EBforcinl Time Inconsistent Government Regulations

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ABSTRACT

Certain government regulations require a good deal of investment by firms before the regulations actually go into effect. In these cases, if a firm does not engage in the desired level of investment, it can be quite costly to society to actually enforce the regulation. This paper derives a game theoretic model of how such regulation could be enforced by examining the bureaucratic incentives of the various governmental parties involved in overseeing a regulatory program.

I. Introduc:tloa

Business firms are required to deal with a number of regulations. In changing their behavior in reaction to government directives, firms must take a number of factors into consideration. Regulations may require them to invest in certain processes and facilities in order to meet the government's mandates. Firms, however, also know that the government cannot legally bind itself to future actions. Thus, when considering its own actions in response to regulation, a firm will consider the possibility that the government will later choose not to enforce its mandate. The firm may also take into its decision function that its own actions may affect whether or not the government later

Firm underwent long term product investment in order to meet the standards. In 1984 and 1985, however, automobile firms petitioned the government for regulatory relief for the following model years. The government eventually did grant relief, but not until the actual start of the model years in question. If relief had not been granted, there would have been no time left for product innovation and firms would have had to meet the standard with the higher cost strategy of restricting the mix of their product output.
In both the cases of automobile fuel economy and pollution it would seem far cheaper for the standard to be reached by investment that takes place before the period in question occurs. The government threatens to enforce the standard even if the proper amount of investment has not taken place. Once this point is reached, however, it may be in the government's best interest to relax the standard and avoid the high costs to society of meeting that standard given the small amount of previous investment. What would seem to occur here is the standard Nash equilibrium, where given that the government will enforce the standard, an automobile firm will undertake the desired level of investment. If, however, the firm undertakes less than that level of investment, it may not pay for the government to force the firm (and perhaps society in general) to undergo the costs involved of meeting the standard. Given that the game is of finite length, the government will never enforce the standard if the investment is not undertaken. The firm will understand this, and thus undertake no investment in meeting the standard. The government will thus be unable to enforce the regulation.

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This conclusion, while logical, is apparently untrue. For example, in
the 1970's the government did pass laws requiring automobile companies to invest millions of dollars in pollution control devices. While the auto firms complained loudly and achieved some delay in the implementation of the law, in the end control devices were installed. (See White (1981).)
A body of literature (for example

situation, assuming that the firm's cost functions are known while the government's response is uncertain. Unlike the above cited papers, this article will assume that at least part of the government is interested in maximizing its own, rather than the public welfare. Because firms realize that the government might act in its own interest against the public welfare, the government may be able to enforce its regulation.

II. The Regulatory Institutions
Let us say that a legislature passes a bill, setting a regulatory standard at S. The bill, however, generally �g�i�~�e�s� the executive branch authority to lower the standard should some unforeseen event occur. Alternatively the bill can be thought of as giving the executive the power to set a regulatory standard up to S. The bill then goes to the executive for his approval.
The bill sets up a bureau to oversee and enforce that standard, and the legislature gives oversight and/or budgetary authority to the committee that originated the bill establishing the standard. Consider the incentives of the regulatory bureau. If its goal is to maximize its prestige and budget, as Niskanen (I 971) suggests, then it will try to keep its oversight committee happy by always enforcing the standard. If it does not enforce the standard, it is then forced to tell the committee its reasons for not doing so. This can a Quite uncomfortable event for the bureau's administrator. Further, the committee may be willing to reduce the bureau's funding if the standard is not enforced. Thus, it is assumed here that the bureau always prefers to enforce the standard.

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It would appear quite likely that this oversight will be done by what Niskanen calls a "high demand" committee. What is meant by "high demand" is that the members of the committee have a greater desire for the government good

"strong" or "dominant" (type-Y) and can intervene and grant regulatory relief or if he is "weak" and cannot (type-N). Given the other actions of the executive, however. the firm knows that there exists a probability p Y, O<p Y<l that the executive is strong. The firm will thus minimize its regulatory costs given that probability and the previous events in the game. It is assumed that p Y cannot be changed by any action of the firm.

