Self-Regulation and Environmental Protection — Bargaining in the Shadow of Rent-Seeking

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Abstract:
Self-regulation is often seen as a means to make use of information, which is unavailable to governments or rule-setting government agencies. Critics fear that self-regulating industries do not only use their superior information to achieve a given level of environmental or consumer protection in a cheaper way, but also use their self-regulatory power to reduce this level of protection. This paper studies self-regulation as a three-stage rent-seeking-and-bargaining process: at the first stage, the industry to be regulated and an environmental interest group invest in lobbying for or against self-regulation. At the second stage, the same parties either lobby to achieve favorable governmental regulation or, respectively, bargain on the content of self-regulation. Should bargaining fail, they enter the third stage of the game, which again is lobbying for or against self-regulation. The paper shows under what conditions the environmental interest group gains from self-regulation, given that protection of their interests becomes cheaper by self-regulation, but their influence in the second, decisive stage is weaker under self-regulation than under government regulation. The paper also shows that higher bargaining power of the environmentalists at the bargaining stage is not only to the benefit of the environmentalists, but may also be to the advantage of the regulated industry.

Alternative:

Self-regulation is often seen as a means to make use of information, which is unavailable to governments or rule-setting government agencies. Critics fear that self-regulating industries do not only use their superior information to achieve a given level of environmental or consumer protection in a cheaper way, but also use their self-regulatory power to reduce this level of protection. This paper studies self-regulation as a three-stage rent-seeking-and-bargaining process: rent-seeking for and against self-regulation, rent-seeking under government regulation or bargaining under self-regulation and finally, if bargaining fails again rent-seeking under government regulation. The paper shows that higher bargaining power of the environmentalists at the bargaining stage is not only to the benefit of the environmentalists, but may also be to the advantage of the regulated industry by reducing the environmentalists opposition to self-regulation. The paper also shows that environmentalists may gain from more efficient self-regulation even when protection of their interests under self-regulation is harder than under government-regulation.

1 Introduction

When externalities or information asymmetries entail market failures, one possible remedy is to regulate market or non-market behavior. It nearly goes without saying that practically all government regulation suffers from two shortcomings, lack of information and rent-seeking.

Lack of information implies that at least for more complex technologies, government regulation will induce inefficient ways of reaching the desired goal, typically because the inefficient ways are easier to control. Rent seeking will most often induce politicians to opt for suboptimal degrees or modes of regulation.

Inefficiencies of government regulation serve as one of the major arguments to replace government regulation by some kind of self-regulation of the affected industry. Self-regulation is a term of opaque meaning. It may refer (i) to regulation of markets by spontaneous institutions (e.g. O'Driscoll and Hoskins, 2006), (ii) to firms' adoption of certain ethical or other behavior rules for reputational reasons (e.g. Calveras et al., 2007), (iii) to self restriction of an industry or single firms to avoid government regulation (see e.g. Heyes, 2005), or (iv) to regulation delegated by the government to some regulatory body representing the regulated industry and possibly further interests (e.g. Bortolotti and Fiorentini, 1999, and Van den Bergh, 1999). In this paper, we use the term in the latter sense.

We observe self-regulation in a number of industries, most prominently among the professions (see Stephen and Love, 2000, and Olsen, 2000, for self-regulation of the legal and the medical profession), but also in the media (German Press Council), in occupational safety and health (decision making bodies of German *Berufsgenossenschaften*, who organize both insurance and safety and health regulation, are equally staffed by employers and employees) and in environmental protection (food containers, electronic garbage recycling). Self regulation of the internet (see e.g. Kesan and Gallo, 2006) falls somewhere between self regulation in the sense we use the term in this paper and the spontaneous-order concept of self-regulation.

While many aspects of self-regulation have been studied (for a marvelous overview, see Ogus, 2000), only few publications have addressed self-regulation in the field of environmental policy. Self-regulation in the filed of environmental policy differs from most other fields of self-regulation in the underlying rationale for regulation: while it is usually asymmetric information, for environmental policy it is the externality problem which makes regulation an attractive policy option. Maxwell et al. (2000) study the effect of self-regulation on the level of lobbying-costs. Stefanadis (2003) finds a certain acceleration of procedures ensuing from self-regulation and Núñez (2007) studies the effects of corruption on self-regulation in a setting of exclusively reputation based self-regulation similar to the setting of Calveras et al. (2007).

None of these publications deals with the political emergence and the content of self-regulation at the same time. The only exception in this field is a paper by Grajzl and Murell (2007). In a model of uncertain states of the world, they compare the resulting level of regulation when the government, or the regulated industry concretize legal rules after new information has emerged, and who this affects the interests of the regulated industry and the government in having this right to decide. Apart from the regulated industry and the government, no interests are regarded in their study. In contrast to Grajzl and Murell, the current paper starts from a rent-seeking approach and combines it with a model of bargaining in the shadow of government regulation. Rent-seeking takes place between the competing interests of the industry and environmentalists.

Obviously, introducing self-regulation instead of government regulation will not only make more information available to the regulator and thus allow for more efficient ways of regulating, but will also alter the possibilities of rent-seeking interest groups to influence the degree and the content of regulation stipulated by the respective regulating body. In particular,

those agents who regulate their own activities will gain influence while other interest groups who would participate in, or at least influence government regulation will lose influence. As a consequence, the decision on the mode of regulation – government regulation or self-regulation – is in itself a political decision subject to rent seeking activities of the very same interest groups who will try to influence the substance of regulation in their favor.

