Corporate Social Responsibility or Voluntary Agreements?

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Abstract

Does Corporate Social Responsibility (CSR) improve welfare when it occurs in equilibrium? We develop a policy game featuring a regulator and a firm that can unilaterally commit to better environmental or social behavior. We show that the answer depends on the set of policy instruments available to the regulator. The answer is positive if the regulator can only legislate. It is negative when it also has the option of making a Voluntary Agreement (VA) with the firm. In this latter case, the firm uses early voluntary efforts to weaken the legislative threat that determines the VA strictness. This suggests that CSR and VAs are not necessarily good complements. We derive the policy implications, and extend the basic model in several dimensions.

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1 Introduction

Voluntary Agreements (hereafter VAs) are part of the regulator's toolbox for about twenty years.[1] They consist of schemes whereby a firm - or a group of firms - commits to an environmental objective on a voluntary basis. In the United States, the usual form is the *public voluntary program* in which firms agree to meet goals which are pre-established by the regulator. The EPA web site lists 62 of such programs in place as of June 24, 2008.[2] In Europe or in Japan, VAs are mostly *negotiated agreements* in which the firms and the regulator jointly devise 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 car CO2 emissions.

These traditional VAs are bilateral in that they associate both the firms and the regulator. Though the firms' commitment is clearly stated, the regulator's one is usually far less explicit. However, in many cases, the regulator implicitly pledges to suspend public intervention in the field covered by the agreement. Accordingly, such VAs are obtained under the threat of legislative action.

Since the introduction of VAs, the trend is clearly towards a more active role of the firms. With the Corporate Social Responsibility movement, firms even self regulate by making abatement efforts before the involvement of any public authority. In contrast with VAs, CSR is purely unilateral in that the regulator does not promise anything.

This evolution leads to an interesting set of questions. The first concerns firms' motivations. Do they undertake CSR activities for reputation benefits? For market reasons related to the existence of green consumers? Or, does CSR aim to influence subsequent public policies? We do not explore these assumptions. Instead, the focus of the analysis is directly put on CSR activities which aim at preempting or shaping future policies.

We adopt the regulator's perspective and address the following questions: what role for VAs today in a context where CSR becomes pervasive? How does CSR influence the welfare properties of VAs? Are CSR and VAs substitutes or complements?

To answer these questions, we construct a simple policy model involving a firm and a regulator. The firm moves first and can undertake CSR activities which consist in abating pollution. Then, the regulator sets its policy strategy. In a first version of the model, we assume that its only option is a legislative quota mandating pollution abatement. In an extended version, it can also make a VA with the firm.

[1] Exceptions are Germany and Japan where public authorities have used VAs since the seventies.

[2] http://www.epa.gov/partners/programs/.

A consistent body of theoretical work has now brought a number of explanations for the existence and the welfare effects of VAs, CSR or self regulation. It is convenient to classify these contributions in two categories which are ultimately based on firms' motives. The first category gathers contributions in which firms engage in voluntary environmental and/or social activities for market reasons. In the second, they do so for political reasons: they anticipate that voluntary commitments can preempt or shape future public policies.

Although our paper clearly belongs to the last category, it is not useless to briefly review the first research stream. In the real world, certain economic agents–consumers, workers, shareholders–have personal preferences for contributing to social or environmental causes and they can reward environmentally or socially-friendly companies. In this context, voluntary commitments serve to signal the firms' social/environmental performances.

In this branch of the literature, many contributions deal with green consumerism and develop models of product differentiation (see for instance Arora and Gangopadhyay, 1995; Besley and Ghatak, 2007). Brekke and Nyborg (2004) focus on the labor market. They describe employers which use CSR as a screening device to attract more productive workers. And socially-or environmentally-aware workers may increase productivity by mitigating moral hazard problems like shirking. Models analyzing the role of green investors in capital market are less frequent. Baron (2008) has recently made a very interesting contribution which jointly analyze the impacts on managerial contracting of three factors: the existence of green consumers in the product market, of green shareholders in the the capital market and the role of personal preferences of managers.

