Self-Regulation and Negotiated Agreements: Complements or Substitutes?

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Abstract

The literature on negotiated agreements generally assumes away the possibility of corporate self-regulation. Yet in practice firms may have incentives to self-regulate in order to influence the outcome of negotiations. When the two are studied jointly in a single model, the question arises whether self-regulation and negotiated agreements are complements or substitutes. We present a general model of the two tools, in which the firm can self-regulate both before and after negotiations regarding a voluntary agreement. In such a setting, we find that the two instruments are complements.

1 Introduction

One of the most striking changes in environmental policy in recent years has been the substitution of voluntary programs for mandatory government regulation. Negotiated agreements, public voluntary programs, and industry self-regulation all have become more prominent as command-and-control regulation, and even market-based instruments, have attracted less interest.[1] A substantial literature has developed exploring the performance of these new voluntary approaches, with rather mixed results. [Alberini and Segerson (2002); Baranzini and Thalmann (2003); OECD (2005); Morgenstern and Pizer (2007); Lyon and Maxwell (2007)] This literature has shown that voluntary approaches

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[1]Information disclosure programs, both mandatory and voluntary, have also become more popular in recent years, but they are beyond the scope of the present paper.

hold the potential to improve upon the performance of traditional regulation, but whether this potential is realized depends upon a number of factors in the institutional environment. Morgenstern and Pizer (2007, p. 184) conclude: "[N]one of the case study authors found truly convincing evidence of dramatic environmental improvements. Therefore, we find it hard to argue for voluntary programs where there is a clear desire for major changes in behavior." A recent OECD (2003, p. 15) report argues that "The performance of many voluntary approaches would be improved if there were a real threat of other instruments being used if (appropriately set) targets are not met." Similarly, Baranzini and Thalmann (2004, p. 23) note that "VAs are more effective when the environmental authority's bargaining power is stronger. A strong background threat or some reward is needed to prompt emitters to make efforts that are really costly for them." Likewise, Alberini and Segerson (2002, p. 163) conclude that "The outcome of a voluntary approach is likely to be directly related to the magnitude of the background threat."

Although substantial progress has been made in understanding voluntary approaches taken individually, there has been relatively little work exploring how they may interact with one another. Lyon and Maxwell (2003) show that the existence of public voluntary programs may undermine firms' incentives to undertake self-regulation, which suggests that sometimes it may be advantageous for regulators to commit not to offer public voluntary programs. Indeed, the Obama Administration has suspended its Performance Track and Climate Leaders voluntary programs.[2] Fleckinger and Glachant (2011) argue that self-regulation is socially beneficial when the regulator's only policy tool is mandatory regulation, but can be socially detrimental when the regulator offers a negotiated agreement. The government might benefit, then, by prohibiting negotiated agreements, at least when the regulator's bargaining power is weak.[3]

[2]Regarding Performance Track, see http://www.greenbiz.com/news/2009/03/18/epa-derails-performance-track-program. Regarding Climate Leaders, see http://www.environmentalleader.com/2010/09/16/epa-begins-phase-out-of-climate-leaders-program/

[3]To be precise, Fleckinger and Glachant (2011) find that self-regulation is harmful when the regulator can affect the likelihood of legislation, but innocuous when the regulator can

