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**Social Accountability: Persuasion and Debate
to Contain Corruption**

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JEL Codes: D73, D81, D86, H11

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Social Accountability: Persuasion and Debate to Contain Corruption

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Abstract

In this paper we investigate the properties of simple rules for reappointment aimed at holding a public official accountable and monitor his activity. The public official allocates budget resources to various activities which results in the delivery of public services to citizens. He has discretion over the use of resource so he can divert some of them for private ends. Because of a liability constraint, zero diversion can never be secured in all states. The optimal reappointment mechanism under complete information is shown to exhibit some leniency thus departing from the zero tolerance principle. Under asymmetric information (about the state), a rule with random verification in a pre-announced subset is shown to be optimal in a class of common rules. Surprisingly, those common rules make little use of hard information about service delivery when available. Similarly, PO's claim about his record is of no value to improve the performance of the examined rules. In contrast requesting that the PO defends his records publicly can be very useful if the service users are given the chance to refute false claims with cheap talk complaints: the first best complete information outcome can be approached in the absence of any observation by the manager of the accountability mechanism.

JEL: D73, D81, D86, H11

1 Introduction

Typically, we do not observe high power incentive contracts for public officials and politicians. Most often the official receives a fixed salary and incentive transfers are rare. Instead the decision as to whether or not to keep the official in office is used to discipline public officials. Politicians can be ousted from power by general elections and high level bureaucrats by politicians or bureaucratic procedures.

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The recent developments of the so called transparency and accountability initiatives have come about because of a great frustration with elections and bureaucratic procedures as the dominating means for holding politicians and high level bureaucrats accountable for their decisions.¹ There is a broad consensus that those instruments are grossly inefficient in terms of monitoring public officials and fighting corruption and that they need to be complemented with novel mechanisms.

Transparency and accountability initiatives have a long tradition in the US (cf. Open Government) with recent very interesting developments (see e.g., Noveck 2009). There is also a recent fascinating upsurge of activities in developing countries including India. Partly, this is due to the enactment of the Right to Information Act, partly to the development of new technologies that allows for innovative approaches based on web 2.0 technology. For a review of those initiatives see e.g., Posani and Aiyar (2009). As emphasized in multiple evaluation reports (see e.g., Mc Gee and Gaventa 2010) "we are facing a serious deficit of understanding of the mechanisms at work in those initiatives which makes their evaluation hazardous". The present paper aims at contributing to filling this gap.

Accountability is a composite concept. It has been described (see e.g., Malena et al. 2004) as comprising three elements: "answerability" - the obligation to justify one's action; "enforcement" - the sanction if the action or the justification not satisfactory; and "responsiveness" - the willingness of those held accountable to respond to demand made. The first element is informational, we can formulate it as the obligation to persuade of the suitability of one's action upon request. The second is incentives (or effective sanction). The third element is monitoring. Accountability can be reformulated as a monitoring mechanism that includes an obligation to participate to an ex post persuasion procedure. As already mentioned the use of incentive is typically very constrained: the wage is fixed and the sanction is often reduced to "no reappointment". The emphasis in this paper is therefore on (ex-post) mechanisms that determine how the public official (PO) can persuade the citizens that he deserves reappointment.

The kind of situation that we consider is the provision of public services such as education, health or any other valuable service to citizens.² In our model, the provision of public services depends on the resources the PO allocates to the service as well as on some stochastic (service specific) state of productivity only observed by the PO. Our main focus is on corruption here described as diversion of public funds from the provision of public services to private ends. The public official has effective discretion to divert resources because of a liability constraint (the hardest punishment is dismissal) and because of the just described informational asymmetry. In the absence of any signal of the PO's behavior (e.g., performance measure, outcome of verification, announcements, users' complaints

¹Criminal courts are not perceived as alternative either. Partly this is because the process is too much too slow and very demanding in terms evidence.

²They have been subject to the so called "social audit" in India (e.g., in Andhra Pradesh the National Rural employment Guarantee Act has been the playground for well documented accountability initiatives).

etc...) the citizens have no way to prevent a corrupt PO from diverting money: the PO is in effect not accountable at all for the use of resources.

