Environmental Regulation through Voluntary Agreements

(Paper prepared for the workshop on The Economics and Law of Voluntary Approaches in Environmental Policy 18-19 November 1996, Fondazione Levi, Venezia)

Lars Gårn Hansen

AKF
(Institute of Local Government Studies - Denmark)

November 1996

The research leading to this paper is a joint product of the SØM-project 'Complex Regulation Problems' and the AKF-project 'Voluntary Agreements' and has been funded by The Danish Environmental Research Programme and The Danish Energy Research Programme. I thank Peter Munk Christiansen, Signe Krarup, Anders Larsen and Birgitte Sloth for many helpful comments and suggestions.

Please address all correspondence to Lars Gårn Hansen, AKF, Nyropsgade 37, DK-1602 Copenhagen V, Denmark (pho: +45 33 11 03 00, fax: +45 33 15 28 75, E-mail: LGH@AKF.DK).

Abstract

Voluntary agreements with polluting industries are becoming a popular alternative to traditional environmental regulation. One reason may be that voluntary agreements can reduce compliance costs of polluting industries. In this paper we develop a family of simple policy formulation and implementation models enabling us to formally characterize the policy environments that make voluntary agreements possible. The main message of this paper is one of caution. Voluntary agreements that increase compliance costs and reduce social welfare can not be ruled out. The analyses also suggests that giving the legislative branch of government an effective power of veto reduces (but does not eliminate) the possibility of welfare reducing voluntary agreements.

1. Introduction

The purpose of this paper is to propose and analyse simple economic models describing the regulatory policy approach known as *voluntary agreements*.

The term voluntary agreements attempts to capture the idea that environmental goals and/or instruments of implementation are negotiated with the firms to be regulated prior to implementation or at least that there is some freedom of choice (for the regulated firms) with respect to which regulatory scheme a firm is to be submitted. Before defining the concept more precisely we will discuss the related concept *voluntary regulatory instruments*.

The term voluntary regulatory instruments (or voluntary approaches) is used to characterize a wide range of informational and motivational policy instruments which can be divided into three main groups: voluntary instruments that do not involve the public directly, so-called voluntary instruments involving the public and so-called voluntary instruments allowing firms some spectrum of choice as to which regulatory scheme they are to be submitted (see IEA (1995) for an international review of existing schemes for energy efficiency).

Voluntary regulatory instruments that do not involve the public directly include energy auditing schemes, promotion of energy savings, promotion of technologies, golden carrot programmes (e.g. subsidizing development and implementation of energy saving products and technologies) and other 'soft' policy instruments. These programmes can be understood as subsidizing development or supply of preferred technologies and subsidies for provision of certain types of costly information to firms. The industry's reactions caused by such schemes are no more voluntary than those caused by taxes or other incentive-based regulatory instruments. However, subsidy based instruments have non-negative net income effects for polluting firms, implying that the regulator de facto accepts that firms have the right to pollute. Since polluting firms then have no reason to oppose implementation of such policies they may be said to be more voluntary for firms in this respect.

Another class of voluntary regulatory instruments focuses on channeling credible information on firms' environmental performance to the general public (e.g. US EPA's 33/50 program, UK and New Zealand 'corporate commitment' schemes). Economically these schemes are subsidies for provision of credible information bringing environmental performance of firms into the competitive fringe. An environmental dimension is added to firm products which, depending on the weight potential buyers attach to it, may induce better environmental performance by firms. These schemes are formally voluntary, but the ensuing competition among firms may well reduce the average profitability in the sector in question (see Arora and Cason (1995) and Arora and Gangopadhyay (1994) for theoretical and empirical analysis of such schemes).

Finally, the term 'voluntary instruments' is also used for advanced versions of 'hard' regulatory instruments that e.g. specify that a firm may be exempt from standard regulation if it agrees to undertake alternative measures to achieve the same goals.

These are sophisticated regulatory instruments where firms implicitly reveal private information to the regulator by choosing from a menu of regulatory contracts. If designed correctly regulatory schemes offering firms a choice of different regulatory contracts rather than just imposing one uniform contract on all firms may increase regulatory efficiency (see e.g. Laffont and Tirole (1993) for an exposition of applications of contract theory to regulatory economics).

In this paper we will not consider the voluntary regulatory instruments. Instead we will understand the term voluntary agreements as characterizing another way of structuring the *process*, through which environmental goals are formulated and instruments of implementation are decided on. In other words the voluntary agreement process is one way to organize the game of policy formulation, while the 'traditional policy formulation process' is another.

The outcome of a voluntary agreement process can in principle be the same environmental goals implemented through the same regulatory instruments as would have been the outcome of a traditional policy formulation process. However, if the voluntary agreement process is substantially different one would expect a different policy outcome and thus different distributional and social welfare effects.

In the next section I discuss the voluntary agreement process and the traditional policy formulation process and propose three central differences. In the following sections I propose and analyse formal models incorporating these differences. The analysis indicates under which conditions voluntary agreements may occur and which changes in distributional and social welfare effects the resulting environmental regulation may cause.

The approach used in this paper is traditional neoclassic economic analysis. We assume fixed preferences for all agents and that utility is derived from end states only. It is worth noting that when considering alternative negotiation and decision-making processes these assumptions may be critical. It can be argued that preference learning and utility derived from a participatory process are central aspects of voluntary agreements. Through the process firms may learn that they have greater preference for environmental improvement than they were aware of before and firms may be willing to pay for the opportunity of a participatory process by accepting end states that are considered less desirable in themselves.

2. Characteristics Distinguishing Policy Formulation through Voluntary Agreement from the Traditional Policy Formulation Process

Describing the interaction between political players during the policy formulation and implementation process is the subject of much of the political science literature and a growing body of economic literature on public choice and agency capture. In the following I propose a simplistic description of the traditional policy process and the voluntary agreement process based on empirical surveys (e.g. IEA (1995), Glachant (1994)) which point to the key differences to be modelled in the following sections.

The traditional process consists of legislation on regulatory instruments where implementation and administration of these instruments are delegated to a regulatory agency. While environmental policy goals may be contested and subject to negotiation the real battle is over legislation on regulatory instruments. These usually require a legislative process with direct participation of the executive branch of Government (hereafter just called Government) and the legislative bodies of Government (hereafter called Congress). Affected industrial organizations and other interest groups are normally consulted by Government as well as Congress and may indirectly influence the process.

Voluntary agreements generally only have Government agencies and individual firms or industrial organizations (hereafter also denoted IOs) as direct participants. Normally, agreements do not result in legislation. Firms or IOs commit to targets and monitoring procedures, but not necessarily to specific instruments or methods of implementation. Normally, no formal sanctions for non-attention of targets are specified.

One apparent difference between the two policy formulation processes is that Congress participates directly in the traditional process, but is excluded from direct participation in the voluntary process. Instead IOs are elevated to a role as direct participants. Clearly, other (e.g. environmental) interest groups (hereafter also denoted IGs) and Congress may still indirectly influence the voluntary policy process.

When considering voluntary agreements with industrial organizations (on which we will focus in the following) another novelty is that implementation of environmental goals or agreed on instruments is left to the industrial organizations rather than to public agencies. This can be seen as a necessary consequence of not involving Congress directly since implementation by traditional regulatory instruments through Government agencies normally would require passing of legislation. Though regulatory agencies may still have a role as monitors of the agreed targets Governments must contract with industrial organizations for implementation. Thus the responsibility for and practical implementation of regulatory instruments are shifted to industrial organizations - often the choice of instruments of implementation is left to the Ios, too. The reward to IOs for implementing environmental targets is usually implicit in the agreement. One possibility is that Government promises not to push for legislation implementing some kind of traditional regulation if targets are met. Though

IOs may be able to implement effective regulatory instruments vis-à-vis member firms the issue of credibility of Government threats/promises and IO compliance with the negotiated targets is relevant.

Just as implementation through IOs is a logical consequence of excluding Congress from direct participation so is the voluntary agreement process what makes implementation through IOs possible. If IOs are to take responsibility for implementation Government must of course negotiate an agreement with them. Thus the aim of Governments engaging in a voluntary agreement process need not be the exclusion of Congress, but may instead be to shift the responsibility of implementation to IOs (possibly with the full support of Congress).

