

Unilateral Disclosure of
Private Information by a
Regulated Firm

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Penalty and Compliance Systems of Regulation in the Absence of Dictatorial Power

John Kambhu

I. Introduction

Observers of regulatory practice in the United States have spoken of a drift towards more legalistic methods of regulation that give regulators less flexibility in setting standards of compliance. Since the 1960's there has been a transition from a traditional enforcement regime that relied on negotiations over compliance, and towards a system based on strict application of legal regulations and imposition of penalties as routine regulatory procedure.¹ This change in regimes has to some degree been due to a popular perception that granting discretion over standards of compliance to regulatory agencies leads to lax enforcement.² Our analysis, however, suggests that this change in regulatory regime may be counterproductive — paradoxically, the change may weaken regulatory enforcement.

The ideal regulatory scheme in much of the economics literature is a penalty model in which fines or corrective taxes compel economic agents to behave in a socially efficient manner. While this model provides a framework in which the question of efficiency can be easily addressed it is not an entirely accurate view of regulatory practice.³ One extreme assumption in these models is the supposition that the regulator can set fines at any desired level. While some models admit a bankruptcy constraint that limits the size of the effective fine,⁴ most models assume that the regulated firm passively pays the fines. In this paper we shall instead suppose that the regulated enterprise can contest fines levied by a regulator, and we begin by considering the marginal effectiveness of larger fines.⁵ This analysis leads us to a comparison of two regulatory regimes, compliance regulation, and penalty regulation. We shall use the term *compliance regulation* to denote a model of regulation with direct controls where the regulator issues directives and commands to directly regulate behavior.

We use the term *penalty regulation* to represent a type of regulation where through the use of fines or corrective taxes a price system is used to regulate behavior. To be consistent in our analysis of these two types of regulation, we shall assume that the regulator does not have dictatorial power in either regulatory regime. In both types of regulation the regulated enterprise can contest the regulator's decisions. In compliance regulation we allow for the possibility that the firm may challenge the regulator's dictates or injunctions, while in penalty regulation we allow the firm to contest fines levied by the regulator.

The economic models of optimal regulation in which there is a penalty schedule that the regulated enterprise passively submits to may not be a good guide to regulatory policy when negotiation and bargaining is an important feature of the legal system.⁶ There is evidence that the practice of regulation can only be understood in terms of informal "behind the scenes bargaining between the staffs of (regulatory) commissions and the firms concerned" [Joskow and Noll, 1981, p.52].⁷ Because of this feature of regulatory and legal practice we adopt our assumption that the regulator does not have dictatorial power. Specifically, we shall assume that the outcome of the regulatory process depends on the lobbying and legal efforts of both the firm and regulator. In such "contestable" systems of regulation, we shall demonstrate that the penalty approach to regulation is not always superior to compliance oriented regulation. This result should cause us to pause before applying the corrective taxation approach to externality problems. When regulators do not have dictatorial power, we can show that the pollution tax approach to regulating pollution can be inferior to types of regulation that more directly control activities that generate pollution.

Two basic types of regulation systems are, a penalty system, and a compliance system.⁸ The penalty or deterrence system obtains conformity with the law by detecting violations and penalizing violators so as to deter other violators. In the compliance system, on the other hand, the regulator secures conformity with the law by taking actions to bring about

compliance or to prevent violations. "Although both compliance and deterrence law enforcement systems are oriented towards preventing the occurrence of violations, compliance systems are *premonitory*, attending to conditions that induce conformity... By contrast deterrent law enforcement systems are *postmonitory*, reacting to violations that have occurred [Reiss, 1984, p24]." While penalties exist in both systems, the use of penalties to punish violators is integral only to deterrence systems. In a deterrence system, detecting and punishing violators is a signal of successful regulation — as the penalties serve to deter other violators. In a compliance system, however, penalties are invoked as threats that may be rescinded when compliance is achieved, and the levying of a penalty indicates a failure of the regulator to secure compliance.⁹ The penalties are used as threats to strengthen the regulator's bargaining power. Another important distinction between the two types of regulation concerns the meaning of *compliance*. The penalty system is a highly legalistic approach to regulation that routinely employs punishments when violation of an *established* standard of behavior is detected.¹⁰ In the compliance system, however, the standard of behavior that constitutes compliance is *negotiable*. "The enforcement process is typically one involving direct negotiations, accommodations, threats, and tradeoffs between enforcement official and violator that result in compromises and modifications of the law ..." [Veljanovski, 1984, p.172]. In penalty systems the regulated enterprise is expected to comply with a standard of behavior that is established before the regulator meets with the regulated enterprise, whereas in compliance regulation what actually constitutes compliance is determined only after negotiation between the regulated enterprise and the regulator. In addition to these properties, in compliance regulation there can be a cooperative relationship between the firm and the regulator, while in penalty regulation the relationship is more adversarial. In this paper, however, our analysis will not touch upon this last mentioned feature of regulatory enforcement. Because of this omission, a reader could question our use

