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Keywords: self-regulation, rent-seeking, legal rule-making, environmental law

JEL-classification: K23, K49, D720

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Abstract:
Self-regulation is often seen as a means to make use of information unavailable to governments or rule setting agencies. Critics fear that self regulating industries do not only use their superior information to achieve a given level of environmental or consumer protection, but also use their self-regulatory power to reduce this level of protection. This paper studies self-regulation as a two-stage rent seeking process: at the first stage, the industry to be regulated and a group whose interests are protected by the regulation invest in lobbying for or against self-regulation and to achieve favorable conditions of the self regulatory process. At the second stage, the same parties lobby to achieve favorable governmental or, respectively, self-organized regulation. The paper shows under what conditions the interest group protected by the regulation 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.

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. Selfregulation 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). 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.

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.

Not discuss self-regulation as a means to impede market entry (on this topic see e.g. Shaked and Sutton (1981), Bortolotti and Fiorentini (1999) and Van den Bergh (1999).)

Calveras et al. (2007) discuss the self-regulation in the sense of intra firm environmental standards aiming at consumers who care for the environmental effects ensuing from their consumption.

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).

For the older literature on self regulation see the marvelous overview of Ogus (2000).

In this paper we study how rent seeking about the content of regulation is interrelated to rent seeking about the mode of regulation. We will study whether interest groups who lose influence on the substance of the regulation may benefit 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 groups with interests conflicting with those of the regulated industry 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 finally ask how the interconnection of the mode and the content of the regulation, i.e. the interconnection between the technology gain from self-regulation and a possible reduction in the degree of regulation resulting from self-regulation, affects social welfare.

To avoid complexity and to keep the arguments simple, we will concentrate on government and self-regulation whose normative reason is the existence of negative externalities, more concretely: on environment protection regulation. Most, if not all, of the arguments would however also be valid for regulation with asymmetric information as normative basis, but the exposition will be more tractable if we concentrate on regulation with one type of normative background.

The paper proceeds as follows. In Section 2 we will present a model describing rent seeking for the mode of regulation, rent seeking for the content of regulation and the interconnection between the two. We will derive the subgame perfect equilibrium in Section 3 and study effects of parameter variations in Section 4. Section 5 will incorporate effects on social welfare and Section 6 concludes and gives an outlook on possible further variations of the model.

2 The Model

We consider the regulation of an industry (*r*) which emits negative external effects widely distributed. The only opposition to the emission therefore comes from an environmental protection group (*p*) 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 string enough to induce a political thrust for regulation of the emissions. The political process deciding on the regulation is spit in two stages: the decision on government versus self-regulation and the decision on the content of the regulation with the government regulation process or the self-regulation process. We model both 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; in the second stage (content of the regulation) we assume that interest group expenditures affect the degree to which the environment is protected.

Interest groups' expenditures in favor of government regulation at the first stage of the game are denoted by $g_r \geq 0$ and $g_p \geq 0$ for the regulated industry and the environmental protection group, respectively. Corresponding expenditures in favor of self-regulation are $s_r \geq 0$ and $s_p \geq 0$, respectively. Typically we will get $g_r s_r = 0$ and $g_p s_p = 0$, but this will be the result of optimization, rather than an assumption. In the simple Tullock tradition, the probability that the political process decides for self-regulation is assumed to be given by:

$$\pi_s = 1 - \pi_g = \frac{s_r + \alpha s_p}{s_r + \alpha s_p + g_r + \alpha g_p}, \tag{1}$$

where $\alpha \in [0, \infty)$ is a measure of the strength of the environmental protection group.

Should the political process at the first stage result in government regulation, the interest groups will invest $x_r \geq 0$ and $x_p \geq 0$, 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

$$\rho_p = 1 - \rho_r = \frac{\gamma x_p}{\gamma x_p + x_r} \tag{2}$$

where $\gamma \in [0, \infty)$ 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 $V_r = \rho_r A$ and the environmental protection group $V_p = \rho_p B$, 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 expenditures of the interest groups to influence the decision of the self-regulatory body are $y_r \geq 0$ and $y_p \geq 0$ for the regulated industry and the environmentalists, respectively. We assume that the ensuing degree to which regulation protects the environment is

$$\theta_p = 1 - \theta_r = \frac{\beta y_p}{\beta y_p + y_r}, \tag{3}$$

where $\beta \in [0, \infty)$ is a measure of the relative power of the environmental protection group in the self-regulation process (if adopted). Since self-regulation of the industry will typically weaken the influence of environmental interests, one may want to assume $\beta < \gamma$, but as this assumption is not necessary for the remaining argument, we do not do so.

