Preemptive Corporate Social Responsibility or Voluntary Agreements?

Pierre Fleckinger*, Matthieu Glachant†

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*Université Paris 1 - Paris School of Economics. CES, Maison des Sciences Economiques, 106-112 boulevard de l'Hôpital, 75647 Paris Cedex 13. Email: pierre.fleckinger@univ-paris1.fr. Financial support from the Ecole Polytechnique Chairs FDIR and Business Economics is gratefully acknowledged.

†Corresponding author. Mines ParisTech, Cerna, 60 boulevard Saint Michel, 75272 Paris Cedex 06. Ph: +33 140519229; fax: +33 140519145; Email: glachant@mines-paristech.fr.

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Abstract

Do Corporate Social Responsibility strategies improve social welfare? We develop a policy game featuring a regulator and a firm that can unilaterally commit to better environmental or social behavior in order to preempt a future public policy. We show that the answer depends on the set of policy instruments available to the regulator. CSR improves welfare if the regulator can only use a mandatory regulation. It harms welfare when the regulator opts for a voluntary agreement. This suggests that Corporate Social Responsibility and voluntary agreements are not good complements from a welfare point of view. We derive the policy implications, and extend the basic model in several dimensions.

Keywords: Corporate Social Responsibility, Regulation Preemption, Voluntary Agreement, Self-Regulation.

JEL classification: D72, Q28.

1 Introduction

Companies increasingly wish to appear green and socially-friendly. Marks & Spencer have announced their intention to become carbon neutral by 2012. The Coca Cola Company has implemented a comprehensive corporate policy including quantified objectives on packaging recycling, water stewardship, energy conservation, etc. Air France company is funding projects to combat deforestation in Madagascar. Corporate Social Responsibility (CSR) is the usual umbrella concept to designate these practices. CSR is a form of self-regulation whereby firms unilaterally commit to environmental and social activities beyond those required by law and regulations.

In this paper, we develop a political economics model in which firms undertake CSR activities in order to preempt future public policies. The model shows that the diffusion of CSR activity is not always good news for the common interest. For ease of presentation, we only deal with environmental self-regulation, but results also apply to social CSR dealing with health and safety at work, child labor, etc.

Importantly for our analysis, CSR is not the only form of voluntary commitments. In particular, with Voluntary Agreements (hereafter VAs), firms also commit to an environmental objective on a voluntary basis. But, unlike CSR, a VA is a public policy instrument as the regulator is involved in the setting of these commitments. In the United States, the usual form is the *public voluntary program* in which goals are pre-established by the regulator.[1] In Europe or in Japan, VAs are mostly *negotiated agreements* in which the firms and the regulator jointly define the commitments through bargaining. As an illustration, the European Commission has secured negotiated agreements with European (ACEA), Japanese (JAMA) and Korean (KAMA) car manufacturers to reduce new cars' CO2 emissions.[2]

[1]The EPA web site lists 62 of such programs in place as of June 24, 2008. See: http://www.epa.gov/partners/programs/.

[2]A similar bargaining logic is found in national environmental forums which gather firms, NGOs and regulators to elaborate new policies. The French 'Grenelle de l'environnement' is one example of such practices.

The coexistence of CSR and VAs triggers the questions addressed in this paper: From the regulator's perspective, what role can VAs have today in a context where CSR is becoming pervasive? Should regulators give VAs up and restrict themselves to the use of mandatory regulation?

In this paper, we examine how CSR influences the welfare properties of VA and a mandatory legislation with a simple model involving a firm and a regulator. The firm moves first and can commit to CSR activities which consist in abating pollution. Then the regulator seeks to reach a VA with the firm in stage 2. In case of persisting disagreement, he initiates a legislative process which potentially leads to the adoption of a mandatory quota for pollution abatement. We show that CSR reduces welfare when a VA is reached in stage 2. Intuitively, the reason is that the firm strategically makes CSR efforts to lessen the legislative threat that drives the emergence of the VA. In constrast, CSR improves welfare if the policy sequence does not include the VA stage. This suggests that CSR and VAs do not complement each other. Given that prohibiting CSR is not a feasible policy option, should VAs be forbidden? We establish that the answer is ambiguous, and depends on the allocation of bargaining power between the firm and the regulator. Results carry through when we consider the case of many firms and variants of the legislative subgame.

A substantial body of theoretical work has now produced a number of explanations for the existence and the welfare effects of VAs, Corporate Social Responsibility, and self-regulation (for a recent review, see Lyon and Maxwell, 2008). It is convenient to classify these contributions into two categories which are ultimately based on firms' motives. The first category consists of contributions in which firms engage in voluntary environmental and/or social activities for market-driven purposes (Arora and Gangopadhyay, 1995; Fisman et al., 2006; Besley and Ghatak, 2007), to incentivize workers and managers (Brekke and Nyborg, 2004; Baron, 2008) and attract investors. The starting point of this research stream is the idea that, in the real world, certain economic agents – consumers, workers, shareholders – have personal preferences for contributing to social or environmental causes and they may choose to reward environmentally or socially friendly companies. Against this background, voluntary commitments' purpose is to signal the firms' social/environmental performances.

Our paper belongs to a second branch of the literature where firms make voluntary efforts for political reasons: they anticipate that voluntary commitments can preempt or shape future public policies. More precisely, the premise is that improving the social and environmental performance is costly. Consequently, CSR or a VA emerge only when they are less costly than the public policies the firms would face in the absence of voluntary commitments. In this research stream, most papers do not investigate the interplay between VAs and CSR. Some papers only deal with VAs (Manzini and Mariotti, 2003; Segerson and Miceli, 1998; Glachant, 2007), and others only with CSR or self regulation (Maxwell et al., 2000; Heyes, 2005; Denicolo, 2008).

To the best of our knowledge, the only exception is a contribution by Lyon and Maxwell (2003), who analyze VAs and CSR in a unified framework. However, the sequence of moves is different from our paper. Once the firm has chosen its CSR activity in Stage 1, they assume that the regulator initiates a legislative process leading potentially to a tax with a probability p in Stage 2. A VA is made only if the relevant law is not passed. Furthermore, the VA is associated with a subsidy. This allows for the emergence of voluntary efforts in the last stage. We should note that, strictly speaking, real-world VAs do not include monetary payments. But they may be associated with technical assistance or other in-kind compensations, particularly in the U.S. (Lyon and Maxwell, 2003).

In our model, the regulator tries to make a VA in Stage 2. Then, it legislates in Stage 3 only in case of persisting disagreement. We assume that the VA does not include a subsidy. In this set-up, legislation defines the threat which makes voluntary abatement possible in Stage 2. This approach is arguably more realistic for European or Japanese negotiated agreements. This difference in the sequence of moves leads to opposite results: CSR is welfare reducing in our model whereas this is the opposite in Lyon and Maxwell (2003)[3].

[3] In addition, public voluntary programs may be socially detrimental in their paper, whereas in our paper a VA is welfare improving in the absence of CSR.

The paper is organized as follows. In Section 2, we introduce the basic version of the model with a single firm. We fully solve the model in Section 3. Then, in Section 4 we perform the analysis with the sole legislation, and compare the policy outcomes under the two sequences. This enables us to explore whether one should prohibit VAs or not. The generalization of our results to the case of n firms is the subject of Section 5. In Section 6 we explore other models of political influence in the legislative arena. Finally, in the concluding part, we wrap up the main findings.

2 The base model

We consider a sequential policy game involving a firm and a regulator where q is the only policy-relevant variable. In the following we will refer to q as the level of pollution abatement. But this variable can represent any other performance indicator capturing CSR outcomes.

The firm moves first and can commit to CSR activities which consist in abating pollution. The regulator, which moves second, is in charge of policy definition and legislative activity. It tries to reach a VA with the firm in the second stage[4]. In case of persisting disagreement, he initiates a legislative process leading to a quota requiring a specified level of abatement.

2.1 Gross payoffs

The firm's abatement cost is $C(q)$, satisfying $C(0) = C'(0) = 0$ and $C, C', C'' > 0$. This assumption deserves an important remark. We have mentioned in the introduction the literature in which abatement is profitable for market reasons. Our hypothesis is compatible with this view. The case $q = 0$ is just the point where all profitable abatement

[4]In reality, certain VAs involve a coalition of firms represented by an industry association. Our model can also apply to this case if we assume that the members of the coalition have solved their collective action problem. This assumption is usual in the VA literature. We consider the case of several firms in Section 5.

opportunities have been exploited. This implies that the two perspectives–voluntary efforts driven by market forces or driven by political factors–are analytically separable in our framework.