In conclusion voluntary agreements can be seen as a policy process with three central characteristics:

1) Congress is no longer a direct participant in the policy formulation process - instead firms or IOs become direct participants.
2) Responsibility for implementation of regulation is shifted to industrial organizations
3) Statutory sanctions ensuring IO participation and compliance are not possible under voluntary agreements. Instead IOs must be induced to comply through e.g. threats of new regulation in the area covered by the agreement. The question of what government credibly can threaten to do arises.

The presumption in the following is that Government or opposition parties are able to initiate the traditional policy formulation process (involving Congress) in any area of regulation, but that once the process is started it can only to some extent influence the end result. Government is also able to block initiation of the traditional policy formulation process by opposition parties by entering into a voluntary agreement. In other words Government may choose between entering into a voluntary agreement or initiating a legislative process.

To resolve the credibility-compliance issue we will assume that Government threats of imposing punishment (i.e. pushing for legislation or harsher administration of existing legislation) which also reduces the utility of Government are not credible. In other words the only credible Government threat is that of utility maximizing behaviour given that no agreement is made (i.e. Government cannot expropriate utility from firms by threatening death and destruction). To induce firms to comply with the conditions of a voluntary agreement Government must allot firms at least the same utility that they would have had if Government maximized its utility without a voluntary agreement. We thus assume that there must be mutual gains to trade for an agreement to be made which then also insures firm and Government compliance.

In the next three sections we consider voluntary agreements with industrial organizations. In section 3 we develop a model without interest group signalling power focusing on differences in policy goals between Congress and Government. In sections 4 and 5 models with interest group signalling power focusing on the shift of

responsibility for goal formulation and for implementation are developed and in section 6 conclusions are drawn.

3. Voluntary Agreements when Interest Groups do not have Signalling Power

In this section we specify a model without interest group influence through public criticism and find necessary conditions for use of voluntary agreements. These conditions allow us to characterize the possible environmental and welfare effects of voluntary agreements.

The model has three active agents: the IO representing polluting firms (hereafter also just called the firm), the Government and the Congress. Government may initiate the traditional policy formulation process through Congress or enter a voluntary agreement process with the IO.

Both policy formulation processes result in the setting of an environmental goal denoted R (indicating amount by which environmental damage is to be reduced) and a tax revenue goal T (indicating the amount of revenue to be collected through regulatory instruments). Implementation of these goals through the available regulation technology results in firm compliance costs denoted C in addition to the tax revenue payment.

Let U_f denote the utility effect on the firm of regulation and define:

$$U_f = -T - C$$

Government and Congress are both assumed to take into account the utility effects of regulation on the firm, the environmentally concerned part of the public and the part of the public that might benefit from increased tax revenues. However, they may differ in the relative weights attached to these groups in their respective utility function. Let U_c and U_g denote the utility effects of regulation on Congress and Government respectively and define:

$$U_c = U_f + \lambda_c T + \delta_c R$$

$$U_g = U_f + \lambda_g T + \delta_g R$$

where λ_c and λ_g are the utility weights attached to tax revenue by Congress and Government respectively, δ_c and δ_g are the utility weights attached to environmental damage reduction. We make the natural assumptions $\lambda_c > 0,\ \lambda_g > 0,\ \delta_c > 0,\ \delta_g > 0$.

The negotiation process between Government and Congress under the traditional policy formulation process is not modelled explicitly. Instead the utility function of Congress should be interpreted as representing the result of this process incorporating the relative power of Government and opposition parties in Congress. If Government's utility function parameters are equal to the parameters of Congress' utility function this implies agreement between Government and opposition parties or a large relative Governmental negotiation power while unequal parameters indicate disagreement and low Government party negotiation power in Congress.

The traditional policy process sets goals that are implemented through traditional Government policy instruments. Let *C(R, T)* describe the firm compliance costs that result when goals are implemented through the available regulation technology. We assume $C_R > 0$, $C_{RR} > 0$ (i.e. positive and rising marginal compliance cost of damage reduction) and $C_T \$ 0$, $C_{TT} \$0$ (i.e. non-negative and non-falling dead-weight loss of tax revenue collection). Underlying the dead-weight loss assumptions is an assumption that tax revenue (e.g. from environmental tax) can be redistributed to polluting firms through a cost less lump sum scheme. Thus we assume that increasing revenue is possible without dead-weight loss up to the level of revenue implemented by a perfect emission tax and that if revenue increases above this level it results in dead-weight loss. Correspondingly, we assume that $C_{RT} \# 0$ (i.e. that marginal compliance costs are non-increasing in collected revenue). Note that the compliance cost function allows for the possibility that firms as a group derive benefit from environmental damage reduction (e.g. cost reducing effects of reduced environmental damage).

Thus the traditional policy formulation process is assumed to be described by the following maximization problem:

$$\underset{R,T}{Max}\ U_c$$

$$under\ C = C(R,T)$$

the solution to which is denoted R^* and T^*.

Agent utilities with the traditional regulation process become:

$$U_f^* = -T^* - C(R^*, T^*) \qquad \textbf{(1)}$$

The first order conditions from step 1 imply

$$U_c^* = U_f^* + \lambda_c T^* + \delta_c R^* \quad \textbf{(2)}$$

$$U_g^* = U_f^* + \lambda_g T^* + \delta_g R^* \quad \textbf{(3)}$$

$$C_R = \delta_c \quad \textbf{(4)}$$

and

$$C_T = \lambda_c - 1 \quad \textbf{(5)}$$

In the voluntary agreement process goals $\tilde{R}$, $\tilde{T}$ are set through negotiations between Government and the IO and then implemented by the IO. Thus the industrial organization representing firms is assumed to have a regulatory technology vis-à-vis its members with which it can ensure attainment of the environmental goals. Clearly, public tax revenues are not generated (i.e. $\tilde{T} = 0$). We further assume that the regulatory technology is described by the functions *C (cR, T)* where *T = 0.* Thus by assumptions the two regulatory technologies are identical save for the cost parameter *c* and the constraint that *T = 0* under IO implementation. This simplifies the following derivations while capturing the essential difference in relative implementation efficiency through a single parameter c, indicating the relative cost of IO-implementation.

Agent utilities under the voluntary agreement process become:

$$\tilde{U}_f = -C(c\tilde{R}, 0) \quad \textbf{(6)}$$

$$\tilde{U}_c = \tilde{U}_f + \delta_c \tilde{R} \quad \textbf{(7)}$$

$$\tilde{U}_g = \tilde{U}_f + \delta_g \tilde{R} \quad \textbf{(8)}$$

If the agents' utility functions, the *C* function, the *c* parameter are public information the result of the traditional policy process R^*, T^* can be predicted by Government as well as the firm. Given this, a necessary condition for a voluntary agreement is that both parties to the agreement experience a non-negative utility gain vis-à-vis the traditional policy process which both parties know is the alternative. In other words a non-empty set of goals ($\tilde{R}$) must exist for which both the following individual rationality constraints are satisfied:

IR-firm:

$$\tilde{U}_f = -C(c\tilde{R},\ 0) \geq -T^* - C(R^*,\ T^*) = U_f^* \qquad \textbf{(9)}$$

IR-Government:

$$\tilde{U}_g = \tilde{U}_f + \delta_g\tilde{R} \geq U_f^* + \lambda_g T^* + \delta_g R^* = U_g^* \qquad \textbf{(10)}$$

In the following we wish to find the set of parameter tuples (δ_g, λ_g) that for a given tuple of parameter (δ_c , λ_c , *c*) allows a non-empty set of ($\tilde{R}$) satisfying both IR constraints. In other words we wish to characterize the set of parameter tuples (δ_g, λ_g) that makes voluntary agreements possible (hereafter called the VA-set).

