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Implementable Monitoring Policies under Unobservable Levels of Misbehavior

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Abstract

An authority delegates a monitoring task to an agent. It can only observe the number of detected offenders, but neither the monitoring intensity chosen by the agent nor the resulting level of misbehavior. We provide a necessary and sufficient condition for the implementability of monitoring policies. Typically, several monitoring intensities give rise to the same number of detected offenses, and only the minimum of these can be implemented. In equilibrium, a large fraction of potential offenders cannot be deterred.

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1 Introduction

In many situations of monitoring, the number of actual detections does not unambiguously reveal the underlying level of misbehavior. For example, when a division head of a large company reports to cooperate headquarters a low number of violations against some corporate code of conduct for his division (e.g., not accepting bribes), it is not obvious what this information reveals about the true level of misbehavior in the division. The reason is that a low number of detections could either result from a strict monitoring policy leading to few offenders only, most of which are detected (*black sheep*). Instead, the monitoring policy could be lax, leading to a large number of offenders, out of which only few (*scapegoats*) are discovered. As a further example, in sports competitions it is hard to judge for outsiders what a given number of detected dopers reveals about the seriousness and intensity of anti-doping measures by the respective agencies and the virulence of doping among athletes. Further examples include victimless crime such as prostitution, trafficking or drug dealing, where the number of arrests might not be too informative about the prevalence of an illegal activity.

The common feature of these examples is that an authority delegates the task of monitoring a population of individuals to an agent. Thereby, it is an outsider in the sense that it can neither observe the monitoring intensity chosen by the agent nor the resulting level of misbehavior.[1] In contrast, the potential offenders have a good assessment of the monitoring policy (i.e., the probability of being detected) which is a standard assumption in the economic literature on enforcement (see e.g., Polinsky and Shavell, 2000).[2]

We develop a simple model which captures the interaction between the authority, the

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[1] The feature that several monitoring intensities lead to the same number of detections also applies to further settings such as tax evasion, education or loan audits. However, it is less clear in these contexts that the authority can be considered as an outsider who has to rely on the number of reported detections only.

[2] As for the case of street prostitution, regular market participants might (correctly) perceive the actual threat of being arrested by the police (let alone conviction) to be much smaller than might be presumed by outsiders (see e.g., Levitt and Venkatesh, 2007).

monitoring agent and potential offenders, and provide a necessary and sufficient condition for the implementability of a given monitoring policy. Intuitively, when several monitoring intensities give rise to the same level of detected offenses, then a utility maximizing agent can only be induced to choose the minimum of these.[3] Hence, under quite general conditions (for example, with respect to the underlying distribution of individuals' gains from the offense or the agent's effort cost function), a large set of monitoring policies cannot be implemented by the authority, even if it had unlimited funds to reward the inspector.

2 Model

There are three types of players: a population of *individuals* who are potential offenders, an *inspector* who monitors them, and an outside *governor* who incentivizes the inspector.

Individuals There is a unit mass of individuals who differ with respect to their gain from committing an offense, g_i, where the cumulative distribution of these gains is denoted by $G : \mathbb{R} \to [0, 1]$, and which is continuous and strictly increasing. Following the tradition of Becker (1968), we assume that for a given probability of detection $p \in [0, 1]$, and a (exogenous) penalty $T > 0$, each individual will commit the offense if and only if its gain g_i exceeds the expected costs $p \cdot T$. This leads to a threshold $\overline{g} := p \cdot T$, such that all individuals satisfying $g_i > \overline{g}$ ($g_i \leq \overline{g}$) will (not) commit the offense. The resulting crime rate is $F(p) := 1 - G(p \cdot T)$, which is strictly decreasing in p.[4]

Inspector The inspector chooses the monitoring intensity $p \in [0, 1]$ which equals the probability each offender is detected with. Monitoring is costly for the inspector, which

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[3] In Ichino and Muehlheusser (2008), a low monitoring intensity results as an optimal choice of the inspector as this allows him to elicit private information from the individuals.

[4] The specific assumptions on offenders' preferences do not matter. The relevant aspect for the model is that the resulting crime function $F(p)$ is decreasing.

is captured by a strictly increasing cost function $C(p)$. Taking into account the optimal behavior of individuals as characterized above, a monitoring intensity p gives rise to a number of detected offenders $D(p) := p \cdot F(p)$. Denote by $\Delta \subseteq [0,1]$ the image of $D(p)$, that is, $\Delta := \{d \mid d = D(p) \text{ for some } p \in [0,1]\}$, and by p^m the smallest level of p for which $D(p)$ reaches its global maximum.