In this paper we study how rent-seeking and bargaining about the content of regulation is interrelated to rent-seeking about the mode of regulation. We will study whether environmental interest groups who lose influence on the substance of the regulation when self-regulation replaces government regulation may benefit ensuing from the efficiency gains and whether they are always opposed to self-regulation by necessity. The influence of interest groups on the content of regulation does not only depend on whether government or the industry itself regulates, but also on the institutional framework of self-regulation, for example in what way and to what degree environmental groups have the right to participate in the self-regulatory process. We will therefore also ask whether the regulated industry will always oppose institutional arrangements which give more influence to their opponents or whether they may benefit from a stronger influence of their opponents in the self-regulatory process. We will refrain from discussing welfare effects since that would require to determine the relationship between interests of environmentalist groups and the welfare effects of the environment on the one hand and to include consumer interests on the other. While the former requirement would entail mere speculation, the latter would result in a substantial complication of the model. We also simplify the analysis by neglecting the possibility of self-regulation serving as a means to impede market entry of competitors (on this topic see e.g. Shaked and Sutton, 1981, Bortolotti and Fiorentini, 1999, and Van den Bergh, 1999).

The paper proceeds as follows. In Section 2 we will present a model describing the three stage rent-seeking-and-bargaining game. We will derive the subgame perfect equilibrium in Section 3 and study effects of parameter variations in Section 4. Section 6 concludes and gives an outlook on possible further variations of the model.

2 The Model

We consider the regulation of an industry (*i*) which emits negative external effects widely dispersed so that tort law will fail to solve the externality problem. The only opposition to the emission comes from an environmental protection group (*e*) to which we will also refer as ‘the environmentalists’. For simplicity, we treat both the industry and the environmental protection group as unitary actors in the political process. The environmentalists are strong enough to induce a political thrust for regulation of the emissions. The political process deciding on the regulation is split in three stages: the decision on government versus self-regulation, the decision on the content of the regulation with the government regulation process or the self-regulation process of bargaining between the industry and the environmentalists and, if the latter bargaining fails, a second rent-seeking stage on government regulation. We model both rent-seeking stages as a simple rent seeking game following the Tullock (1967) approach. In the first stage (the decision on the mode of the regulation), we assume that interest group expenditures affect the probabilities of selecting one or the other mode (winner-takes-all rent-seeking with prizes of different size); in the second stage (content of the regulation) we assume that interest group expenditures affect the degree to which the environment is protected (shared-prize rent-seeking with prizes of different size). Bargaining will be modeled as Nash bargaining with endogenous bargain power depending on the expenditures of the bargaining partners in preparing their bargaining strategies. This endogenization of bargaining power very much follows the Tullock rent-

seeking model. Bargaining failure and consequential re-entry into government regulation may be costly to the interest groups, for example due to reduced support within the constituency. The stages of the game take place in real time so that a period of failed bargaining is a period of production and externalities under the original regulatory regime (typically low level of regulation).

Interest groups' expenditures in favor of government regulation at the first stage of the game are denoted by $g_i \geq 0$ and $g_e \geq 0$ for the regulated industry and the environmental protection group, respectively. Corresponding expenditures in favor of self-regulation are $s_i \geq 0$ and $s_e \geq 0$, respectively. Expenditures in opposite directions cancel each other in their effectiveness so that neither interest group will expend in both directions, $g_i s_i = 0$ and $g_e s_e = 0$. Which of the expenditures of each interest group will be positive will depend on the parameters of the model. If either both interest groups prefer government regulation or both interest groups prefer self regulation, the legislator will follow this policy. Otherwise the probability that the political process decides for self-regulation is assumed, in the simple Tullock tradition, to be given by:

$$\pi = \frac{(1-\alpha) s_i + \alpha s_e}{(1-\alpha) s_i + \alpha s_e + (1-\alpha) g_i + \alpha g_e}, \tag{1}$$

where $\alpha \in [0,1]$ is a measure of the relative strength of the environmental protection group.

Should the political process at the first stage result in government regulation, the interest groups will invest $x_i \geq 0$ and $x_e \geq 0$, respectively, in order to induce the regulatory government agency to lower or increase the degree to which regulation protects the environment. This degree is assumed to be given by

$$\rho = \frac{\gamma x_e}{\gamma x_e + (1-\gamma) x_i} \tag{2}$$

where $\gamma \in [0,1]$ is a measure of the relative power of environmental protection group in the government-regulation process (if adopted). For simplicity, we assume that payoffs of the interest groups depend on the degree to which regulation protects the environment in a linear way. The regulated industry receives $V_i = (1-\rho) A$ and the environmental protection group $V_e = \rho B$, where the relative size of *A* and *B* depends on how much environmental interests are organized and on technology.

If, however, the political process at the first stage results in self-regulation, the industry and the environmentalists bargain on the level of regulation. Should they not reach an agreement, the government steps in again to regulate and another rent-seeking process starts with expenditures z_i and z_e and an emerging level of regulation $\rho' = \frac{\gamma' z_e}{\gamma' z_e + (1-\gamma') z_i}$. The parameter $\gamma' \in [0,1]$ may differ from γ, for example due to lost support among voters as the result of bargaining failure. In order to isolate which aspects of self-regulation determine the interest groups' preferences in favor or against it, we take $\gamma' = \gamma$ as a benchmark case.