On the border of the VA-set one or both IR constraints are satisfied with equality. For sufficiently small δ_g the $\tilde{R}$ that maximizes Government utility $\tilde{U}_g$ will be small enough so that firm utility is not exhausted (i.e. the firm IR constraint is not binding). In this area the relationship between λ_g and δ_g at the set border must satisfy (10) with equality and $\tilde{R}$ is set to maximize $\tilde{U}_g$. The equation characterizing the relationship between λ_g, and δ_g on the part of the set border where the firm constraint is not binding becomes:

$$\lambda_g = \left[\frac{\tilde{R} - R^*}{T^*}\right]\delta_g + \frac{(\tilde{U}_f - U_f^*)}{T^*} \qquad \textbf{(11)}$$

where $\tilde{R}$ is set to maximize $\tilde{U}_g$ so that the following 1. order condition (derived from (8)) holds:

$$\delta_g = C_R c \qquad \textbf{(12)}$$

As δ_g increases the $\tilde{U}_g$ -maximizing $\tilde{R}$ rises and at some point firm utility is exhausted and both constraints must be satisfied. Using (9) on (11) we find the equation characterizing the relationship between λ_g, and δ_g on the part of the set border where both Government and firm constraints are binding to be:

$$\lambda_g = \left[\frac{\tilde{R} - R^*}{T^*}\right]\delta_g \qquad \textbf{(13)}$$

with (rearranging (9)):

$$\tilde{R} = C^{-1}([T^* + C(R^*, T^*)], 0)/c \qquad \textbf{(14)}$$

The VA-set Border

As noted, when δ_g is sufficiently small the firm constraint does not bind and the $\tilde{R}$ exhausting firm utility is deemed too high by Government so that reducing $\tilde{R}$ increases utility of both agents. In this area only the IR Government constraint (11) binds. Total differentiation of (11) with respect to δ_g and λ_g gives

$$T^* d\lambda_g + R^* d\delta_g = -C_R c \frac{d\tilde{R}}{d\delta_g} d\delta_g + \tilde{R} d\delta_g + \delta_g \frac{d\tilde{R}}{d\delta_g} d\delta_g \qquad \textbf{(15)}$$

Since $\tilde{R}$ is set to maximize $\tilde{U}_g$ we have $C_R c = \delta_g$ so that (15) reduces to:

$$\frac{d\lambda_g}{d\delta_g} = \left[\frac{\tilde{R} - R^*}{T^*}\right] \qquad \textbf{(16)}$$

Since $\tilde{R}$ is set to maximize $\tilde{U}_g$ we know that $d\tilde{R}/d\delta_g > 0$ so that (11) is a convex curve initially (for small δ_g) downward sloping in the δ_g -λ_g-plane. It then attains a minimum when $\tilde{R} = R^*$ and slopes up again.

It is apparent that (δ_c, λ_c) is not in the VA-set when c>1. From (4) we know that $C_R(R^*,T^*) = \delta_c$ and from (12) we know that $C_R(c\tilde{R},0)c = \delta_g$ so that for $\delta_g = c\delta_c$ we have:

$$C_R(R^*,T^*) = C_R(c\tilde{R},0) \quad \textbf{(17)}$$

and by $C_{RT}<0$ and $C_{RR}>0$ we have:

$$\delta_g = c\delta_c \Rightarrow c\tilde{R} < R^* \quad \textbf{(18)}$$

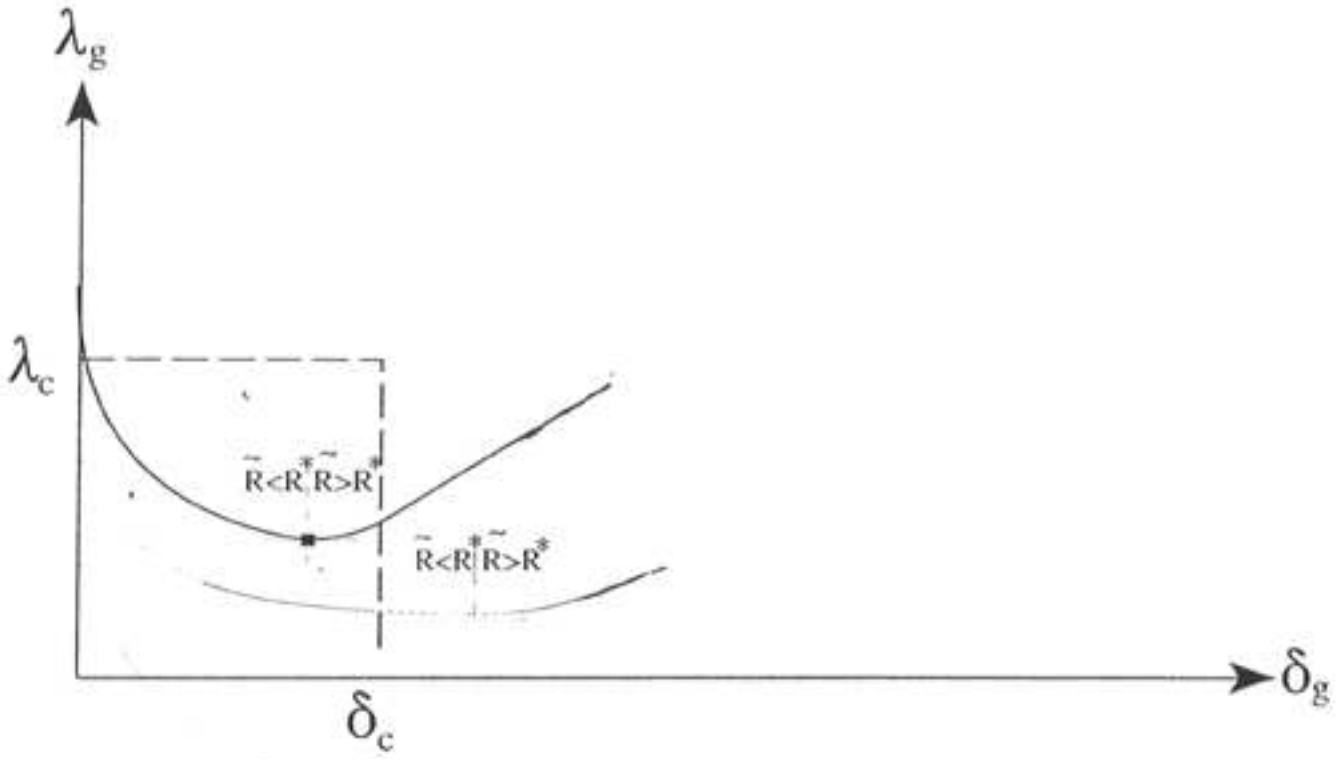
This implies that when c is close to 1 (11) has its minimum at a δ_g value below δ_c and that for $\delta_g = \delta_c$ we have $\tilde{R} > R^*$. However, if c is large enough (11) has its minimum at a δ_g value above δ_c and then $\tilde{R} < R^*$ for $\delta_g = \delta_c$.

Now consider the part of the set border where both IR constraints bind satisfying (13) and (14). Note that equation (14) implies that there is a unique $\tilde{R}$ for which compliance costs under the voluntary agreement technology just exhaust the gain from not having to pay taxes T^* and abating to R^* under the traditional regulatory technology. Thus $\tilde{R}$ only depends on the firm's alternative income and is thus independent of Government utility function parameter δ_g and λ_g .We see from (13) that the set border here is a line through origo with slope: $(\tilde{R} - R^*)/T^*$.

From (13) and (16) we see that for all border tuples where the associated border slope is negative the corresponding voluntary agreement is characterised by $\tilde{R} < R^*$ and for tuples with a positive associated slope the corresponding voluntary agreement is characterised by $\tilde{R} > R^*$.

The above observations allow us to illustrate the set border. In figure 1 three possible set borders are illustrated for $c>1$ (i.e. no compliance cost advantage).The part of the parameter space in which voluntary agreements are possible is the part of the δ_g - λ_g plane below the set border. We know that when $c>1$ the set defined by the border does not include (δ_c,λ_c) and that the boarder for small δ_g (where the firm constraint does not bind) is negatively sloped and convex. When c is close to one the boarder may attain its minimum (marked by a square) before the firm constraint binds and at a δ_g below δ_c (as in the highest placed of the three illustrated border lines).When c is large the boarder equation has no minimum (as in the lowest of the three illustrated border lines) or attains its minimum for a δ_g above δ_c (as in the middle border line).

Fig. 1


λ_g
λ_c
$\tilde{R}<R^*\tilde{R}>R^*$
$\tilde{R}<R^*\tilde{R}>R^*$
δ_g
δ_c

The VA-set Interior: Nash Bargaining Solutions

In this subsection we apply the Nash bargaining solution to the negotiation problem presented above thus allowing us to characterize the result of the voluntary agreement process in the interior of the VA-set where the set of feasible agreements is not a singleton (see e.g. Osborne and Rubinstein (1990) for a presentation of and references to the literature on bargaining models and their applications).

The asymmetric Nash bargaining solution is the agreement that maximizes the Nash product:

$$(\tilde{U}_f - U_f^0)^{\alpha}(\tilde{U}_g - U_g^0)^{(1-\alpha)} \qquad \textbf{(19)}$$

where $U_f^0,\ U_g^0$ are appropriate alternative benefits to the parties and α is a parameter that can be loosely interpreted as expressing relative bargaining power of the two agents.