The possibility that self-regulation and voluntary agreements may be substitutes rather than complements is worrisome from a policy perspective, especially if good policy depends upon intangible factors, such as the regulator's bargaining power or which precise details of legislative proposals can be affected by regulatory effort. In this paper, we explore the interaction between self-regulation and negotiated agreements in a more general setting than Fleckinger and Glachant (2011). In particular, we follow Sutton (1986) and Binmore, Rubinstein and Wolinsky (1986), and treat self-regulation as an outside option for an industry engaged in a negotiation with the government. Thus, we allow the industry to take self-regulatory actions before the negotiation of a voluntary agreement, after a voluntary agreement is signed, or after the failure of the parties to agree to a negotiated outcome. We find that even when the possibility of a negotiated agreement exists, self-regulation is socially beneficial. From a policy perspective, regulators need not fear that industry self-regulation will undermine their ability to negotiate a beneficial voluntary agreement. Furthermore we find that introducing the possibility of a negotiated agreement does not harm regulatory objectives. The regulator must, however, be willing to opt out of negotiations that offer unfavorable terms, and put the onus on industry to self-regulate if it wants to stave off a regulatory threat. The remainder of the paper is organized as follows. Section 2 lays out the model as a game between industry and a regulator, and analyzes the equilibria of the game. Section 3 assesses the welfare implications of the model, and section 4 offers conclusions.

2 The Model

There are two players in our model, a regulator and a firm. We will adopt the convention that the regulator is feminine and the firm is masculine. The firm emits pollution, and can invest in a quantity of abatement q; he desires to minimize its cost of abatement, $C(q)$ where $C'(q) > 0$, $C''(q) > 0$ and $C(0) = 0$. The regulator's objective is to maximize $U(q) - \gamma(p)$, where $U(q)$

shape the stringency of a threatened legislative proposal.

is the net social welfare from abatement level q and $\gamma(p)$ is the political cost of pressing for legislation that would mandate q.[4] We assume the net social welfare is optimized at a level $Q > 0$, and that political costs are described by $\gamma'(p), \gamma''(p) > 0$. Our model follows the structure of [6], but adds one additional stage to the game. The sequence of moves is as follows:

1. The firm unilaterally makes an investment that commits him to abate a quantity of pollution $r \geq 0$.

2. The regulator and the firm bargain over an abatement level $q^{VA} \geq r$.

3. The firm chooses an abatement level s, which must be at least as great as q^{VA}.

4. In the case of disagreement, the regulator may initiate the legislative process by choosing the probability p and a legislative quota L. The new regulation is adopted with the probability p and the firm complies. Otherwise the abatement level remains s.

The only difference between our structure and that of [6] is the addition of stage 3, which generalizes the timing of when the firm can undertake self-regulation. This generalization allows us to focus on how the possibility of self-regulation in the event of a bargaining breakdown affects the bargaining behavior of the firm and the regulator. We feel this is an important and realistic feature of the institutional environment, since firms cannot be prohibited from making investments to reduce their own emissions. We will see that the addition of this stage greatly changes the equilibria of the game.

We solve the game through backwards induction.

[4] The implicit assumption here is that the political effort involved in passing legislation is independent of the legislation's stringency. We adopt this simplifying assumption in order to facilitate comparison with [6], especially since this is the assumption under which they find welfare-reducing effects from self-regulation.

2.1 Stage 4

If there is no negotiated agreement, the regulator can initiate the legislative process. Her choice of a legislative quota is simple: she chooses L to maximize $U(q)$. We denote this optimal quota as Q. In choosing how much effort to devote to passage of the quota, her problem is to

$$\max_p pU(Q) + (1-p)U(s) - \gamma(p), \tag{1}$$

which has first-order condition

$$U(Q) - U(s) = \gamma'(p), \tag{2}$$

and implicitly defines the function $p(s)$, which represents the regulator's optimal probability of legislation given the firm's abatement level s. It is easy to see from (2) that as long as the level of self-regulation chosen by the firm, s, is less than Q then the regulator will find it optimal to expend a positive level of effort to push for legislation mandating the quota. At the same time, it is easy to see that it will never be optimal for the firm to self-regulate to the level Q, since even if the regulator pursues the legislative outcome there is no guarantee passage will occur, and higher abatement is more costly for the firm. Thus, we draw the conclusion stated in the following proposition

Proposition 1 *In the absence of a voluntary agreement the legislative option will be pursued.*