The question we ask in this paper is whether and how much accountability can be improved (diversion reduced) when relying on an ex-post mechanisms that generates new information through a direct verification procedure and through a simple communication game that captures basic features of social accountability mechanisms encountered in reality. On the one hand we have a PO who implicitly or explicitly claims that he spends the money properly. On the other hand we have the citizens who do not trust him. They know a corrupt PO diverts money unless he is punished for doing so.³ They have to devise a mechanism to learn about his behavior and sanction it. The most natural thing that comes to mind is verification i.e., to verify the claims of the PO and if diversion is detected dismiss the PO. Clearly, if the citizen can verify all the claims, they have complete information and first best can be achieved. Systematic verification is not a realistic option however. Citizens typically lack the necessary time (not to mention willingness) and information processing capacity. But they could appeal to a professional auditor and pay for his services. In this paper we do not consider costly verification. One reason - consistent with our concern for corruption - is that in most LDC there exists no reason to trust independent auditors more than bureaucratic audits.⁴ The failure of bureaucratic verification is precisely what triggers the development of citizen based initiatives: bureaucrats collude with the PO and the PO is expected to collude with an outside auditor. Therefore instead of costly verification we consider limited verification i.e., only a few - most of the time only one - service can be verified. The verification is performed the citizens themselves: they process the evidence provided by the PO upon their request.⁵ The question boils to the design of a selection rule to determine which one of all the services will be verified. Our focus is therefore on accountability mechanisms of the form: to persuade the citizens that the PO did not divert fund and be reappointed, he must provide some evidence specified by the mechanism. Otherwise, i.e., if he fails to provide the evidence, the citizens believe that he diverted money and he will be dismissed. The accountability mechanism is announced before the PO makes his allocation decision. The objective is to minimize diversion (monitoring).

Our first finding is that because of the fixed wage, the first best complete information outcome exhibits diversion of funds in some states. The optimal accountability mechanism departs from the zero tolerance principle. Instead, it is characterized by a satisfaction level (e.g., a number of high quality services) above which the PO is implicitly allowed to divert funds. In the absence of any information about the PO's behavior, the optimal P-rule based on random verification calls for verification in a pre-announced subset of services. Surprisingly, the availability of information about the quality of

³In this paper the term corruption is used in the sense of embezzlement.

⁴The recent scandals with auditing firms e.g., Enron show that even in developed economies, collusion is very difficult to prevent.

⁵In contrast with Rubinstein 2007 we do not let the PO choose which service to provide evidence on.

service delivery (a signal of PO's behavior) is of very little value. In particular we find that a most intuitive mechanism which consists in a rule that calls for the verification of one of the services where diversion might have occurred i.e., low quality services is a very bad idea. It leads to maximal diversion. The intuition is that such a rule increases the PO's cost of refraining from diversion in the first place. Instead diluting detection probability maximally by diverting whenever possible becomes optimal. We next show that combining random verification with a necessary performance target weakly improves upon the optimal random verification outcome. As we investigate the value of communication, we first find that asking the public official to defend his records is of no value in those mechanisms. However, the picture changes dramatically if we introduce service users and invite them to submit cheap talk complaints. We show that requesting that the public official publicly defends his record and giving service users an opportunity to refute his claim can be exploited in a mechanism that approaches the complete information first best. This result supports the intuition behind social accountability initiatives. It reveals that a well-designed persuasion game involving the public can play a significant role in securing the accountability of public officials and reducing the extent of corruption. The analysis offers a framework that can be generalized along various dimensions and provide concrete recommendations as to how new technology can be used to improve governance in specific contexts.

Related literature

The issue of accountability has been addressed in the political science and political economy literature (cf. Persson et al.,1997). The emphasis in that branch of literature is on election rules and organisational structure. Our approach shares common features with the literature on optimal monitoring with ex-post verification (cf Townsend 1979, and Gale and Hellwig 1985). In contrast with e.g., Townsend, we do not consider an explicit cost of verification instead we assume limited verification resources. Moreover we are interested in the value of communication. This brings us closer to the persuasion literature (cf. Glazer Rubinstein 2004, 2006). A contribution of this paper is to introduce moral hazard in a persuasion problem. We show that a persuasion mechanism can be used to monitor the action of the agent in a (constrained) principal-agent problem.