Initially we briefly review two specifications of the underlying dynamic negotiation game that implement the Nash bargaining solution and important implications for specification and interpretation of the Nash bargaining solution that were pointed out by Binmore, Rubinstein and Wolinsky (1986).

The underlying bargaining process is in both cases assumed to be a game of alternating offers. For such a game to have a unique solution agents must experience costs in connection with continuation of the bargaining process. Binmore *et al.* point out that such a game may be driven by impatience or by risk and in both cases result in implementation of the Nash bargaining solution when the cost per negotiation step goes to zero. In the first case the dominant cost of bargaining is the delay of payoff that continued negotiation causes. If agents are impatient to reap the rewards of a bargain each new bargaining step entails a cost in that it postpones the payoff entailed by an agreement. In this case agent utility functions reflect time preferences, and the relevant alternative benefits are the benefits accruing to agents during the bargaining process. In the second case the dominant cost associated with bargaining is not the delay of payoff caused, but that continued negotiation encompasses an external risk of losing the bargain opportunity altogether (the preposition 'external' indicates that the risk is uncontrolled by the negotiating parties). Each new bargaining step entails a cost in prolonging the period that the agents are subject to the external risk of losing the opportunity of payoff though an agreement - a risk that can only be eliminated by entering into an agreement. In this case the agent utility functions reflect risk aversion and the relevant alternative benefits are the benefits that agents would attain if the opportunity of an agreement were to be lost (and not the benefits actually accruing during negotiation).

Here the exogenous risk model seems an obvious choice for the underlying negotiation game for two reasons: 1) there is a risk that the traditional legislative process may be initiated by opposition parties thus eliminating the opportunity of a voluntary agreement, and 2) firms (that are net losers vis-à-vis the unregulated state in either case) cannot as such be impatient for an agreement. This implies that the relevant alternative benefit is the benefit expected to result from initiation of the traditional legislative process (and not the benefits resulting from the current unregulated situation as would be the case if the negotiation process were driven by impatience). The thus specified Nash product is:

$$(\tilde{U}_f - U_f^*)^{\alpha}(\tilde{U}_g - U_g^*)^{(1-\alpha)} \qquad \textbf{(20)}$$

Specifying $\alpha=1/2$ (the symmetric solution) is tempting since differences in risk aversion are embedded in the utility functions and therefore cannot motivate use of an asymmetric bargaining solution (in our case both agents have linear (i.e. risk neutral) utility functions[1]. The asymmetric bargaining solution can, however, be motivated by differences in the perception of the exogenous risk of break down of negotiations (i.e.

1) Introducing differences in risk aversion into the model can be done by letting firm utility be a convex function of monetary costs. This complicates derivation somewhat, but does not essentially change the model.

differences in the perception of the risk of opposition parties initiating the traditional policy process) or by asymmetries in the bargaining process itself (e.g. the time allotted for responding to offers etc.) both of which seem plausible in our case. In the following we therefore uphold the general asymmetric specification.

The first order condition for maximising (20) with respect to $\tilde{R}$ is:

$$\alpha(\tilde{U}_f - U_f^*)^{(\alpha-1)}\frac{d\tilde{U}_f}{d\tilde{R}}(\tilde{U}_g - U_g^*)^{(1-\alpha)} +$$

$$(\tilde{U}_f - U_f^*)^{\alpha}(\alpha - 1)(\tilde{U}_g - U_g^*)^{-\alpha}\frac{d\tilde{U}_g}{d\tilde{R}} = 0$$

which reduces to:

$$(\tilde{U}_g - U_g^*) = (\tilde{U}_f - U_f^*)\frac{(1-\alpha)}{\alpha}\frac{(d\tilde{U}_g/d\tilde{R})}{-(d\tilde{U}_f/d\tilde{R})}$$

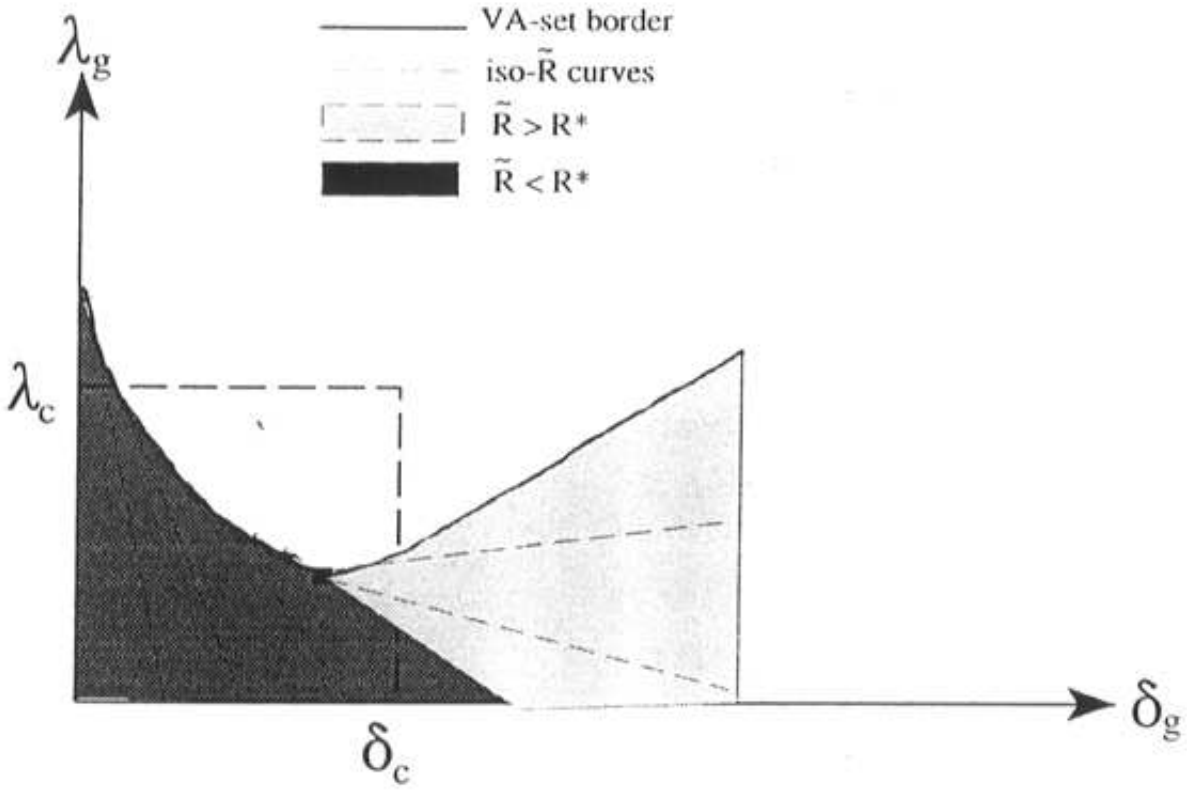
Inserting the definitions of $\tilde{U}_g$, U_g^* , $\tilde{U}_f$, U_f^* we have:

$$\lambda_g = \left[\frac{\tilde{R} - R^*}{T^*}\right]\delta_g - \frac{(\tilde{U}_f - U_f^*)}{T^*}\left[\frac{(1-\alpha)}{\alpha c C_R}\right]\delta_g + \frac{(\tilde{U}_f - U_f^*)}{T^*}\left[\frac{(1-\alpha)}{\alpha} + 1\right] \quad \textbf{(21)}$$

The equation defines $\tilde{R}$ as a function of model parameters and for fixed $\tilde{R}$ it defines the equation for isoquants (iso- $\tilde{R}$ curves) in the (δ_g λ_g) plane of figure 1.

For $\tilde{R} < R^*$ (where $\tilde{U}_f \geq U_f^*$) isoquants are straight lines with a negative slope. As $\tilde{R}$ grows isoquant slopes grow and become positive if $\tilde{R} > R^*$ when $\tilde{U}_f = U_f^*$. Note also that if α increases isoquants move to the right in the graf and their slope increases (i.e. for any given (δ_g λ_g) parameter set increased firm bargaining power reduces $\tilde{R}$ in the resulting voluntary agreement which is in accordance with intuition). In figure 2 one of the VA-sets from figure 1 is reproduced with its associated interior isoquants indicating the resulting $\tilde{R}$ for the entire VA-set.