2.2 Stage 3

If the parties failed to reach an agreement in stage 2, then the firm's problem is now

$$\begin{array}{c} \min_s p(s)C(Q) + (1-p(s))C(s) \\ s.t.\ s \geq r \end{array} \tag{3}$$

which creates the Lagrangian

$$\min_s p(s)C(Q) + (1-p(s))C(s) - \lambda[s-r]. \tag{4}$$

This problem has Kuhn-Tucker conditions

$$\begin{aligned} p'(s)[C(Q)-C(s)]+(1-p(s))C'(s)-\lambda &\leq 0 \\ s\left[p'(s)[C(Q)-C(s)]+(1-p(s))C'(s)-\lambda\right] &= 0 \\ s-r &\geq 0 \\ \lambda[s-r] &= 0 \\ s &\geq 0 \\ \lambda &\geq 0 \end{aligned}$$

Let S be the solution to

$$p'(s)[C(Q)-C(s)]+(1-p(s))C'(s)=0. \tag{5}$$

Note that from (2) we know that $p\,(Q)=0$, and equation (5) implies $S<Q$. The Kuhn-Tucker solutions imply that the firm's optimal level of abatement is simply $\max[S,r]$. This level helps define the outside options of the two players in the negotiation game.

If the level of abatement that would result from the negotiated agreement, examined in the next subsection, would result in an expected payoff below the firm's expected payoff under self-regulation, then the firm can exercise his outside option of self-regulation. Similarly, if the negotiated agreement would result in an expected payoff to the regulator that is less than the payoff she would receive from the firm engaging in optimal self-regulation, then the regulator can exercise her outside option by walking away from the negotiation, since she knows the firm will then engage in optimal self-regulation under the threat of legislative action. Thus, the expected payoffs in stage 3, if there was no VA, are

$$\overline{U}(S)=p(S)U(Q)+(1-p(S))U(S)-\gamma(p(S)) \tag{6}$$

and

$$\overline{C}(S)=p(S)C(Q)+(1-p(S))C(S). \tag{7}$$

If the parties reached an agreement in stage 2, of course, then legislation is off the table, and the firm has no reason to increase its abatement. Thus, it simply complies at the level q^{VA}, which is characterized below.

2.3 Stage 2

At this stage, the firm and the regulator bargain over a voluntary agreement with abatement level q^{VA}. We follow Sutton (1986) and conceptualize the bargaining process as involving an alternating sequence of offers, each of which can be accepted or rejected and replaced with a counter-offer. Importantly, each player, at his or her turn to make an offer, can opt out of the bargaining process and access his or her outside option, which we have described in Stage 3 of the game above. Binmore, Rubinstein and Wolinsky (1986) show that in the limit as the time between offers goes to zero, the solution to the dynamic bargaining game converges to the static axiomatic Nash bargaining solution. Both of these papers make the important point that an outside option is distinct from simply shifting the status quo point of a static Nash game. If an outside option offers the parties less than they could achieve through bargaining, then it has no impact on the bargaining process and should *not* be interpreted as a shift in the disagreement point of the static Nash game. Similarly, if the outside option offers more than the bargaining outcome, then a player that can benefit from the outside option selects it and obtains that payoff; again this is different from simply shifting the disagreement point. Binmore, Shaked and Sutton (1989) provide experimental evidence showing that this "outside option principle" describes actual bargaining behavior quite well. Thus, in our model, pursuit of the outside option following a breakdown in bargaining has no impact on the status-quo bargaining positions. Nevertheless, the outside option of self-regulation plays a key role in shaping the ultimate outcome of the game.

