exerted by interest groups. In their model, fixed costs are incurred by pressure groups in the process of entering the political influence process. These costs arise in part because of the resources necessary for interest group members to acquire relevant information and to successfully organize and coordinate their activities. Individuals of similar interests must then organize themselves around a clear position. In the Stigler/Peltzman framework, interest groups experience diseconomies of scale – organization costs increase faster than group size. For example, the larger the group the more diffuse are the benefits, and thus the free-rider incentive increases faster than group size.
24. These costs are often very high due to the incomplete state of scientific knowledge and its inaccessibility to those who are not experts in the relevant fields.
25. We assume the social costs of environmental degradation can be measured in money units and combined with consumer surplus from the consumption of the good to generate a welfare measure that is denominated in money equivalents.
26. Note that it would not be profitable for the industry to choose Z^* in equilibrium. A voluntary level just below Z^* is sufficient to preempt consumers, since by avoiding the influence game consumers save substantial lobbying expenditures and sacrifice little in reduced emissions control.

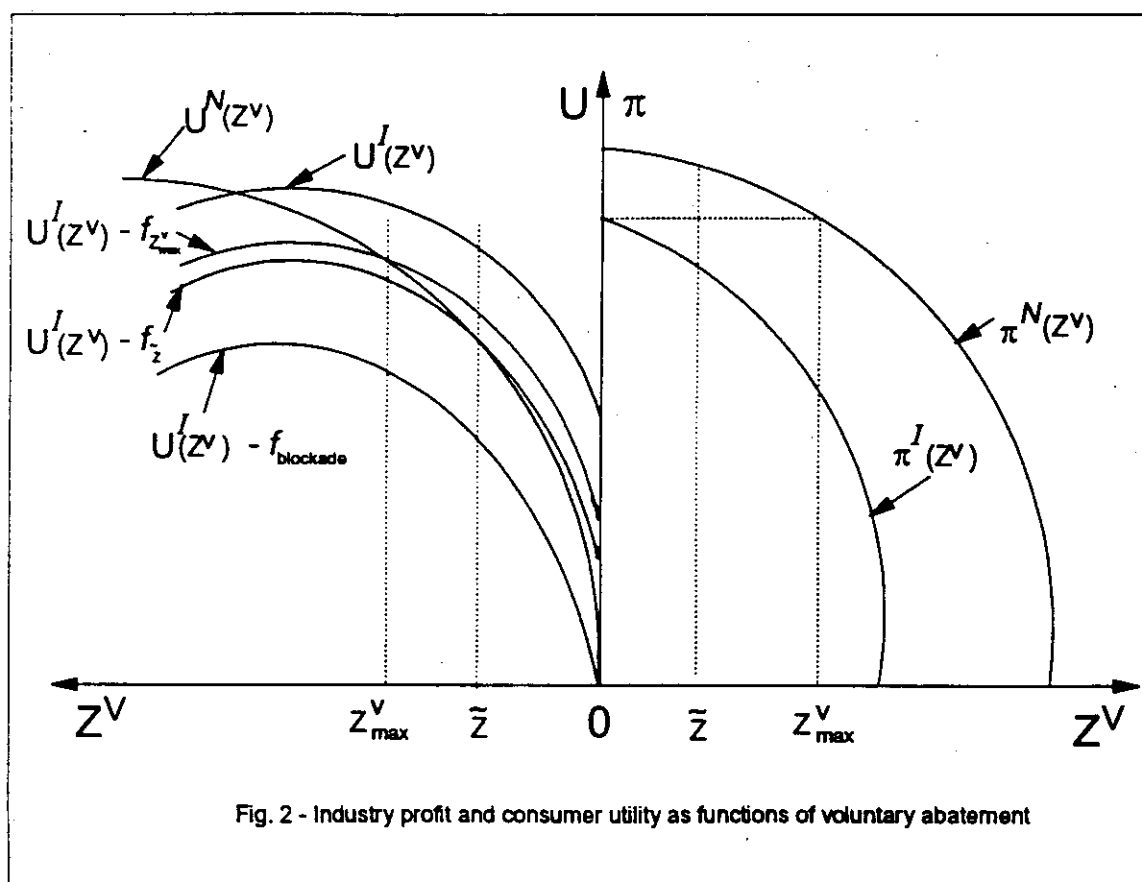
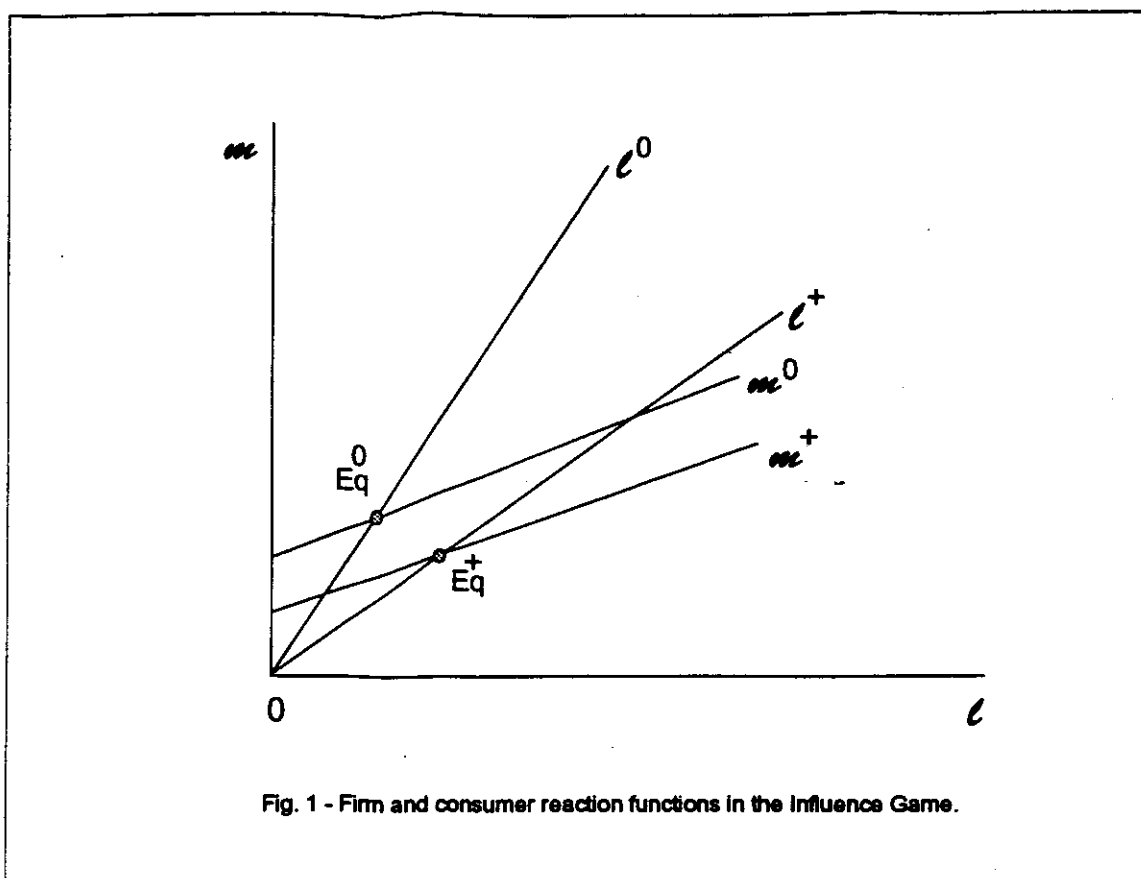
27. With respect to the firms' pressure activities, Peltzman shows that firms' aggregate influence eventually falls as the number of firms grows, but one cannot predict in general whether an additional group member strengthens or weakens the pressure group. Consumer pressure activities are also ambiguously affected by an increase in N' . On the one hand, if demand is not too convex consumers become more hesitant to press for an increase in abatement, since now more of the cost of such an increase is passed through into price. On the other hand, they more aggressively push for an increase in abatement because each increase in the required level of abatement now has a greater effect on total pollution. Again the net effect is ambiguous.