FIGURE 2 *Illustration characterising the VA-set for a model without interest group signalling power*


VA-set border
iso-$\tilde{R}$ curves
$\tilde{R} > R^*$
$\tilde{R} < R^*$
λ_g
λ_c
δ_c
δ_g

Realisation of Voluntary Agreements and their Distributional and Welfare Effects

We now specify the social welfare function with which to evaluate the result of the voluntary agreement process. Clearly at any given time different political parties and the different branches of government may be biased towards special interest groups (be this because of lobbyism or because of fundamental bias). Though by no means perfect the division of power between executive and legislative braches of government and the possibility of public scrutiny and debate under the traditional legislative process in a democracy is often cited as important for balancing off special interest groups and thus securing some adherence to the interests of the general public during the policy formulation process. If these elements are important it seems likely that the policy priorities implied by the congressional utility function (embedding compromises between different parties and branches of government through such a legislative process) in general will deviate less from those implied by the 'true' social welfare function than will the policy priorities implied by the government utility function. Taking this outset we will assume that the congressional utility function under the traditional policy formulation process is the best estimator of the social welfare changes caused by changes in goal attainment, i.e. we specify the following social welfare function:

$$SW(R,T) = U_f(R,T) + \lambda_c T + \delta_c R$$

giving the following social welfare effect of allowing a policy formulation through voluntary agreements:

$$SW(\tilde{R},0) - SW(R^*,T^*) = \tilde{U}_f - U_f^* - \lambda_c T + \delta_c(\tilde{R} - R^*) \qquad \textbf{(22)}$$

Subtracting equation (2) from equation (7) we get the utility effect of voluntary agreements for Congress:

$$\tilde{U}_c - U_c^* = \tilde{U}_f - U_f^* - \lambda_c T + \delta_c(\tilde{R} - R^*) \quad \textbf{(23)}$$

and for Government (equation (8) minus equation (3)):

$$\tilde{U}_g - U_g^* = \tilde{U}_f - U_f^* - \lambda_g T + \delta_g(\tilde{R} - R^*) \quad \textbf{(24)}$$

We see that in this model the social welfare effect of a voluntary agreement is equal to the effect on congressional utility.

Figure 2 illustrates that if Government and Congress disagree on policy priorities (i.e. if $\delta_g \neq \delta_c$ or if $\lambda_g \neq \lambda_c$) voluntary agreements become possible even though they imply a fall in implementation efficiency (i.e. $c>1$). If Government is sufficiently more pro-firm than Congress then firms as well as Government gain from reducing environmental goals and tax revenue below the level that would result from the traditional policy formulation process involving Congress even though implementation efficiency falls.

If Government is sufficiently more pro-environment (relative to revenue) than Congress then it becomes possible for Government to offer a mutually advantageous reduction in tax revenue in return for an increase in environmental performance even though implementation efficiency falls. In both cases firms and Government gain utility (a necessary condition for a voluntary agreement) while the utility of Congress is necessarily reduced (since deviating from congressional policy priorities is the only possible generator of utility gains for firms and Government when implementation efficiency falls). The utility of the environmental interest group may be reduced or increased as indicated in figure 2.

If on the other hand implementation efficiency increases sufficiently (i.e. $c<1$) the VA-set boundary shifts up and voluntary agreements become possible when Government and Congress agree on policy priorities. In this case Congress and the environmental interest group as well as firms and Government gain utility. However, if Government and Congress disagree on policy priorities, the resulting voluntary agreement may reduce congressional utility (and social welfare) and/or environmental performance even though it increases implementation efficiency.

The distributional and welfare consequences of voluntary agreements can be summarised as follows:

Effect of voluntary agreements on:	Falling implementation efficiency		Rising implementation efficiency	
	Government and Congress have same policy priorities*	Government and Congress have different policy priorities	Government and Congress have same policy priorities	Government and Congress have different policy priorities
– Firm utility		+	+	+
– Government		+	+	+
– Congress		-	+	?
– Environment		?	+	?
– Tax Revenue		-	-	-
– Social welfare		-	+	?

* Voluntary Agreements are not possible

Voluntary agreements become possible when they encompass implementation efficiency gains or when Congress and Government disagree on policy priorities. If Congress and Government agree on policy priorities only agreements that imply increased implementation efficiency and a social welfare gain will be realised. If agreement on policy priorities can be insured then allowing policy formulation through voluntary agreements entails a clear cut welfare gain. However, if Congress and Government disagree on policy priorities this may reduce or eliminate the welfare gains associated with lower compliance costs. Further, if policy disagreement is large enough, voluntary agreements become possible even though implementation efficiency is reduced.

The potential welfare problem for voluntary agreements in this model arises because Government is allowed to enter voluntary agreements that reduce congressional utility. Within the model set up the obvious solution is to give Congress the right to veto voluntary agreements. This would restrict the VA-set to agreements that also satisfy the congressional utility constraint (i.e. to agreements that are welfare improving).

4. Voluntary Agreements when the Firm s Interest Group has Signalling Power

The following is an augmentation of the model in the previous section incorporating direct influence of interest groups in a very simple way. We assume that interest groups may reward/punish those responsible for a decision or a policy result by publicly applauding or criticizing the decision or result. Utility of political actors is affected directly because the general public’s perception of them is influenced by

interest group criticism.

In the following we assume that this process takes on a very simple structure. We assume that an IG can only credibly criticize observed decisions or results as such and that the criticism then will be perceived by the public as applying to all agents responsible for the decision or result. Thus the IG may vary the intensity of criticism, but is not able to influence the relative utility effect on the different actors responsible for the decision or result being criticized. In effect then IG-criticism is a public good/bad for the group of actors responsible for a decision. Further activities of IGs are assumed to be embedded in a larger environment of repeated policy formulation and criticism. We assume that to be effective IGs must have a predictable and consistent pattern of response to policy across different policy settings and that this pattern is a strategy set by each IG outside the model. We further assume that the costs of deviating from the pre-set pattern are so large as to make this a non-viable option in the given case (i.e. that deviation if discovered by the public would result in a general and very costly loss of credibility). Basically we assume that IG criticism in order to be credible must be a trustworthy signal that the public can translate into an indicator of damage done to the interest group by policy.

The public's punishment decision problem is also assumed to be embedded in a larger environment of repeated decisions and criticism with periodic public punishment of decision makers (through, e.g. voting at elections or product buying decisions). Punishment must be based on an accumulated measure of decision maker performance. The punishment effectuated by the public may be a non-linear function of the aggregate performance measure which again may be a non-linear function of the damage signals from interest groups. However, if we assume that the decision problem at hand is small it may be reasonable to model the marginal effects of an interest group's signal on public punishment as linear functions of the damage caused to the interest group.

With this rationale we will model the effect of an IG's criticism on a decision maker's utility as a linear function of damage done to the interest group. The coefficient being the marginal weight the public attaches to interest group damage in the performance indicator times the marginal disposition to punish times the marginal utility effect of punishment on the decision makers utility - all of which are assumed to be constant over the spectrum covered by the 'small' regulation problem at hand.

Augmenting the previous model we have the following agent utilities under the traditional policy process:

$$U_f^* = -T^* - C(R^*, T^*) \qquad \textbf{(25)}$$

$$U_c^* = U_f^* + \lambda_c T^* + \delta_c R^* + s_c^e(R^* - \bar{R}^e) + s_c^f(U_f^* - \bar{U}^f) \qquad \textbf{(26)}$$

$$U_g^* = U_f^* + \lambda_g T^* + \delta_g R^* + s_g^e(R^* - \bar{R}^e) + s_g^f(U_f^* - \bar{U}^f) \quad \textbf{(27)}$$

and under the voluntary agreement process:

$$\tilde{U}_f = -C(c\tilde{R}, 0) + s_f^e(\tilde{R} - \bar{R}^e) \quad \textbf{(28)}$$

$$\tilde{U}_c = \tilde{U}_f + \delta_c \tilde{R} \quad \textbf{(29)}$$

$$\tilde{U}_g = \tilde{U}_f + \delta_g \tilde{R} + s_g^e(\tilde{R} - \bar{R}^e) \quad \textbf{(30)}$$

where s_f^e, s_c^e and s_g^e are the marginal utility effects of environmental interest group criticism on the firm, Congress and Government respectively and s_g^f and s_c^f are the marginal utility effects of firm interest group criticism. $\bar{R}^e$ and $\bar{U}^f$ are the levels of environmental damage reduction and firm utility where interest group criticism switches from having a negative to having a positive net utility effect.