The regulator maximizes a social welfare function[5] $U(q)$, which is assumed twice-continuously differentiable and concave with a maximum at some positive and finite level q^*. U obviously includes the abatement cost. We assume $U'(0) > 0$, and, without loss of generality, we use the normalization $U(0) = 0$.

2.2 Legislation

As a real-world environmental agency, the regulator does not directly enact the abatement quota. This is the task of legislators. The regulator only initiates the process by proposing a given quota L. But political imperfections exist in Congress which prevent the systematic adoption of its proposal. More specifically, we assume that the proposed quota is enacted with a probability $p < 1$. Otherwise, no legislation is passed.

Furthermore, we posit that the probability p of adopting the regulation depends on the regulator's effort to successfully present the case in Congress. For example, the regulatory agency has to produce evidence that the type of pollution should indeed be regulated, that the competitiveness of the firm would not be harmed too much by the new legislation and so on. We assume that obtaining adoption with probability p costs the regulator $\gamma(p)$ where $\gamma(0) = \gamma'(0) = 0$ and $\gamma', \gamma'' > 0$. The fact that the probability of ending up with the quota is zero when no effort is granted has strictly no incidence. It only simplifies the presentation. In turn, assuming that the marginal cost at the minimum probability is zero allows for interior solutions. Otherwise, legislative action would simply be irrelevant in some cases, because never used. Finally we assume that $\gamma''' \geq 0$, which is (scarcely) needed for technical reasons.

The assumption that the adoption of legislation is subject to uncertainty is both realis-

[5] Actually, U can represent any utility function giving various weights to consumers' surplus, producers' profits, environmental concerns, employment and the like.

tic and usual in papers dealing with voluntary abatement.[6] Assuming that the regulator can make efforts to increase this probability is realistic but original.[7]

In other papers, p is either purely exogenous (Segerson and Miceli, 1998) or influenced by pressure groups. Lobbying can be explicitly modeled as in Glachant (2005). Or it is implicit as in Lyon and Maxwell (2003) who assume that p decreases with L to reflect political efforts by polluters which presumably increase with the environmental strictness of legislation. In Section 6.1 we study an extension of the model with lobbying by the firm which competes with the regulator to influence p.

Note also that γ does not depend on the strictness of the abatement quota L in the base model. To test the robustness of the results, we also develop in Section 6.2 a second variant in which the regulator does not influence the adoption probability but the quota level L. That is, $\gamma = \gamma(L)$.

2.3 Timing

The game has three stages:

1. (Corporate Social Responsibility) The firm unilaterally abates a quantity of pollution r.

2. (Voluntary Agreement) The regulator and the firm bargain over an abatement level, q^{VA}. If both parties agree, the firm complies.

3. (Legislation) In case of disagreement, the regulator initiates the legislative process by choosing the probability p and the legislative quota L. The new regulation is adopted with the probability p and the firm complies. Otherwise the abatement level remains r.

[6] Glachant (2005); Lyon and Maxwell (2003); Heyes (2005); Segerson and Miceli (1998); Manzini and Mariotti (2003) all use this assumption.

[7] See Maxwell and Decker (2006) for the related case of costly enforcement. In their model CSR activity eases compliance to existing regulation.

In this sequence, the policy process continues even when the firm undertakes CSR activities in Stage 1 ($r > 0$). This captures the fact that a CSR policy is purely unilateral: the regulator does not commit to anything. In our view, this is the key difference between CSR and traditional VAs in which the regulator commits to refrain from making further policies.

Furthermore, the timing we consider for public action - to negotiate first and then to legislate in case of disagreement - is the only relevant sequence for a regulator that has both options. The legislative option provides the threat that makes the agreement feasible. Reversing the order - legislating first and then negotiating a VA - would suppress the firm's incentives to enter the VA.

3 Equilibrium analysis

3.1 Legislative stage

Reasoning backwards, we start the analysis of the legislative subgame by assuming that the polluter has voluntarily committed to abate some quantity of pollution r in the first stage. Under our assumptions, the regulator proposes obviously the quota $L = q^*$ as its strictness has no influence on the adoption probability. Its effort to bring the case to Congress is given by:

$$p(r) \equiv \underset{p}{argmax} \;\; pU(q^*) + (1-p)U(r) - \gamma(p)$$

The optimal probability p is determined uniquely as a function of r. Note the following:

Lemma 1 (Preemption Effect) *The probability of successful legislative action is strictly decreasing in the level of CSR: $p'(r) < 0$.*

Proof. The first-order condition $\gamma'(p(r)) = U(q^*) - U(r)$ has to hold, otherwise $r > q^*$, which would be strictly dominated for the firm. Differentiating the first-order condition yields $p'(r) = -U'(r)/\gamma''(p(r))$ which is negative, since $r \leq q^*$. ■

CSR decreases the strictness of legislation as the regulator's incentives to make efforts in the legislative process are weakened: there is less to gain in Congress given that some abatement has already been granted.

3.2 VA stage

The negotiation of the VA target, q^{VA}, takes place under the following two individual rationality constraints:

$$U(q^{VA}) \geq p(r)U(q^*) + (1 - p(r))U(r) - \gamma(p(r)) \tag{1}$$

$$C(q^{VA}) \leq p(r)C(q^*) + (1 - p(r))C(r) \tag{2}$$

In the following we use the notations $\overline{U}(r)$ and $\overline{C}(r)$ to denote the reservation utility level of the regulator and the reservation cost of the firm, respectively:

$$\begin{aligned} \overline{U}(r) &\equiv p(r)U(q^*) + (1 - p(r))U(r) - \gamma(p(r)) \\ \overline{C}(r) &\equiv p(r)C(q^*) + (1 - p(r))C(r) \end{aligned}$$

They are obviously also the expected utility and the cost of legislation.

Clearly, as U and C are respectively concave and convex, the set of acceptable q^{VA} is not empty. For example, $q^{VA} = p(r)q^* + (1 - p(r))r$ satisfies (strictly) both constraints.[8] Also, since the two participation constraints are continuous, the feasible set is an interval of the form $[\underline{q}^{VA}, \overline{q}^{VA}]$, with the lower bound corresponding to a binding participation constraint for the regulator - $U(\underline{q}^{VA}) = \overline{U}(r)$)-, and the upper bound to a binding participation constraint for the firm - $C(\overline{q}^{VA}) = \overline{C}(r)$. In summary,

Lemma 2 *A VA always emerges in equilibrium, and is Pareto-superior to regulation.*

This replicates usual results in the literature on VAs. The message is that, when a VA emerges, it is less constraining than the ex-post optimal regulation ($q^{VA} < q^*$). But it

[8] As U is concave, we have $U\left[p(r)q^* + (1 - p(r))r\right] > p(r)U(q^*) + (1 - p(r))U(r)$. This directly implies that (1) is satisfied. Similarly, $C\left[p(r)q^* + (1 - p(r))r\right] < p(r)C(q^*) + (1 - p(r))C(r)$ because C is convex.

is obtained for sure and this is preferable overall. One reason for that is the concavity of at least one of the utility functions, which grants a risk advantage to the VA, since it is definitely implemented contrary to legislation. The second reason is that making the agreement saves the legislative cost $\gamma(p)$ borne by the regulator.

In what follows, it will prove useful to work with a single equilibrium abatement level q^{VA} in the feasible set $[\underline{q}^{VA}, \overline{q}^{VA}]$. It obviously depends on the allocation of bargaining power between the regulator and the firm. To derive the equilibrium, we consider the generalized Nash bargaining solution[9] with bargaining powers α and $1-\alpha$ for, respectively, the regulator and the firm ($0 \leq \alpha \leq 1$). The Nash program then writes:

$$\max_{q} \quad [U(q) - \overline{U}(r)]^{\alpha} [\overline{C}(r) - C(q)]^{1-\alpha}$$

The solution $q^{VA}(\alpha, r)$ to this program is implicitly given by the first-order condition:

$$\left(\frac{\alpha}{1-\alpha}\right) \frac{U'(q^{VA}(\alpha, r))}{C'(q^{VA}(\alpha, r))} = \frac{\Delta U(\alpha, r)}{\Delta C(\alpha, r)} \tag{3}$$

where we use the notations:

$$\Delta U(\alpha, r) \equiv U(q^{VA}(\alpha, r)) - \overline{U}(r) \qquad \text{and} \qquad \Delta C(\alpha, r) \equiv \overline{C}(r) - C(q^{VA}(\alpha, r))$$

3.3 CSR stage

We have just seen that the firm and the regulator always settle for a VA in stage 2. Therefore, when choosing its unilateral commitment in the first stage, the firm solves:

$$\min_{r} \; C(q^{VA}(\alpha, r)) \tag{4}$$

where $q^{VA}(\alpha, r)$ is implicitly defined by (3). Let us use index 1 to denote the solution to this program.