2 The model

There is a finite number n of different services in N , which have to be provided to the citizens. To provide these services, a public official (PO) is hired with the task to allocate a budget B to the provision of these services but the the PO can choose to divert money to private ends instead. For each service i , the quality delivered to the citizens, denoted s_i , is a function of the share of the budget spent on i and an exogenous and uncertain productivity parameter of the service $\theta_i : s_i = f(\theta_i, b_i)$ where b_i is the share of the budget allocated to service i . The quality of each service i can be either

null, low or high, $s_i \in \{0, \underline{s}_i, \overline{s}_i\}$ ⁶ where $s_i = 0$ is a quality of service below the minimum acceptable level. A provision of services below the minimum level is liable of prosecution.⁷ The productivity θ_i of each service is high ($\overline{\theta}_i$) with probability p and low ($\underline{\theta}_i$) with probability $1 - p$. The technology for the delivery of the qualities of service is the following:

- $f(\theta_i, b_i) = \overline{s}$ for $b_i \geq \frac{B}{n}$ and $\theta_i = \overline{\theta}_i$
- $f(\theta_i, b_i) = \underline{s}$ for $b_i < \frac{B}{n}$ and $\theta_i = \overline{\theta}_i$ or $b_i \geq \frac{B}{n}$ and $\theta_i = \underline{\theta}_i$;
- $f(\theta_i, b_i) = 0$ for $b_i < \frac{B}{n}$ and $\theta_i = \underline{\theta}_i$.

Since the only purpose of allocating money is to provide quality with this technology the choice of b_i simplifies to $b_i \in \{0, \frac{B}{n}\}$ and the mandate of the PO simplifies to spending $\frac{B}{n}$ on each service. There are two crucial features to this production technology:

- The delivery of a low quality service \underline{s} can result from either spending the appropriate budget on a low productive service $f(\underline{\theta}_i, \frac{B}{n}) = \underline{s}$ or spending 0 (diverting money) on a productive service $f(\overline{\theta}_i, 0) = \underline{s}$.
- The amount that the PO can divert (discretionary budget) depends on the state of the world e.g., in state $\theta = (\theta_1, \dots, \theta_n)$ with $\theta_i = \underline{\theta}$ for all $i = 1, \dots, n$, there is no discretionary budget to be diverted. The PO cannot afford delivering below the minimal level.

The PO's decision (x_1, \dots, x_n) consists, for each service i , to either spend the share $\frac{B}{n}$ on service i denoted $x_i = 0$ or to keep the money for himself $x_i = 1$. This decision is taken after having observed the realization of the vector of productivities $\theta = (\theta_1, \dots, \theta_n)$. The citizens denoted CI do not observe this vector but CI may observe a signal of PO's decisions, that is, the resulting vector of service qualities $s = (s_1, \dots, s_n)$. We also consider the case when CI observes nothing.

The PO's objective is to maximize his expected payoff including the money he diverts and the wage when remaining in office

$$U = \sum_{i \in N} x_i \frac{B}{n} + P(K)w$$

where $P(K)$ is the probability that CI keeps the PO and w is the continuation wage. The probability $P(K)$ depends on the procedure for reappointment which is the choice of the CI (see below). The CI wishes to minimize the expected diversion of public budget:

$$EV = -E_\theta \sum_{i \in N} x_i(\theta) \frac{B}{n}.$$

In the analysis we also use an alternative but equivalent formulation in terms of saved discretionary budget.

⁶The idea is that service users distinguish between three level of services: unacceptable, low and good.

⁷This captures the idea that it may endanger the life of citizens or deny their basic rights, e.g., the hospital or the school is kept close.