We introduce the central idea of self-regulation, i.e. the argument that the self-regulating industry can better use its own information about emission abatement technologies than any government agency, by an increase in the industry's payoff 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 $\tilde{V}_r = A_o + \theta_r \left(A - A_o \right)$, where $A_o < A$ 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 $\tilde{V}_p = \theta_p B$.

Since all effects of time preferences may be included in the payoff parameters A, A_o, and B, we neglect all discounting and describe the objectives of the interest groups before the first stage of the game as

$$\max_{g_r, s_r, x_r, y_r} \left[\Pi_r \equiv \pi_g \left(V_r - x_r \right) + \pi_s \left(\tilde{V}_r - y_r \right) - g_r - s_r \right] \tag{4}$$

for the regulated industry and

$$\max_{g_p, s_p, x_p, y_p} \left[\Pi_p \equiv \pi_g \left(V_p - x_p \right) + \pi_p \left(\tilde{V}_p - y_p \right) - g_p - s_p \right]. \tag{5}$$

for the environmental protection group.

3 The Equilibrium

To determine the interest groups' behavior within this model, we choose the subgame perfect equilibrium as the relevant concept. Since the *x*- and the *y*-investments neither affect the decision on the kind of regulation, nor the regulation decisions under the respective alternative regulation regime, and since there is complete information, we can determine all optimal investments by backwards induction. We start with the optimal investments in the second stage.

3.1 Equilibria at the Second Stage

Under the government-regulation regime, the regulated industry maximizes $\frac{x_r}{x_r+\gamma x_p}A - x_r$ over x_r, and the environmental protection group maximizes $\frac{\gamma x_p}{x_r+\gamma x_p}B - x_p$ over x_p. By the standard calculation, we thus get $x_p^* = B\frac{\gamma AB}{\left(A+\gamma B\right)^2}$ and $x_r^* = A\frac{\gamma AB}{\left(A+\gamma B\right)^2}$ as equilibrium expenditures under government regulation. The resulting net payoffs are also standard:

(6) $$V_r\left(x_r^*\right) - x_r^* = A\left(\frac{A}{A+\gamma B}\right)^2 \quad \text{and} \quad V_p\left(x_p^*\right) - x_p^* = B\left(\frac{\gamma B}{A+\gamma B}\right)^2$$

for the regulated industry and the environmental protection group, respectively.

Under the self-regulation regime, the maximization problems are

(7) $$\max_{y_r}\left[A_o + \frac{y_r}{y_r+\beta y_p}\left(A-A_o\right) - y_r\right] \quad \text{and} \quad \max_{y_p}\left[\frac{\beta y_p}{y_r+\beta y_p}B - y_p\right],$$

which results in $y_p^* = B\frac{\beta\left(A-A_o\right)B}{\left(A-A_o+\beta B\right)^2}$ and $y_r^* = \left(A-A_o\right)\frac{\beta\left(A-A_o\right)B}{\left(A-A_o+\beta B\right)^2}$ as equilibrium expenditures under self-regulation. The resulting net payoff of the regulated industry is:

(8) $$\tilde{V}_r\left(y_r^*\right) - y_r^* = A_o + \left(A-A_o\right)\left(\frac{A-A_o}{A-A_o+\beta B}\right)^2$$

and for the environmental protection group it is

(9) $$\tilde{V}_p\left(y_p^*\right) - y_p^* = B\left(\frac{\beta B}{A-A_o+\beta B}\right)^2.$$

We note that the environmental protection group gains when its influence β under self-regulation increase, while the regulated industry loses. The effect of an increase in the maximal efficiency gains A_o from self-regulation is strictly positive for the environmentalists, but ambiguous for the regulated industry: $\frac{\partial \tilde{V}_r\left(y_r^*\right) - y_r^*}{\partial A_o} = \frac{\beta B}{A-A_o+\beta B}\left(1 - 2\left(\frac{A-A_o}{A-A_o+\beta B}\right)^2\right)$ is positive only for $A_o < A - \beta B\Big/\left(\sqrt{2}-1\right) \approx A - 2.41\beta B$ and negative if the reverse is true. The reason for why the regulated industry's net payoff may first decline in the efficiency gains is that additional efficiency gains have two opposing effects. On the one hand, they directly increase the net payoff. On the other hand, they reduce the industry's incentives to spend resources for influencing the regulatory process, because more regulation matters less. If the environmentalists' incentives to invest in regulation are small (only then $A - \beta B\Big/\left(\sqrt{2}-1\right)$ may be positive) the latter effect may outweigh the former.