[9] We discard alternating offer bargaining procedures, because they would not parameterize the *Pareto*-frontier in our model, whereas the Nash solution does. Alternating offers bargaining would not be ex-ante optimal in terms of risk-sharing, given the concavity of the utility functions in q and the absence of monetary transfers.

We are in a position to establish a central result. If the firm undertakes CSR activities in equilibrium ($r^1 > 0$), we necessarily have $C(q^{VA}(\alpha, 0)) > C(q^{VA}(\alpha, r^1))$ and thus $q^{VA}(\alpha, 0)) > q^{VA}(\alpha, r^1)$. That is, the VA abatement level is lower with CSR. This implies that $U\left(q^{VA}(\alpha, 0)\right) > U\left(q^{VA}(\alpha, r^1)\right)$ as U is an increasing function below q^*. To sum up,

Proposition 1 *If the firm makes strictly positive CSR efforts in equilibrium ($r^1 > 0$), this harms the regulator's payoff.*

The intuition is extremely simple. If CSR emerges in equilibrium, this necessarily implies less VA abatement. And the regulator's utility declines as it widens the gap with the first best abatement level q^*.

Given the negative impact of possible CSR activities, the next key question is whether CSR actually emerges in equilibrium. To answer the question, we need to solve the firm's optimization program (4). This is done in Appendix and we obtain:

Proposition 2 *Let α denote the regulator's bargaining power. There exists a unique value $\hat{\alpha} \in (0, 1)$ such that the firm undertakes CSR abatement ($q^* > r^1 > 0$) if and only if $\alpha > \hat{\alpha}$.*

Proof. See the Appendix. ■

The intuition is again simple. With limited bargaining power on the public authority's side ($\alpha \leq \hat{\alpha}$), the firm has no interest in preempting the regulation since it will appropriate a high fraction of the surplus in the voluntary agreement. On the contrary, facing a tough negotiator ($\alpha > \hat{\alpha}$), the firm prefers to reduce the stake in the forthcoming negotiation because it will mostly be appropriated by the regulator anyway and because higher unilateral abatement makes the regulator more lenient.

The results of Proposition 1 and Proposition 2 could suggest that bargaining power has ambiguous effects on the regulator's utility. On the one hand, a high α helps the regulator to obtain a stricter VA target. On the other hand, more bargaining power raises CSR abatement, which cuts its utility. In fact, the former effect outweighs the latter:

Lemma 3 *In equilibrium, VA abatement increases with the regulator's bargaining power. Therefore, the regulator is always better off with a higher bargaining power.*

Proof. See the Appendix. ■

It is now possible to discuss the policy implications of the results obtained so far. We have seen that CSR and VAs are not good complements as CSR weakens the VA abatement level. Is it possible to solve this problem? Two policy solutions come to mind. The first would consist in prohibiting CSR activities while the regulator keeps using VAs. This is clearly not feasible in a market economy.[10] The second option may be to prohibit the regulator from making VAs, which sounds legally easier. Note that this *ex ante* rule must be binding as opting for a VA in Stage 2 always improves regulators' and firms' utilities.

In order to explore the potential of this solution, we need to analyze a policy game without VAs.

4 A game without the VA

We simply eliminate the second stage of the game. As we have already characterized the legislative subgame equilibrium in Lemma 1, we need only to analyze the first stage when the polluter makes its CSR policy.

4.1 CSR stage

Let r^2 denote the equilibrium CSR level of abatement in this scenario. The firm minimizes its expected cost of abatement under legislation: [11]

$$\underset{r}{min}\ \overline{C}(r) = p(r)C(q^*) + (1 - p(r))C(r) \tag{5}$$

We then establish that

Proposition 3 *In the absence of VAs, the firm always commits to CSR activities: There is a unique equilibrium with CSR abatement* $r^2 > 0$.

[10] Although public authorities can find ways to discourage partly these activities.

[11] Note that this expected cost is exactly $\overline{C}(r)$, the reservation utility in the VA.

Proof. At $r = 0$, we have:

$$\overline{C}'(0) = p'(0)C(q^*) < 0$$

Hence, the minimum r^2 has to be strictly positive. In addition,

$$\overline{C}''(r) = p''(r)(C(q^*) - C(r)) - 2C'(r)p'(r) + (1 - p(r))C''(r)$$

From Lemma 1, we know that $p'(r) = -U'(r)/\gamma''(r) < 0$ in equilibrium for any r. Differentiating yields:

$$p''(r)\gamma''(p(r)) = p'(r)^2\gamma'''(p(r)) - U''(r)$$

in which RHS is positive since $\gamma''' \geq 0$ and U is concave. This implies $p'' > 0$. Therefore $\overline{C}$ is convex with a single minimum. ■

The firm systematically prefers to preempt legislation, whereas in the previous case CSR activities occured only when the regulator's bargaining position was strong.

Recall Lemma 1 which says that CSR reduces the legislation probability p. Does it mean that the regulator is worse off than without CSR? Again, the result differs sharply from the base model:

Proposition 4 *In the absence of VAs, CSR is socially beneficial and the regulator's payoff increases with CSR activity.*

Proof. For any given level of CSR abatement r, the regulator's expected utility in the regulation game is $\overline{U}(r) = p(r)U(q^*) + (1 - p(r))U(r) - \gamma(p(r))$. Differentiating yields

$$\overline{U}'(r) = p'(r)\left[U(q^*) - U(r) - \gamma'(p(r))\right] + (1 - p(r))U'(r)$$

From Lemma 1, we know that $\gamma'(p) = U(q^*) - U(r)$, so that $\overline{U}'(r) = (1 - p(r))U'(r)$ which is positive ($U'(r) > 0$ since $r < q^*$). ■

Why does CSR now improve social welfare? Consider the legislative probability $p(0)$ the regulator would select in the absence of CSR. If it was to choose exactly the same probability with positive CSR efforts, its payoff would be strictly higher: legislation would be adopted with the same probability; costs would be the same; but if the legislation failed, its payoff would be higher given the positive CSR level. Unlike the scenario with VA, there is no drawback to CSR, and it should be promoted without restriction.

4.2 Prohibiting VAs?

We have just seen that, in the absence of VAs, the firm systematically undertakes desirable CSR activities. Does it justify the prohibition of VAs? We now compare the outcomes of the two policy games.

We focus first on the particular case where the regulator has zero bargaining power: $\alpha = 0$. In the VA scenario, the regulator's participation constraint (1) is binding, $U(q^{VA}) = \overline{U}(r)$, so that the VA arising in equilibrium satisfies

$$U(q^{VA}) = p(r^1)U(q^*) + (1 - p(r^1))U(r^1) - \gamma(p(r^1))$$

Hence, for the regulator's utility, the VA and legislation are payoff-equivalent.

In the scenario without VAs, the equilibrium regulator's utility is similar:

$$\overline{U}(r^2) = p(r^2)U(q^*) + (1 - p(r^2))U(r^2) - \gamma(p(r^2))$$

The only difference lies in the level of CSR abatement. In this regard, Proposition 2 states that that $r^1 = 0$ when $\alpha = 0$, while Proposition 3 states $r^2 > 0$. As more CSR improves the regulator's utility of legislation (Proposition 4), we can conclude that prohibiting VAs would improve welfare in this case.

Turning next to the other extreme case, $\alpha = 1$, we have

$$C(q^{VA}) = p(r^1)C(q^*) + (1 - p(r^1))C(r^1)$$

with $r^1 > 0$. The VA and legislation are now cost-equivalent for the firm. One consequence is that the CSR abatement level is the same under legislation and under the VA ($r^1 = r^2$). Furthermore, the regulator's participation constraint is not binding, meaning that

$$U(q^{VA}) > p(r^1)U(q^*) + (1 - p(r^1))U(r^1) - \gamma(p(r^1))$$

As $r^1 = r^2$, the right-hand side of this inequality is also the equilibrium utility under legislation. The use of VAs now benefits the regulator.