The second branch of the literature takes a different starting point. Improving the social and environmental environmental performance is costly. Given this, CSR or VAs only emerge when it is less costly than the public policies the firms will face in the absence of voluntary commitments. In such a context, CSR can also be used to forge a competitive advantage, as argued by Lutz et al. (2000) and Denicolo (2000).

Our paper does not deal with market forces. A second set of papers put forward political factors. The general intuition is that firms improve their environmental or social performances to influence, preempt or shape future public policies.

Some papers deals with VAs (Manzini and Mariotti, 2003; Segerson and Miceli, 1998; Glachant, 2007), others with self regulation or CSR (Maxwell et al., 2000; Heyes, 2005). Our work is more closely related to Lyon and Maxwell (2003) which analyze VAs and

CSR in a unified framework. However, the sequence of moves is different in the two papers. Once the firm has chosen its CSR activity in stage 1, Lyon and Maxwell (2003) 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 legislation fails to pass. Importantly, the VA is associated with a subsidy. This makes possible the emergence of voluntary efforts in the last stage. In our model, the regulator tries to make a VA in stage 2. Then, it legislates in stage 3 in case of persisting disagreement. We assume that the VA does not include a subsidy.

We believe that our setting is more realistic. Strictly speaking, VAs do not include monetary payments. Lyon and Maxwell (2003) rightly argue that they may be associated with technical assistance or other in-kind compensations. But, in our opinion, these benefits are too modest to influence significantly firms' behavior. If one considers VAs without subsidy, the only relevant sequence is to negotiate first and then to legislate in case of disagreement. In this set-up, legislation defines the threat which makes voluntary abatement possible in stage 2. Following the sequence of moves in Lyon and Maxwell (2003) would lead to a trivial result: a VA never emerges in stage 3 as firm's incentives to abate are lacking.

We show that CSR always damages regulator's utility when the sequence is CSR $\rightarrow$ VA $\rightarrow$ legislation. This is a different result from (Lyon and Maxwell, 2003). But CSR improves its utility when the policy set is restricted to legislation, that is, when the policy sequence is CSR $\rightarrow$ legislation. 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, depending in particular on the allocation of bargaining power between the firm and the regulator. This bargaining power has a straightforward interpretation in terms of Public versus Negotiated Voluntary Agreements. We establish in particular that Public Voluntary Program and CSR are a good policy tools combination, while this is not true with Negotiated VAs.

The paper is organized as follows. In section 2, we present the basic version of the model with the full policy sequence. We fully solve the model in section 3. Then, in section 4 we conduct the analysis when only legislation takes place, 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 many firms is the subject of section 5. In section 6 we explore other models of political influence in the legislative arena. Finally, the conclusion gathers the main findings.

2 The model

We consider a sequential policy game involving a firm and a regulator where abatement q is the only environmentally relevant variable.

BUT CAN BE SOCIAL ETC.

The firm moves first and can undertake CSR activities which consist in abating pollution[3]. The regulator, which moves second, is in charge of policy definition and legislative activity. He tries to make a VA with the firm in the second stage. In case of persisting disagreement, he initiates a legislative process leading to a quota mandating a specified level of abatement.

2.1 Gross payoffs

The firm's cost of abatement is $C(q)$, satisfying $C(0) = C'(0) = 0$ and $C', C'' > 0$. The regulator values abatement q according to $U(q)$, which is assumed twice-continuously differentiable and concave with a maximum at some positive and finite level q^*. We assume $U'(0) > 0$, and, without loss of generality, we use the normalization $U(0) = 0$. For the sake of simplicity, we will refer to U as social welfare. But this can represent any utility function giving various weights to consumers' surplus, producers' profits, environmental concerns, employment and the like.