of the labels *compliance regulation* and *penalty regulation* for the models in this paper. One could then say that the compliance model should be called regulation with direct controls, while the penalty model should be labelled regulation with corrective taxes and fines. We chose to use these labels, however, because the models do have some properties of compliance and penalty regulatory systems, and it is these properties that we wish to analyze.

A significant part of the economics literature supports the perception that regulatory methods which employ direct controls on behavior are inferior to types of regulation that incorporate features of a price system. For example, in the case of externalities, the use of fines, or corrective taxes is typically seen as a more efficacious method of correcting the externality. In the area of accidents, the use of a liability system is also seen as a more efficient method of regulation than a system that employs direct controls on accident prone activities. There are, nonetheless, exceptions to this view. Shavell [1984] demonstrates that when bankruptcy limits liability, and there is private information about accident risks, then the optimal system of regulation will combine both liability rules and regulation.¹¹ Weitzman [1974] compares pollution standards with pollution fees when the regulator does not know precisely the benefits and costs of reducing pollution, and argues that neither method of controlling pollution is better in all circumstances. The economist's skepticism of the efficacy of direct controls may be due to the possibility that economic models ignore significant aspects of problems that lead societies to adopt a regulatory solution. One economist who holds this view is Goldberg [1976] who sees regulation, under some conditions, to be a more efficient alternative to private contractual arrangements.¹² The results in this paper also lend support to some features of regulatory practice that economists have dismissed as inefficient or benighted practice. Having said all this, it must also be said that some recent research in the economics of incentives may contribute to the practice of regulation. One possible contribution is in the regulation of public utilities and natural

monopolies. Papers by Baron and Besanko [1984], Baron and Myerson [1982], and Sappington [1983] study the design of pricing regulations when the regulator can not observe the regulated firm's costs. These papers propose pricing schemes that lead the firm to truthfully reveal private cost information to the regulator. A paper by Rose-Ackerman [1986] studies the design of incentive schemes that have application to the management of a regulatory agency or, more generally, a public bureaucracy.

II. The Model

In a society in which procedures of due process exist, regulators will not have dictatorial powers. Even when both the firm and the regulator are aware that the firm is in violation of law, the likelihood that the regulator's enforcement effort will succeed will depend on the level of that effort. In penalty based regulation before any fines can be levied, aside from the obvious need to monitor and inspect, the regulator also must prove in formal proceedings that a violation exists. In the United States, a firm that is in violation of OSHA regulations can appeal any citation, and the burden of proof is on the OSHA.¹³ In such cases, the likelihood that the citation will be upheld will depend on the regulator's investment of time and other resources in monitoring and documenting the violation. Hence, given the constraints on enforcement resources and the vagaries of the appeal process, some regulated enterprises will successfully contest a regulator's decisions even when the appeal is without merit. With this possibility in mind, we shall compare compliance regulation and penalty regulation when procedures of due process and the right of appeal allow the regulator's decisions to be challenged. Because of such challenges the actual level of compliance that the regulator is able to enforce might fall short of full compliance - where full compliance could be interpreted as the level of compliance that is socially optimal. In such an imperfect world, we ask which regulatory regime can attain a higher level of compliance with lower enforcement costs?

To allow for the possibility that the regulator's decisions can be challenged by the firm, we shall suppose that the likelihood that the regulator's decision prevails depends on the lobbying and legal efforts of both the firm and the regulator. Specifically, let β be a measure of the degree to which the regulator's decisions survive the firm's challenge, let m denote the regulator's enforcement effort, and let k denote the firm's expenditure in challenging the regulator's decisions. The outcome, β , of the firm's challenge is assumed to be a function of m and k , where,

$$\beta = \beta(m,k), \quad 0 \leq \beta \leq 1,$$

and, $\partial\beta/\partial m > 0$, $\partial\beta/\partial k < 0$, $\partial^2\beta/\partial m^2 < 0$, $\partial^2\beta/\partial k^2 > 0$.¹⁴ To be consistent in our comparison of the two regulatory regimes, in both cases we shall use the same function $\beta(m,k)$ to represent the degree to which the regulator's decisions survive the firm's challenge. In compliance regulation, β represents the part of the regulatory standard that survives the firm's challenge, while in penalty regulation, β represents the part of the fine that remains after the firm contests the penalties. In both cases, β measures the extent to which the regulator's decision survives the firm's challenge. The process that determines the outcome of the firm's challenge to the regulator's decisions might be either argument in formal legal proceedings or informal negotiation. We do not specify the details of this process, but simply suppose that the outcome depends on the resources expended by both parties, as described by the function $\beta(m,k)$.