Comparing net payoffs in stage 2 for both interest groups in the two scenarios shows that the environmental protection group prefers government regulation to self-regulation if both β and A_o are small, namely if $\tilde{V}_p\left(y_p^*\right) - y_p^* < V_p\left(x_p^*\right) - x_p^*$, which reduces to:

(10) $$A_o < A\left(1-\beta/\gamma\right).$$

If the reverse is true, then the environmental protection group prefers self-regulation to government regulation, because then its loss from the smaller influence in self-regulation is offset by the lower interest of the regulated industry to avoid environmental protection. In other words, as long as $\beta > \gamma\left(1-A_o/A\right)$ the environmentalists participate enough in the cost savings of the regulated industry to offset their loss in power under self-regulation; $\beta \geq \gamma$ is not required for this preference. We thus get our first result:

> **Result 1:** The environmental protection group prefers self-regulation to government regulation if its loss in influence under self-regulation is small enough, i.e. if β remains larger than $\gamma\left(1-A_o/A\right)$.

The regulated industry will prefer self-regulation, if the environmentalists' power β is small enough (remember that $\tilde{V}_r\left(y_r^*\right)-y_r^*$ as derived in equation (8) strictly decreases in β) or the industry's efficiency gain A_o is large enough: The regulated industry's net payoff $\tilde{V}_r\left(y_r^*\right)-y_r^*$ from self-regulation reduces to A_o for $\beta\to\infty$. Since $\tilde{V}_r\left(y_r^*\right)-y_r^*$ decreases in β, $\tilde{V}_r\left(y_r^*\right)-y_r^* > V_r\left(x_r^*\right)-x_r^*$ for all $\beta\in[0,\infty)$ if $A_o \geq A\left(\frac{A}{A+\gamma B}\right)^2$. However, if $A_o < A\left(\frac{A}{A+\gamma B}\right)^2$, then $\tilde{V}_r\left(y_r^*\right)-y_r^* > V_r\left(x_r^*\right)-x_r^*$ holds true only if $\beta < \hat{\beta}\left(A_o\right)$, where $\hat{\beta}\left(A_o\right)$ is defined by

$$\tilde{V}_r\left(y_r^*\right)-y_r^* = A_o + \left(A-A_o\right)\left(\frac{A-A_o}{A-A_o+\hat{\beta}\left(A_o\right)B}\right)^2 = A\left(\frac{A}{A+\gamma B}\right)^2 = V_r\left(x_r^*\right)-x_r^*.$$

If $\beta > \hat{\beta}\left(A_o\right)$, the regulated industry prefers government regulation to self-regulation. By the implicit function theorem, the slope of $\hat{\beta}\left(A_o\right)$ is given by $\frac{d\hat{\beta}}{dA_o} = -\frac{\frac{\partial}{\partial A_o}\left(\tilde{V}_r\left(y_r^*\right)-y_r^*\right)}{\frac{\partial}{\partial \hat{\beta}}\left(\tilde{V}_r\left(y_r^*\right)-y_r^*\right)}$ and thus negative under the same conditions as $\tilde{V}_r\left(y_r^*\right)-y_r^*$ declines in A_o.

One should note that for $\beta=\gamma$ and $A_o=0$, we have both $\tilde{V}_p\left(y_p^*\right)-y_p^* = V_p\left(x_p^*\right)-x_p^*$ and $\tilde{V}_r\left(y_r^*\right)-y_r^* = V_r\left(x_r^*\right)-x_r^*$. So a negative slope of $\hat{\beta}\left(A_o\right)$ close to $A_o=0$ implies that the regulated industry may prefer government regulation to self-regulation even when self-regulation increases abatement efficiency and increases the relative power of the industry in the regulatory process.