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 legislative process by proposing a given quota L. Then, there exists political imperfections 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 introduce that the probability p of adopting the regulation depends on the regulator's effort to successfully bring the case in Congress. For example, the regulatory agency has to produce evidence that the type of pollution should indeed be

[3] 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.

regulated, that the competitiveness of the firm would not be too harmed by the new legislation and so on. We assume that obtaining adoption with probability p costs $\gamma(p)$ to the regulator 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 exposition. 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 legislation is subject to uncertainty is both realistic[4] and usual in papers dealing with voluntary abatement.[5] Albeit realistic, assuming that the regulator can make efforts to increase this probability is original.[6]

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.

We will see that our assumption–namely, the fact that the regulator can influence p–is key to the results. This leads us to consider alternative modeling routes in section 6. In a first variant of the model, we introduce lobbying by the firm who competes with the regulator to influence p. In a second variant, we consider that the regulator's efforts do not target the adoption probability but the quota level L only.

2.3 Timing

The game has three stages:

1. (Corporate Social Responsibility) The firm unilaterally and irreversibly commits to a minimal abatement level r.

[4] As an illustration, in France during the legislative term 1997-2002 the Government made 476 Law proposals out of which 351 were finally adopted by the Parliament, implying an average probability of adoption of 0.74.

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

[6] See Maxwell and Decker (2006) for the related case of costly enforcement. In their model CSR activity eases compliance to existing regulation. In this context, it can typically be used to curb the monitoring effort of the regulator.

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, which depends on its efforts γ, and the legislative quota L. The new regulation is adopted with the probability p and the firm complies. Otherwise the abatement level remains r.

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

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

The optimal probability p is uniquely determined as a function of r. We can notice 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 $r \leq q^*$. ■

The effect of CSR is to decrease the strictness of legislation, since the incentives of the regulator to make legislative efforts in the legislative process are weakened: there is less to gain in Congress since some abatement is already granted.

3.2 VA stage

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

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

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

Clearly, as U and C are respectively concave and convex, the set of acceptable q^{VA} is non-empty. For example, $q^{VA} = p(r)q^* + (1 - p(r))r$ satisfies (strictly) both constraints.[7] 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, and the upper bound to a binding participation constraint for the firm.

Lemma 2 *A VA always emerges in equilibrium, and it 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 is obtained for sure and this is overall preferable. A first 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 implemented for sure contrary to legislation. A 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 parameterize the feasible frontier, we

[7] 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.

consider the generalized Nash bargaining solution[8] 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.

We are in 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 less 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 gets lower 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 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:

[8] We discard alternating offer bargaining procedures, because they would not parameterize the *Pareto*-frontier in our model, whereas the Nash solution does. Indeed, 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.

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 ($r^1 > 0$) if and only if $\alpha > \hat{\alpha}$.*

Proof. See the Appendix. ■

The intuition is again simple. With limited bargaining power on the public authority 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 be mostly appropriated by the regulator anyway and because higher unilateral abatement makes the regulator softer.

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 fix 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.[9] The second option may be to forbid the regulator to make VAs which sounds legally easier. Note that this *ex ante* rule must be binding as opting for a VA in stage 2 always improves regulator's and firm's utilities.

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

4 A game without VAs

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

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

4.1 CSR sub game

Let r^2 denotes the equilibrium CSR level of abatement in this scenario. The firm minimizes its expected cost of abatement under legislation:[10]

$$\min_r \{p(r)C(q^*) + (1 - p(r))C(r)\} \tag{5}$$

Then we establish that

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

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:

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

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

Now the firm systematically prefers to preempt legislation, whereas in the previous case CSR activities were taking place only when the regulator's bargaining power was high.

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 beneficial and the regulator's payoff increases with CSR activity.*

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

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 is CSR now socially beneficial? In the absence of CSR activity, the regulator's payoff would choose some level of effort. But if it chooses exactly the same level effort when the firms has exerted some positive level of CSR, its payoff would be strictly higher: legislation is obtained with the same probability, costs are the same, but in case legislation fails, his payoff is higher given the positive CRS level. Contrary to 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 regards, 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 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 to 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 with the usual distinction between *public voluntary programs* and *negotiated agreements*. These are two types of VAs which allocate differently the bargaining power between the business side and the public side. 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 better suited when firms undertake CSR activities.