In both regulatory regimes we let a denote the extent of the firm's compliance with a regulatory standard, where $0 \leq a \leq 1$. We can suppose that the socially optimal level of compliance is $a = 1$, so that an outcome with $a < 1$ represents a social loss. We shall assume that the extent of the firm's compliance is observable and known to everyone, so that the value of a is not in dispute. The issue over which the parties are in disagreement will be how the firm is to be treated when its compliance falls short of the social optimum. The dispute

concerns how the firm's non-compliance will be dealt with: What level of non-compliance will lead to penalties and enforcement actions? What penalties will be levied for non-compliance?

We can now define the two regulatory models, and after doing so we shall interpret them as special cases of a more general model of regulation.

THE MODEL OF COMPLIANCE REGULATION

In compliance regulation the regulator attempts to control the value of a directly, with a degree of success determined by $\beta(m,k)$. Specifically, $a = \beta(m,k)$, and the regulator attempts to enforce compliance through his enforcement effort m , while the firm attempts to obtain relief from the regulator's directives through its lobbying or legal expenditure k . The firm's total cost function in this regulatory regime may be written as,

$$C^C = c(a) + k, \quad a = \beta(m,k),$$

where $c(a)$ is the cost of compliance with the regulatory standard.¹⁵ The firm's objective then is to minimize its total costs,

$$\min_k C^C = c(\beta(m,k)) + k.$$

THE MODEL OF PENALTY REGULATION

In penalty regulation, the firm freely chooses its level of compliance, and the degree of compliance then determines a fine. If the fines are a linear function of the extent of non-compliance, then the nominal penalty for non-compliance is, $f \cdot (1-a)$, and the effective fine is, $f \cdot (1-a) \cdot \beta(m,k)$. The effective fine is determined by the regulator's enforcement effort, m , and the firm's expenditure on its legal defence, k . In this regime, the firm's total cost function is,

$$C^P = c(a) + f \cdot (1-a) \cdot \beta(m,k) + k,$$

where, $c(a)$ is the cost of compliance with the regulatory standards. The firm's objective is to minimize its total costs,

$$\min_{a,k} C^P = c(a) + f \cdot (1-a) \cdot \beta(m,k) + k.$$

Here, the regulator attempts to influence the firm's behavior through the size of the fine f , and his effort to enforce penalties m , while the firm both chooses its compliance level, a , and also a legal expenditure, k , to avoid penalties for non-compliance.

To compare these regulatory models in sharper contrast, we can view them as special cases of a more general model. In the general model there are two points at which the regulator's decisions can be challenged. First, the firm can challenge the regulatory standard against which compliance will be measured. This challenge determines what behavior will be considered to be non-compliance, and penalties are invoked when behavior falls short of this standard.¹⁶ In addition, the firm can also contest the penalty that is imposed for non-compliance. Let the function $\pi(m,k)$ describe the outcome of the challenge to the penalties, where π is the proportion of the fine that remains after the challenge, and $0 \leq \pi \leq 1$. Let the function $\mu(m,k)$ describe the part of the regulatory standard that survives the firm's challenge, where μ is the standard against which compliance is actually measured in the enforcement process, and $0 \leq \mu \leq 1$. The firm faces the following total cost function,

$$C = \begin{cases} c(a) + f \cdot \pi(m_1, k_1) \cdot (\mu(m_2, k_2) - a) + k_1 + k_2, & \text{if } a < \mu(m_2, k_2) \\ c(a) + k_2, & \text{if } a \geq \mu(m_2, k_2), \end{cases}$$

where m_i , $i = 1, 2$ denotes the regulator's enforcement effort, and k_i , $i = 1, 2$ denotes the firm's expenditures in challenging the regulator's decisions.

Our model of penalty regulation is a special case of this model, where $\mu(m,k) = 1$, $\forall m$ and $\forall k$, and $\pi(m,k) = \beta(m,k)$. With these restrictions, the firm's total cost function becomes,

$$C = c(a) + f \cdot \beta(m,k) \cdot (1-a) + k,$$

as in our earlier description of penalty regulation.