To discourage the PO from stealing, we assume that CI can commit to a procedure of reappointment. It involves a rule for verifying the state of productivity and (when unobservable) the quality of some service(s) and a rule for deciding whether CI reappoints the PO or dismisses him. When kept in place, the PO receives a wage with discounted value $w > 0$.⁸ CI is assumed to only have resources to verify one single service reflecting limited capacities to process evidences provided by the PO. More formally at the beginning of the period, CI commits to a persuasion or P-rule. A P-rule is composed of two mappings f and d . The first mapping depicts the rule for selecting one service if any for verification: $f : I^0 \rightarrow P$ where I^0 is the information set at time 0: $I^0 \in \{\Theta \times S, S \times A, \emptyset \times A \times \Sigma\}$ with Θ denoting the set of states, S the set of services, A the set of announcements from the PO Σ the set of signals from service users⁹, P is the set of probability distributions over the elements of N so (p_1, \dots, p_n) is a probability vector. With probability p_i element (θ_i, s_i) is verified, the CI can only verify one service, and depending on the outcome of $x_i \in X_i = \{0, 1\}$ where 0 means the PO did not steal and 1 means he stole the unit of budget ($\frac{B}{n}$) intended to service i . The second mapping depicts the rule for reappointment $d : I^1 \rightarrow \{K, D\}$ where $I^1 = \{I^0 \times X_i, \}$ $\rightarrow \{K, D\}$. We confine attention to deterministic decision rules: $d(I^1, x_i) \in \{K, D\}$.^{10,11}

The general timing of the interaction between the PO and the CI is as follows:

- (1) The CI publicly commits to a P-rule (a f and a d mapping),
- (2) Nature picks the profile of productivities θ which is perfectly observed by the PO,
- (3) The PO decides on how to spend money on the different services, he takes decision $(x_1, x_2, \dots, x_n), x_i \in \{0, 1\}$,
- (4) Services (s_1, \dots, s_n) are delivered to the service users which is observed or not by CI
- (5) A message from the PO may be demanded and/or a signal from service users.
- (6) A service i is selected according to the P-rule (f -mapping) and verified $x_i \in \{0, 1\}$.
- (7) CI decides whether to keep or dismiss the PO according to d -mapping.

Our basic framework is characterized by linear utilities and a liability constraint is imposed: the

⁸The present paper depicts a situation where the budget allocation task is unique but takes place in a long-running relationship so w is the discounted wage. In a repeated allocation game the discounted income would include future rents from stealing as well.

⁹We postpone to section 6 development about Σ .

¹⁰To the best of our knowledge no public administration uses a stochastic dismissal rule presumably because appealing to a random device to decide over the fate of people is not politically feasible. Therefore, we focus on deterministic dismissal rules. The probabilistic character of the mechanism is introduced through verification, signaling or communication.

¹¹Interestingly a similar case refer to a proposal made under the second world war. British pilots suffered great losses because they had to carry a lot of gasoline to be able to fly back. Some smart scientists showed that expected survival could be increased significantly if instead the pilots were selected randomly and then sent to a sure death in planes with no gasoline to turn back. The proposal to introduce the new system was unanimously rejected. Having one's fate determined by a random device was not acceptable.

largest cost that can be imposed on the PO in case of low quality delivery is dismissal (the loss of w).

We have the following 2 assumptions:

- $B > w$ meaning that the PO always prefers to divert the whole budget and lose his job than refrain from diverting altogether. But

- $\frac{B}{n} < w$ so the PO does not always divert whatever he can.

The two assumptions above can be summarized in a number $l \in [2, n]$ such that $l\frac{B}{n} < w$ whereas $\frac{B}{n}(l+1) \geq w$, l is the largest amount of budget shares such that the PO prefers to keep his job rather than divert $l\frac{B}{n}$.

Definition 1 Let $l = \max_{y \in \mathbb{N}} \{y; y < \frac{wn}{B}\}$.

The number l will play a central role in the analysis. For w large enough $l \geq n$, perfect monitoring is trivially achievable when relying on verification. The constraint on "punishments" is what creates the challenge of accountability. We assume that when he is indifferent between stealing or not the PO chooses not to. We shall see that l is the maximal number of shares of the discretionary budget that can ever be obtained from the PO.

For the rest of the paper it is useful to introduce the following notation. The set Θ of states θ is partitioned into classes characterized by the number of high productivity services. We call class- k the element of the partition of Θ where there are exactly k high productivity services and denote this subset $\Theta(k)$. The cardinality of $\Theta(k)$ is $= \frac{n!}{k!(n-k)!}$. With some abuse of language we shall also be referring to a PO of type k in the sense of a PO who inherited for a state in class(k). We use the two formulations interchangeably.

3 Benchmark: Accountability with full observability

We first look at a particular situation in which the CI actually has access to all the information: $I = \Theta \times S$, he observes the productivity state θ and the service quality s . It follows that CI perfectly detects any diversion of funds by the PO. A natural candidate for the P-rule (only the d -mapping since no verification is needed) is to dismiss the PO for any amount he steals. We call this P-rule the zero tolerance rule. We next show that this rule does not perform so well and that CI can do much better.