5 Many firms

An important aspect of VAs is that they are usually adopted at the branch level, and it has been argued that participation of the firms may be subject to a form of free-riding. We extend in this section our results to a setting with n identical firms choosing participation non-cooperatively (the case of a single firm treated above can be seen as the case of full coordination among different firms). We seek to understand how he interplay of CSR and VAs is modified by the collective dimension of VAs.

5.1 Policy cycle with a VA

As in Manzini and Mariotti (2003), we assume that *all* firms must participate in the VA, and regulation is triggered otherwise.[11] At the end of the section, we discuss informally another setting in which unanimity is not required, and in which the firms that do not commit to the VA may subsequently be subject to regulation. Also, we focus on the two extreme cases of bargaining power,[12] $\alpha = 0$ or $\alpha = 1$. 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. Also, we use the following definition:

$$R \equiv \sum_i r_i$$

At the regulatory (last) 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, namely it is decreasing and convex.

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

Now, under unanimous VA, the second stage payoffs are such that the regulator obtains his reservation utility (since $\alpha = 0$), and the firms should all participate. It is clear that a level q^{VA} exists such that all firms' participation constraints are satisfied (otherwise some firm would have already chosen an abatement level higher than q^*, which would be absurd). Therefore only the regulator's participation constraint matters:

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

Finally, in the first stage, firm j's problem is to choose its CSR level. But by differentiating the regulator's participation with respect to r_j (it is defined for any collection $\{r_i\}$), and

[11] This setting shares some features one with nonpoint pollution in which firms are made collectively responsible, see Segerson and Wu (2006).

[12] 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.

using the envelope theorem, one obtains:

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

which implies $\frac{\partial q^{VA}}{\partial r_j} > 0$. We therefore conclude that firms do not invest in CSR in this case, similarly to the case of one firm and low bargaining power of the regulator.

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

We now turn to the other extreme case, which is a bit more involved. Here, at the VA stage, a set of constraints–and not a single one–characterizes the VA. With unanimity, *all* the following firms' participation constraints must be satisfied:

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

Note also that if some firm i has chosen $r_i \geq q^{VA}$, its participation is immediately satisfied, but since CSR is assumed to be a perfect commitment, it is still committed to its CSR abatement level r_i. The cost of firm i is thus $max\{C(r_i), C(q^{VA})\}$. Quite obviously, it can not happen in equilibrium than a firm over-abate compared to the VA, as we will see.
A key observation for the following analysis is that only the constraints corresponding to the lowest CSR levels will be binding. We therefore divide the firms into the 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. Necessarily, in a unanimous VA, one has:

$$C(q^{VA}) = p(R)C(q^*) + (1 - p(R))C(r_l) \tag{7}$$

The fact that only the participation constraints of laggards is binding resembles the 'toughest firm principle' derived in Manzini and Mariotti (2003). But while in their paper asymmetry between firms is given, it is here endogenous, since it is the result of chosen CSR activities. More can already be said on the shape of the putative equilibria, as stated in the next lemma.

Lemma 4 *In any equilibrium, there is exactly one laggard, and all the other firms choose the same CSR levels, equal to the forthcoming VA level:*

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

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

Proof. To prove the first assertion, assume by contradiction that $\mathbb{L}$ contains at least two elements in equilibrium. But then if one of the laggards increases its CSR level by some small $\varepsilon > 0$, r_l is not affected, so that the cost under the deviation is:

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

since p is a decreasing function. Therefore there is exactly one laggard in any equilibrium. Now, the derivative at $r_l = 0$ of the laggard's costs is

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

hence the laggard exerts some positive CSR effort.
Turning now to the other firms, by the same reasoning as before, it is also true that any firm m that is not a laggard wants to increase its CSR level when $r_m < q^{VA}$: It is a strict best-reply since it only decreases the probability of legislation, and therefore the equilibrium VA level in (7). Furthermore, it can not happen in equilibrium that a firm chooses $r_m > q^{VA}$, since its costs would then be $C(r_m)$, which is increasing in r_m. In conclusion, for any firms i in $\mathbb{M}$, $r_m = q^{VA}$ has to hold in equilibrium. ■