In the intermediate case $\alpha \in (0, 1)$, Lemma 3 tells us that social welfare under the VA increases with α while it has obviously no effects in the scenario without VAs. Hence, there is a unique threshold value of α such that the prohibition of VAs increases social welfare below this threshold and decreases it above. We summarize these findings in:

Proposition 5 *There exists a unique value of the regulator's bargaining power $\tilde{\alpha} \in (0, 1)$ such that prohibiting the use of VAs improves (damages) social welfare if $\alpha \leq \tilde{\alpha}$ ($\alpha > \tilde{\alpha}$).*

This proposition echoes the usual distinction mentioned in the introduction between *public voluntary programs* and *negotiated agreements*. These are two types of VA which allocate the bargaining power between the business side and the public side differently. In a voluntary program, the regulator proposes a set of environmental objectives or activities that the firms are free to accept or not. There is no discussion between the parties about these goals. Hence, by design, a voluntary program gives all the bargaining power to the regulator. Negotiated agreements are different in that the environmental objectives are jointly set by the firms and the regulator. Proposition 5 suggests that voluntary programs may be more appropriate when firms undertake CSR activities.

4.3 A graphical summary

Before turning to various extensions of the model, a summary of the results so far is in order. Figure 1 offers a full overview of the various regulatory alternative. Point A corresponds to a case in which only regulation would be used, and the firm does not take self-regulation actions. In this case, $r = 0$, and the regulator controls through the effort the lottery between $q = 0$, if regulation fails, and $q = q^*$, if regulation is successfully carried on.

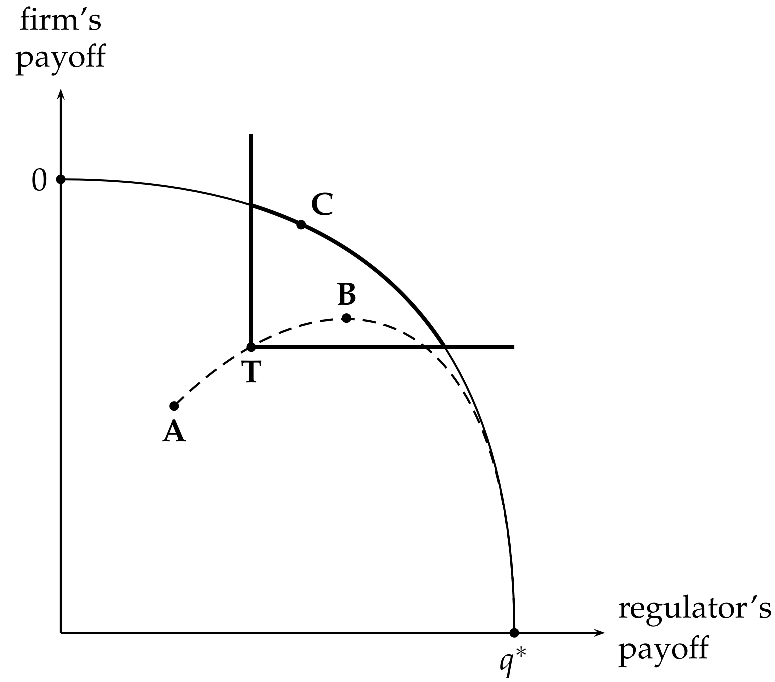

Figure 1: Equilibria in the various cases

Point B corresponds to the equilibrium in the scenario without VAs. The dashed line is the locus of payoffs pairs when the level of CSR varies from $r = 0$ (point A) to $r = q^*$. It is clear that from A to B any increase in r is a Pareto-improvement. Therefore, the firm takes CSR actions to reach point B, and CSR is welfare-improving (proposition 4).

Finally, point C corresponds to the VA a equilibrium for some bargaining level α. Point T is the threat point in the VA when the firm has chosen some (equilibrium) CSR level in the first period. The payoffs at this status-quo option of the VA bargaining are the expected payoffs in case the legislative process is launched. The two thick lines starting at T represents the participation constraint of the regulator (the vertical line) and the participation constraint of the firm (the horizontal line). Point C on the frontier corresponds to the point reached for the given bargaining power α. Two extreme cases are worth mentioning: if $\alpha = 1$, for any level of CSR, the bargaining outcome is on the horizontal line, and the firm will therefore choose the same r as in the case without VA. At the other extreme, the bargaining outcome is on the vertical line, and the firm has no incentives to engage in CSR at all, so that in equilibrium $r = 0$ (see proposition). Equilibrium C shown on the figure corresponds to a situation in which $\alpha < \hat{\alpha}$, and the regulator would be better off in the equilibrium A (proposition 5).

5 Several firms

The base model with one firm misses an important issue. Legislation is not firm-specific. It applies to several firms, and frequently to all firms of a given industry. As a result, reducing the legislative probability is a public good for the firms. The fact that the political benefit of CSR is collective whereas its cost is private obviously raises free riding concerns. In this section we extend the model to a setting with n identical firms which choose CSR efforts non-cooperatively. We will see that this does not alter the results obtained so far.

5.1 Game with VA

As in Manzini and Mariotti (2003), we assume that *all* firms must participate in the VA, otherwise legislation is triggered otherwise.[12] This assumption introduces a clear-cut difference between VAs and CSR as free riding will affect only the latter. This is clearly restrictive because VA participation also yield the collective benefit of avoiding legislation. However we believe that the public good issue is less severe at the VA stage. A first reason is that VAs are frequently set up at the branch level. In particular, this is almost always the case in Europe and in Japan. Although this does not totally eliminate free-riding incentives, the central role of branch associations in the negotiation and implementation of the agreement mitigates the problem. Moreover many contracts include provisions requiring a minimal level of participation for the VA to be definitely adopted.

This is arguably less true for US Public Voluntary Programs which are based on the individual participation of companies. However the presence of a public authority nec-

[12] This setting shares some features with non-point pollution in which firms are made collectively responsible, see Segerson and Wu (2006).

essarily implies a stronger integration of individual behaviors in these programs as compared to purely decentralized CSR policies.

Given the symmetry of the firms, we define the total optimal abatement as nq^*, so that q^* is the optimal uniform quota for the regulator. Firms are indexed by i and their CSR activity levels are denoted r_i. We use the following definition:

$$R \equiv \sum_i r_i$$

At the last (legislative) stage, the regulator chooses p to maximize

$$pU(nq^*) + (1-p)U(R) - \gamma(p)$$

which defines $p(R)$ implicitly through the first-order condition

$$U(nq^*) - U(R) = \gamma'(p) \tag{6}$$

The properties of $p(R)$ are therefore the same as in the previous section, that is, it is decreasing and convex.

For the sake of brevity we now focus on the two extreme cases of bargaining power,[13] $\alpha = 0$ or $\alpha = 1$.

Firm's bargaining power ($\alpha = 0$ ***)***

Under unanimous VA, the regulator obtains its reservation utility (since $\alpha = 0$), and firms' payoffs should be such that they all participate. There exists clearly a level q^{VA} which satisfies all firms' participation constraints: the regulator is ready to accept a laxer policy than the legislation, as this saves the regulatory cost γ. Therefore, the regulator's participation constraint determines the equilibrium VA:

$$U(nq^{VA}) = p(R)U(nq^*) + (1-p(R))U(R) - \gamma(p(R)) \tag{7}$$

[13] Another modeling option would be to use a two-stage negotiation as in Manzini and Mariotti (2003), with firms collectively choosing an offer to make in a subsequent alternating offer bargaining game against the regulator.

Finally, in the first stage, firm j chooses its CSR level. But by differentiating with respect to r_j (7), which is defined for any collection $\{r_i\}$, and by using the envelope theorem, one obtains:

$$nU'(nq^{VA})\frac{\partial q^{VA}}{\partial r_j} = (1 - p(R))U'(R) > 0$$

which implies $\partial q^{VA}/\partial r_j > 0$. Therefore firms do not commit to CSR when $\alpha = 0$ like in the base model.