We study a context where the inspector can only be rewarded on the basis of the number of detections $D(p)$, which is observable. Denoting the monetary reward by $R(D(p))$, the inspector's payoff is[5]

$$u(p) = R(D(p)) - C(p). \tag{1}$$

Governor The governor remunerates the inspector by setting a payment scheme $R(D(p))$, without being able to verify the inspector's actual behavior (p) or the crime level ($F(p)$). For our purpose, it is not necessary to specify explicitly the preferences of the governor, for example, with regards to her distaste for crime. Rather, we assume that the governor aims at implementing some *desired* monitoring intensity $\hat{p}$. For instance, $\hat{p}$ could indeed be her privately optimal choice or, alternatively, the socially efficient level which results when taking into account the preferences of all involved individuals, including the gains and the harm from the offense.

3 Implementable Monitoring Policies

We now analyze under which circumstances the governor can successfully induce the inspector to choose $\hat{p}$, i.e. find payments R such that $\hat{p} \in \arg\max_p u(p)$. For any given level of detections $d \in \Delta$, define an ordered set of monitoring intensities $(P^d, <)$ such that each $p_l^d \in P^d$ satisfies $D(p_l^d) = d$. Typical sets P^d consist of exactly two elements, $p_1^d < p_2^d$. Importantly, while the number of detected offenses is equal to d for all $p_l^d \in P^d$, the underlying crime level is decreasing in l, while the inspector's effort costs are

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[5] Additive separability of rewards and costs is assumed for convenience only. The assumption that the inspector's utility is not affected by the crime level $F(p)$ is discussed in Section 4 below.

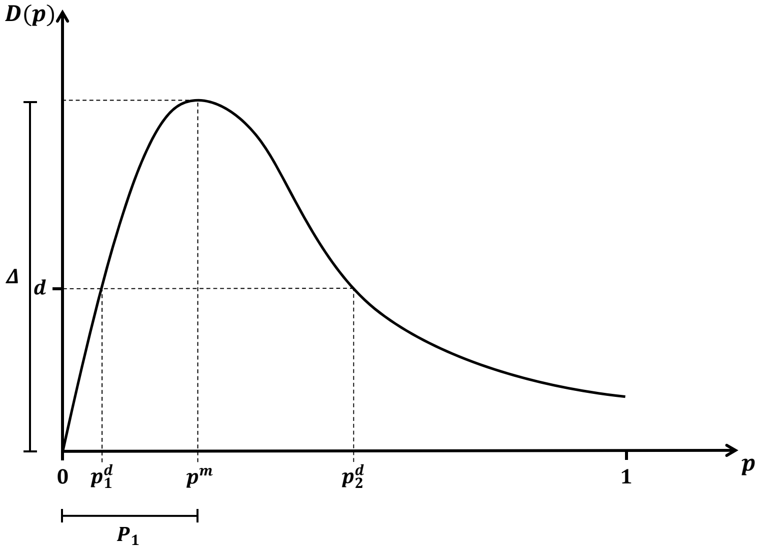

Figure 1: Number of detections as a function of monitoring intensity p

increasing in l, that is, for all $l = 1, 2, ...$ we have $F(p_l^d) \geq F(p_{l+1}^d)$ and $C(p_l^d) < C(p_{l+1}^d)$, respectively. Denote by P_1 the set containing all minimum monitoring intensities, that is, $P_1 = \{p \mid p = p_1^d \text{ for some } d \in \Delta\}$.

Theorem 1. *A desired monitoring policy $\hat{p}$ is implementable if and only if $\hat{p} \in P_1$. The resulting set of implementable monitoring policies P_1 satisfies $P_1 \subseteq [0, p^m]$.*

Proof. For $\hat{p} \notin P^1$ there is a $\tilde{p} \in P^1$ such that $D(\tilde{p}) = D(\hat{p})$ by definition of P^1. Noting, that $R(D(\tilde{p})) = R(D(\hat{p}))$ while $C(\tilde{p}) < C(\hat{p})$, it follows that $u(\tilde{p}) > u(\hat{p})$, which shows that $\hat{p}$ cannot be implemented. Now, suppose $\hat{p} \in P^1$. Let $R(d) = C(p_1^d) + \varepsilon$ if $d = \hat{d} := D(\hat{p})$ and $R(d) = 0$ otherwise. Then $u(\hat{p}) = \varepsilon > 0$, while for ε small enough we have $u(p) \leq 0$ for all $p \neq \hat{p}$ because other monitoring intensities $\tilde{p}$ that lead to the same number of detections (i.e. $\tilde{p} \in P^{\hat{d}}$) are associated with higher costs and all other choices (i.e. $p \notin P^{\hat{d}}$) do not lead to any reward.