Our model of compliance regulation is also a special case, where $\pi(m,k) = 1$, $\forall m$, and $\forall k$, and $\mu(m,k) = \beta(m,k)$. The total cost function becomes,

$$C = \begin{cases} c(a) + f \cdot (\beta(m,k) - a) + k, & \text{if } a < \beta(m,k), \\ c(a) + k, & \text{if } a \geq \beta(m,k). \end{cases}$$

In this model of compliance regulation, a standard of behavior, $\beta(m,k)$, is established, and non-compliance with the standard leads to a penalty, $f \cdot (\beta(m,k) - a)$. If the penalty, f , is sufficiently large then, given m and k , the cost minimizing firm will choose to comply fully with the standard, and we will have, $a = \beta(m,k)$.¹⁷ Hence, for large values of f , the firm's optimal choice of a allows us to write the cost function as

$$C = c(\beta(m,k)) + k,$$

as in our earlier representation of compliance regulation. Here, the firms' optimal choice of a , is trivially, $a = \beta(m,k)$, and the non-trivial choice is to choose the level of k , as in our initial description of compliance regulation. Note that the firm will comply with the standard, that is established, and consequently the fine, f , is not levied. The central issue in this type of regulation will be the firm's effort to influence the regulatory standard. The more general model that subsumes our compliance and penalty models allows us to be more precise in our formal comparison of the two regulatory regimes. Our model of compliance regulation represents regulatory regimes where the firm can challenge the regulatory standard against which compliance will be measured, while our penalty regulation model represents types of regulation where the firm can contest penalties for non-compliance, but the regulatory standard can not be challenged. Hence, the penalty regulation model represents a more "legalistic" method of regulation, where compliance is measured against a non-negotiable legal standard. From our remarks in the introduction the reader will note that our models have features that are consistent with some characteristics of compliance and penalty systems of

regulation. Finally, we can also interpret our compliance regulation model as regulation with direct controls, while our penalty regulation model represents types of regulation that employ the price system, as in the use of corrective taxes to rectify an externality. From this perspective our analysis is a comparison of direct controls and fines or corrective taxes, when in both cases the regulator's decisions can be challenged.

III. Penalty Oriented Regulation

To study the effectiveness of fines in regulating behavior, consider the first order conditions of the firm's cost minimization problem,

$$\min_{a,k} C = c(a) + f \cdot (1-a) \cdot \beta(m,k) + k.$$

$$(1) \quad \partial C / \partial a - f \cdot \beta(m,k) = 0,$$

$$(2) \quad f \cdot (1-a) \cdot \partial \beta / \partial k + 1 = 0.$$

These conditions give us the optimal values of a and k , and comparative statics analysis gives us the relationships, (see the Appendix for the derivations)

$$\frac{da^*}{df} = \frac{\frac{\beta}{\partial^2 C / \partial a^2} - \frac{f \cdot (\partial \beta / \partial k)^2}{\partial^2 C / \partial a^2 \cdot f \cdot \partial^2 \beta / \partial k^2}}{1 - \frac{f \cdot (\partial \beta / \partial k)^2}{\partial^2 C / \partial a^2 \cdot (1-a^*) \cdot \partial^2 \beta / \partial k^2}},$$

$$\frac{da^*}{dm} = \frac{\frac{f \cdot \partial \beta / \partial m}{\partial^2 C / \partial a^2} - \frac{f \cdot \partial \beta / \partial k \cdot \partial^2 \beta / \partial k \partial m}{\partial^2 C / \partial a^2 \cdot f \cdot \partial^2 \beta / \partial k^2}}{1 - \frac{f \cdot (\partial \beta / \partial k)^2}{\partial^2 C / \partial a^2 \cdot (1-a^*) \cdot \partial^2 \beta / \partial k^2}},$$

where a^* denotes the optimal value of a . In general, the sign of da^*/df and da^*/dm depends on the form of the functions $c(a)$ and $\beta(m,k)$, and general conclusions about the effectiveness of fines cannot be supported. We shall, however, construct an example that

demonstrates that the assumption in the economics literature, that regulators can influence behavior by suitably choosing the level of fines, is not an innocuous assumption, even when there are no bankruptcy constraints and fines can be set at arbitrarily high levels. As may already be apparent from the model, the example demonstrates that large fines lose their power to deter when a larger fine merely causes the firm to intensify its efforts to contest the fines.

EXAMPLE 1

$$\beta(m,k) = 1 - \frac{1}{1 + (m/sk)} = \frac{m}{m + sk}; \quad s > 0,$$

where s is a parameter that represents the relative strength of the parties in the legal proceedings (when the firm is not in compliance) — the regulator is weaker when s is larger. For example, if $m = k$ then $\beta = 1/(1+s)$. Note also that $\beta = 0$ when $m=0$ and $k > 0$ (if the regulator makes no enforcement effort, a penalty will never be levied), and $\beta = 1$ when $k=0$ and $m > 0$ (if the firm does not contest the fines, then penalties can never be avoided). With these properties of $\beta(m,k)$, we can claim that the example is a reasonable one.