The Nash bargaining problem is

$$\max_{q}[U(q) - \overline{U}(r)]^{\alpha}[\overline{C}(r) - C(q)]^{1-\alpha} \tag{8}$$

where α is the bargaining power of the regulator, and the reservation values are

$$\begin{aligned}\overline{U}(r) &= p(r)U(Q) + (1-p(r))U(r) - \gamma(p(r)) \\ \overline{C}(r) &= p(r)C(Q) + (1-p(r))C(r).\end{aligned}$$

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

$$\left(\frac{\alpha}{1-\alpha}\right)\frac{U'(q^{VA}(\alpha,r))}{C'(q^{VA}(\alpha,r))} = \frac{\Delta U(\alpha,r)}{\Delta C(\alpha,r)} \tag{9}$$

where the payoffs from the VA negotiation are $U(q^{VA}(\alpha,r))$ and $C(q^{VA}(\alpha,r))$, and we use the notation:

$$\begin{aligned}\Delta U(\alpha,r) &= U(q^{VA}(\alpha,r)) - \overline{U}(r) \\ \Delta C(\alpha,r) &= C(q^{VA}(\alpha,r)) - \overline{C}(r).\end{aligned}$$

We immediately obtain the following proposition.

Proposition 2 *For sufficiently large $r \leq S$ the parties will always sign a VA.*

Proof. Suppose that at stage 1 the firm chooses $r = S$, and consider a VA defined by $q^{VA}(\alpha, S) = p(S)Q + (1-p(S))S$. We see that both parties will accept this VA, since by Jensen's Inequality we know that $U(q^{VA}(\alpha,S)) > p(S)U(Q) + (1-p(S))U(S) = \overline{U}(S)$ and $C(q^{VA}(\alpha,S)) < p(S)C(Q) + (1-p(S))C(S) = \overline{C}(S)$. Recall that if the parties fail to sign a VA, the payoffs they will receive at stage 3 are $\overline{U}(S)$ and $\overline{C}(S)$. Thus, both parties will accept this VA. The continuity of the utility and cost functions, and the strict inequalities above imply that there exist values of $r < S$ such that both parties will sign a VA. ■

The proposition demonstrates the existence of a voluntary agreement in equilibrium for sufficiently large r. However, it does not guarantee that a VA will be signed. As discussed earlier, the outside option of self-regulation at stage 3 yields payoffs $\overline{U}(S)$ and $\overline{C}(S)$. Thus, if $U(q^{VA}(\alpha,r)) > \overline{U}(S)$ and $C(q^{VA}(\alpha,r)) < \overline{C}(S)$, then the outside option is irrelevant and has no effect on the bargaining outcome (Sutton 1986). If either player's outside option

exceeds their expected payoff from signing the VA, then the player whose outside option dominates bargaining opts out of the bargaining process, and the outside option is implemented. Thus, the players' expected payoffs at stage 2 are $\max\{U(q^{VA}(\alpha,r)),\overline{U}(S)\}$ and $\min\{C(q^{VA}(\alpha,r)),\overline{C}(S)\}$. In the next subsection we show specifically which payoffs will arise in equilibrium.

2.4 Stage 1

In stage 1, the firm chooses r to minimize its expected costs over the remainder of the game. We analyze the firm's decision in a series of propositions.

From Proposition 2 we see that the parties could benefit by negotiating a VA at level $q^{VA}(\alpha,S)$. Obviously the firm would be happy to lower its costs even further by agreeing to a VA at any level $q < q^{VA}(\alpha,S)$. Furthermore, because the regulator's utility $U(q^{VA}(\alpha,S))$ is strictly greater than what it obtains without a VA, there exists a VA of level $q < q^{VA}(\alpha,S)$ that the regulator would accept. Recalling that the existence of outside options for the firm and regulator will not affect $q^{VA}(\alpha,r)$ arising from the Nash bargaining problem (8) we can use the results of [6] to examine the functional behavior of $q^{VA}(\alpha,r)$. In [6] the authors prove that there exists some value $\alpha^* \in (0,1)$ such that the firm only undertakes $r > 0$ if $\alpha > \alpha^*$, and undertakes $r = 0$ otherwise. We will say that the regulator is "strong" if $\alpha > \alpha^*$, and "weak" otherwise. These authors also show that for $\alpha > \alpha^*$, $\partial q^{VA}(\alpha,r)/\partial r < 0$, and this implies that the firm has an incentive to invest in self-regulatory efforts when it faces a strong regulator. These observations result in the following two propositions describing firm and regulatory behavior in our model.