For the time being, we assume that all environmental damages entering the objective function of the environmental interest group (δD^b, for simplicity, we assume that these are a constant fraction δ of the true corresponding environmental damages D^b) and abatement costs

savings (S^b) occurring during the bargaining time are bygones when it comes to rent-seeking on government regulation after the bargaining stage. Hence, the interests in government regulation or non-regulation (*A* and *B*) are independent of whether rent-seeking on government regulation is preceded by failed self-regulatory bargaining or not. In a variation of the model, we will take care of long lasting effects emanating from regulatory delay due to the unsuccessful intermediate bargaining stage.

Bargaining on the level of regulation follows a simple Nash-structure with bargaining power b of the environmentalists and $1-b$ of the industry. However, bargaining power is not taken as given. Rather, both sides may invest in preparing the bargaining by increasing their information on the technology of the externality source, or on their opponent, by influencing mass media likely to observe the bargaining process, or by simply employing talented lawyers as representatives in the bargaining process. Expenditures are denoted by y_i and y_e for the industry and the environmentalists, respectively. The resulting bargaining power is $b = \frac{\beta y_e^{\,r}}{\beta y_e^{\,r} + (1-\beta) y_i^{\,r}}$ where β is a parameter which measures the relative ease by which the environmentalists improve their bargaining power and $r \in [0,1]$ is a parameter measuring how much the marginal effects of expenditures for improving bargaining power decrease. We note that for $r = 0$ bargaining power of the environmentalists reduces to $b = \beta$, but for expositional ease, we concentrate on the other extreme, $r = 1$. If an agreement is reached at this bargaining stage, the resulting degree of regulation, ϕ, is between the threat points according to the Nash bargaining solution. Successful bargaining allows for two advantages. First, rent-seeking expenditures on the threatening subsequent stage are avoided, and second, regulation will be organized in a more efficient way by better making use of the industry's information on abatement technologies. If bargaining fails, the aforementioned second rent-seeking stage sets in.

The first positive effect of successful bargaining is already implied in the model presented so far. We will present the consequences of this positive effect in sections 3 and 4. To integrate the second positive effect of self-regulation, i.e. technological efficiency gains, we will assume in section 5 that the industry's payoff increases under regulation emerging from the bargaining process relative for any given degree of regulation. However, if the degree to which the regulation protects the environment is very small, abatement costs are small under either mode of regulation and thus the potential to save by more efficient abatement under the self-regulation regime also becomes very small. We therefore describe the payoff of the regulated industry by $\tilde{V}_i = A_o + (1-\phi)(A - A_o)$, where $A_o \in [0, A)$ measures the maximal savings from more efficient abatement under self-regulation. One should note that with this formulation of the efficiency effect of self-regulation, the regulated industry suffers less from environmental protection not only for given levels of environmental protection but also at the margin. Under self-regulation, where the industry chooses the most efficient way to abate emissions, *additional* environmental protection reduces the industry's payoff less than under government regulation. Given that we continue to measure the degree of regulation by the degree to which it protects the environment, it makes sense to model the environmentalists' payoff in a parallel way to the government regulation case as $\tilde{V}_e = \phi B$.

3 The Equilibrium

To determine the interest groups' behavior within this model, we choose the subgame perfect equilibrium as the relevant concept. Since the model relies on complete information, we can determine all optimal investments by backwards induction. We start with the benchmark case of $\gamma' = \gamma$. For variations of this case we only present results and relegate their derivation to the Appendix.

Following the standard argument of the Tullock rent-seeking model, under the government-regulation regime the environmentalists' and the industry's equilibrium expenditures on rent-seeking are $x_e^* = z_e^* = B\frac{\gamma(1-\gamma)AB}{\left((1-\gamma)A+\gamma B\right)^2}$ and $x_i^* = z_i^* = A\frac{\gamma(1-\gamma)AB}{\left((1-\gamma)A+\gamma B\right)^2}$, respectively. The corresponding equilibrium payoffs are

$$\Pi_i^{g_0} = \Pi_i^{g_1} = \frac{A\left((1-\gamma)A\right)^2}{\left((1-\gamma)A+\gamma B\right)^2} \text{ and } \Pi_e^{g_0} = \Pi_e^{g_1} = \frac{B(\gamma B)^2}{\left((1-\gamma)A+\gamma B\right)^2} \tag{3}$$

and total rent dissipation is

$$x_i^* + x_e^* = z_i^* + z_e^* = (A+B)\frac{\gamma(1-\gamma)AB}{\left((1-\gamma)A+\gamma B\right)^2}. \tag{4}$$

These equilibrium payoffs serve as threat points for the bargaining stage. If bargaining is successful, the degree of regulation is ϕ and thus payoffs are $(1-\phi)A$ for the industry and ϕB for the environmentalists. Gains from bargaining are thus

$$\Delta_i = (1-\phi)A - \Pi_i^{g_1} \text{ and } \Delta_e = \phi B - \Pi_e^{g_1}. \tag{5}$$

Following the Nash bargaining model, we maximize the product $\left((1-\phi)A - \Pi_i^{g_1}\right)^{1-b}\left(\phi B - \Pi_e^{g_1}\right)^b$ with respect to bargaining outcome ϕ. The first order condition is given by $(1-b)A\left(\phi B - \Pi_e^{g_1}\right) = bB\left((1-\phi)A - \Pi_i^{g_1}\right)$ which reduces to $\phi = \left((1-b)A\Pi_e^{g_1} + bB\left(A - \Pi_i^{g_1}\right)\right)\Big/(AB)$. Inserting this into equation (5) yields

$$\Delta_i = (1-b)A\frac{2\gamma(1-\gamma)AB}{\left((1-\gamma)A+\gamma B\right)^2} \text{ and } \Delta_e = bB\frac{2\gamma(1-\gamma)AB}{\left((1-\gamma)A+\gamma B\right)^2}. \tag{6}$$