Given this function, we have the expression,

$$\frac{da^*}{df} = \frac{\frac{m}{2 \cdot \partial^2 c / \partial a^2 \cdot (m + sk^*)}}{1 - \frac{fm}{2 \cdot \partial^2 c / \partial a^2 \cdot (1 - a^*) \cdot (m + sk^*)}} = \frac{\frac{\beta}{2 \cdot \partial^2 c / \partial a^2}}{1 - \frac{f\beta}{2 \cdot \partial^2 c / \partial a^2 \cdot (1 - a^*)}}$$

From this expression, we can see that the regulator can never bring about full compliance even if fines are made arbitrarily large. As f is made larger, either k^* remains finite so that β remains finite, or k^* becomes larger and $\beta \rightarrow 0$. If k^* is finite and a^* approaches 1, then the expression $f\beta/[2 \cdot \partial^2 c / \partial a^2 \cdot (1 - a^*)]$ is certainly greater than 1, so that $da^*/df < 0$. On the other hand, if k^* becomes large, so that $\beta \rightarrow 0$, then the term $f\beta/[2 \cdot \partial^2 c / \partial a^2 \cdot (1 - a^*)]$ need not become larger than 1. However, in this case, from the first order condition (1) we

know that, $a^* \rightarrow 0$. Note that these relationships are true for all values of m . Hence, we see that there is no penalty, f , that can secure full compliance. Next, we consider the sign of da^*/dm ,

$$\frac{da^*}{dm} = \frac{\frac{fm}{2 \cdot \partial^2 c / \partial a^2 \cdot (m+sk^*)^2} + \frac{f sk^*}{2 \cdot \partial^2 c / \partial a^2 \cdot (m+sk^*)^2}}{1 - \frac{fm}{2 \cdot \partial^2 c / \partial a^2 \cdot (1-a^*) \cdot (m+sk^*)}} = \frac{\frac{f}{2 \cdot \partial^2 c / \partial a^2 \cdot (m+sk^*)}}{1 - \frac{f \beta}{2 \cdot \partial^2 c / \partial a^2 \cdot (1-a^*)}}$$

Because of the expression in the denominator, with an argument similar to the preceding one, we can show that there is no enforcement effort, m , that can secure full compliance.¹⁸

From these remarks, we can conclude that for any level of f and m chosen by the regulator, the resulting level of compliance chosen by the firm will be less than full compliance. To be more concrete, if $c(a) = v \cdot a^2$, where v is a constant, then the level of compliance chosen by the firm satisfies the constraint, $a^* < 2/3$,¹⁹ — the firm's level of compliance will fall short of full compliance by a large margin. The reason why fines have limited deterrence power here, is that as the fine is made larger the firm intensifies its legal challenge to the penalties, and this defence prevents the expected fine from becoming large enough to compel full compliance. The severe diminishing returns to larger fines in this example may suggest why fines levied by regulatory agencies sometimes appear small to an outside observer.

IV. Compliance Oriented Regulation

Our analysis of compliance regulation begins with the firm's cost minimization problem,

$$\min_k C = c(\beta(m,k)) + k.$$

The solution to this problem gives the optimal level of the firm's challenge to the regulator's directives. Because the regulator determines the level of compliance through the function

$\beta(m,k)$, where $a = \beta(m,k)$, the effectiveness of the regulator's enforcement effort is given by the expression,

$$da/dm = \partial\beta/\partial m + \partial\beta/\partial k \cdot dk^*/dm,$$

where k^* denotes the optimal level of the firm's challenge. In general the relationship, da/dm , will depend on the form of the functions $c(a)$ and $\beta(m,k)$. For purposes of comparison, however, we shall use the function $\beta(m,k) = m/(m+sk)$, as in our example in the preceding section.