Regulator's bargaining power ($\alpha = 1$)

We now turn to the other extreme case. The analysis will be a little bit more complicated as, at the VA stage, a set of constraints – and not just a single one – characterizes the VA. With unanimity, *all* the following firms' participation constraints must be satisfied:

$$C(q^{VA}) \leq p(R)C(q^*) + (1 - p(R))C(r_i) \qquad \text{with } i = 1, ..n \tag{8}$$

Note that if some firm i chooses $r_i \geq q^{VA}$ in the first stage, its participation constraint is immediately satisfied. But as CSR is assumed to be a perfect commitment, the firm needs to abate the quantity r_i. As a result its cost is $C(r_i)$ which exceeds $C(q^{VA})$. Obviously, this cannot happen in equilibrium.

A key observation for the following analysis is that among the contraints (8), the only binding ones correspond to the lowest CSR levels. Web therefore divide the firms into two groups:

$$\mathbb{L} = \{l \in \{1..n\} | r_l = \min_i r_i\} \quad \text{and} \quad \mathbb{M} = \{m \in \{1..n\} | r_m > \min_i r_i\}$$

We refer to group $\mathbb{L}$ as the laggards, and generically use r_l to denote their CSR activity. In a unanimous VA, we necessarily have:

$$C(q^{VA}) = p(R)C(q^*) + (1 - p(R))C(r_l) \tag{9}$$

Intuitively this is so because the laggards are those which lose less under the legislative route as their abatement efforts are limited in the event that the law is not passed. This resembles the 'toughest firm principle' derived in Manzini and Mariotti (2003). But while in their paper asymmetry between firms is given, it is endogenous here as it results from endogenously determined CSR activities. More can be said on the shape of the putative equilibria:

Lemma 4 *Provided it exists, in any equilibrium there is exactly one laggard which exerts a strictly positive CSR effort, and all the other firms choose the same CSR levels which are equal to the forthcoming VA level. Formally:*

$$\mathbb{L} = \{l\},\ \mathbb{M} = \{1..n\} \backslash \{l\}$$

$$0 < r_l < r_m = q^{VA} \quad \forall\, m \in \mathbb{M}$$

Proof. To prove the first assertion, assume by contradiction that $\mathbb{L}$ contains at least two firms in equilibrium. Then if one of the laggards unilaterally increases its CSR level by some small $\varepsilon > 0$, the VA still emerges as the participation constraint of the other laggard still holds. Hence the cost for the deviating laggard under deviation is now:

$$C(q^{VA}) = p(R+\varepsilon)C(q^*) + (1 - p(R+\varepsilon))C(r_l)$$

which is less than the cost before deviation $p(R)C(q^*) + (1 - p(R))C(r_l)$ as p is a decreasing function. Therefore there is exactly one laggard in any equilibrium.

It exerts a strictly positive CES effort as the derivative at $r_l = 0$ of its cost is

$$\left.\frac{\partial C(q^{VA})}{\partial r_l}\right|_{r_l=0} = p'(R)C(q^*) < 0.$$

Turning next to the other firms, by the same reasoning, any firm m which is not a laggard wants to increase its CSR level when $r_m < q^{VA}$: It is a strict best-reply as it only decreases the legislative probability, and thus decreases the equilibrium VA level in (9). This is true until $r_m = q^{VA}$. Going further ($r_m > q^{VA}$) would cost $C(r_m)$ which is higher than $C(q^{VA})$. In conclusion, for any firms i in $\mathbb{M}$, $r_m = q^{VA}$ has to hold in equilibrium. ■

We now establish the existence of a VA in equilibrium. From Proposition (4) it follows directly that the equilibrium VA satisfies two equations:

$$p'(r_l + (n-1)q^{VA})(C(q^*) - C(r_l)) + (1 - p(r_l + (n-1)q^{VA}))C'(r_l) = 0 \tag{10}$$

$$C(q^{VA}) = p(r_l + (n-1)q^{VA})C(q^*) + (1 - p(r_l + (n-1)q^{VA}))C(r_l) \tag{11}$$

where (10) is the first-order condition for the laggard's CSR level, and (11) states that the other firms commit at the CSR stage to abate exactly the amount that will be prescribed by the VA. We show in Appendix that this system of equations always admits a unique solution. The following can thus be stated:

Lemma 5 *There exists an essentially unique equilibrium (i.e. up to the identity of firms) when* $\alpha = 1$. *It is characterized by (10) and (11).*

Proof. See the Appendix. ■

Let us sum up the results obtained so far. We have shown that firms do not undertake CSR activities when $\alpha = 0$ while they all do so when $\alpha = 1$. Any positive CSR effort damages social welfare as it weakens the VA abatement level q^{VA}. These results are identical to the ones derived in the base model with a single firm. Does this mean that prohibiting VAs might still be interesting when the regulator's bargaining power is low as established in Proposition 5 for the base model? We now consider the policy sequence without the VA.

5.2 Legislation only

In the absence of a VA, the regulator's effort is still determined by (6). It is therefore clear that any positive effort of CSR ($R > 0$) increases its utility as in the base model as

$$\overline{U}'(R) = p'(R)\left[U(nq^*) - U(R) - \gamma'(p(R))\right] + (1 - p(R))U'(R)$$

is positive given (6).

In the first stage, the firms play a CSR subgame with payoffs

$$\overline{C_i}(\{r_i\}) = p(R)C(q^*) + (1 - p(R))C(r_j)$$

This subgame is solved in the following lemma:

Lemma 6 *There exists a unique symmetric equilibrium with CSR level $r^3 > 0$, which is decreasing in n. Furthermore, $0 < r_l < r^3 < q^{VA}$.*

Proof. The first and second derivatives of the expected costs of firm j with respect to r_j are:

$$\begin{aligned}
\frac{\partial \overline{C_j}}{\partial r_j} &= p'(R)(C(q^*) - C(r_j)) + C'(r_j)(1 - p(R)) \\
\frac{\partial^2 \overline{C_j}}{\partial r_j^2} &= p''(R)(C(q^*) - C(r_j)) - 2C'(r_j)p'(R) + C''(r_j)(1 - p(R))
\end{aligned}$$

As in proposition 3, $p'' > 0$ given $\gamma''' \geq 0$. Thus $\overline{C_j}(\{r_i\})$ is strictly convex in r_j. The level of CSR is thus given by the first-order condition, and as in proposition 3 again, $r_j > 0$.

Now, consider two firms j and k in equilibrium. By combining the two corresponding FOCs, we obtain:

$$p'(R)(C(r_j) - C(r_k)) = (1 - p(R))(C'(r_j) - C'(r_k))$$

As $p' < 0$, and C and C' are increasing function, the only solution is $r_j = r_k$ for any pair (j, k). This proves that any equilibrium is symmetric.

Now, let r^3 be the (uniform) equilibrium CSR level. It satisfies the FOC, so that:

$$p'(nr^3)(C(q^*) - C(r^3)) = -(1 - p(nr^3))C'(r^3)$$

Using lemma 10 contained in the appendix, we establish that a unique CSR equilibrium level exists. The inequalities follow easily from the proof of the previous proposition. ■

This result directly parallels the one-firm case. The only difference is that firms free ride on CSR. As they do not internalize the positive externality they exert on others by raising their CSR activity, the proposition implies that firms invest less in CSR than if they acted cooperatively.[14] Interestingly, both the regulator and the firms would be better off under cooperation. CSR would be higher, which is beneficial to the regulator, as has

[14]The proof of this claim is trivial, and simply amounts to comparing the result of proposition 3 with $C \equiv nC$ to those of proposition 6.

been established previously. The firms would also benefit from a reduced regulation risk premium which, by revealed preferences, would more than offset the loss due to CSR investment.

5.3 Prohibiting VAs

As for the case with one firm, it is plain to see that prohibiting VAs improves social welfare when the regulator's bargaining power is zero. Firms do not undertake CSR activities in this case, and the VA is equivalent to legislation for the regulator. In contrast, firms commits to some CSR abatement $r^3 > 0$ when VAs are not allowed and this improves the legislative option.