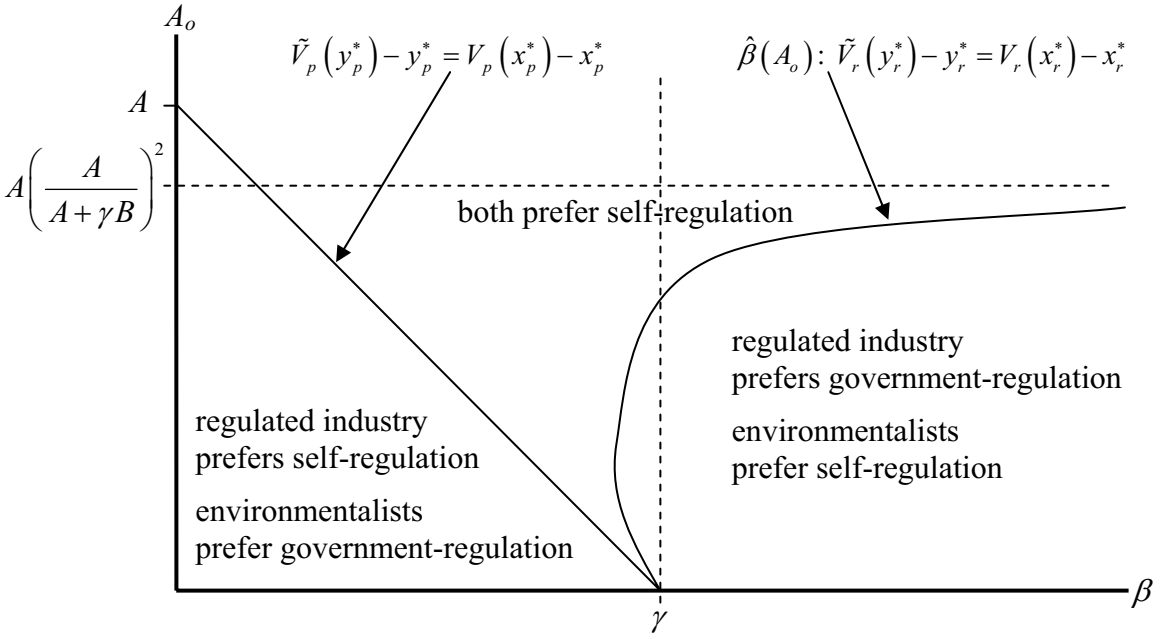

Figure 1: Effects of cost savings from self-regulation and environmentalists' power under self-regulation on preferences for types of regulation.

However, $A_o \le A\left(1-\beta/\gamma\right)$ implies $\left(\frac{A-A_o}{A-A_o+\beta B}\right)^2 > \left(\frac{A}{A+\gamma B}\right)^2$ and thus that $\tilde{V}_r\left(y_r^*\right)-y_r^* > V_r\left(x_r^*\right)-x_r^*$.[1] In words: if the environmentalists prefer government-regulation, then the industry prefers self-regulation. Figure 1 shows how A_o and β affect the preferences of the interest groups for government regulation and self-regulation.

We combine the insights of the two previous paragraphs in the following:

> **Result 2:** The regulated industry usually prefers self-regulation to government regulation if its relative influence under self-regulation increases or declines only to a limited degree (β remains smaller than $\hat{\beta}\left(A_o\right)$). If efficiency gains are small ($A_o < A-\beta B\left/\left(\sqrt{2}-1\right)\right.$), it may prefer government regulation even when self-regulation has a small positive effect on the relative power of the industry in the regulatory process. However, when the environmental protection group prefers government regulation to self-regulation, then the industry's preferences will be opposed.

Results 1 and 2 have immediate implications for the interest groups' expenditures in the first stage of the game:

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[1] To see why this last implication holds true, rewrite $\tilde{V}_r\left(y_r^*\right)-y_r^*$ as a weighted average of A_o and A and rewrite $V_r\left(x_r^*\right)-x_r^*$ as a weighted average of 0 and A. Then the latter is clearly smaller than the former for $A_o \le A\left(1-\beta/\gamma\right)$ since not only $A_o \ge 0$, but also the weights on A is relatively larger for $\tilde{V}_r\left(y_r^*\right)-y_r^*$.

Corollary 1: If $\beta \in \left[0, \gamma\left(1 - A_o / A\right)\right)$ the interests of the two groups at the first stage are opposed: environmentalists prefer government regulation and the regulated industry prefers self-regulation. Hence $s_r > g_r = 0$ and $g_p > s_p = 0$.

If $A_o < A^3 / \left(A + \gamma B\right)^2$ and $\beta \in \left[\gamma\left(1 - A_o / A\right), \hat{\beta}\left(A_o\right)\right]$ or $A_o \geq A^3 / \left(A + \gamma B\right)^2$ and $\beta \in \left[\gamma\left(1 - A_o / A\right), \infty\right)$, then both interest groups prefer self-regulation. Rent seeking expenditures at the first stage of the model are undefined.

If $A_o < A^3 / \left(A + \gamma B\right)^2$ and $\beta \in \left(\hat{\beta}\left(A_o\right), \infty\right)$, then interests of the two groups at the first stage are opposed: environmentalists prefer self-regulation and the regulated industry prefers government regulation. Hence $g_r > s_r = 0$ and $s_p > g_p = 0$.

In the remainder of the paper, we will concentrate on the first case of the corollary, since the conflict vanishes in the second case and the third case is of little empirical relevance. For easier reference, we state this restriction as follows:

Assumption 1: Under self-regulation, the influence of the environmental protection group is small enough to induce conflict, such that the regulated industry prefers self-regulation while the environmental protection group prefers government regulation, i.e. $\beta \in \left[0, \gamma\left(1 - A_o / A\right)\right)$.