Since bargaining power b depends on preparatory expenditures of both parties, payoffs at the beginning of the bargaining stage, i.e. when decisions are made on preparatory expenditures y_e and y_i, are given by:

$$\Pi_i^{g_1} + \Delta_i - y_i = \frac{A\left((1-\gamma)A\right)^2}{\left((1-\gamma)A+\gamma B\right)^2} + \frac{(1-\beta)y_i}{(1-\beta)y_i+\beta y_e}A\frac{2\gamma(1-\gamma)AB}{\left((1-\gamma)A+\gamma B\right)^2} - y_i - \delta D^b \tag{7}$$

and

$$\Pi_e^{g_1} + \Delta_e - y_e = \frac{B(\gamma B)^2}{\left((1-\gamma)A+\gamma B\right)^2} + \frac{\beta y_e}{(1-\beta)y_i+\beta y_e}B\frac{2\gamma(1-\gamma)AB}{\left((1-\gamma)A+\gamma B\right)^2} - y_e + S^b, \tag{8}$$

where we remind the reader that D^b and S^b denote the environmental damages and abatement costs savings, respectively, which occur during the bargaining phase and are

bygones thereafter, and that δ is the fraction of these environmental damages entering the environmental interest group's objective function.

Taking first derivatives and equating them to zero implies $y_i / y_e = A/B$ and thus

$$y_i^* = A\frac{\beta(1-\beta)AB}{\left((1-\beta)A+\beta B\right)^2}\frac{2\gamma(1-\gamma)AB}{\left((1-\gamma)A+\gamma B\right)^2}$$

and

$$y_e^* = B\frac{\beta(1-\beta)AB}{\left((1-\beta)A+\beta B\right)^2}\frac{2\gamma(1-\gamma)AB}{\left((1-\gamma)A+\gamma B\right)^2}.$$

Total rent dissipation is thus given by

$$\left(y_i^* + y_e^*\right) = (A+B)\frac{\gamma(1-\gamma)AB}{\left((1-\gamma)A+\gamma B\right)^2}\frac{2\beta(1-\beta)AB}{\left((1-\beta)A+\beta B\right)^2} = \left(x_i^* + x_e^*\right)\frac{2\beta(1-\beta)AB}{\left((1-\beta)A+\beta B\right)^2}.$$

As the last term may be written as $2\phi(1-\phi) \le 1/2$, it is obvious that rent dissipation resulting from expenditures aiming at better bargaining positions is not more than one half of the rent dissipation resulting from rent-seeking expenditures at the stage of immediate government regulation. This gives us our first result:

> **Result 1:** If a preceding self-regulatory stage leaves the relative weights of rent-seeking expenditures in the success function of rent-seeking for government regulation unaffected, then self regulation under the shadow of rent-seeking for government regulation reduces rent dissipation by at least one half as compared to immediate rent-seeking for government regulation.

Inserting the Nash equilibrium expenditures to increase the parties' bargaining powers into equations (7) and (8) yields

$$\Pi_i^s = A\frac{\left((1-\gamma)A\right)^2}{\left((1-\gamma)A+\gamma B\right)^2} + A\left(\frac{(1-\beta)A}{(1-\beta)A+\beta B}\right)^2\frac{2\gamma(1-\gamma)AB}{\left((1-\gamma)A+\gamma B\right)^2} + S^b \qquad (9)$$

and

$$\Pi_e^s = B\frac{(\gamma B)^2}{\left((1-\gamma)A+\gamma B\right)^2} + B\left(\frac{\beta B}{(1-\beta)A+\beta B}\right)^2\frac{2\gamma(1-\gamma)AB}{\left((1-\gamma)A+\gamma B\right)^2} - \delta D^b \qquad (10)$$

as equilibrium payoffs at the beginning of the self-regulation-by-bargaining stage.

Obviously, if $D^b = S^b = 0$ both interest groups win from self-regulation in the form of bargaining under the shadow of rent-seeking for government-regulation as compared to immediate government-regulation, for which the payoffs are given by equation (3) and are thus equivalent to the first terms of the right-hand sides of equations (9) and (10). In this case, both interest groups prefer self-regulation to government regulation, independently of the bargaining powers, as long as they are both positive. The intuition is simple: bargaining in the shadow of rent-seeking for government regulation saves the rent-seeking costs at the stage of rent-seeking for government regulation, since this stage is only virtual: it determines the threat points for bargaining and is never reached, since bargaining in this type of models is always successful.

In particular, the second terms of the right-hand side of equations (9) and (10), which represent the gain from self-regulation, may be interpreted as follows: the last factor is the

proportion of the rent which would be dissipated by rent-seeking expenditures for government expenditures (note that this term and the second factors of the respective first terms of the right-hand side of equations (9) and (10) add up to unity); the second factor is the proportion of the rent which is not dissipated by expenditures seeking for higher bargaining power; and the first tem is the maximum rent.