With the proposed P-rule the PO is dismissed whether he steals one share or the whole (discre-

tionary) budget since utility increases in stolen money, the type k PO's incentive constraint¹² writes:

$$k \frac{B}{n} \leq w \quad (1)$$

Recall that by assumption we have $\frac{B}{n} \leq \frac{1}{l}w$ whereas $(l+1) \frac{B}{n} > w$. This means that whenever $\theta \in \Theta(k)$, $k \leq l$, the candidate P-rule achieves full deterrence. However for $\theta \in \Theta(k)$, $k \geq l$ the threat of dismissal induces a PO of type k to steal the whole discretionary budget since $(l+1) \frac{B}{n} > w$. In expectation the budget saved from diversion is equal to $\sum_{i=0}^{i=l} q(i) \frac{i}{n} B$ where $q(z) = \text{prob}\{\theta_i \in \Theta(z)\}$.

Now consider a rule where the PO is granted some leniency or a sufficient target in the sense that CI commits to keep the PO if he delivers HQ services whenever possible i.e., $\theta_i = \bar{\theta}$ up to a number y of HQ services. Once the PO has delivered y HQ services, CI is satisfied, he "closes his eyes" so the PO may unsanctioned steal above the target.

More precisely, suppose that the CI commits to the following rule, the lenient P-rule: for any $\theta \in \Theta(k)$, $k < y$ the the PO is dismissed for stealing any amount of discretionary budget; and for $\theta \in \Theta(k)$, $k \geq y$ the PO is kept if and only if he delivers at least y services and he is dismissed otherwise. For the sake of comparison we shall express this rule in terms of the general mechanism. The first mapping $f : \Theta \times S \rightarrow P$ is trivial since there is no use to verification because of complete information:

$$- f(\theta, \mathbf{s}) = (0, \dots, 0) \quad \forall \theta \in \Theta \text{ and } \mathbf{s} \in \mathbf{S}.$$

The second mapping $d : \Theta \times S \rightarrow \{K, D\}$ is defined as follows. Let $\hat{x} = \#s_i \in S$; $s_i = \bar{s}$ and k be the type of the PO:

$$- d(k, \hat{x}) = K \text{ if either } \hat{x} = k, k < y \text{ or } \hat{x} \geq y, k \geq y \text{ and}$$

- $d(k, \hat{x}) = D$ if either $\hat{x} < k$, $k < y$ or $\hat{x} < y$, $k \geq y$ where y is a target i.e., a number of HQ services.

When he faces this P-rule, the PO chooses how many budget share to divert \hat{x} , the incentive constraints of a PO of type k writes

$$\hat{x} \frac{B}{n} \leq w \text{ for } k \leq y \quad (2)$$

$$\hat{x} \frac{B}{n} \leq w + (k - y) \frac{B}{n}, \text{ for } k > y \quad (3)$$

since the diversion payoff (lhs) is increasing in \hat{x} the constraints are most demanding at $\hat{x} = y$ respectively $\hat{x} = k$. Both are satisfied for $y \leq l$ since by definition $l \frac{B}{n} \leq w$. For $k \leq y$ the PO chooses not to divert. And for $k > y$ he chooses to divert exactly $k - y$ the P-rule induces the PO to steal unsanctioned.

We now integrate the PO's optimal behavior in CI's objective function. In the appendix we show that minimizing diversion is equivalent to maximizing the amount of expected discretionary budget

¹²We remind that we call type k PO a PO that faces a state belonging to $\Theta(k)$ that is with a discretionary budget equal to $\frac{kB}{n}$.

that is saved i.e., not stolen by the the PO:

$$EV^{fi} = \sum_{i=0}^{i=y} q(i) \frac{i}{n} B + (1 - Q(y)) \frac{y}{n} B \quad (4)$$

where $Q(z) = \sum_{i=0}^{i=z} q(i)$ so $(1 - Q(l))$ is the probability for the PO to be of type $i \geq y$.¹³ The first term of the expression in (4) is the expected discretionary budget up to class $\Theta(y)$ which is never stolen. The term is the same as with the zero tolerance rule. The second term is the discretionary budget associated with the share l of HQ services that must be delivered in states belonging to classes $\Theta(k)$ with $k > y$. This term is absent under the zero tolerance regime. The optimal lenient P-rule maximizes EV^{fi} subject to the IC constraints, $y \leq l$ maximizes

$$\frac{\Delta EV^{fi}}{\Delta y} = q(y+1) \frac{y+1}{n} B + (1 - Q(y)) \frac{B}{n} - q(y+1) \frac{y}{n} B > 0$$

so it saturates the constraint and $y^* = l$.