With this restriction and the net payoffs from the two types of regulation, we may now turn to stage 1 of the game.

3.2 Equilibria at the First Stage

Given the payoffs under government regulation and under self-regulation and Assumption 1, it is obvious that the regulated industry will not spend money working for government regulation while the environmental protection group will not spend money working for self-regulation, i.e. $s_r > g_r = 0$ and $g_p > s_p = 0$ as stated in Corollary 1. The interest groups' objectives then become:

$$\max_{s_r} \left[\Pi_r = \frac{\alpha g_p}{s_r + \alpha g_p} A \left(\frac{A}{A + \gamma B} \right)^2 + \frac{s_r}{s_r + \alpha g_p} \left(A_o + \left(A - A_o\right) \left(\frac{A - A_o}{A - A_o + \beta B} \right)^2 \right) - s_r \right]$$

for the regulated industry and

$$\max_{g_p} \left[\Pi_p = \frac{\alpha g_p}{s_r + \alpha g_p} B \left(\frac{\gamma B}{A + \gamma B} \right)^2 + \frac{s_r}{s_r + \alpha g_p} B \left(\frac{\beta B}{A - A_o + \beta B} \right)^2 - g_p \right]$$

for the environmental protection group.

Taking first derivatives yields

$$\frac{\partial \Pi_r}{\partial s_r} = \frac{\alpha g_p}{\left(s_r + \alpha g_p\right)^2} \left(A_o + \left(A - A_o\right) \left(\frac{A - A_o}{A - A_o + \beta B} \right)^2 - A \left(\frac{A}{A + \gamma B} \right)^2 \right) - 1$$

and

$$\frac{\partial \Pi_p}{\partial g_p} = \frac{\alpha s_r}{\left(s_r + \alpha g_p\right)^2} B\left(\left(\frac{\gamma B}{A+\gamma B}\right)^2 - \left(\frac{\beta B}{A - A_o + \beta B}\right)^2\right) - 1 .$$

We abbreviate

$$\Gamma_r \equiv A_o + \left(A - A_o\right)\left(\frac{A - A_o}{A - A_o + \beta B}\right)^2 - A\left(\frac{A}{A+\gamma B}\right)^2$$

and

$$\Gamma_p \equiv B\left(\left(\frac{\gamma B}{A+\gamma B}\right)^2 - \left(\frac{\beta B}{A - A_o + \beta B}\right)^2\right)$$

for the net gains of the interest groups from acting under their preferred regulation regime. Of course, both these net gains are strictly positive as long as Assumption 1 holds true. It is important to note that Γ_p continuously declines to zero as β increases to $\gamma\left(1 - A_o / A\right)$.

It is then easy to describe the outcome of the first stage of the rent-seeking process. Equating the derivatives to zero and rearranging terms, we get $g_p = s_r \Gamma_p / \Gamma_r$ and thus

$$s_r = \frac{\alpha \Gamma_p \Gamma_r^2}{\left(\Gamma_r + \alpha \Gamma_p\right)^2} \text{ and } g_p = \frac{\alpha \Gamma_r \Gamma_p^2}{\left(\Gamma_r + \alpha \Gamma_p\right)^2} .$$

This implies that the probabilities of entering a self-regulation regime or a government-regulation regime are given by $\pi_s^* = \frac{\Gamma_r}{\Gamma_r + \alpha \Gamma_p}$ and $\pi_g^* = \frac{\alpha \Gamma_p}{\Gamma_r + \alpha \Gamma_p}$, respectively. Obviously, when β increases to $\gamma\left(1 - A_o / A\right)$, π_s^* and π_g^* approach 1 and 0, respectively, in a continuous manner.

The resulting expected payoffs in equilibrium are given by:

$$\begin{aligned} \Pi_r^* &= \pi_s^*\left(A_o\left(1 - \left(\frac{A - A_o}{A - A_o + \beta B}\right)^2\right) + A\left(\frac{A - A_o}{A - A_o + \beta B}\right)^2\right) \\ &\quad + \left(1 - \pi_s^*\right) A\left(\frac{A}{A+\gamma B}\right)^2 - \frac{\alpha \Gamma_p \Gamma_r^2}{\left(\Gamma_r + \alpha \Gamma_p\right)^2} \\ &= A\left(\frac{A}{A+\gamma B}\right)^2 + \frac{\Gamma_r^3}{\left(\Gamma_r + \alpha \Gamma_p\right)^2} \end{aligned} \tag{11}$$

and:

$$\begin{aligned} \Pi_p^* &= \left(1 - \pi_s^*\right) B\left(\frac{\gamma B}{A+\gamma B}\right)^2 + \pi_s^* B\left(\frac{\beta B}{A - A_o + \beta B}\right)^2 - \frac{\alpha \Gamma_r \Gamma_p^2}{\left(\Gamma_r + \alpha \Gamma_p\right)^2} \\ &= B\left(\frac{\gamma B}{A+\gamma B}\right)^2 - \frac{\Gamma_p \Gamma_r\left(\Gamma_r + 2\alpha \Gamma_p\right)}{\left(\Gamma_r + \alpha \Gamma_p\right)^2} \end{aligned} \tag{12}$$

For both interest groups, the second line expresses the equilibrium expected payoffs as the sum of the payoff under government regulation and a second term which expresses the gain from allowing to engage in rent seeking for (and against) self-regulation. In principle, the second term need not be positive for the regulated industry even if Assumption 1 holds true,

since it not only gains from self-regulation but also loses from the rent seeking expenses which entail from the possibility to engage in rent seeking for (and against) self-regulation. However, as we can see from the above equation, the industry's gains from the possibility of self-regulation always outweigh the rent seeking expenditures.

For the environmental protection groups, we already know that they prefer government regulation to self-regulation when Assumption 1 reflects reality, so the additional rent seeking costs may only further increase the losses from allowing self-regulation. One should however note that the loss reduces to zero in a continuous manner, when the environmentalists become indifferent between government-regulation and self-regulation, i.e. when the inequality in Assumption 1 turns into an equality, since then they will not engage in any rent-seeking at the first stage any more.

As a consequence, when the power of the environmentalists is large enough under the self-regulation regime – though still less than under the government-regulation regime – self-regulation induces a strictly positive welfare gain: the industry gains and the environmentalists are as well off as without any possibility of self-regulation. As long as the interests of both the industry and the environmentalists are contained in social welfare function with a positive weight, a similar positive welfare gain results from introducing the possibility of self-regulation even when Assumption 1 reflects reality, but the difference between the actual power of environmentalists under self-regulation is close enough to the level which would make them indifferent between self-regulation and government-regulation.

4 Variations in the Environmentalists' Influence Under Self-Regulation

So far, we have taken the institutional arrangements under self-regulation as given. Of course, the influence of the environmental protection group under self-regulation crucially depends on these institutional arrangements. 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,[2] we will in the following study how the power β of the environmentalists under the self-regulation regime 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:

$$\frac{\partial \Gamma_r}{\partial \beta} \equiv -2B\left(\frac{A-A_o}{A-A_o+\beta B}\right)^3 < 0 \text{ and } \frac{\partial \Gamma_p}{\partial \beta} \equiv -2B\frac{A-A_o}{A-A_o+\beta B}\frac{\beta B^2}{\left(A-A_o+\beta B\right)^2} < 0$$

Hence, the larger the power of the environmental protection group under self-regulation, the less the interest groups gain from acting under their respective preferred regulation regime.

[2] 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.

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

$$\frac{\partial \pi_s^*}{\partial \beta} = \alpha \frac{\frac{\partial \Gamma_r}{\partial \beta}\Gamma_p - \frac{\partial \Gamma_p}{\partial \beta}\Gamma_r}{\left(\Gamma_r + \alpha \Gamma_p\right)^2}$$

$$= \frac{-2\alpha B}{\left(\Gamma_r + \alpha \Gamma_p\right)^2} \frac{A - A_o}{A - A_o + \beta B}\left[\left(\frac{A - A_o}{A - A_o + \beta B}\right)\Gamma_p - \frac{\beta B^2}{\left(A - A_o + \beta B\right)^2}\Gamma_r\right]$$

Here the term before the brackets is clearly negative. The first term inside the brackets is strictly positive if $\beta \approx 0$ and declines to zero as β approaches $\gamma \frac{A - A_o}{A}$, i.e. the level at which environmentalists become indifferent between government-regulation and self-regulation. The second term approaches zero as β declines towards zero and is strictly negative otherwise. Hence their sum is positive if $\beta \approx 0$ and negative if $\beta \approx \gamma \frac{A - A_o}{A}$. The derivative $\frac{\partial \pi_s^*}{\partial \beta}$ is thus negative for small β and is positive if $\beta \approx \gamma \frac{A - A_o}{A}$, i.e. if the environmentalists are nearly indifferent between government-regulation and self-regulation. We thus get the following:

> **Result 3:** The probability that the first stage of the rent-seeking process results in self-regulation first declines in the power of the environmentalists under the self-regulation regime, but eventually increases again until it reaches unity at $\beta = \gamma \frac{A - A_o}{A}$, i.e. when the environmentalists are nearly indifferent between government-regulation and self-regulation and therefore do not oppose self-regulation any more.