Proposition 3 *If the regulator is strong, the firm chooses r such that $U(q^{VA}(\alpha,r)) = \overline{U}(S)$ and both parties sign the VA.*

Proof. Recall that $U(q^{VA}(\alpha,S)) > \overline{U}(S)$. Thus there exists a VA of level $q < q^{VA}(\alpha,S)$ that the regulator would accept rather than exercising her outside option which results in the expected payoff of $\overline{U}(S)$. Since the regulator is strong, we know that $\partial q^{VA}(\alpha,r)/\partial r < 0$, and since reducing q is profitable for

the firm, the firm will choose $r = \widehat{r}$ such that $U(q^{VA}(\alpha|_{\alpha>\alpha^*}, \widehat{r})) = \overline{U}(S)$. Both parties will sign the VA. ■

The proposition shows that if the regulator is strong, a VA will be negotiated that will be accepted by both parties, and it will be at level r such that $U(q^{VA}(\alpha, r)) = \overline{U}(S)$. While the firm uses r strategically to reduce its negotiated level of abatement, the regulator receives exactly the same expected payoff under the negotiated agreement as she would if no negotiated agreement had existed.

Proposition 4 *If the regulator is weak, the firm chooses* $r = 0$. *The regulator will exercise her outside option and not sign the VA.*

Proof. Proposition 1 of [6] establishes that if the regulator is weak the firm chooses $r = 0$. Now recall that if the regulator is strong the firm will choose $r = \widehat{r}$ such that $U(q^{VA}(\alpha|_{\alpha>\alpha^*}, \widehat{r})) = \overline{U}(S)$, where $q^{VA}(\alpha|_{\alpha>\alpha^*}, \widehat{r})$ refers to the level of abatement under the negotiated agreement when the regulator is strong. Next note that $q^{VA}(\alpha|_{\alpha<\alpha^*}, \widehat{r}) < q^{VA}(\alpha|_{\alpha>\alpha^*}, \widehat{r})$ where $q^{VA}(\alpha|_{\alpha<\alpha^*}, \widehat{r})$ is the level of abatement that would be negotiated if the firm undertook an initial level of self-regulation $\widehat{r}$, and the regulator was a weak bargainer. [[**Note I am asserting strict inequality. For sure weak inequality holds but that will not give us predictive power about when VAs will be signed. May need another argument to ensure strict. It could come if we can show** $dq^{VA}/d\alpha > 0$]]. It follows that $U(q^{VA}(\alpha|_{\alpha<\alpha^*}, \widehat{r})) < U\left(q^{VA}(\alpha|_{\alpha>\alpha^*}, \widehat{r})\right)$. Finally note that $q^{VA}(\alpha|_{\alpha<\alpha^*}, 0) < q^{VA}(\alpha|_{\alpha<\alpha^*}, \widehat{r})$. Thus we know that $U(q^{VA}(\alpha|_{\alpha<\alpha^*}, 0)) < U\left(q^{VA}(\alpha|_{\alpha<\alpha^*}, \widehat{r})\right) < U\left(q^{VA}(\alpha|_{\alpha>\alpha^*}, \widehat{r})\right) = \overline{U}(S)$, and therefore the regulator prefers her outside option to the outcome of the negotiated agreement when she is weak. ■

We now turn to a summary of the above results, and an examination of the empirical implications of the model.

2.5 Equilibria and Empirical Implications

Our analysis of the 4-stage game leads to the following proposition.