In the traditional process Government and Congress are responsible and thus affected by criticism/applause from the environmental and firm interest group. In the voluntary agreement process Congress is not responsible and therefore unaffected while the firm now is affected by environmental IG criticism. Taking responsibility for the decision the firm IG can no longer criticize the decision so this element is eliminated from Government utility.

Deriving the voluntary agreement set border as in the previous section the equation describing the firm unconstrained part of the border (corresponding to equation (11)) is

$$\lambda_g = \left[\frac{\tilde{R} - R^*}{T^*}\right](\delta_g + s_g^e) + \frac{(\tilde{U}_f - U_f^*)}{T^*} - \frac{s_g^f}{T^*}(U_f^* - \bar{U}^f) \quad \textbf{(31)}$$

while the firm constrained part is described by the following equations (corresponding to (13) and 17))

$$\lambda_g = \left[\frac{\tilde{R} - R^*}{T^*}\right](\delta_g + s_g^e) - \frac{s_g^f}{T^*}(U_f^* - \bar{U}^f) \quad \textbf{(32)}$$

and

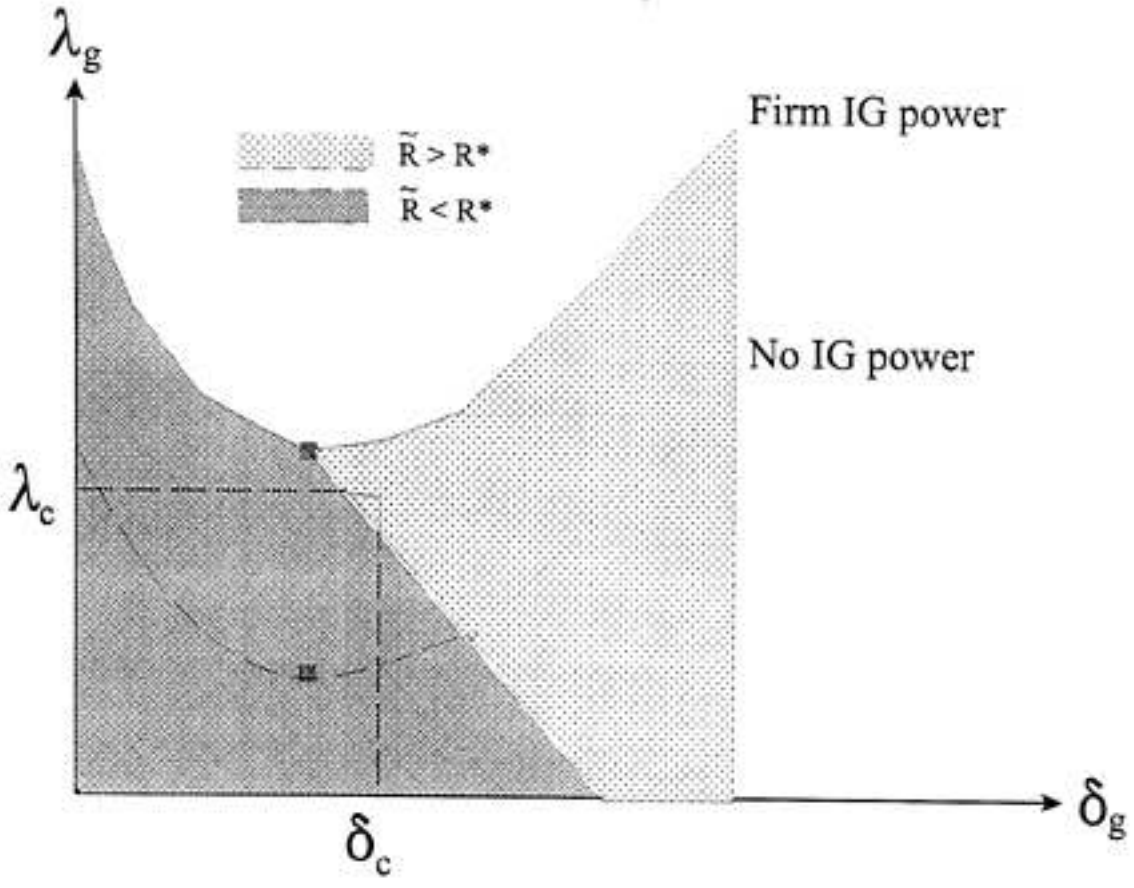
$$\tilde{R} = C^{-1}([T^* + C(R^*, T^*) + s_f^e(\tilde{R} - \bar{R}^e)], 0)/c \qquad \textbf{(33)}$$

The equation for the isoquant curves that characterize the VA-set interior corresponding to equation (21) becomes:

$$\lambda_g = \left[\frac{\tilde{R} - R^*}{T^*}\right](\delta_g + s_g^e) - \frac{(\tilde{U}_f - U_f^*)}{T^*}\left[\frac{(1-\alpha)}{\alpha c C_R}\right](\delta_g + s_g^e) + \frac{(\tilde{U}_f - U_f^*)}{T^*}\left[\frac{(1-\alpha)}{\alpha} + 1\right] - \frac{s_g^f}{T^*}(U_f^* - \bar{U}^f) \qquad \textbf{(34)}$$

In the special case where only the firm IG has signalling power (i.e. $s_f^e = s_g^e = s_c^e = 0$) we see that the set border here is equal to the set border in the previous section except for the presumably positive constant $-s_g^f(U_f^* - \bar{U}_f)/T^*$. Thus the effect of firm IG signalling power corresponds to an upward shift of the set border and iso-quant equation from the previous section. This is illustrated in figure 3.

FIGURE 3 *Illustration characterising the VA-set for a model with firm interest group signalling power*


λ_g
$\tilde{R} > R^*$
$\tilde{R} < R^*$
Firm IG power
No IG power
λ_c
δ_c
δ_g

We now specify a social welfare function with wich to evaluate the result of the voluntary agreement process. The two characteristics of the traditional policy formulation process that we have cited as central for balancing off special interest groups are the division of power and the possibility of public scrutiny. As in the previous section interest groups may subtly affect policy priorities through lobbyism or political agents may be fundamentally biased. Thus we will assume that the importance of division of power justifies using the congressional utility function as a starting point for specifying a social welfare function. In this model, however, the firm interest group also sends a credible signal to the public that allows direct public disciplining of decision makers. This accentuates the potential importance of public scrutiny. Based on this we will assume that public disciplining resulting from firm IG signalling in general brings the resulting policy decisions closer to the socially optimal. This in turn allows us to assume that the congressional utility function under the traditional policy formulation process is the best estimator of the social welfare changes caused by changes in goal attainment giving the following social welfare function:

$$SW(R,T) = (1 + s_c^f)U_f(R,T) + \lambda_c T + \delta_c R$$

and the following social welfare effect of voluntary agreements:

$$\begin{gathered} SW(\tilde{R},0) - SW(R^*,T^*) = \\ (1 + s_c^f)(\tilde{U}_f - U_f^*) - \lambda_c T + \delta_c(\tilde{R} - R^*) \end{gathered} \qquad \textbf{(35)}$$

The effect of voluntary agreements on congressional utility (equation (29) minus equation (26)) now becomes:

$$\begin{gathered} \tilde{U}_c - U_c^* = \\ (1 + s_c^f)(\tilde{U}_f - U_f^*) - \lambda_c T + \delta_c(\tilde{R} - R^*) + s_c^f(\bar{U}^f - \tilde{U}_f) \end{gathered} \qquad \textbf{(36)}$$

and the effect on Government utility (equation (30) minus equation (27)):

$$\begin{gathered} \tilde{U}_g - U_g^* = \\ (1 + s_g^f)(\tilde{U}_f - U_f^*) - \lambda_g T + \delta_g(\tilde{R} - R^*) + s_g^f(\bar{U}^f - \tilde{U}_f) \end{gathered} \qquad \textbf{(37)}$$

When comparing with the model in the previous section we see that voluntary agreements give Congress an extra utility gain as a result of avoiding public criticism. Thus the effect on congressional utility may differ from the effect on social welfare (intuitively the utility gained by Congress when avoiding public criticism is as such irrelevant for the general public). If Government and Congress agree on policy

priorities and have the same susceptibility to firm criticism the utility effects on Government and Congress are the same.

The distributional and welfare effects of voluntary agreements are summarised below:

Effect of voluntary agreements on:	Falling implementation efficiency		Rising implementation efficiency	
	Government and Congress have same policy priorities	Government and Congress have different policy priorities	Government and Congress have same policy priorities	Government and Congress have different policy priorities
– Firm utility	+	+	+	+
– Government	+	+	+	+
– Congress	+	?	+	?
– Environment	?	?	?	?
– Tax Revenue	-	-	-	-
– Social welfare	-	-	?	?