When the regulator has all the bargaining power, the welfare comparison is less straightforward. However, we show that:

Lemma 7 *When $\alpha = 1$, the level of CSR is higher when a VA is forthcoming than under legislation only.*

Proof. We first establish two useful facts.

$$\frac{d}{dr}\left(\frac{C'(r)}{C(q^*) - C(r)}\right) = \frac{C''(r)(C(q^*) - C(r)) + C'(r)^2}{(C(q^*) - C(r))^2} > 0$$

which indicates that $C'(r)/(C(q^*) - C(r))$ is an increasing function of r, and

$$\frac{d}{dR}\left(\frac{-p'(R)}{1 - p(R)}\right) = \frac{-p''(R)(1 - p(R)) - p'(R)^2}{(1 - p(R))^2} < 0$$

since p is convex, as we have already seen. Therefore $-p'(R)/(1 - p(R))$ is a decreasing function of R.

¿From the previous analysis, we know that the CSR abatement in the case of regulation only is given by the first-order condition:

$$\frac{C'(r^3)}{C(q^*) - C(r^3)} = \frac{-p'(nr^3)}{1 - p(nr^3)}$$

while in the case of a VA, i.e. in the laggard equilibrium, from (10) it follows that:

$$\frac{C'(r_l)}{C(q^*) - C(r_l)} = \frac{-p'(r_l + (n-1)q^{VA})}{1 - p(r_l + (n-1)q^{VA})}$$

Since $r_l < r^3$ from proposition 5, the LHS's are increasing functions and the RHS's are decreasing functions, we conclude that $r_l + (n-1)q^{VA} > nr^3$. ■

This allows us to compare social welfare. When a VA is allowed, the regulator obtains strictly more than if he initiates a legislative process (recall that $\alpha = 1$). In addition, the level of abatement already granted is higher than if no VA was allowed. Making a VA improves welfare.

We summarize these developments as follows:

Proposition 6 *When $\alpha = 0$, prohibiting VAs is socially desirable, while it is not if $\alpha = 1$.*

As a consequence, extending the model with n firms which can free ride at the CSR stage does not alter our results. Actually, the last result would be even strengthened if we considered *collective* self-regulation. Some sectors indeed define at the branch level their rules-of-conduct. It is worth remarking that there are incentives for such behavior in our model, since there is free-riding at the first-stage of the game on the level of CSR–the firms do not internalize the positive externality they have on others by reducing the regulatory threat. This free-riding is damaging for them, but also for the regulator since we have shown that more CSR is always beneficial in absence of VAs. This implies that coordination of the firms aiming at self-regulation should be promoted in the scenario without VA.

In turn, coordination by the firms should be prevented when VAs are used. We have seen that at the (non-cooperative) equilibrium there is a laggard firm who's level of CSR determines the future VA strictness. If firms were allowed to coordinate, they would reach an agreement by which one of them would not exert any CSR effort at all, inducing an even lower level of abatement in the subsequent VA. The conclusion to be drawn here is that it is better for the regulator to use a divide-and-conquer approach in negotiating VA, and not to deal with firms that have coordinated before. This suggests interesting research directions for the design of optimal VA, both in terms of quorum in the VA and negotiation strategies for the regulator.

6 Influencing legislative action

The legislative dimension of the model is quite straightforward. In our view, two assumptions are critical. First, the regulator can influence the adoption probability p whereas the firm(s) cannot. In other words, the firm is not able to lobby the Congress. Second, political distortions concern only p and not the quota level (recall that the first best quota q^* is implemented whenever legislation is enacted). In this section, we successively relax these two assumptions in the single firm case.

6.1 Lobbying by the firm

In this first variant of the model, we assume that the firm competes with the regulator to influence the probability of adoption. Like the regulator, the firm makes efforts to convince legislators that the proposed law is not adequate. Let β denote the firm's influence expenditures. As to the relationship between influence costs and the adoption probability p, we adopt the unit logit function:

$$p(\gamma, \beta) = \frac{\gamma}{\gamma + \beta} \tag{12}$$

where γ is still the regulator's influence cost. The functional form (12) is the contest success function pioneered by Tullock (1980) which is usual in rent seeking models. Note that, under these assumptions, the regulator still makes a law proposal including the socially optimal quota q^*. We now analyze the impact of lobbying when the policy sequence involves a VA.

At the legislative stage, the firm minimizes $p(\gamma, \beta)C(q^*) + [1 - p(\gamma, \beta)]\, C(r) + \beta$. This function is concave in γ: $\left(\partial^2 p / \partial \gamma^2\right)(\gamma, \beta)[C(q^*) - C(r)] < 0$. Moreover, it is decreasing at $\beta = 0$ since $\left(\partial p / \partial \gamma\right)(\gamma, 0)[C(q^*) - C(r)] < 0$. Hence, the private optimum is given by the FOC:

$$-\frac{\gamma \Delta C(r)}{(\gamma + \beta)^2} = -1 \tag{13}$$

Similarly, the regulator's minimization program leads to

$$\frac{\beta \Delta U(r)}{(\gamma + \beta)^2} = 1 \tag{14}$$

Combining (13) and (14), the equilibrium probability of passing the legislation in the lobbying game is therefore:

$$p(r) = \frac{\Delta U(r)}{\Delta U(r) + \Delta C(r)}$$

Then, it is easily shown that Lemma 1's preemption effect continue to operate as

$$p'(r) = \frac{C'(r)\Delta U(r) - U'(r)\Delta C(r)}{[\Delta U(r) + \Delta C(r)]^2}$$

is negative[15], and the equilibrium probability p has the same qualitative features as in the original setting. As a consequence:

Proposition 7 *When the firm can lobby the Congress, the results of the base model remain valid.*

Proof. See the Appendix. ■

This result is not so surprising. The relationship between the regulator's cost of influence γ and p exhibits properties which have no reason to be strongly affected by the political competition with the firm.

6.2 Influencing quota level

We now examine a variant in which the regulator needs to make efforts to influence the level of the legislative quota. More specifically, we suppose Congress' ideal legislative quota is q^C which differs from the social optimum. Congress can be more environmentally friendly than the regulator ($q^C > q^*$) or vice-versa ($q^C \leq q^*$).

The regulator can make an effort γ to deviate the quota from q^C. As to the relationship between γ and the quota L, we assume that γ is U-shaped with a minimum in q^C, convex ($\gamma'' > 0$) and $\gamma'(q^C) = 0$. We also make the assumption that the Congress' ideal quota is adopted if the regulator makes no efforts ($\gamma(q^C) = 0$). For clarity, we finally assume $p = 1$.

[15]¿From $U'' < 0$ follows $\Delta U(r) > U'(r)[q^* - r]$. Hence, $p'(r) < U'(r)\frac{C'(r)[q^*-r]-\Delta C(r)}{[\Delta U(r)+\Delta C(r)]^2}$. Furthermore, $C'' > 0$ implies $C'(r)[q^* - r] < \Delta C(r)$. Therefore, $p'(r) < 0$.

We consider first the legislative stage. The regulator selects the quota L so as to maximize

$$U(L) - \gamma(L) \text{ s.t. } U(L) - \gamma(L) > U(r)$$

The legislative quota contingent on r is thus

$$L(r) = \begin{cases} \hat{q} \text{ such that } U'(\hat{q}) = \gamma'(\hat{q}), \text{ if } U(r) < U(\hat{q}) - \gamma(\hat{q}) \\ 0, \text{ otherwise} \end{cases} \tag{15}$$

This expression is very important. In comparison with the base model, the preemption effect is much more clearcut: either r is lower than a threshold defined by the condition $U(r) \geq U(\hat{q}) - \gamma(\hat{q})$ and CSR has no effect on the legislative quota finally adopted, or CSR suspends legislative action ($L = 0$) if r is higher.

Turning next to the VA stage, the two individual rationality constraints write

$$\begin{aligned} U(q^{VA}) &\geq U(L) - \gamma(L) \\ C(q^{VA}) &\leq C(L) \end{aligned}$$

Similarities with (1) and (2) immediately imply that the two parties always make a VA which saves the legislative cost $\gamma(L)$.

Turning next to the CSR stage, we show that:

Lemma 8 *When the policy sequence includes a VA, CSR never emerges in equilibrium* ($r^1 = 0$).

Proof. To preempt the VA with $r^1 > 0$, we must have $U(r^1) > U(q^{VA})$. Otherwise, the regulator makes a VA. But this also means that $C(r^1) > C(q^{VA})$: preempting is costly to the firm. As a result, we always have $r^1 = 0$. ■

This result contrasts with Proposition where the firm self regulates in stage 1 if regulator's bargaining power is sufficiently high. The intuition is as follows. CSR is now very close to a VA as it suspends legislation. The only difference is that the regulator has zero bargaining power. As a result, Stage 2 may be viewed as the renegotiation of the CSR commitment. CSR in Stage 1 is therefore useless to the firm.