EXAMPLE 2

Given the function, $\beta(m,k) = m/(m+sk)$, from the first order condition of the firm's cost minimization problem, we have the firm's optimal challenge,

$$k^* = (-m + \sqrt{m s \partial c / \partial a})$$

In compliance regulation, the regulator attains the level of compliance, $a = \beta(m,k^*)$, or in the case of this example,

$$a = m/(m + sk^*),$$

and we have,

$$a = \frac{1}{(1-s) + \frac{s \sqrt{s \partial c / \partial a}}{\sqrt{m}}},$$

and,

$$\frac{da}{dm} = \frac{\frac{s \sqrt{s \partial c / \partial a}}{m \sqrt{m}}}{2 \left[(1-s) + \frac{s \sqrt{s \partial c / \partial a}}{\sqrt{m}} \right]^2 + \frac{s \sqrt{s} \partial^2 c / \partial a^2}{\sqrt{m} \sqrt{\partial c / \partial a}}} > 0.$$

From which we see that in spite of the firm's challenge, if there is less than full compliance, the regulator can always secure a higher level of compliance by increasing his enforcement effort. Moreover, if the level of the regulator's enforcement effort is, $m = s \partial c / \partial a$, then the regulator successfully brings about full compliance.

V. Discussion

In our examples as the enforcement effort increases, in compliance regulation full compliance will ultimately be secured, but in a penalty regulatory regime full compliance remains unattainable. While the regulator in a penalty system of regulation is unable to secure full compliance, one may still wonder whether at low levels of enforcement effort the penalty regime might be more effective than compliance regulation? Such is not the case, however, in our model. To see this, consider the derivatives da^*/dm in each regulatory regime. We have,

$$\lim_{m \rightarrow 0} da^P/dm = f / (2 \cdot \partial^2 c / \partial a^2 \cdot sk),$$

and,

$$\lim_{m \rightarrow 0} da^C/dm = \infty,$$

where a^P , and a^C are the level of compliance under penalty regulation, and compliance regulation. From these expressions, we can see that at low levels of enforcement effort, compliance oriented regulation is also more effective than the penalty regulatory regime.

Because in our examples we used the same function $\beta(m,k)$ to represent the likelihood that the regulator's decision prevails, we can conclude that when the two regulatory regimes have appeal processes with similar likelihoods of their outcomes then penalty oriented regulation is not always superior to compliance oriented regulation. In our model, the regulator in the compliance regime is more effective than the regulator in the penalty regime. This result should cause economists to pause before applying the corrective taxation solution to externality problems. When the regulator does not have dictatorial power, the use of pollution taxes may be less effective than direct controls on activities that generate pollution — even when the regulator's directives can be challenged. The ease with which we have been

able to construct a reasonable example in which regulation with direct controls is superior to regulation with corrective taxes and fines suggests that regulation with direct controls should not be so quickly dismissed as inefficient or benighted practice.

Several observers of regulatory practice in the United States have spoken of a drift towards more legalistic methods of regulation, that give regulators less flexibility in setting standards of compliance. "The shift has been away from a traditional enforcement style that relied heavily on ... negotiations (about the level of compliance), and towards a legalistic style that stresses strict application of legal regulations and prompt imposition of heavier legal sanctions for all detected violations" [Kagan, 1980]. This change in regimes has to some degree been due to a popular perception that granting discretion to regulatory agencies leads to lax enforcement of regulatory standards.²⁰ Our analysis, however, suggests that this change in regulatory regime may be counter productive. To the degree that the change shifts the locus of disputes in the enforcement process away from the standard against which compliance will be measured, and towards the severity of the fines to be imposed for violations of a binding and non-negotiable legal standard, our analysis suggests that this change may, paradoxically, make regulatory enforcement less effective. If we wish to design regulatory procedures that obtain higher levels of compliance while preserving the right of appeal and procedures of due process,²¹ then our results suggest that regulatory procedures should channel the locus of dispute and argument away from the size of penalties and towards the standard against which compliance will be measured. This means that rulings of non-compliance should not be determined in a rigid legalistic manner that leaves no room for negotiation. Whenever the right of appeal is present, procedures of due process and limited enforcement resources will at times result in the regulator's decisions being overturned, even when the appeal is without merit. In such an imperfect world, it is better that regulatory procedures allow the regulated enterprise to weaken the regulatory standard, than to allow

the size of the penalty to be appealed. This result may be somewhat paradoxical to environmentalists who put great effort in tightening regulations, closing loopholes, and generally opting for rigid non-negotiable environmental standards. If such efforts channel polluters' challenges to environmental regulations away from the interpretation or implementation of the standards and towards challenges to the size of penalties, then the environmentalists' efforts will have made environmental enforcement more difficult. If rights of due process require that challenges be allowed at some point in the process of regulatory enforcement, our results show that allowing challenges to the standard against which compliance is measured can lead to higher levels of compliance at lower enforcement costs than allowing challenges to penalties.