If we allow for $D^b \neq 0$ and $S^b \neq 0$, then the industry will continue to prefer self-regulation, but the gain from self-regulation to the environmentalists vanishes and may eventually turn negative. More precisely, the environmentalists will prefer government-regulation if the relevant environmental damages are a sufficiently large proportion of the environmentalists' maximum rent are large enough, and the environmentalists power is small. Formally, the condition is given by:

$$\frac{\delta D^b}{B} > \left(\frac{\beta B}{(1-\beta)A + \beta B} \right)^2 \frac{2\gamma(1-\gamma)AB}{\left((1-\gamma)A + \gamma B\right)^2} \tag{11}$$

The right-hand side of this condition monotonously increases in β, but increases in relative weight of the environmentalists' expenditures in the success function of the rent-seeking-for-government-regulation stage only up to $\gamma = \frac{A}{A+B}$ and then decreases. The explanation for this non-monotonicity lies in the proportion of rents that would be dissipated completely in rent-seeking for government-regulation but only partly in bargaining for regulation under the shadow of government-regulation: The more the ratio of the relative weights of the interest groups' expenditures in rent-seeking for government-regulation ($\frac{\gamma}{1-\gamma}$) differs from the ratio of the maximum rents (A/B), the more of the rent would be dissipated in rent-seeking for government regulation and thus the less remains to be distributed by bargaining. Accordingly, even when the environmentalists can easily increase their bargaining power (i.e. even when the parameter β is large) the environmentalists may still prefer government-regulation to self-regulation. We summarize this in the following:

Result 2: Industry will always prefer self-regulation to government regulation. The environmental protection group prefers government-regulation to self-regulation if and only if

- the relevant environmental damages are a sufficiently large proportion of the environmentalists' maximum rent are strictly positive and large enough (if $\frac{\delta D^b}{B}$ is large enough) and
- it is relatively hard for the environmentalists to increase their bargaining power by expending on preparing for bargaining (if β is small enough).

The latter condition becomes less restrictive, the more the ratio of the relative weights of the interest groups' expenditures in rent-seeking for government-regulation differs from the ratio of the maximum rents (i.e. the more $\frac{\gamma}{1-\gamma}$ differs from A/B).

Two points are worth to be mentioned here: (1) The environmentalists may prefer self-regulation to government-regulation even if it is harder for them to increase their bargaining power than to increase their proportion of the rent in government-regulation (i.e. if $\beta < \gamma$).

But $\beta \geq \gamma$ is clearly neither sufficient nor necessary for the environmentalists to prefer self-regulation. (2) For very large values of $\frac{\delta D^b}{B}$ the environmentalists prefer government regulation for all values of β.

In the following, we concentrate on cases in which condition (11) is satisfied, i.e. cases in which the environmentalists will prefer government regulation to self-regulation. The gain from having government regulation rather than self-regulation will then be

$$\Gamma_e = \delta D^b - B\left(\frac{\beta B}{(1-\beta)A+\beta B}\right)^2 \frac{2\gamma(1-\gamma)AB}{\left((1-\gamma)A+\gamma B\right)^2}, \tag{12}$$

while the industry will gain

$$\Gamma_i = A\left(\frac{(1-\beta)A}{(1-\beta)A+\beta B}\right)^2 \frac{2\gamma(1-\gamma)AB}{\left((1-\gamma)A+\gamma B\right)^2} + S^b \tag{13}$$

from self-regulation rather than government regulation.

With these conflicting interests in the mode of regulation, environmentalists will only engage in expenses in favor of government-regulation at the first stage of the entire game and the industry will only engage in expenses in favor of self-regulation, $g_i^* = s_e^* = 0$. Equation (1), which describes the success function of this stage, thus reduces to the structure of the success function in the standard Tullock rent-seeking model. Expected payoffs of the entire game for the two groups are then given by

$$\Pi_i = \pi \Pi_i^s + (1-\pi)\Pi_i^{g_0} - s_i = \pi\Gamma_i - s_i + \Pi_i^{g_0} = \frac{(1-\alpha)s_i}{(1-\alpha)s_i + \alpha g_e}\Gamma_i - s_i + \Pi_i^{g_0} \tag{14}$$

for the industry, and

$$\Pi_e = \pi \Pi_e^s + (1-\pi)\Pi_e^{g_0} - g_e = (1-\pi)\Gamma_e - g_e + \Pi_e^s = \frac{\alpha g_e}{(1-\alpha)s_i + \alpha g_e}\Gamma_e - g_e + \Pi_e^s \tag{15}$$

for the environmentalists. Since the expected payoffs at the immediate government-regulation stage and at the self-regulation-before-government-regulation stage and their differences, $\Pi_i^{g_0}$, Π_e^s, Γ_i, and Γ_e, are independent of s_i and g_e, the structure of this stage is again a standard Tullock rent-seeking model. Rent-seeking expenses at the first stage of the game will hence be given by

$$s_i^* = \Gamma_i \frac{\alpha(1-\alpha)\Gamma_i\Gamma_e}{\left((1-\alpha)\Gamma_i + \alpha\Gamma_e\right)^2} \quad \text{and} \quad g_e^* = \Gamma_e \frac{\alpha(1-\alpha)\Gamma_i\Gamma_e}{\left((1-\alpha)\Gamma_i + \alpha\Gamma_e\right)^2} \tag{16}$$

while the probability that the mode of regulation is self-regulation is

$$\pi^* = \frac{(1-\alpha)\Gamma_i}{(1-\alpha)\Gamma_i + \alpha\Gamma_e} \tag{17}$$

and expected payoffs of the entire game in equilibrium are

$$\Pi_i^* = \Gamma_i\left(\frac{(1-\alpha)\Gamma_i}{(1-\alpha)\Gamma_i + \alpha\Gamma_e}\right)^2 + \Pi_i^{g_0} \quad \text{and} \quad \Pi_e^* = \Gamma_e\left(\frac{\alpha\Gamma_e}{(1-\alpha)\Gamma_i + \alpha\Gamma_e}\right)^2 + \Pi_e^s. \tag{18}$$