The main story here is concerned with welfare effects. When the firm IG has signalling power Government may find it advantageous to enter agreements with firms even when implementation efficiency falls and Government has the same policy priorities and susceptibility to firm criticism as Congress. Driving such agreements is the opportunity of avoiding firm IG criticism that otherwise would be initiated if policy was formulated in the normal way. In exchange for this firms gain a reduction in taxes and possibly a reduction in the severity of environmental goals relative to what would be the result of the normal policy process. When Government and Congress share policy priorities and susceptibility to firm criticism congressional utility will also increase - however, social welfare is reduced.

Assuming as we have for Government that the net utility effect for Congress of firm criticism is negative (i.e. $s_c^f(\bar{U}^f - \tilde{U}_f)>0$) any welfare increasing voluntary agreement will also increase congressional utility (as easily seen by comparing (35) and (36)). Thus the VA-set restriction that results when Congress is given the power to veto voluntary agreements is still welfare increasing. However, a congressional right to veto no longer *assures* that voluntary agreements will be welfare increasing.

5. Voluntary Agreements when the Environmental Interest Group has Signalling Power

In this section we focus on environmental interest group signalling power, but in a model allowing separation in time of goal formulation and implementation. This in turn allows responsibility for goal setting to be decoupled from responsibility for policy implementation.

The idea is that it takes time for policy to work and more important that the results of policy instruments cannot be predicted with certainty at the time of implementation. This means that time elapses between goal setting and observation of the result of policy instruments implemented at the time of goal setting. The environmental interest group may then criticize goal setting as well as goal attainment.

Let R_g denote the goal set at the time of policy implementation and R the damage reduction attained after time has elapsed. Let the utility effect of environmental IG criticism have the following structure:

1) at the time of goal setting the utility effect of criticism is:

$$s(R_g - \tilde{R}^e)$$

2) at the time of goal attainment the utility effect of criticism is:

$$s(R - R_g) - \hat{s}(Max[R_g - R, 0])^2$$

so that goal attainment criticism neutralizes applause of previous criticism of the formulated goal and punishes the agent for non-attainment of the goal while not rewarding for over-attainment.

Defining $DR_g = R_g - R$ agent utilities under the traditional policy process become:

$$U_f^* = -T^* - C(R^*, T^*) \qquad \textbf{(38)}$$

$$U_c^* = U_f^* + \lambda_c T^* + \delta_c R^* + s_c^e(R^* - \bar{R}^e) - \hat{s}_c^e(Max(DR_g^*, 0))^2 \qquad \textbf{(39)}$$

$$U_g^* = U_f^* + \lambda_g T^* + \delta_g R^* + s_g^e(R^* - \bar{R}^e) - \hat{s}_g^e(Max(DR_g^*, 0))^2 \qquad \textbf{(40)}$$

Trivially $DR_g^* = 0$ (*i.e.* $R_g^* = R^*$) .

Under the voluntary agreement process the Congress has no responsibility. Government shares responsibility for goal formulation with the firm while implementation is the sole responsibility of the firm. We then have

$$\tilde{U}_f = -C(c\bar{R},\ 0) + s_f^e(\tilde{R} - \bar{R}^e) - \hat{s}_f^e(Max(D\tilde{R}_g,\ 0))^2 \qquad \textbf{(41)}$$

$$\tilde{U}_c = \tilde{U}_f + \delta_c\tilde{R} \qquad \textbf{(42)}$$

$$\tilde{U}_g = \tilde{U}_f + \delta_g\tilde{R} + s_g^e(\tilde{R} + D\tilde{R}_g - \bar{R}^e) \qquad \textbf{(43)}$$

The equation characterizing the firm unconstrained part of the voluntary agreement set border (corresponding to equation (11)) becomes:

$$\lambda_g = \left[\frac{\tilde{R} - R^*}{T^*}\right](\delta_g + s_g^e) + \frac{(\tilde{U}_f - U_f^*)}{T^*} + \frac{s_g^e}{T^*} D\tilde{R}_g \qquad \textbf{(44)}$$

while the firm constrained part of the set border (corresponding to equation (13)) is characterized by:

$$\lambda_g = \left[\frac{\tilde{R} - R^*}{T^*}\right](\delta_g + s_g^e) + \frac{s_g^e}{T^*} D\tilde{R}_g \qquad \textbf{(45)}$$

with (corresponding to equation (14)):

$$\tilde{R} = C^{-1}([T^* + C(R^*,\ T^*) + s_f^e(\tilde{R} - \bar{R}^e) - \hat{s}_f^e(Max(D\tilde{R}_g,\ 0))^2],\ 0)/c \qquad \textbf{(46)}$$

The equation for the isoquant curves that characterize the VA-set interior corresponding to equation (21) becomes:

$$\lambda_g = \left[\frac{\tilde{R} - R^*}{T^*}\right](\delta_g + s_g^e) - \frac{(\tilde{U}_f - U_f^*)}{T^*}\left[\frac{(1-\alpha)}{\alpha c C_R}\right](\delta_g + s_g^e) + \frac{(\tilde{U}_f - U_f^*)}{T^*}\left[\frac{(1-\alpha)}{\alpha} + 1\right] + \frac{s_g^e}{T^*} D\tilde{R}_g \quad \textbf{(47)}$$

Assume that $s_f^e = 0$. We see that if $D\tilde{R}_g = 0$ all equations are equal to the equations in model I where δ_g is redefined as $\delta_g + s_g^e$. The possibility of decoupling goal setting and implementation responsibility (positive $D\tilde{R}_g$) shifts the boarder and iso-quant curves upwards in the graph vis-à-vis the corresponding curves in section 3. As $\hat{s}_f^e$ is reduced $D\tilde{R}_g$ rises in both parts of the curve and eventually we have:

$$\hat{s}_f^e \, D\tilde{R}_g^2 = T^* + C(R^*, T^*) = \hat{U}_f$$

with

$$\tilde{R} = 0 \quad \textbf{(48)}$$

After this point we have

$$D\tilde{R}_g = \frac{\sqrt{\hat{U}_f}}{\sqrt{\hat{s}_f^e}} \quad \textbf{(49)}$$

so when inserting (48) and (49) into (45) we have:

$$\lambda_g = \frac{R^*}{T^*}(\delta_g + s_g^e) + \frac{s_g^e}{T^*}\frac{\sqrt{\hat{U}_f}}{\sqrt{\hat{s}_f^e}}$$

This means that any (δ_g, λ_g) can be included in the set with a sufficiently small $\hat{s}_f^e$ (i.e. the upward shift of the curve is not bound). This situation is illustrated in figure 4.