We have the following proposition:

Proposition 1 *With full observability, the “lenient P-rule” with a target $y^* = l$ achieves*

- (i) *high quality delivery of all productive services in every state in $\Theta(k)$ for $k < l$ and*
- (ii) *high quality delivery of l productive services in every state in $\Theta(k)$ for $k \geq l$.*
- (iii) *This rule is optimal under Full Observability.*
- (vi) *In the optimal scheme the expected saved budget is $EV^{fi} = \sum_{i=0}^{i=l} q(i) \frac{i}{n} B + (1 - Q(l)) \frac{l}{n} B$.*

Proof: The proof of (i) - (iii) follows from the definition of l and the incentive constraint in (1) and the arguments above which establishes that whatever the state θ_i CI can never obtain more than l high quality services.

Proposition 1 characterizes the largest expected utility achievable by the citizens when keeping the PO accountable for his decisions given that they can only dismiss him. This limitation is aimed at reflecting a characteristics of citizen based accountability mechanisms as opposed to judicial in the sense that citizens’ assessment of evidence is not subject to the same standard as a court where stealing public money can be more severely punished. In many transparency and accountability initiatives even dismissal can be difficult to enforce. The analysis in this paper aims at identifying

¹³ $q(z) = \text{prob} \{ \theta_i \in \Theta(z) \} = \frac{n!}{z!(n-z)!} p^z (1-p)^{(1-z)}$

Define $g(z)$ the expected diversion associated with letting PO of type $i \leq z$ steal the discretionary budget:

$$g(z) = \sum_{i=0}^{i=z} q(i) \frac{i}{n} B. \quad (5)$$

the value of complementing a public official's employment contract with an obligation to go through a simple procedure to defend his records in order to remain in place.

The result in proposition 1 are consistent with Persson et al. 97. They also find that the politician must be granted some rents which they call power rents in order to refrain from stealing the whole budget.

When the CI does not observe the vector of productivity parameters and service delivery, the scheme above cannot be implemented. The PO can always claim $\theta_i = \underline{\theta}$ and divert the whole discretionary budget. The question we are interested in is how close to the first best can we get within a class of P-rules that will be defined later in the absence of complete information. We shall in turn consider the case when no information is available ex-post, when the CI has information about service delivery and when he can ask the PO for announcement.

4 Accountability with no information

In this section we look at the case polar to full information: CI does not observe the state of productivity or the quality of delivered services. This will invite the introduction of basic verification procedures. For the case $I = \emptyset$ there is no information to condition verification probabilities for the different services. The f -mapping boils down to the set of probability distributions P , $\mathbf{p} = (p_1, \dots, p_n); \sum_{i=0}^{i=n} p_i \leq 1$. Since the services are symmetric for the CI, we can focus on verification rules that treat services symmetrically. The second mapping $d : X_i \rightarrow \{K, D\}$ is trivially determined: $d(0) = K$ and $d(1) = D$. The only feasible alternatives make no use of the only available information i.e., from verification and hence can have no monitoring power whatsoever. In this context the only decisions for the CI with respect to the P-rule is therefore the selection of the probabilities for verification of each service and what announces before the PO makes his decisions.

4.1 Random verification procedures

In this subsection we focus on random verification procedure with no announcement from the PO or signal from services users. For any given $\mathbf{p} = (p_1, \dots, p_n), \sum p_i \leq 1$, PO's objective function writes

$$U = \sum_{i \in N} x_i \frac{B}{n} + (1 - \sum_{p_i; x_i=1} p_i)w$$

so the marginal payoff from stealing on service i is determined by the constant gain $\frac{B}{n}$ and detection probability $-p_i w$. It does not depend on whether the PO stolen on other services. The *IC* constraint writes

$$\frac{B}{n} - wp_i \leq 0 \Leftrightarrow wp_i \geq \frac{B}{n} \tag{6}$$

Since by assumption $\frac{B}{w} > 1$, we have that the IC constraint requires $p_i \geq \frac{1}{n}$. This gives us the following lemma.