Finally, expected total rent-seeking expenditures are given by:

$$s_i^* + g_e^* + \frac{\alpha g_e^*}{(1-\alpha)s_i^* + \alpha g_e^*}(x_i^* + x_e^*) + \frac{(1-\alpha)s_i^*}{(1-\alpha)s_i^* + \alpha g_e^*}(y_i^* + y_e^*). \tag{19}$$

Remembering that $y_i^* + y_e^* < x_i^* + x_e^*$ and considering the results expressed in equation (16) it is easy to derive the following

> **Result 3:** If a preceding self-regulatory stage leaves the relative weights of rent-seeking expenditures in the success function of rent-seeking for government regulation unaffected, and the environmentalists' interest in government regulation (Γ_e) is sufficiently small, the expected rent dissipation in the entire game (as expressed by equation (19)) is less than rent dissipation in a situation without any possibility of self regulation ($x_i^* + x_e^*$). If the environmentalists' interest in government regulation (Γ_e) is large enough, the reverse follows.

Hence, the effect of the introducing the possibility of self-regulation on the degree of rent-dissipation is ambiguous.

4 Variations of Abilities to Gain Bargaining Power

So far, we have taken the relative ability of environmentalists to increase their bargaining power (β) as given. Of course, this ability crucially depends on the institutional arrangements and specificities of self-regulation. The environmental protection group may have to rely on its influence via the mass media on the one extreme or may have veto rights or exclusive rights to propose new regulation or may even have a near majority in the decisive body of the self-regulatory body at the other extreme. Without going into institutional details,[1] we will study how the parameter β affects the equilibrium values of the probability that self-regulation emerges at the first stage of the game and the expected equilibrium payoffs of the entire game.

Before we come to the variables proper, we take a look at the net gains of the interest groups from acting under their preferred regulation regime. Both clearly decline in β:

$$\frac{\partial \Gamma_i}{\partial \beta} = \frac{-4(1-\beta)A^3B}{\left((1-\beta)A+\beta B\right)^3}\frac{\gamma(1-\gamma)AB}{\left((1-\gamma)A+\gamma B\right)^2} < 0 \qquad (20)$$

and

$$\frac{\partial \Gamma_e}{\partial \beta} = \frac{-4\beta AB^3}{\left((1-\beta)A+\beta B\right)^3}\frac{\gamma(1-\gamma)AB}{\left((1-\gamma)A+\gamma B\right)^2} < 0\,. \qquad (21)$$

Hence, the larger the relative ability of environmentalists to increase their bargaining power (β), the less the interest groups gain from acting under their respective preferred regulation regime.

We first apply this result to the probability of getting self-regulation as a result of rent-seeking. We have:

[1] See for example McNollgast (1989) for a detailed discussion of possibilities to strengthen or weaken the influence of interest groups in regulation by agencies and bureaucracies. These possibilities may be easily transferred to the case of self-regulation. Also see Wangenheim (1999) for an overview.

$$\frac{\partial \pi^*}{\partial \beta} = \frac{(1-\alpha)\alpha\left(\Gamma_e \frac{\partial \Gamma_i}{\partial \beta} - \Gamma_i \frac{\partial \Gamma_e}{\partial \beta}\right)}{\left((1-\alpha)\Gamma_i + \alpha\Gamma_e\right)^2}$$

$$= \frac{(1-\alpha)\alpha}{\left((1-\alpha)\Gamma_i + \alpha\Gamma_e\right)^2} \frac{4AB}{\left((1-\beta)A + \beta B\right)^3} \frac{\gamma(1-\gamma)AB}{\left((1-\gamma)A + \gamma B\right)^2}$$

$$\cdot \left[\frac{\beta(1-\beta)A^2B^2}{\left((1-\beta)A + \beta B\right)} \frac{2\gamma(1-\gamma)AB}{\left((1-\gamma)A + \gamma B\right)^2} + \beta B^2 S^b - (1-\beta)A^2 \delta D^b \right]$$

Here the term before the brackets is clearly positive. The term in the brackets is negative if $\beta \approx 0$ and positive if $\beta \approx 1$. Some calculus shows that its first derivative is positive for small β and negative for large β. Its second derivative is strictly negative. As the term in the brackets is obviously continuous in β, it is thus negative for all β below some threshold level and positive above it. Hence we get the following:

> **Result 4:** The probability that the first stage of the rent-seeking process results in self-regulation (π) first declines in the relative ability of environmentalists to increase their bargaining power (β), but increases again once β has surpassed some threshold level. If the environmentalists prefer self-regulation for large values of β, then once β has surpassed the threshold level π continuously increases until it eventually reaches unity. If β grows further, both industry and the environmentalists prefer self-regulation.

As a consequence, if one wants to increase the probability that the political decision on the mode of regulation results in self-regulation, increasing the power of the environmentalists under self-regulation does not necessarily help. As long as this power is too small, the negative effect of β on π via the industry's gains from self-regulation outweighs the positive effect via the reduction in the environmentalists loss from self-regulation. However, if the power of the environmentalists is already large enough, then further increasing this power does increase the probability that self-regulation emerges. Eventually, this probability may reach unity.