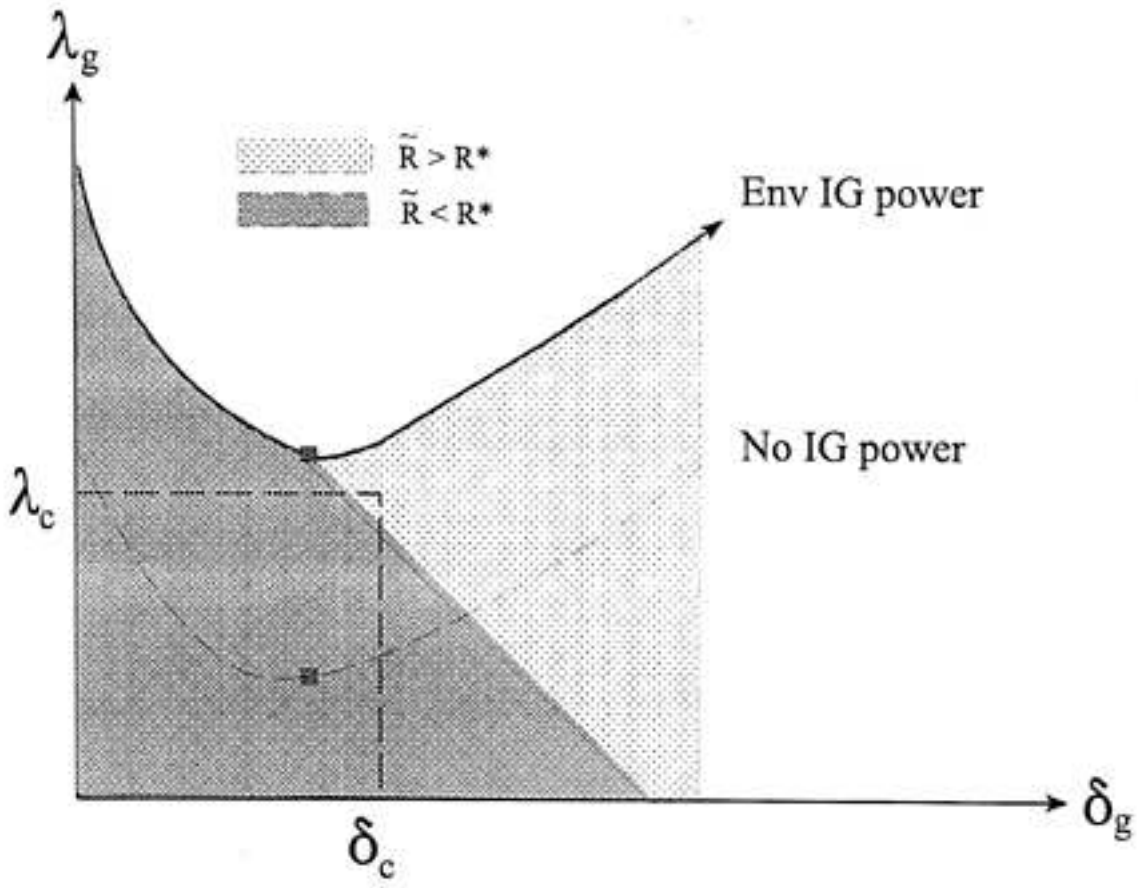

λ_g
$\tilde{R} > R^*$
$\tilde{R} < R^*$
Env IG power
No IG power
λ_c
δ_c
δ_g

FIGURE 4 *Illustration characterising the VA-set for a model with environmental interest group signalling power*

Based on the assumption that IG signalling generally brings the resulting policy decisions closer to social optimum, we uphold the assumption that the congressional utility function under the traditional policy formulation process is the best estimator of the social welfare changes caused by changes in goal attainment. This gives the following social welfare function:

$$SW(R,T) = U_f(R,T) + \lambda_c T + (\delta_c + s_c^e)R$$

and the following social welfare effect of voluntary agreements:

$$\begin{aligned} &SW(\tilde{R},0) - SW(R^*,T^*) = \\ &\tilde{U}_f - U_f^* - \lambda_c T + (\delta_c + s_c^e)(\tilde{R} - R^*) \end{aligned} \qquad \textbf{(50)}$$

The effect of voluntary agreements on congressional utility is (equation (42) minus equation (39)):

$$\begin{aligned} &\tilde{U}_c - U_c^* = \\ &(\tilde{U}_f - U_f^*) - \lambda_c T + (\delta_c + s_c^e)(\tilde{R} - R^*) + s_c^e(\bar{R}^e - \tilde{R}) \end{aligned} \qquad \textbf{(51)}$$

and the effect on Government utility is (equation (43) minus equation (40)):

$$\tilde{U}_g - U_g^* = (\tilde{U}_f - U_f^*) - \lambda_g T + (\delta_g + s_g^e)(\tilde{R} - R^*) + s_c^e(D\tilde{R}_g) \quad \textbf{(52)}$$

As in the previous section we see that voluntary agreements affect Congress by eliminating public criticism from the environmental IG so that the effect on congressional utility may differ from the effect on social welfare. In contrast to what was the case in the previous section if Government and Congress agree on policy priorities and have the same susceptibility to environmental IG criticism the utility effects on Government and Congress are *not* the same. The distributional and welfare effects of voluntary agreements are summarised below:

Effect of voluntary agreements on:	Falling implementation efficiency		Rising implementation efficiency	
	Government and Congress have same policy priorities	Government and Congress have different policy priorities	Government and Congress have same policy priorities	Government and Congress have different policy priorities
– Firm utility	+	+	+	+
– Government	+	+	+	+
– Congress	?	?	?	?
– Environment	?	?	?	?
– Tax Revenue	-	-	-	-
– Social welfare	-	-	?	?

Further as environmental interest group signalling power increases (corresponding to an upward shift of the VA-set in figure 4) we see that environmental performance relative to the traditional policy process is reduced. Thus it is possible that an increase in environmental interest group signalling power will harm the environment by inducing a shift to policy formulation through voluntary agreements with a lower absolute environmental performance[2].

2)The counter intuitive observation that increasing its power may hurt the environmental interest group is also seen in other models of regulation with interest groups, e.g. Laffont and Tirole (1993).

The effect of agreements on congressional utility is unclear even if Government and Congress share the same utility function. Congressional utility may increase as Congress like Government avoids the effect of environmental interest group criticism of goal achievement. However, unlike Government, Congress is excluded from the (possibly positive) utility effect of applause of high goal setting so the net utility effect for Congress may be negative.

Turning to social welfare effects we again find that when the environmental IG has signalling power Government may find it advantageous to enter agreements even though implementation efficiency is reduced and Government has the same policy priorities and susceptibility to environmental IG criticism as Congress. By shifting responsibility for implementation Governments avoid criticism for non-attainment of goals - a criticism which firms may be less vulnerable to. Firms take responsibility and endure the criticism of non-attainment while instead gaining the defacto acceptance by Government of a reduction in the attained environmental goals.

Giving Congress the power to veto agreements is a somewhat more complicated model change than in the previous models. Since giving Congress the right to veto also moves Congress into the set of actors responsible for goal formulation Congress will be affected by environmental IG signalling and the effect of a voluntary agreement on congressional utility becomes:

$$\tilde{U}_c - U_c^* = (\tilde{U}_f - U_f^*) - \lambda_c T + (\delta_c + s_c^e)(\tilde{R} - R^*) + s_c^e(D\tilde{R}_g) \quad \textbf{(53)}$$

As in the previous section any welfare increasing voluntary agreement will also increase congressional utility. Thus giving Congress the power to veto voluntary agreements is welfare increasing. However, we again see that giving Congress such a power does not *assure* that voluntary agreements will increase social welfare.

6. Conclusion

This paper concerns the conditions under which voluntary agreements become possible and their distributional and social welfare effects. The simple models developed here focus on two aspects of voluntary agreements: the exclusion of legislative bodies from the policy formulation process and the shift of responsibility for meeting environmental goals and for policy implementation to industrial organisations . To specify a social welfare function we assume that the balance of power between legislative branches and the possibility of public scrutiny through a legislative process are important for securing the interests of the general public during the policy formulation process. This enables us to base specification of the social welfare function on the congressional utility function.

The models developed in the paper focus on the difference between political

environments where interest groups can signal the utility effects of policy to the general public and political environments where this is not possible. If interest groups have little signalling power we find:

- that welfare reducing voluntary agreements are possible only when Government and Congress *disagree* on policy objectives and
- that giving Congress the power to veto voluntary agreements ensures that only welfare increasing agreements are possible.

This is not surprising given that the social welfare function is based on the congressional utility function.

However, in political environments where firm interest groups or environmental interest groups have signalling power we find:

- that welfare reducing voluntary agreements are possible even when Government and Congress *agree* on policy objectives and
- that giving Congress the power to veto voluntary agreements no longer ensures that agreements will be welfare increasing (although such a rule in it self is welfare increasing).

This *is* surprising given that the social welfare function is based on the congressional utility function. Further - counter to intuition - an increase in the environmental interest groups signalling power may harm the environment by inducing a voluntary agreement that reduces environmental performance.

The balance of power between executive and legislative braches of Government and the possibility of public scrutiny and debate under the legislative process are often cited as important for securing some adherence to the interests of the general public vis-à-vis special interest groups. If these characteristics are important, it seems likely that a voluntary agreement process will tend to reduce adherence to the interests of the general public by shifting the balance of power toward the executive branch of Government and by shifting responsibility for policy goal implementation to firms thus reducing the disciplining effect of public scrutiny and debate. While voluntary agreements may be advantageous if compliance costs are reduced the message of the paper is one of caution. Voluntary agreements may be possible when compliance costs increase and may - even when compliance costs fall - be welfare reducing.

The theoretical models developed here are consistent with the hypothesis that voluntary agreements may be part of a defensive strategy used by less environmentally inclined industries and governments in the face of increasing public concern for the environment. At any rate, the analyses here suggests that empirical research focussing on the roles of different branches of government and the motivations of government and industries for entering in to voluntary agreements is important and possibly essential for uncovering the effects voluntary agreements.

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