III. The Regulatory Game
The game analyzed here has two periods. i=I.2. Each period has
three stages. In the first stage of period i of the game the firm improves the regulatred aspect of its product Fi

• moving towards reaching the
towards reaching the regulatory standard with cost g(Fi

). The firm choos57 616.57 Tm (t.85

(3-3) C. ::II ap.2 + bH.2 1 I I

The firm is assumed to gain no benefit from the production of this good and hence without regulation it would not be produced. The firm is also

optimal standard S· =Sl=S2 in the bill establishing the standard. It is also assumed that the government cannot observe Fj prior to the second stage of period i.
The firm has an initial probability p Y that the executive is of strong type. The firm updates its probability during the game according to Bayes' Law. If the executive is of strong type, it sets the standard to maximize net welfare, knowing that the firm will take a new standard in period I into account when making its investment in period 2. The firm's strategy in each period is to set Fj so 2.

or

Note that the value of H2 is not dependent on the level of first stage improvement F2• This implies that if the firm knows that the executive is of type Y, he has no incentive to undergo first stage improvements.

Second Period: First Stage
The goal of the regulated firm at this point is to minimize its expected costs over the probability that the executive is of type Y. That probability, P2' is a function of p Y, the a priori probability that the executive is of type Y, and the events of the first period. If the executive did intervene in period one the firm knows with probability 1 that the executive is of type Y. Therefore, P2' the probability of the executive intervening in period 2 is

(3-11) P2 = 1

if intervention occurred in period one and

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if intervention did not occur. (SI equals S* if intervention did not occur.) The firm thus knows that given its first stage improvements F2 it will have to improve its good H* with probability P2 and face probability I-P2 that its good will have to be improved S*-F2' Given this, the firm thus minimizes its expected costs over F2,

(3-13) Min E(C2) = P2(aF22 + bH*2) + (I-P2)(aF22 + b(S2 - F2)2)

Taking the derivative of (3-13) with respect to F2 and setting it equal
to zero yields

Solving for F2:

Substituting in for S· yields

The function k is the fraction of optimal investment undertaken by the firm given the firm's conditional probability that the executive is Type Y (strong). Note that k(l)=O, k(O)=1 and dk/dP2<0. Thus, if the firm is certain that the executive is of type Y it will not undergo any first stage improvements in

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the good in the second period, Conversely, if the firm is certain that the executive is of type N then it will undertake the socially optimal amount of first stage improvements,

First Period: Third Stage
The firm now faces a standard SI and has made first stage improvements Fl (As shown above, SI will either equal S" or F1+H\ The firm has no choice but improve its product Sl-F1,

First Period: Second Stage
If the executive is of type N then the standard will be set at S", If the executive is of type Y, then he will grant relief (setting the standard at Fl+H"«S") if the benefits of doing so outweigh the costs,
The benefits from relief occur in the first period, as the reduced cost from the lower standard b(S"-Fl)2-bH*2 is greater than the loss from the lower standard v(S"-H*+Fl) if Fl<F",

(3-17) Benefit of Relief = BY(F1) = [b(S"-Fl)2 - bH*2]
- [v(S*-(H"+Fl))]

Note that dBY/dF1<O if Fl<F*, Thus, the lower the investment in the first stage, the more there is to be gained from granting relief,
The cost of granting relief occurs in the second period, Since the granting of relief demonstrates that the executive is of type Y, (3-15) implies that if relief is granted in period one the firm will undergo no product improvement in the first stage of period two, Let Pl'Il::P2(P Y, F l' No

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relief). Since these costs are one period later

where Q(pY) equals

Define Region III as [Fn, F'"j. By definition if F 1 is in Region III, the executive will prefer not to grant relief, since the costs of granting relief are greater than the benefits. If relief is not granted when F 1 is in Region III, the firm has no reason to believe P2>P Y. Thus, if F 1 is in Region III, it always is optimal for the executive if he is to

point F 1 in Region II. If the executive's

+ pY(aF12 + bH*2)
+ R[(l-p Y)(aF*2+bH*2) + p YbH*2]

where R is the private or market discount rate. Solving for Fl yields

* Y I (3-25) F 1 = F k(p) = F

FI can be in any of the three regions. If FI is in Region I, that is the minimum cost point for the firm. The proof is as follows: Given that the probability of relief being granted is p Y, the firm will prefers FI over all other points in Region I. Take any Fl in Regions II or III. The probability of relief being granted at any such investment F 1 is less than p Y. Since dE(C(F1»/dp < 0, such a point has higher costs associated with it then if it had probability of relief p Y. By the definition of FI, however, even were the probability of relief p Y at an F 1 in Regions II and III, the firm would still have lower expected costs at Fl. Thus, the firm will choose FI over any F 1 in Regions II or III.
The situation is more complicated if FI lies in Regions II or III. In
that case, dE(C(F1)/dF1>O for all Fl in Region I and the firm prefers FY to any other point in Region I.
Assume that the

the executive is of type Y is sufficiently low the firms will act to meet the standard in period 1. The results in Table 2 indicate that p Y must be at a fairly low level for the policy to be upheld. Put another way, to enforce a time inconsistent regulation implies that there is a good probability that the bureau, not the executive, is setting policy.
Table 2 generates the maximum pY allowable for the policy to be enforced. The coefficient of first period costs, a, is set at numeraire. The marginal utility of the regulated good is set at

as the
in the
computer program, although the results are invariate with respect to it. The private discount