28. Recall that $I_i < 0$, so the right-hand side of (13) is negative.

29. Of course, the number of firms and consumers still affects the equilibrium of the influence game through the left-hand side of (13), as discussed above.

30. These companies are participating in the EPA's 33/50 Program, which seeks voluntary reductions of 17 high priority chemicals. Its name derives from its goals: a 33% reduction by 1992 and a 50% reduction by 1995. See U.S. EPA (1994).

31. Dean and Brown (forthcoming) present empirical evidence that tighter standards do indeed discourage entry.



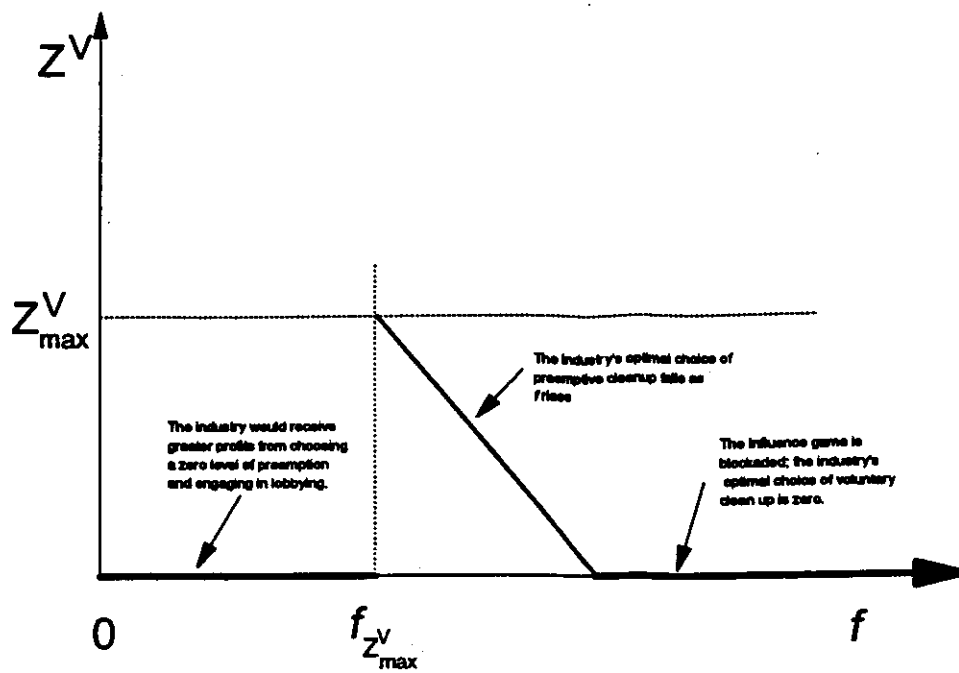


Fig. 3 - The preemptive level of voluntary abatement as consumer fixed costs rise.

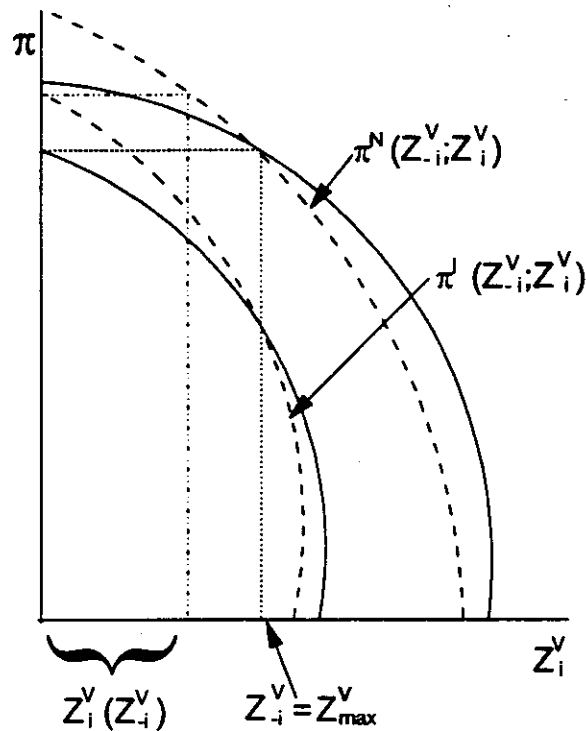


Fig. 4 - A comparison of the maximum levels of cooperative and noncooperative voluntary abatement.

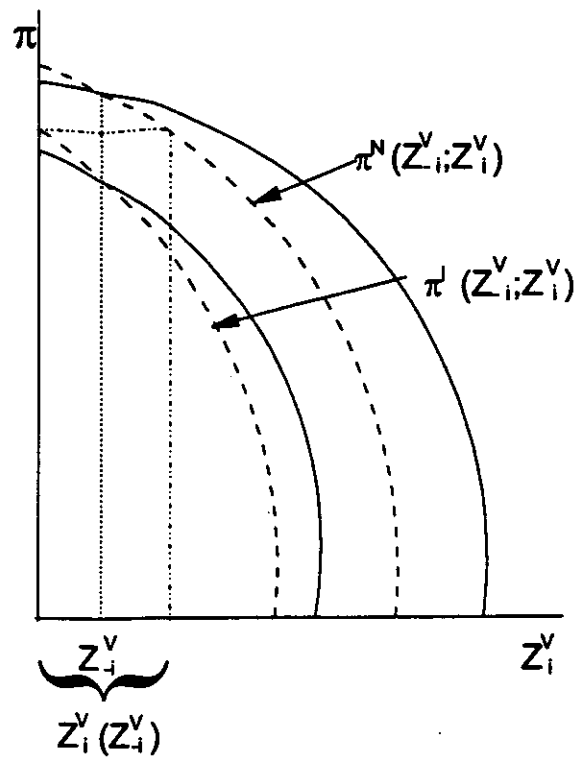


Fig. 5 - An illustration of feasible noncooperative voluntary abatement.