From this result, we know that a unanimous VA equilibrium (provided it exists) is determined by two parameters: the laggard's CSR level r_l, and the VA level q^{VA}, or alternatively the total CSR abatement level, $R = r_l + (n-1)q^{VA}$. An equilibrium (provided it exists) must therefore satisfy the two equations:

$$p'(r_l + (n-1)q^{VA})(C(q^*) - C(r_l)) + (1 - p(r_l + (n-1)q^{VA}))C'(r_l) = 0 \tag{8}$$

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

where (8) is the first-order condition for the laggard's CSR level, and (9) states that the other firms abate in advance exactly the amount that will be prescribed by the VA. This system happens to a unique solution. This fact, proved in appendix, allows to state the following:

Proposition 6 *There exists an essentially unique (i.e. up to the identity of firms) equilibrium when $\alpha = 1$. It is the unique laggard equilibrium characterized by (8) and (9).*

Proof. See the Appendix. ■

5.2 Legislation only

When a VA is not part of the policy cycle, the effort of the regulator is still determined by (6). In the first stage, the firms play a CSR investment game with payoffs

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

This game is solved in the following lemma:

Proposition 7 *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. Though apparently similar to a Cournot game, the CSR game has a particular structure for which no uniqueness results apply (existence is in turn trivial here given the regularity properties of the payoffs). We therefore resort to a full constructive proof.
The first and second derivatives of the expected costs of firm j with respect to r_j are:

$$\frac{\partial EC_j}{\partial r_j} = p'(R)(C(q^*) - C(r_j)) + C'(r_j)(1 - p(R))$$

$$\frac{\partial^2 EC_j}{\partial r_j^2} = p''(R)(C(q^*) - C(r_j)) - 2C'(r_j)p'(R) + C''(r_j)(1 - p(R))$$

As in proposition 3, $p'' > 0$ given $\gamma''' \geq 0$. Thus $EC_j(\{r_i\})$ 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:

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

but $p' < 0$, and C and C' are increasing function, therefore 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 an 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 8 contained in the appendix, we conclude that there exists a unique CSR equilibrium level. The inequalities follow easily from the proof of the previous proposition. ■

This result parallels directly the case of one firm, with the additional free-riding on CSR among the firms. Indeed they do not internalize the positive externality they exert

on others by raising their CSR activity. In particular, the lemma implies that firms invest less in CSR than if they acted in coordination.[13] Interestingly, both the regulator and the firms would be better off in this case if the firms acted in coordination. Indeed CSR would be higher, which is beneficial to the regulator as has been established previously. And 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 of one firm, it is straightforward to see that when the regulator's bargaining power is zero, prohibiting VAs is optimal. We have seen indeed that they do not undertake CSR activities in this case, and the VA is equivalent to legislation for the regulator, with a reference point at zero abatement. In turn, when VAs are nor allowed, firms commits to some CSR abatement $r^3 > 0$, and legislation is therefore better than in the case of no abatement.

In the other extreme case, when the regulator has all the bargaining power, the comparison of the payoffs is less straightforward. The next lemma compares first the level of abatement at the CSR stage between the case with a VA and the case without a VA.

Lemma 5 *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 already seen. Therefore $-p'(R)/(1 - p(R))$ is a decreasing function of R.

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

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

[13] The proof of this claim is trivial, and simply amounts to compare the result of proposition 3 with $C \equiv nC$ to those of proposition 7.

while in the case of a VA, i.e. in the laggard equilibrium, we have from (8):

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

Since $r_l < r^3$ from proposition 6, and the LHS's are increasing functions and the RHS's are decreasing functions, we conclude that $r_l + (n-1)q^{VA} > nr^3$. ■

We are now able to finish the comparison. In the case of a VA, the regulator obtains strictly more than if he initiates a regulation process. In addition, the level of abatement already granted is higher than if no VA was allowed. This allows to state the final proposition:

Proposition 8 *When $\alpha = 0$, prohibiting VAs is socially desirable, while it is not is $\alpha = 1$.*

In other words, the results are identical to the case of one single firm when we consider the case of multiple firms and unanimous VAs.