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 countervailing effect of reducing the industry's interest in self-regulation may prevail. 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 will reach unity.

Similarly, we can show that the equilibrium expected payoff of the environmental protection group increases in β not only when Assumption 1 fails to reflect reality, but also if it does, at least if the environmentalists' power is sufficiently large under the self-regulation regime. For $\beta = \gamma \frac{A - A_o}{A}$, the equilibrium expected payoff is given by the net payoff under the government-regulation regime, to which the net payoff under the self-regulation regime is identical, whence no investments in rent-seeking against self-regulation occurs. Formally:

$$\Pi_p^*\Big|_{\beta = \gamma \frac{A - A_o}{A}} = B\left(\frac{\gamma B}{A + \gamma B}\right)^2$$

When β becomes smaller, the equilibrium expected payoff becomes the weighted average of the net payoffs under the government-regulation regime and the – now smaller – net payoffs

under the self-regulation regime and is further diminished by the expenses for rent seeking at the first stage. Hence a reduction of β implies a reduction of Π_p^*; in other words, the equilibrium expected payoff grows in β: $\frac{\partial \Pi_p^*}{\partial \beta} > 0$.

The corresponding result for the equilibrium expected payoff of the regulated industry crucially depends on the power of the environmental protection group at the first stage a. Writing Π_r^* as in the last line of equation (11) it is obvious that increasing β has two opposing effects: Π_r^* grows in Γ_r, which in turn declines in β, but declines in Γ_p, which also declines in β. If α is large, the latter effect prevails and if α is small, the former.

Result 4: The environmental protection group always gains from additional power at the self-regulation stage.
The regulated industry gains from additional power of the environmental protection group from an ex-ante point of view, if and only if the environmentalists power α at the first stage is large and the environmentalists prefer government regulation. If α is small or the environmentalists prefer self-regulation, the regulated industry fails to gain from additional power of the environmental protection group.

At the critical level $\beta = \gamma \frac{A - A_o}{A}$, we can determine the critical level of α without too much algebra: the derivative

$$\left.\frac{\partial \Pi_r^*}{\partial \beta}\right|_{\beta=\gamma\frac{A-A_o}{A}} = \left.\frac{\partial}{\partial \beta}\left(\frac{\Gamma_r^3}{\left(\Gamma_r + \alpha \Gamma_p\right)^2}\right)\right|_{\beta=\gamma\frac{A-A_o}{A}} = \left.\frac{\partial \Gamma_r}{\partial \beta}\right|_{\beta=\gamma\frac{A-A_o}{A}} - 2\alpha \left.\frac{\partial \Gamma_p}{\partial \beta}\right|_{\beta=\gamma\frac{A-A_o}{A}}$$

$$= -2B\frac{A}{A+\gamma B}\left(\left(\frac{A}{A+\gamma B}\right)^2 - \frac{2\alpha}{\beta}\left(\frac{\gamma B}{A+\gamma B}\right)^2\right)\Bigg|_{\beta=\gamma\frac{A-A_o}{A}}$$

$$= \frac{2AB}{\left(A+\gamma B\right)^3}\left(\frac{2\alpha A}{\left(A-A_o\right)}\gamma B^2 - A^2\right)$$

is positive if and only if $\alpha > \frac{A\left(A - A_o\right)}{2\gamma B^2}$. In words, this implies:

Result 4a: If β is slightly less than the value $\gamma\left(A - A_o\right)/A$ then the regulated industry gains from further increasing β from an ex-ante point of view if and only if $\alpha > \frac{A\left(A - A_o\right)}{2\gamma B^2}$.

In the model presented in this paper, we have taken the value of β, the power of the environmentalists, 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 allowing more power to the environmentalists at the self-regulation stage and therefore support the environmentalists to become more powerful at the self-regulation stage.

5 Effects on Social Welfare

We have so far concentrated on the positive analysis of self-regulation as a two stage game. There are good reasons to do so, in particular that the gains of interest groups typically fail to represent social welfare in a reasonable way. The main reason for this discrepancy between the gains of interest groups and social welfare is the varying ability of interests to organize as a (powerful) interest group.

Despite these problems we will give up this hesitance to engage in welfare considerations. We will assume that all social gains and losses from regulation are included in the two interest groups payoffs. This is most likely to be wrong, but may nevertheless allow for some relevant insight in welfare effects of government and self-regulation. In particular, we will investigate whether the efficiency gain in abatement technology resulting from self-regulation necessarily translates into an increase in social welfare.