V. Conc:lusioD

Enforcing time inconsistent regulatory standards in the model presented has been shown to be a very difficult task. For such policies to be followed by the affected firms there must be a large probability that the regulatory bureau, and not the executive, is the agent setting policies. In the numerical examples listed the maximum likelihood that the executive is actually setting the policy never rises greatly above one half. This implies that for time inconsistent policies to be effective, a large degree of decision making power in the executive branch of government must lie with the regulatory bureau and not the chief executive. This implies that for time inconsistent policies to be effective, government may need to be less "reasonable" in order to precommit itself.
It has also been shown that if a firm is not going to meet the initial part of a regulatory it will miss it by a great deal in order to force the executive into granting relief. There is no point in missing the standard by a small amount, as in that case even a strong type executive will enforce the standard. This also implies that there is no pooling equilibrium if the firm chooses not to make the optimal amount of first stage investment. As the game is laid out, a firm will not reach the optimal first stage level of regulatory investment if the ex ante probability of that executive being strong is above a certain cut-off level. In Table 2 that level was only once above .50.

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a

b

F*

FI

FN

Table I
List of Definitions of Terms

Coefficient of cost in g( ), a>O

Coefficient of cost in j(

Table 1 (cont'd)
L(pID(Fj),pY) Probability that executive will grant relief,
given the firm is of type Y and Fj is in Region II.
P2 Probability that executive is of type Y in period 2,
given the events of period 1.
pM Ex post probability P2 for Fi in Region II
such that executive is indifferent to granting relief
in period 1.
p Y Probability that executive is strong type Y
R Discount rate for the firm, O<R<1
Rg Discount rate for the government, O<Rg<O
Region I

Region II

Region III
s·

v

w

Region for F 1 such that relief is granted with probability p Y
Region for F 1 such that Type Y executive implements mixed strategy for granting relief
Region for F 1 such that relief is never granted
Optimal level of total improvement in one period. Regulatory standard set in period i.
Marginal and average value of regulatory improvements Net welfare of regulatory policy

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1.0
2.0
3.0
Factor 4.0
of 3rd 5.0
Stage 6.0
Costs(B) 7.0
8.0
9.0
10.0

Table 2
Maximum pY That Enforces Standard
A=I, 0-1, R=.96

Government

FIGURE ONE

Description of Stages of Game

Period 0 .. ! ...
Legislature Sets Standard at S ','
Executive of Strong Type with Probability pY

Period 1, Stage 1
Firm sets first stage improvement F1

Period 1, Stage 2
Executive sets first period standard S1 {S1=S* or F1

+H*}

Period 1, Stage 3

Firm sets third stage improvement H1=S1- F1

Period 2, Stage 1
Firm sets first stage improvement F2

Period 2, Stage 2
Executive sets second period standard S2

Per iod 2, Stage 3
Firm sets third stage improvement H2=S2- F 2

REFERENCES

Baron, D.P. and Besanko, D., "Regulation and Information in a Continuing Relationship," Information Economics and Policy. Vol. 1 (1984) pp.267-
302.

Niskanen, W., Bureaucracy and Reoresentative Government, Chicago: Aldine-Atherton, 1971.

Sappington, D. "Optimal Regulation of Research and Development Under Perfect Information," Bell Journal of Economics, Vol. 13 (Autumn 1982), pp.354-368.

Weingast, B. and Moran, M, "Bureaucratic Discretion or Congressional Control? Regulatory Policy Making by the Federal Trade Commission," Journal of Political Economy. Vol. 91, no.5, pp.765-800.

White, L., The Regulation of Air Pollution Emissions from Motor Vehicles, Washington, D.C., American Enterprise Institute (1981)

Yao D., "Strategic Responses to Automobile Emission Control: A Game-Theoretic Analysis," Center for the Study of Organizational Innovation, University of Pennsylvania, Discussion Paper #188, October 1985. Forthcoming in Journal of Environmental Economics and Management.

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