6 Influencing legislative action

The legislative dimension of the model is quite simplistic. The main restrictions probably lie in the way we model political imperfections under the legislative route. 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 only concern p and not the quota level (recall that the first best quota q^* is implemented whenever legislation is enacted). In this section, we 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 law proposal 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:

$$p(\gamma, \beta) = \frac{\gamma}{\gamma + \beta} \tag{10}$$

where γ is still the regulator's influence cost. The functional form (10) 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: $\frac{\partial^2 p}{\partial \gamma^2}(\gamma,\beta)[C(q^*) - C(r)] < 0$. Also, it is decreasing at $\beta = 0$ since $\frac{\partial p}{\partial \gamma}(\gamma,0)[C(q^*) - C(r)] < 0$. Hence, the private optimum is given by the FOC:

$$-\frac{\gamma \Delta C(r)}{(\gamma+\beta)^2} = -1 \tag{11}$$

Similarly, the regulator's minimization program leads to

$$\frac{\beta \Delta U(r)}{(\gamma+\beta)^2} = 1 \tag{12}$$

Combining (11) and (12), and abusing slightly the notations, 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, and the equilibrium probability p has the same qualitative features as in the original setting.[14] As a consequence, the results of the base model are still valid in this variant (the complete proof is relegated to 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 the Congress' ideal legislative

[14] 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, $p'(r) < 0$.

quota is q^C which differs from the social optimum. Congress can be more environmentally friendly than the regulator ($q^C > q^*$) or the reverse ($q^C \leq q^*$). The regulator must bear the cost 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 expositional clarity, we also assume $p = 1$. We will see that CSR is neutral in this setting.

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

$$L(r) = \begin{cases} \hat{q} \text{ such that } U'(\hat{q}) = \gamma'(\hat{q}), \text{ if } U(r) < U(\hat{q}) - \gamma(\hat{q}) \\ 0, \text{ otherwise} \end{cases} \tag{13}$$

This expression is very important. It indicates that any CSR level r such that $U(r) \geq U(\hat{q}) - \gamma(\hat{q})$ allows to avoid legislation ($L = 0$). This is different from the base model where CSR does not suspend legislative action. In this regards, CSR is now closer to a VA. In fact it looks like a VA where the firm has all the bargaining power. We come back to this later on.

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 6 *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 $r^1 = 0$. ■

The intuition is very simple. Recall that we can assimilate CSR to a VA with zero bargaining power for the regulator. As a result, stage 2 may be viewed as the renegotiation

of the initial VA. Committing to CSR in stage 1 is therefore useless. Note that the renegotiation always reduces the firm's utility as the allocation of bargaining power between the two parties is more balanced in stage 2.

What happens in the scenario without VAs? In the first stage, the firm sets its CSR strategy by minimizing $C(r)$ under the constraint that $C(r) < C(L)$. Given (13), we easily establish the following:

Lemma 7 *When the policy sequence does not include a VA, there always exists CSR activities in equilibrium ($r^2 > 0$) which 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 such 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 such 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 a VA where the firm has all the bargaining power. Then, the firm always opts for CSR since, due to the influence cost γ, the regulator is ready to (implicitly) accept a level of CSR abatement which is less than with legislation. And moving first allows the firm to entirely reap this benefit so that both options are utility equivalent for the regulator.

We summarize the whole analysis in the following:

Proposition 9 *When the regulator only influences the quota level, CSR does not influence 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 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 does influence the quota strictness does not yield effects or results that would contradict our previous results. The assumption is essentially neutral.

7 Conclusion

We have developed a policy game in which the regulator needs to make efforts to have his optimal regulation adopted by the Congress. He 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, as function of the stake for a regulator. Put differently, 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.

In this context, we show that CSR improves regulator's utility when the regulator 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.

Importantly, these results only hold when the regulator's efforts increase the *probability of passing legislation*. In contrast, CSR does not affect its utility when it makes efforts for influencing the *level* of the quota.