What happens in the scenario without the VA? In the first stage, the firm sets its CSR strategy by minimizing $C(r)$ under the constraint that $C(r) < C(L)$. Given (15), we easily establish the following:

Lemma 9 *When the policy sequence does not include a VA, there are always CSR activities in equilibrium ($r^2 > 0$). This prevents legislation. For the regulator, the presence of CSR is neutral as its utility is always $U(\hat{q}) - \gamma(\hat{q})$.*

Proof. Consider first that $L = \hat{q} \Leftrightarrow U(\hat{q}) - \gamma(\hat{q}) > U(r)$. In this case, the firm selects r^2 so that $U(r^2) = U(\hat{q}) - \gamma(\hat{q}) + \varepsilon$ where ε is small and negligible. In the case where $L = 0$, the firm selects r^2 so that $U(r^2) = U(\hat{q}) - \gamma(\hat{q})$. The firm is better off with the latter option. In equilibrium, we thus have $L = 0$ and $U(r^2) = U(\hat{q}) - \gamma(\hat{q})$, implying that the regulator's utility is the same with and without CSR. ∎

The intuition of this lemma is as follows. As highlighted above, CSR is now equivalent to a VA where the firm has all the bargaining power. The firm then always opts for CSR as, due to the influence cost γ, the regulator is ready to (implicitly) accept a level of CSR abatement which is less than with legislation. Moreover moving first allows the firm to reap the entire benefit so that both options are utility equivalent for the regulator.

We summarize the whole analysis in the following:

Proposition 8 *When the regulator influences only the quota level, CSR does not influence the regulator's utility. More precisely,*

1. *When the policy sequence includes a VA, CSR never emerges in equilibrium.*

2. *When the policy sequence does not include a VA, CSR always emerges in equilibrium and this prevents the adoption of legislation ($L = 0$). But the regulator's utility would be the same under legislation.*

This proposition has two implications for robustness. First, it shows that the results of the base model decisively hinges on the assumption that the regulator influence the adoption probability of legislation. It no longer holds when political imperfections only affect quota strictness. Second, the assumption that the regulator influences the quota strictness does not yield effects or results that would contradict our previous results. If both dimensions of influence are present at the same time, then our results carry through.

7 Conclusion

We have developed a policy game in which the regulator needs to make efforts to have its optimal regulation adopted by the Parliament. It needs to prepare the case, gather evidence to convince legislators that the regulation improves social welfare, etc. In this context, more or less time and resources will be devoted to the regulation of a given industry, depending on how it is important to the regulator. In other words, what matters is that the incentives to prepare a case are *endogenously determined by how much a new law can improve on the status-quo situation*. This implies that unilateral (preemptive) CSR can be used by firms to decrease the regulator's incentives to incur legislative costs.

Against this background, we show that CSR improves the regulator's net payoff when it opts for the legislative route. But it harms welfare when it tries to make a VA before legislation. The general intuition is that CSR reduces the threat of regulation and improves the firm's bargaining position in the VA. These results hold true both in the base model with one single firm and in the extension with n firms which allows for free riding considerations to be taken into account.

The above findings suggest that CSR and VAs might not be good complements. As it is impossible to prevent CSR activities in a market economy, one might wonder if prohibiting VAs could solve the problem. We show that this ultimately depends upon the allocation of bargaining power between the regulator and the firm. When the regulator has a strong bargaining position, the negative impact of CSR on VAs is less than the welfare gains potentially achieved by a VA as compared to legislation. This means that, in this case, prohibiting VAs would be socially inefficient. But the contrary is true for a weak regulator. In terms of policy implications, this analysis suggests that the regulator should not promote the diffusion of CSR in areas where VAs can be used.

A Appendix

A.1 Proof of Proposition 2

Program (4) is equivalent to $min_r \; q^{VA}(\alpha, r)$. We solve the latter program as follows: 1) We compute $\partial q^{VA}/\partial r$ when $r = 0$. 2) We show that $\partial q^{VA}(\alpha, 0)/\partial r$ decreases with α over the interval $[0, 1]$. 3) We show that $\partial q^{VA}(0, 0)/\partial r > 0$, meaning that $r^1 = 0$ when $\alpha = 0$. 4) We show that $\partial q^{VA}(1, 0)/\partial r < 0$, meaning that there exists $\alpha^1 < 1$ such that $r^1 > 0$ for $\alpha > \alpha^1$.

1) Differentiating (3) and rearranging leads to

$$\frac{\partial q^{VA}}{\partial r} = \frac{\Delta C(\alpha, r)(1 - p(r))U'(r) + \Delta U(\alpha, r)\left[p'(r)(C(q^*) - C(r)) + (1 - p(r))C'(r)\right]}{U'(q^{VA})\Delta C(\alpha, r) + \Delta U(\alpha, r)C'(q^{VA}) - \alpha \Delta C(\alpha, r)\frac{U''(q^{VA})C'(q^{VA}) - U'(q^{VA})C''(q^{VA})}{(1-\alpha)\left[C'(q^{VA})\right]^2}}$$

The denominator is strictly positive as $U', \Delta C(\alpha, r), \Delta U, C' > 0$ and $U'' < 0$. Hence, it is sufficient to study the sign of the numerator. Let Ω denote this expression in the particular case where $r = 0$. We have

$$\Omega(\alpha) = \Delta C(\alpha, 0)(1 - p(0))U'(0) + \Delta U(\alpha, 0)p'(0)C(q^*)$$

2) We differentiate Ω with respect to α:

$$\Omega'(\alpha) = \frac{\partial q^{VA}}{\partial \alpha}\left[-C'(\alpha, 0)(1 - p(0))U'(0) + U'(\alpha, 0)p'(0)C(q^*)\right]$$

The term in brackets is negative. Also, $\partial q^{VA}/\partial \alpha q^{VA}_{\alpha} > 0$. This is shown by differentiating (3):

$$\frac{\partial q^{VA}}{\partial \alpha} = \frac{U'\Delta C + C'\Delta U}{U'C' - \alpha U''\Delta C + (1 - \alpha)C''\Delta U} > 0 \tag{16}$$

where all the functions are evaluated at (α, r). The fact that this expression is positive is easily established by remarking that any solution to the bargaining program should be such that $q^{VA}(\alpha, r) < q^*$, the delta functions are positive, and U and C are respectively concave and convex.

Hence $\partial q^{VA}(\alpha, 0)/\partial r$ decreases with α over the interval $[0, 1]$.

3) When $\alpha = 0$, $\Delta U = 0$ so that $\Omega(0) = \Delta C(0, 0)(1 - p(0))U'(0) > 0$. Thus $q^{VA}(0, 0)/\partial r > 0$.

4) When $\alpha = 1$, $\Delta C = 0$ and thus $\Omega(1) = \Delta U(\alpha, 0)p'(0)C(q^*) < 0$.

A.2 Proof of Lemma 3

Let $r^1(\alpha)$ denote the equilibrium level of CSR contingent on α. We have:

$$\frac{dq^{VA}(\alpha, r^1(\alpha))}{d\alpha} = \frac{\partial q^{VA}(\alpha, r^1(\alpha))}{\partial \alpha} + \frac{\partial r^1(\alpha)}{\partial \alpha}\frac{\partial q^{VA}(\alpha, r^1(\alpha))}{\partial r} \tag{17}$$

Then, differentiating (3) with respect to α and rearranging, we obtain:

$$\frac{\partial q^{VA}}{\partial \alpha} = \frac{U'\Delta C + C'\Delta U}{U'C' - \alpha U''\Delta C + (1-\alpha)C''\Delta U}$$

where all the functions are evaluated at (α, r). This derivative is positive as any solution to the bargaining program should be such that $q^{VA}(\alpha, r) < q^*$, the delta functions are positive, and U and C are respectively concave and convex.

Furthermore, Proposition 1 tells us that $r^1 = 0$ if $\alpha \leq \hat{\alpha}$, and thus $\partial r^1(\alpha)/\partial \alpha = 0$. This implies that $dq^{VA}/d\alpha = \partial q^{VA}/\partial \alpha > 0$. If $\alpha > \alpha^1$, r^1 satisfies $\partial q^{VA}(\alpha, r^1(\alpha))/\partial r$. Once again, $dq^{VA}/d\alpha = \partial q^{VA}/\partial \alpha > 0$.