APPENDIX

Let $A(m,f,k)$ denote the optimal choice of a as a function of the values of m , f , and k (the solution to (1)), and let $K(m,f,a)$ denote the optimal choice of k given the values of m , f , and a (the solution to (2)). The optimal values of a and k , are then given by,

$$a^* = A(m,f,k^*)$$

$$k^* = K(m,f,a^*).$$

Let A_m , A_f , A_k , K_m , K_f , and K_a denote the partial derivatives to the functions $A(\cdot)$ and $K(\cdot)$.

We can then write,

$$\frac{da^*}{df} = A_f + A_k \frac{dk^*}{df}$$

$$\frac{dk^*}{df} = K_f + K_a \frac{da^*}{df}.$$

From these equations, we have,

$$\frac{da^*}{df} = \frac{A_f + A_k K_f}{1 - A_k K_a}.$$

This expression then gives us the expression for da^*/df in section III. In a similar fashion, we have,

$$\frac{da^*}{dm} = \frac{A_m + A_k K_m}{1 - A_k K_a},$$

which gives us the expression for da^*/dm in section III.

NOTES

1. See Bardach and Kagan [1982 a, pp.3-4], and Kagan [1980]. The federal regulatory statutes of the 1960's and 1970's restricted regulatory agency discretion and their ability to moderate regulatory standards.
2. For a discussion, see Kelman [1984], and Silbey [1984].
3. "The deterrence system of social control may serve as a master framework for some regulatory officials and some social scientists (particularly economists) by which the regulatory world is interpreted. It provides a definition of the regulated enterprise as ... being deterred through the imposition of adequate penalties ... This, however, is not ... an accurate interpretation" [Hawkins and Thomas, 1984 b, p. 18].
4. See Shavell [1984].
5. In a recent case, the FAA levied a \$2.9 million fine on Pan American that was reduced to \$1.9 million after the airline contested the penalties. In another case Eastern has refused to pay a \$13 million fine, and to date the FAA has been unable to collect the fine.
6. "The bargaining features of law enforcement are ... pervasive. In all areas of law, justice is negotiated: over 95 percent of tort claims and criminal cases in the United States are resolved not by formal legal procedure, but by informal "bargains" between the parties in the form of out-of-court settlements and the negotiated guilty plea respectively" [Veljnovski, 1984, p.172].
7. See, also Joskow [1973].
8. An introduction to these types of regulation can be found in Hawkins and Thomas [1984 a]. See also the discussion in Stiglitz [1986], pp.190 - 193.
9. Reiss, p.24.
10. See, Veljnovski [1984], p.172.
11. See also the discussion of liability and regulation in Bardach and Kagan [1982 b].
12. For another view, see the discussion in Williamson [1983]. For a discussion of the use of private bargaining and regulation in workplace safety, see Bacow [1982].
13. Kelman [1984].
14. The firm's contesting the regulator's decision can be thought of as a *directly unproductive profit seeking activity* (DUP). Bhagwati [1982] describes such activity as actions that provide a pecuniary return but do not make available more goods or services to society. If the regulator's objective is to control an externality, then the firm's legal expenditure to contest the regulator's enforcement effort has this property. Examples of papers on DUP would include a seminal paper by Krueger [1974] that analyzed rent seeking activities, and Findlay and Wellisz [1982] on lobbying and tariffs.
15. $c(a)$ is assumed to have the properties, $\partial c / \partial a > 0$, and $\partial^2 c / \partial a^2 > 0$.

16. This process should not be interpreted as determining the socially optimal standard of behavior. Whatever the socially optimal standard is, there is another practical standard whose role is to determine to what degree a firm is not in compliance, so that penalties can be invoked. We are making a distinction between an ideal standard and a standard that is actually used in the enforcement process, and this practical standard is the product of negotiation and argument between the firm and the regulator. In the United States, the standard setting process is characterized by negotiation and modification of proposed regulations, and the final rule can still be challenged in formal legal proceedings. In the appeal process the court would consider whether "(1) NHTSA had committed procedural errors, (2) its factual findings were supported by substantial evidence, and (3) the rule was reasonable" [Breyer, 1982, p.100].

17. On occasion penalties can be criminal penalties, especially where the regulatory standard is the product of formal legal proceedings and takes the form of a court order.

18. By inspection, we know that as m is made larger, if k^* is finite and a^* approaches 1, then the expression $f\beta/[2\partial^2c/\partial a^2\cdot(1-a^*)]$ becomes larger than 1, and we have, $da^*/dm < 0$. On the other hand, if k^* becomes large, and $\beta \rightarrow 0$, then from the first order condition (1) we know that, $a^* \rightarrow 0$.