For the second statement note that G continuous renders F continuous and thus D as well. Since $D(p)$ starts with $D(0) = 0$ and reaches its global maximum for the first time at p^m, $D(p)$ attains every value of its image Δ in the interval $[0, p^m]$. Thus, for any

$d \in \Delta$, $p_1^d \in [0, p^m]$.[6] $\square$

The result is illustrated in Figure 1. In special cases there is a unique monitoring intensity associated with a given number of (observable) detections such that implementability is not an issue.[7] Otherwise, when P^d is not a singleton, the inspector has a choice between several monitoring regimes in order to generate d detections (see Figure 1). For example, he can either choose a low monitoring effort p_1^d (at low cost) which leads to a relatively high number of offenders, out of which d are detected (*scapegoats*). Alternatively, the inspector can choose a higher effort $p_2^d > p_1^d$ (at higher cost) which leads to fewer offenses, but again to d detections (this time better referred to as *black sheep*). Since the inspector's payment is the same for all $p_l^d \in P^d$, the inspector prefers to "deliver" any given number of detections $d \in \Delta$ at the lowest cost, and so his optimal choice is p_1^d. As a consequence, only monitoring policies $p \in P_1$ can be implemented so that $\hat{p} \in P_1$ is a necessary condition for its implementation. As for sufficiency, all monitoring levels $\hat{p} \in P_1$ can be implemented by sufficiently rewarding the corresponding detection level $D(\hat{p})$, compared to all other detection levels $d \neq D(\hat{p})$.

Importantly, Theorem 1 renders all $p > p^m$ non-implementable, which means that the level of misbehavior is larger than $F(p^m)$. This suggests that detected offenders might be better classified as scapegoats rather than as black sheep. The result can also be expressed in terms of the elasticity of crime $e(p) := -F'(p)\frac{p}{F(p)}$. Suppose that F is not "too convex" such that $D(p) = pF(p)$ is strictly concave. Then it is readily derived that $e(p) \geq 1$ if and only if $p \geq p^m$. Thus, as a rule, inspectors never choose a monitoring regime in the elastic range of the crime function.

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[6] Note that P^1 does not necessarily coincide with $[0, p^m]$ since D might be non-monotonic (i.e. exhibit local extrema) in this interval. In this case, $p \in [0, p^m]$ does not imply $p \in P^1$. A sufficient condition for $P^1 = [0, p^m]$ is $F''(p) < \frac{-2F'(p)}{p} (> 0)\ \forall p > 0$, i.e. F is not "too convex". Then, D is a concave function and reaches its global maximum at the unique point p^m.

[7] This is true for the global maximum $D(p^m)$ if it is unique and it can occur for very small numbers of detections, when there are individuals with $g_i > T$, who even misbehave under full monitoring (such that $D(1) = 1 \cdot F(1) > 0$).

Example Let gains from committing an offense be uniformly distributed on $[0,1]$ (formally, $G(x) = x$ for $x \in [0,1]$) and $T = 1$ so that $F(p) = 1 - p$, and $D(p) = p \cdot (1-p)$. Then, $D(p)$ is hump-shaped and symmetric around $p^m = \frac{1}{2}$ with $\Delta = [0, \frac{1}{4}]$. As a result, we have $P^d = \{p_1^d, p_2^d\}$ for each $d \in [0, \frac{1}{4})$, which gives rise to a set of implementable monitoring intensities $P_1 = [0, \frac{1}{2}]$. Under the realistic assumption that more than half of the population should be deterred, the respective desired monitoring policy (i.e. some $\hat{p} > \frac{1}{2}$) cannot be implemented.

4 Discussion

In our simple model, inspectors cannot be induced to choose monitoring intensities beyond the threshold p^m, so that detected offenders tend to be scapegoats rather than black sheep. In this respect Theorem 1 is very general in the sense that it holds for *any* payment scheme $R(D(p))$ which the governor might use and for any specification of the crime function $F(p)$. We only require that more monitoring effort is more costly for the inspector.

In the basic setup, the inspector is not personally affected by the crime level. While this assumption seems plausible in many applications, it can be relaxed, for example by considering a utility function $u(p, \beta) = R(D(p)) + \beta F(p) - C(p)$, where β measures the inspector's net utility from crime. Benefits of crime can arise, for example, from accepting bribes, and disutility can be caused by intrinsic motivation to keep the crime level low. Interestingly, inspectors with a sufficiently strong intrinsic motivation (i.e. $\beta << 0$) can be induced to implement monitoring policies ($p > p^m$), which are not implementable in the basic set-up. However, this remedy relies on the assumption that the governor can observe the inspector's β-type.

As a further extension, β could also be the inspector's private information. In contrast to standard screening models, the resulting design problem for the governor becomes significantly more intricate because of additional incentive and participation constraints. This is again due to the fact that multiple monitoring intensities give rise to the same number of detections, which increases the scope of mimicking.

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References

Becker, G. (1968): "Crime and Punishment: An Economic Approach," *Journal of Political Economy*, 76(2), 169–217.

Ichino, A., and G. Muehlheusser (2008): "How often should you open the door? Optimal monitoring to screen heterogeneous agents," *Journal of Economic Behavior & Organization*, 67, 820–831.

Levitt, S. D., and S. A. Venkatesh (2007): "An empirical analysis of street-level prostitution," *University of Chicago, mimeo.*

Polinsky, M., and S. Shavell (2000): "The Economic Theory of Enforcement of Law," *Journal of Economic Literature*, 38(1), 45–76.