A.3 Proof of proposition 5

We first begin by proving a lemma that will be useful in the following.

Lemma 10 *There exists a unique $r \in (0, q^*)$ such that*

$$p'(nr)(C(q^*) - C(r)) + (1 - p(nr))C'(r) = 0.$$

Proof. The LHS is an increasing function of r since its derivative is

$$np''(nr)(C(q^*) - C(r)) - (n+1)p'(nr)C'(r) + (1 - p(nr))C''(r) > 0$$

It is equal to $p'(0)C(q^*) < 0$ when $r = 0$ and it is equal to $C'(q^*) > 0$ when $r = q^*$. The desired result follows. ■

The equilibria that we want to construct correspond to intersections of the graphs of (10) and (11) in the (r_I, q^{VA}) plane. We will prove 1-2) that each equation defines q^{VA} as a (continuous) function of r_l, 3) that the corresponding curves intersect, implying equilibrium existence, and 4) that they intersect exactly once. The conditions of the laggard equilibrium described in lemma 4 will be gathered along with the proof.

1) Consider first (10). Let $F(q^{VA}, r_l)$ be its LHS. It is a strictly increasing function of q^{VA} since $\partial F/\partial q^{VA} = (n-1)p''(r_l + (n-1)q^{VA})(C(q^*) - C(r_l)) - p'(r_l + (n-1)q^{VA})C'(r_l) > 0$, and it is also an increasing function of r_l, by convexity of p and C.

We need the fact that $p'(nq^*) = 0$. Indeed, by differentiating the first-order condition defining p with respect to nq^* we obtain $\gamma''(p(r))p'(r) = -U'(r)$. Since $\gamma'' > 0$ and $U'(nq^*) = 0$ by assumption, $p'(nq^*) = 0$. This implies that for any $r_l \leq q^*$, there exists q^{VA} such that $F(q^{VA}, r_l)$ is positive. Namely, it is sufficient to take q^{VA} such that $(n-1)q^{VA} + r_l = nq^*$, since then $F(q^{VA}, r_l) = C'(r_l)$.

Now, from the preceding lemma, let r be the unique solution of $F(r,r) = 0$. Since F is increasing in its second argument, $F(r,s) < F(r,r) = 0$ for any $s < r$. Therefore, for any $r_l < r$, there exists $q^{VA} > r_l$ such that $F(q^{VA}, r_l)$ is negative. Overall, since F is continuous, for any $r_l \leq r$, there always exists a q^{VA} satisfying (10), and it is unique since F is increasing in q^{VA}. Let $q_1(r_l)$ denote the corresponding implicit function which is continuously differentiable by the regularity of F.

2) Consider now (11). Since $0 \leq p(R) \leq 1$, and the LHS is a convex combination of $C(r_l)$ and $C(q^*)$, there exists a solution q^{VA} such that $r_l \leq q^{VA} < q^*$ for all $r_l < q^*$. Moreover, the LHS increases with q^{VA}, while its RHS decreases with q^{VA}, so that the solution is unique. This allows to express q^{VA} as a function of r_l for (11) as well. By $q_2(r_l)$ we denote this function, which is also continuously differentiable.

3) From these previous results, we know that $q_1(0) = n/(n-1)q^*$, while $C(q_2(0)) = p((n-1)q_2(0))C(q^*)$, which implies $q_1(0) > q_2(0)$. Also, $q_1(r) = r$, while $q_2(r) > r$. Since both function are continuous, there exists $r_l \in (0, r)$ such that $q_1(r_l) = q_2(r_l) > r_l$. This guarantees equilibrium existence.

4) Finally, along (10), one obtains by differentiating:

$$(n-1)\left[p''(R)(C(q^*)-C(r_l))-p'(R)C'(r_l)\right]q_1'(r_l)=$$
$$-p''(R)(C(q^*)-C(r_l))-(1-p(R))C''(r_l)+2p'(R)C'(r_l)$$

in which the coefficient of q_1' is positive and the RHS is negative. Thus q_1 is a decreasing function.

In turn, by differentiating (11), we obtain:

$$\left[C'(q_2(r_l))-(n-1)p'(R)(C(q^*)-C(r_l))\right]q_2'(r_l)=F(q_2(r_l),r_l)$$

Consider any intersection of the curves q_1 and q_2 (i.e. $q_1(r_l)=q_2(r_l)$). The coefficient of q_2' is strictly positive, and the RHS is equal to zero as $F(q_2(r_l),r_l)=F(q_1(r_l),r_l)=0$. Therefore $q_2'(r_l)=0$. As $q_1'<0$, the two curves cannot be tangent to each other, and the graph of q_2 necessarily crosses that of q_1. But for any r_l such that $q_2(r_l)>q_1(r_l)$, we have $F(q_2(r_l),r_l)>0$ and thus q_2 is increasing for any r_l on the right-hand side of the intersection. On the other hand as q_1 is always decreasing, there can be only one intersection. This proves that the equilibrium is essentially unique up to the identity of the laggard.

A.4 Proof of Proposition 8

We first consider the policy sequence with the VA. Moving backward to the VA stage, the two individual rationality constraints are:

$$\begin{aligned} U(q^{VA}) &\geq \overline{U}(r) \\ C(q^{VA}) &\leq \overline{C}(r)+\beta(r) \end{aligned}$$

They are similar to (1) and (2) except that signing a VA provides the firm with the additional benefit of avoiding $\beta(r)$. Hence, the firm's incentives to make an agreement are higher than before and Lemma 2 is still valid.

Proposition 1, which says that any positive CSR efforts decrease regulator's utility, obviously remains true as well since this result follows directly from the general property that C is strictly increasing.

We now turn to the existence of CSR in equilibrium. In the base model, Proposition 2 says that it depends on the bargaining power parameter α. This is still true here. For the sake of simplicity, we restrict the analysis here to the two extreme cases $\alpha = 0$ and $\alpha = 1$:

- When $\alpha = 0$, the equilibrium VA is defined by $U(q^{VA}) = \overline{U}(r)$. As $\overline{U}'(r) > 0$ (see Lemma 3), q^{VA} increases with r as well. Hence, the firm has no interest in undertaking CSR activities ($r^1 = 0$).

- When $\alpha = 1$, the VA is such that $C(q^{VA}) = \overline{C}(r) + \beta(r)$. As $\overline{C}'(0) < 0$ and $\beta'(0) < 0$, we necessarily have $r^1 > 0$.

The same line of reasoning allows us to fully extend Proposition 2.

We now consider the policy sequence without VAs. In sStage 1, the firm selects r^1 which minimizes $\overline{C}(r) + \beta(r)$. Combining (13) and (14) yields β as a function of r:

$$\beta(r) = \frac{\Delta C(r)[\Delta U(r)]^2}{[\Delta U(r) + \Delta C(r)]^2}$$

Substituting $p(r)$ in this function yields $\beta(r) = \Delta C(r) p(r)^2$. Hence,

$$\overline{C}(r) + \beta(r) = p(r)C(q^*) + (1 - p(r))C(r) + \Delta C(r) p(r)^2$$

We then compute

$$\overline{C}'(0) + \beta'(0) = p'(0)\Delta C(r)\left[1 + 2p(r)\right]$$

which is obviously negative as $p' < 0$. We deduce $r^2 > 0$ (Proposition 3).

In order to establish that CSR improves the regulator's utility (Proposition 4), we first differentiate $\overline{U}$

$$\overline{U}'(r) = \left(\frac{\partial p}{\partial \gamma}\gamma'(r) + \frac{\partial p}{\partial \beta}\beta'(r)\right)\Delta U(r) + (1 - p(r))U'(r) - \gamma'(r)$$

Collecting $\gamma'(r)$, plugging (13) and (14) yields

$$\begin{aligned} \overline{U}'(r) &= \left(\frac{\partial p}{\partial \beta}\right) \beta'(r)\Delta U(r) + (1 - p(r))U'(r) \\ &\quad -\beta'(r)\frac{\Delta U(r)}{\Delta C(r)} + (1 - p)U'(r) \end{aligned}$$

which is strictly positive as $\beta'(r) = 2p'(r)\Delta C(r)p(r) - C'(r)p(r)^2 < 0$. Hence, $\overline{U}$ increases with CSR efforts.

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