We define social welfare as the sum of the regulated industry's payoff and the environmental protection group's payoff. We first compare the welfare effects of the two alternative regulation regimes at the second stage of the game and then turn to the entire game to ask whether allowing interest group to engage in rent seeking may have positive or negative effects on social welfare.

When both interest groups favor self-regulation, social welfare obviously is larger under self-regulation than under government regulation. Either rent seeking expenditures increase but the efficiency gain offsets this welfare loss, or rent seeking expenditures and abatement costs decrease.

However, if one of the interest groups prefers government regulation, the total welfare effect might also be negative. In line with previous simplifications, we continue to restrict the analysis to the case where the environmental protection group prefers government regulation. We consider two extremes to see that the welfare effect may both be positive and negative. A positive welfare effect easily results when $\beta \approx \gamma\left(1 - A_o / A\right)$: then the regulated industry gains a clearly positive amount from self-regulation, while the environmental protection group loses close to nothing.

However, if β is close to zero and the environmentalists interest in environmental protection B is large enough, government regulation entails more social welfare than self-regulation due to the following calculation. The difference between social welfare under self-regulation and social welfare under government regulation is given by:

$$\Gamma_r - \Gamma_p = A_o\left(1-\left(\frac{A-A_o}{A-A_o+\beta B}\right)^2\right) + A\left[\left(\frac{A-A_o}{A-A_o+\beta B}\right)^2-\left(\frac{A}{A+\gamma B}\right)^2\right]+B\left[\left(\frac{\beta B}{A-A_o+\beta B}\right)^2-\left(\frac{\gamma B}{A+\gamma B}\right)^2\right] \quad (13)$$

For $\beta = 0$ this reduces to

$$\Gamma_r - \Gamma_p = A\left[1-\left(\frac{A}{A+\gamma B}\right)^2\right]-B\left(\frac{\gamma B}{A+\gamma B}\right)^2$$

which is negative if and only if $A\left[2\gamma AB+\gamma^2B^2\right] < B(\gamma B)^2$ or simply $B > \frac{A}{2}\left(1+\sqrt{1+8/\gamma}\right)$, which implies $B > A$. By continuity of Γ_r and Γ_p in β and B we can generalize the result:

Result 5: The welfare effect of replacing government regulation by self-regulation is negative for sufficiently large B and sufficiently small β.

The intuition is simple: if B is larger than A more regulation is better than less from a social point of view. However, due to the difference between β and γ, self-regulation tends to induce less regulation than government regulation. If β is sufficiently smaller than γ, the loss in the degree of environmental protection resulting from self-regulation may be large enough to offset the gain in abatement efficiency. In addition, the total amount of rent seeking expenditure depends on the size of β and γ. Hence, the transition from a relatively large level of γ to a smaller level of β may increase the total rent seeking expenditure and thus reduce social welfare. However, in particular for very small levels of β, which were at the basis of the first argument within this intuition, the total rent seeking expenditures will decline as a consequence of the transition to self-regulation.

Given this result, one has to be careful when arguing in favor of allowing self-regulation. Not only does one invite rent seeking activities and thus provokes the consequential expenditures, but one furthermore incurs the risk of reducing the level of environmental regulation to a degree which more than offsets the efficiency gains from self-regulation.

6 Conclusions

In this paper we have studied self-regulation as an alternative to government regulation. We have treated both modes of regulation as a rent seeking game and embedded the two games into an overarching rent seeking game on the mode of regulation. Concentrating on environmental regulation, we have assumed that self-regulation increases abatement efficiency and the influence of the self regulating industry on the outcome of the regulatory process relative to the influence of an opposing environmental protection group. It has turned out that contrary to first intuition the environmental protection group may gain 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. Finally, we have shown that despite efficiency gains entailing from self-regulation, the welfare effect of replacing government regulation by self-regulation may be negative, because the efficiency of environmental protection may increase at the cost of its degree.

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.

Finally, one could refine the welfare analysis. With the current linear structure of the model the deliberately simple way of approaching the welfare effects of the alternative modes of regulation necessarily entails corner solutions as maxima of social welfare: full regulation or none. This suggests allowing for payoffs concave in the degree of regulation so that an interior socially optimal degree of regulation exists. The insights of section 5 would have to be modified and conditioned, but the central point would continue to come out of the model: if government regulation only reaches less regulation than socially optimal (in the linear model: less than complete protection of the environment) then turning to self-regulation may reduce social welfare despite the consequential efficiency gain in the abatement technology, because the environmentalists lose so much power in the regulatory process that the degree of regulation decreases more than the efficiency gain can offset.

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