We the now turn to the effect of the environmentalists' relative ability to increase their bargaining power (β) on the expected equilibrium payoffs of the entire game (Π_e^* and Π_i^*) as defined by equation (18). For the environmentalists, we make use of the definition $\Gamma_e = \Pi_e^{g_0} - \Pi_e^s$ to rewrite the second equation in (18) as

$$\Pi_e^* = \Pi_e^{g_0} - \Gamma_e \left(1 - \left(\frac{\alpha\Gamma_e}{(1-\alpha)\Gamma_i + \alpha\Gamma_e}\right)^2\right)$$

where only Γ_i and Γ_e but not $\Pi_e^{g_0}$ depends on β. Taking the first derivative with respect to β yields

$$\frac{\partial \Pi_e^*}{\partial \beta} = -\frac{\partial \Gamma_e}{\partial \beta}\left(\frac{(1-\alpha)\Gamma_i}{((1-\alpha)\Gamma_i + \alpha\Gamma_e)}\right)^2\left(1+2\left(\frac{\alpha\Gamma_e}{(1-\alpha)\Gamma_i + \alpha\Gamma_e}\right)\right)$$
$$-2\frac{\partial \Gamma_i}{\partial \beta}\left(\frac{\alpha\Gamma_e}{(1-\alpha)\Gamma_i + \alpha\Gamma_e}\right)^2\frac{\Gamma_e(1-\alpha)}{((1-\alpha)\Gamma_i + \alpha\Gamma_e)}$$

of which both terms are strictly positive due to inequalities (20) and (21). Hence, environmentalists always gain from becoming relatively more able to increase their bargaining power β.

For the industry, the result is less clear. Taking the derivative of Π_i^* with respect to β and using $\frac{\partial \Gamma_e}{\partial \beta} = \frac{\partial \Gamma_i}{\partial \beta}\frac{B^2\beta}{A^2(1-\beta)}$ from equations (20) and (21) yields

$$\begin{aligned}\frac{\partial \Pi_i^*}{\partial \beta} &= \frac{\left((1-\alpha)\Gamma_i\right)^2}{\left((1-\alpha)\Gamma_i + \alpha\Gamma_e\right)^2}\frac{\partial \Gamma_i}{\partial \beta} + 2\alpha\frac{\left((1-\alpha)\Gamma_i\right)^2}{\left((1-\alpha)\Gamma_i + \alpha\Gamma_e\right)^3}\left(\Gamma_e\frac{\partial \Gamma_i}{\partial \beta} - \Gamma_i\frac{\partial \Gamma_e}{\partial \beta}\right) \\ &= \frac{\left((1-\alpha)\Gamma_i\right)^2\alpha\Gamma_e}{\left((1-\alpha)\Gamma_i + \alpha\Gamma_e\right)^3}\left[3 + \frac{\Gamma_i}{\Gamma_e}\left(\frac{1-\alpha}{\alpha} - 2\frac{B^2\beta}{A^2(1-\beta)}\right)\right]\frac{\partial \Gamma_i}{\partial \beta}\end{aligned}, \quad (22)$$

where the first line splits the total effect into the effect on Γ_i, which is always negative, and the effect on $\left(\frac{(1-\alpha)\Gamma_i}{(1-\alpha)\Gamma_i + \alpha\Gamma_e}\right)^2 = (\pi^*)^2$, which may be positive as argued before and may be large enough to offset the negative effect on Γ_i. Rewriting the derivative as in the second line of equation (22) allows expressing the conditions for a positive effect of β on Π_i^* in terms of the parameters of the model. It is positive if and only if the term in brackets is negative. A necessary condition for the term in brackets to be negative is that the term in the inner parentheses is negative, i.e. that $\frac{\alpha B}{(1-\alpha)A}\frac{\beta B}{(1-\beta)A} > \frac{1}{2}$. The environmentalists' expenditures thus have to be sufficiently effective relative to the industry's expenditures both at the first stage of the game (rent-seeking for the type of regulation) and at the bargaining stage. Two insights are worth mentioning: First, the environmentalists expenditures need not be equally effective as the industry's. Second, for every α there exists a threshold value of β beyond which this necessary condition is satisfied and vice versa. In addition, the ratio Γ_i/Γ_e has to be large enough, i.e. the environmentalists' gains from government-regulation as compared to self-regulation must be small.

Only when in equation (22) the term in brackets is positive, the industry gains from making the environmentalists' expenditures to increase their bargaining power less effective. It is easy to see that the same is true, when both the industry and the environmentalists prefer self-regulation. We summarize these insights in the following:

Result 5: The environmental protection group always gains from additional power at the self-regulation stage.
The industry prefers more effective expenditures of the environmentalists at the bargaining stage if

(i) this effectiveness together with the effectiveness of the environmentalists' expenditures at the stage determining the type of regulation is strong enough and

(ii) the gains of the environmentalists from government regulation as compared to self-regulation are positive, but small.

Otherwise the industry prefers less effective expenditures of the environmentalists at the bargaining stage.