Lemma 1 *Any P-rule that aims at preventing stealing from service i must have $p_i \geq \frac{B}{wn}$.*

The proof follows immediately from the IC constraint (6). The Lemma allows establishing the following results

Proposition 2 *i. In any state $\theta \in \Theta(k)$, $k = 1, \dots, n$ uniform random verification over the set N of all services has no monitoring power. $\forall k \in [0, N]$, a PO of type k steals the whole available discretionary budget and is dismissed with probability $\frac{k}{n}$;*

ii. For any $M \subset N$; a partial verification rule that entails uniform random verification over a pre-announced subset M , $\#M = m$ such that $p_i = \frac{1}{m} \geq \frac{1}{n}$ for $s_i \in M$, secures no stealing in M .

Proof. i. Uniform random verification entails $p_i = \frac{1}{n}$ for all i but by Lemma 1 p_i must be larger than $\frac{B}{wn}$, with $\frac{B}{wn} > \frac{1}{n}$. Hence random verification violates the IC constraint in all states. In any state $\theta \in \Theta(k)$, the PO steals k shares of the budget and he is discovered with probability $\frac{k}{n}$ in which case he is dismissed.

ii. First note that there is no point in performing verification on $M \subset N$ if the subset M is not pre-announced. Indeed since all services are symmetric, the probability for verification for the PO is then $\text{prob}\{s_i \in M\} \cdot \frac{1}{m} = \frac{m}{n} \cdot \frac{1}{m} = \frac{1}{n}$ which we know by (i) has no monitoring power. When the set M is pre-announced with $p_i \geq \frac{1}{n}$, $i \leq m$, we have $\frac{B}{n} < \frac{w}{p_i}$ for any s_i , $i \leq m$ so the PO prefers to spend the money properly $x_i = 0$, $\forall i$, $i \leq m$.

We next derive the optimal APV (pre-Announced Partial Verification) that maximizes CI's objective. We want to establish the magnitude of the potential gains from partial verification and the loss due to asymmetric information. ■

4.2 Optimal Partial Verification.

Generally, departures from uniform verification over N can take many forms. Simple arguments allows to narrow down significantly the set of interesting APV however. We know from Proposition 2 that any candidate optimal rule will feature the property that some services are verified with sufficient probability to deter stealing and other are not. Next, since verification is a scarce resource there can be no rationale for spending it for no good i.e., to verify a service with a probability that is positive but insufficient to deter stealing. Therefore, any optimal use of verification resources must entails that some services are never verified while other are verified with sufficiently high probability. We can therefore focus on APV schemes that pre-announces a partition of the set of services into two subsets M and $N \setminus M = U$. The set U (for *unverified*) contains services that are never verified and

the set M contains services that are verified with some equal probability. In the previous section we settled the question regarding the reappointment rule d . It uses the only available information, i.e., the result from the verification procedure in the most natural way: dismiss if diversion is uncovered and reappoint otherwise. The relevant set of APV P-rule is:

$$\begin{aligned} f: \mathbf{p} &= (p_1, \dots, p_n) \text{ with } p_i = \frac{1}{m}, i \leq m, p_i = 0, i > m \text{ and} \\ d: X &\rightarrow \{0, 1\}; d(x_i = 0) = K \text{ and } d(x_i = 1) = D, x_i; i \leq m \end{aligned}$$

The question that we next investigate is what is the optimal $m = \#M$ (recall the services are fully symmetric)?