Proposition 5 *If $\alpha < \alpha^*$, then $r = 0$ in stage 1 and a negotiated agreement will not be signed. The firm will engage in a level of self-regulation $r = S$ prior to proposed legislation, resulting in expected payoffs of $\overline{U}(S)$ and $\overline{C}(S)$. If $\alpha > \alpha^*$, then $r = \widehat{r} > 0$ and the firm and regulator will sign a voluntary agreement, resulting in payoffs $U(q^{VA}(\alpha, \widehat{r})) = \overline{U}(S)$ and $C(q^{VA}(\alpha, \widehat{r})) \leq \overline{C}(S)$, and ending the game after stage 2.*

Proposition 5 shows that the overall equilibrium of the game depends upon a variety of parameters, but most critically upon the regulator's bargaining strength. If the regulator is weak, i.e. $\alpha < \alpha^*$, the firm undertakes no self-regulation at stage 1. At stage 2, the players negotiate over a VA. As we have shown above, however, the regulator will exercise its outside option and not sign the VA. The firm engages in self-regulation in stage 3, and the regulator presses for legislation in stage 4.

If the regulator is strong, i.e. $\alpha > \alpha^*$, the firm invests in self-regulation of $r > 0$ in stage 1, in order to weaken the VA that is negotiated in stage 2. The VA is signed by both parties. The firm undertakes no further self-regulation in stage 3, and the regulator does not press for legislation in stage 4.

The model generates the empirical prediction that negotiated VAs are most likely to be observed in regions in which regulators have considerable bargaining power relative to firms. The literature on VAs that was discussed in the Introduction, and specifically OECD (2005), makes it clear that negotiated voluntary environmental agreements as a policy tool are much more popular in Europe than in the United States. In this regard it is interesting to note that Lyon and Maxwell (2004) point out that American laws controlling the regulatory process, such as the 1946 Administrative Procedures Act, may encumber the regulator to the point where "she loses the bulk of her bargaining power," and suggest that this may be a reason for the relative scarcity of negotiated agreements in the United States.

The previous literature on negotiated agreements reaches the unrealistic conclusion that if negotiated agreements are not prohibited by law, then they will

always be signed. We uncover conditions under which these agreements will not be signed even if they exist as a possibility. In particular, we find that if the regulator is in a weak bargaining position, she will choose to exercise her outside option of pushing for legislation rather than signing the VA. The existence of this outside option, which arises from the fact that the firm has incentives to engage in self-regulation if negotiations fail, benefits the regulator. The regulator also benefits from the outside option even if she does sign the VA. Recall that the firm can use its pre-negotiation self-regulatory efforts to reduce the regulator's expected payoff from the negotiated VA. However, the regulator's expected payoff from the negotiation is bounded from below by her outside option.

3 Welfare Analysis

We have seen that our model generates instances where negotiated voluntary agreement will be signed, but also instances where one of the two parties will decide to exercise their outside option. In this section we review the welfare implications of each of these outcomes.

Proposition 6 *The opportunity to offer a VA cannot make the regulator worse off. Furthermore, the opportunity is socially beneficial if the VA is signed by both parties.*

Consider first the possibility that the regulator is prohibited from offering a negotiated voluntary agreement. In this case, the firm facing a threat of legislative action will undertake his optimal level of voluntary abatement, S, and the regulator's expected payoff will be $\overline{U}(S)$. Our previous analysis has shown that when the possibility of a negotiated voluntary agreement exists, two outcomes are possible. If the regulator is weak, she will exercise her outside option, ending negotiations and leading to an expected payoff of $\overline{U}(S)$. If the regulator is strong, the firm will undertake self-regulation to a level $\widehat{r}$ prior to entering negotiations. We have shown that this level of initial self-regulation

is chosen to induce the regulator to sign a VA requiring a level of abatement given by $q^{VA}(\alpha, \widehat{r})$. In addition, $U(q^{VA}(\alpha, \widehat{r})) = \overline{U}(S)$ so the regulator is not worse off under the voluntary agreement than she would be if VAs were prohibited. Furthermore we note that if the firm and regulator sign the VA, then it is clear that the firm's expected payoff is no worse off than it would be under self-regulation, and we have already shown that the regulator is equally well off. Additionally the regulator saves resources $\gamma(\rho(r))$ that it otherwise would expend on pushing for legislation. Thus, a signed negotiated voluntary agreement is socially preferable to no agreement.