In the model presented in this paper, we have taken the value of β, the ability of the environmentalists to influence their bargaining power, as given. If we consider β as a result of a political process connected to the process determining the mode of the regulation, then these results show that the environmental protection group will always fight to get more power under the self-regulation regime, but the regulated industry will not fight against this additional power necessarily. If environmentalists are strong in the political process determining the mode of the regulation, then the regulated industry will gain from giving more power to the environmentalists at the self-regulation stage: the reduction in the environmentalists' resistance to self-regulation will be more valuable than the loss in favorable (self) regulation.

Corollary 2: If the regulated industry is relatively weak at the first stage of the political process, it may benefit from institutional arrangements of the self-regulation bargaining stage that support the environmentalists' influence at that stage. The industry will then support such arrangements at the early stages of the game.

5 Efficiency Gains from Self-Regulation

In this section we turn to the second fundamental change emanating from self-regulation, besides savings in rent-seeking costs: reductions of X-inefficiencies of the regulation.
Sketch of argument: Efficiency gains from self-regulation work best, when regulation is strong. In other words: with these efficiency gains, losses to the industry from more regulation are smaller under self-regulation than under government regulation. Hence their stakes in non- or deregulation is smaller. Thus the equilibrium level of self-regulation tends to be larger than under government regulation. Therefore, the environmentalists gain from the efficiency gains.

6 Conclusions

In this paper we have studied self-regulation as an alternative to government-regulation. We have treated government-regulation as a rent seeking game and self-regulation as a bargaining game with endogenous bargaining powers under the threat of subsequent government-regulation. Both games are embedded into an overarching rent-seeking game on the mode of regulation. Contrary to first intuition, environmentalists may gain from self-regulation for two reasons: first, self-regulation based on bargaining under the shadow of rent-seeking for government-regulation tends to reduce rent-seeking expenses, since the shadow is only virtual; second, environmentalists will participate in the efficiency gains from self-regulation, because the reduction in abatement costs lowers the industry's incentives to fight against regulation and thus the environmentalists may participate in the gains from more efficient abatement. Similarly, during a political discussion on whether to introduce self-regulation as an option, the regulated industry may support the environmentalists in their striving for more power under the self-regulatory regime in order to increase the chances to end up in such a

regime. However, this may only be the case when the environmentalists are a strong interest group in the political sphere.

The model may be extended in various directions. As we have argued on the interests to politically influence the powers of interest groups in the self-regulatory process, formal endogenization of β and γ suggests itself as part of an additional rent-seeking process. However, the model and its results become extremely complex if one allows for an influence of g_r, g_p, s_r, and s_p on β and γ. Introducing additional and independent rent seeking expenditures to influence the power at the self-regulation stage would yield straight forward results, but fail to capture the close interconnection between the political discussion about the possibility of self-regulation and its institutional specifics.

Another interesting extension could be to consider further effects of self-regulation: the ability to erect entry barriers to the market or similar actions could increase the industry's payoff under the self-regulation regime above the level it may expect from government-regulation even if the regulation (of whichever type) is extremely in favor of the industry. If one takes this approach, the other groups' payoffs, in our model represented by the environmentalists, should probably decline by an even larger amount in case of regulation completely in favor of the industry.

The game discussed in this paper is a two-stage but one-shot game. The real political process, however, is not restricted to one point in time when the decision on the mode of regulation is made once and forever. Rather, all self-regulation (and, in principle, all government regulation, too) is subject to the constant threat or hope – depending on the perspective – of reconsideration in the political sphere. In fact, some historical self-regulation, such as the German regulation on recycling of beverage containers was organized as self-regulation with the legal provision that it would be, and in fact was, replaced by government regulation should the proportion of recycled containers fall under a certain limit. So it would make sense to restructure the model game as a repeated game. Then the environmentalists might be willing to accept self-regulation even with very little power β, if and as long as the self-regulating industry refrains from exploiting its powerful position and produces sufficiently environment-friendly regulation. As with many other repeated games, a multiplicity of equilibria is likely to result. Extension to regulation due to asymmetric information should also be possible.

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Appendix

$$\frac{\partial}{\partial\beta}\left[\frac{\beta(1-\beta)A^2B^2}{\left((1-\beta)A+\beta B\right)}\frac{2\gamma(1-\gamma)AB}{\left((1-\gamma)A+\gamma B\right)^2}+\beta B^2S^b-(1-\beta)A^2\delta D^b\right]$$

$$=\frac{A^2B^2\left((1-\beta)^2A-\beta^2B\right)}{\left((1-\beta)A+\beta B\right)^2}\frac{2\gamma(1-\gamma)AB}{\left((1-\gamma)A+\gamma B\right)^2}+B^2S^b+A^2\delta D^b$$

$$\frac{\partial^2}{\partial\beta^2}\left[\frac{\beta(1-\beta)A^2B^2}{\left((1-\beta)A+\beta B\right)}\frac{2\gamma(1-\gamma)AB}{\left((1-\gamma)A+\gamma B\right)^2}+\beta B^2S^b-(1-\beta)A^2\delta D^b\right]$$

$$=-2\frac{\left((1-\beta)A+\beta B\right)\left((1-\beta)A+\beta B\right)+(B-A)\left((1-\beta)^2A-\beta^2B\right)}{\left((1-\beta)A+\beta B\right)^3}\frac{2\gamma(1-\gamma)A^3B^3}{\left((1-\gamma)A+\gamma B\right)^2}$$

$$=-2\frac{AB}{\left((1-\beta)A+\beta B\right)^3}\frac{2\gamma(1-\gamma)A^3B^3}{\left((1-\gamma)A+\gamma B\right)^2}<0$$