The above results 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 fix 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. It also indicates that *public voluntary programs* may be better suited in contexts where CSR is pervasive. The reason being that, by design, they give all the bargaining power to the regulator (they consist of take-it-or-leave-it offers to the firms).

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, $\partial q^{VA}/\partial \alpha q_\alpha^{VA} > 0$. This is shown by differentiating (3):

$$\frac{\partial q^{VA}}{\partial \alpha} = \frac{U'\Delta C + C'\Delta U}{U'C' - \alpha U''\Delta C + (1 - \alpha)C''\Delta U} > 0 \tag{14}$$

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:

$$\frac{dq^{VA}(\alpha, r^1(\alpha))}{d\alpha} = \frac{\partial q^{VA}(\alpha, r^1(\alpha))}{\partial \alpha} + \frac{\partial r^1(\alpha)}{\partial \alpha}\frac{\partial q^{VA}(\alpha, r^1(\alpha))}{\partial r} \tag{15}$$

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 Analysis with firm's lobbying

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

$$\begin{aligned} U(q^{VA}) &\geq p(r)U(q^*) + (1-p(r))U(r) - \gamma(r) \\ C(q^{VA}) &\leq p(r)C(q^*) + (1-p(r))C(r) + \beta(r) \end{aligned}$$

They are similar to (1) and (2) except that signing a VA provide 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 it depends on the bargaining power parameter α. This is still true here. For the sake of simplicity, we restrict here the analysis to the two polar cases $\alpha = 0$ and $\alpha = 1$:

- When $\alpha = 0$, the equilibrium VA is defined by $U(q^{VA}) = EU(r)$. As $EU'(r) > 0$ (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 $C(q^{VA}) = EC(r)$. As $EC'(0) < 0$, we necessarily have $r^1 > 0$.

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

We now consider the policy sequence without VAs. In stage 1, the firm selects r^1 which minimizes

$$EC(r) = p(r)C(q^*) + (1 - p(r))C(r) + \beta(r)$$

Combining (11) and (12) 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,

$$EC(r) = p(r)C(q^*) + (1 - p(r))C(r) + \Delta C(r)p(r)^2$$

Then, we compute

$$EC'(0) = p'(0)\Delta C(r)\left[1 + 2p(r)\right]$$

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

In order to establish that CSR improves regulator's utility (Proposition 4), we first differentiate EU

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

Collecting $\gamma'(r)$, plugging (11) and (12) yields

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

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

A.4 Proof of proposition 6

We first begin by proving a lemma that will be useful in this proof and the following ones.

Lemma 8 *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 we want to construct correspond to intersections of the graphs of (8) and (9) in the (r_l, q^{VA}) plane. We will prove that each equation defines q^{VA} as a (continuous) function of r_l (points 1 and 2), 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 the proof.

1) Consider first (8). 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, 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 some 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 some $q^{VA} > r_l$ 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 (8), and it is unique since F is increasing in q^{VA}. Denote by $q_1(r_l)$ the corresponding implicit function, which is continuously differentiable by the regularity of F.

2) Consider now (9). 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 is an increasing function of q^{VA}, while its RHS is a decreasing function of q^{VA}, so that the solution is unique. This allows to express q^{VA} as a function of r_l for (9) as well. We denote by $q_2(r_l)$ this function, which is continuously differentiable as well.

3) Gathering the 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 (8), 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 (9), one obtains:

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

Consider some 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 since $F(q_2(r_l), r_l) = F(q_1(r_l), r_l) = 0$. Therefore $q_2'(r_l) = 0$. Since $q_1' < 0$, the two curves can not be tangent to each other, and the graph of q_2 has to cross that of q_1. But for any r_l such that $q_2(r_l) > q_1(r_l)$, $F(q_2(r_l), r_l) > 0$ and thus q_2 is increasing for any r_l on the right of the intersection. Since on the other hand q_1 is always decreasing, there can be only one intersection. This proves that the equilibrium is essentially unique, i.e. up to the identity of the laggard.

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