Our results have important implications for policy that differ from those in the current literature. Fleckinger and Glachant (2011) argue that self-regulation and VAs are substitutes, and that welfare might be enhanced if VAs were banned. Our analysis leads us to conclude that when firms have the option to engage in unilateral self-regulation if a VA is not signed, then self-regulation and negotiated VAs are complements rather than substitutes. We never identify conditions under which self-regulation overall (including both r and S) reduces welfare, relative to a world where only VAs are possible. Nor do we find that VAs reduce welfare, relative to a world in which only self-regulation is possible. Thus, sophisticated regulators who understand their outside options need not fear that signing a VA will lock them into an unfavorable position. Of course, unsophisticated regulators may well sign bad VAs, but by the same token unsophisticated firms may fail to maximize profits. A discussion of how sophisticated regulators are in practice is beyond the scope of this paper.

4 Conclusions

In this paper, we have examined the interaction between self-regulation and negotiated agreements in a quite general setting in which industry self-regulation can be conducted before the negotiation of a voluntary agreement, after a voluntary agreement is signed, or after the failure of the parties to agree to a negotiated outcome. We find that in this context, self-regulation is socially beneficial,

and does not interfere with the performance of negotiated agreements.

From a policy perspective, regulators need not fear that industry self-regulation will undermine their ability to negotiate a beneficial voluntary agreement. They must, however, be willing to opt out of negotiations that offer unfavorable terms, and put the onus on industry to self-regulate if it wants to stave off a regulatory threat. In our model, negotiated agreements are only signed when regulatory bargaining power is strong; otherwise, the regulator opts out of negotiations and simply relies upon industry self-regulation rather than agreeing to a weak voluntary agreement. We believe this prediction is a step forward in realism relative to earlier work [Segerson and Miceli (1998); Fleckinger and Glachant (2011)] that predicts that government and industry always sign a negotiated agreement.

Our model implies that when negotiated agreements are signed, they improve social welfare, relative to a baseline in which mandatory regulation is the only option. This result seems to be in tension with overviews such as OECD (2003), Morgenstern and Pizer (2007), and Lyon and Maxwell (2007), all of whom find that the empirical literature provides scant evidence that voluntary approaches provide demonstrable evidence of welfare improvements, relative to traditional regulation. Of these, the analysis that focuses more directly on negotiated agreements (as opposed to public voluntary programs) is OECD (2003), which concludes (p. 11) that

> "Whilst some of the approaches studied...probably have contributed significantly to target achievement, it is highly unlikely that a number of other approaches have contributed much to target fulfilment...The econometric studies that are available also often indicate that the contribution of the voluntary approaches in question to target fulfilment has been limited."

One perspective on these claims comes directly from our model: when industry can invest in self-regulation prior to the negotiation of a VA, it does so strategically, so as to ensure the regulator obtains a payoff no greater than what

it would have received had there been no option for a VA at all! Then the VA contributes nothing to environmental performance. It does provide a social benefit, however, by reducing the transaction costs of the regulatory process. In particular, a VA obviates the need to fight for legislation, thereby economizing on the regulatory effort that would have been required for passage of legislation.

An alternative perspective is to call into question our assumption that the regulator can credibly commit not to press for legislation after a VA is signed. Without this assumption, the regulator has nothing to offer the industry in bargaining over a VA, and VAs would not be signed. Instead, we would simply observe self-regulation that is calculated to reduce the risk of future legislation. In fact, if one reads carefully the case studies in EEA (1997) and OECD (2003), one finds that few of them actually appear to embody a regulatory target backed up by a clear regulatory threat. Instead, the more common form of a VA is actually oriented toward providing greater flexibility in the implementation of existing regulations. Surprisingly, this aspect of VAs has not been explored in the theoretical literature. We leave it for future research.

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