19. After some substitution using the first order condition, we have

$$\frac{da^*}{df} = \frac{\frac{m}{4 \cdot v \cdot (m + sk^*)}}{1 - \frac{a^*}{2(1-a^*)}}$$

from which it is apparent that $da^*/df > 0$ if and only if $a < 2/3$.

20. For a discussion of this change in regulatory regime, see Kelman [1984], and Silbey [1984].

21. We use the word *appeal* not in reference to a binary decision of guilt or innocence, but instead in reference to a question of how non-compliance is to be treated. As mentioned in section II, the action taken by the firm is known to everyone and is not in dispute. The dispute centers around how the firm's non-compliance will be dealt with: What level of non-compliance will lead to penalties and enforcement actions? What penalties will be levied for non-compliance?

REFERENCES

- Bacow, L., 1982, "Private Bargaining and Public Regulation," in Bardach and Kagan (eds.).
- Bardach, E., and Kagan, R., (eds.), 1982 a, SOCIAL REGULATION: STRATEGIES FOR REFORM, Transaction Books, New Brunswick.
- 1982 b, "Liability Law and Social Regulation," in Bardach and Kagan (eds.).
- Baron, D. P., and Besanko, D., 1984, "Regulation, Asymmetric Information, and Auditing," RAND JOURNAL OF ECONOMICS, v. 15, pp. 447-470.
- Baron, D. P., and Myerson, R., 1982, "Regulating a Monopolist with Unknown Costs," ECONOMETRICA, v. 50, pp. 911-930.
- Bhagwati, J., 1982, "Directly Unproductive, Profit Seeking (DUP) Activities," JOURNAL OF POLITICAL ECONOMY, v. 90, pp. 988 - 1002.
- Breyer, S., 1982, REGULATION AND ITS REFORM, Harvard University Press, Cambridge, MA.
- Findlay, R., and Wellisz, S., 1982, "Endogenous Tariffs: The Political Economy of Trade Restrictions and Welfare," in J. Bhagwati (ed.) IMPORT COMPETITION AND RESPONSE, Chicago University Press, Chicago.
- Goldberg, V., 1976, "Regulation and Administered Contracts," BELL JOURNAL OF ECONOMICS, v. 7, pp. 426 - 448.
- Hawkins, K., and Thomas, J., (eds.), 1984 a, ENFORCING REGULATION, Kluwer-Nijhoff, Boston.
- 1984 b, "The Enforcement Process in Regulatory Bureaucracies," in Hawkins and Thomas (eds.).
- Joskow, P., 1973, "Pricing Decisions of Regulated Firms: A Behavioral Approach," BELL JOURNAL OF ECONOMICS, v. 4, pp. 118 - 140.
- Joskow, P., and Noll, R., 1981 "Regulation in Theory and Practice," in G. Fromm (ed.) STUDIES IN PUBLIC REGULATION, MIT Press, Cambridge, MA.
- Kagan, R., 1980, "The Positive Uses of Discretion: The Good Inspector," Paper presented at Law and Society Association Meeting, Madison, Wisconsin, 1980.
- Kelman, S., 1984, "Enforcement of Occupational Safety and Health Regulations," in Hawkins and Thomas (eds.).
- Krueger, A., 1974, "The Political Economy of the Rent-seeking Society," AMERICAN ECONOMIC REVIEW, v. 64, pp. 291-303.
- Reiss, A., 1984 "Selecting Strategies of Social Control Over Organizational Life," in Hawkins and Thomas (eds.).

- Rose-Ackerman, S., 1986, "Reforming Public Bureaucracy," JOURNAL OF LAW, ECONOMICS, AND ORGANIZATION, v.2, pp.131-161.
- Sappington, D., 1983, "Optimal Regulation of a Multiproduct Monopoly with Unknown Technological Capabilities," BELL JOURNAL OF ECONOMICS, v.14, pp.453-463.
- Shavell, S., 1984, "A Model of the Optimal Use of Liability and Safety Regulation," RAND JOURNAL OF ECONOMICS, v.15, pp.271-280.
- Silbey, S., 1984, "The Consequences of Responsive Regulation," in Hawkins and Thomas(eds.).
- Stiglitz, J., 1986, ECONOMICS OF THE PUBLIC SECTOR, W. W. Norton, New York.
- Veljanovski, C., 1984, "The Economics of Regulatory Enforcement," in Hawkins and Thomas (eds.).
- Weitzman, M., 1974, "Prices vs. Quantities," REVIEW OF ECONOMIC STUDIES, v.41, pp.477-491.
- Williamson, O.E., 1983, "Credible Commitments; Using Hostages to Support Exchange," AMERICAN ECONOMIC REVIEW, v.73, pp.519-540.