Consider a PO of type k optimal response to $APV(m)$. Assume there are $k' \leq k$ productive services in U when the state is $\theta \in \Theta(k)$. the PO can guarantee himself a payoff of $\frac{k'}{n}B + w$ when stealing from all high productivity services in U . If in addition among services in M , the PO can steal some amount $\hat{x}_m \in [0, k - k']$ where $\hat{x}_m = \sum_{i=1, \dots, m} x_i$, he gets $U = \frac{\hat{x}_m + k'}{n}B + \frac{m - \hat{x}_m}{m}w$. The incentive constraint for not stealing in M writes

$$\frac{k'}{n}B + w \geq \frac{\hat{x}_m + k'}{n}B + \frac{m - \hat{x}_m}{m}w \Leftrightarrow \frac{1}{n}B - \frac{1}{m}w \leq 0$$

The marginal payoff from stealing in M is constant by linearity and equiprobability of verification. Consequently, if $m > l$, we have that $\frac{m}{n}B > w$, which implies that the PO prefers to steal from any service in M that is high productive rather than stealing only from U . Since utility is increasing in \hat{x}_m , the PO chooses to steal on every productive service in M , and therefore steals on a total of $k' + k - k' = k$ services. If $m \leq l$, utility is a decreasing function of \hat{x}_m and the PO chooses to steal only on productive services in U . We next consider the CI incentives with respect to m . In order to do that we define classes of states and probabilities in the subset M in a way similar to what we did before. Let $q'(z; M) = \text{prob}\{\theta \in \Theta(z; M)\} = \frac{m!}{z!(m-z)!}p^z(1-p)^{m-z}$. It is the probability that $\theta = (\theta_1, \dots, \theta_m)$ has z high productivity parameters. We can now express the expected saved budget for an incentive compatible APV:

$$EV^{APV} = \sum_{i=0}^{i=m} q'(i; M) \frac{i}{n}B, \text{ s.t. } m < l \quad (7)$$

which is unambiguously increasing in m , hence $m^* = \arg \max_m EV^{APV} = l$.

Proposition 3 *For $I = \emptyset$, the optimal partial verification P-rule yields a pre-announced partition of the set of services into two subsets. The subset subject to verification has cardinality l . The expected saved public funds is $EV^{APV} = \sum_{i=0}^{i=l} q'(i; M) \frac{i}{n}B$.*

ii. In equilibrium the PO is always reconducted, stealing occurs (in subset U) but verification never unveils stealing.

Proof. i. The argument about pre-announcement is the same as in Proposition 2. Next, by linearity of utility, in any state k , the PO faces a choice between stealing the whole discretionary budget or not stealing at all from M . The IC constraint $\frac{k'}{n}B + w \geq \frac{x+k'}{n}B + \frac{m-x}{m}w$ simplifies to $m \leq l$. It is independent of the true state. Hence, the same set M of cardinality l minimizes stealing in all states and thus maximizes the expected saved budget EV .

ii. Subset M is designed to deter stealing so verification in subset M results in $x_i = 0 \ i \in [1, m]$ and $d(0) = K$. Since U contains services that are never verified for any $\theta_i, i \in [m+1, n]$, with $\theta_i = \bar{\theta}$, $x_i = 1$, the PO diverts the whole discretionary budget in U . ■

The result in proposition 3 is not surprising. Announced Partial Verification (APV) follows the same logic as the optimal full information scheme: it leaves rents in order to avoid full stealing. In contrast with the complete information setting the P-rule cannot be made conditional on the state of productivity and the quality of services. Asymmetric information about the θ_i implies an additional constraint on the CI which is only partially mitigated by limited (to one item) ex-post verification

Remark 1 *As shown in the proof of Proposition 2 pre-announcement is key to the efficiency of APV. Interestingly practitioners are often reluctant to announce M because they understand that the PO is given "carte blanche" on the complement subset $N \setminus M$. They often fail to realize that this is the cost they have to pay to achieve any monitoring effect. Part of the confusion comes from the fact the efficiency of verification and audits is often measured in terms of unveiled diversion i.e., from an ex-post perspective. While the optimal APV never unveils any diversion even though diversion occurs systematically. In this context CI must credibly resist the temptation to verify outside of pre-announced M . So CI's commitment to an APV scheme can turn out a demanding feature.*

Evaluating the performance of the optimal APV

The first point is that it increases the expected saved budget from 0 with random verification to $EV^{APV} > 0$. Yet, there is of course a cost of asymmetric information. Comparing $EV^{APV*} = \sum_{i=0}^{i=l} q'(i; M) \frac{i}{n} B$ with the full information optimal outcome $EV^{fi} = \sum_{i=0}^{i=l} q(i) \frac{i}{n} B + (1 - Q(l)) \frac{l}{n} B$, we see that the first term of the two expressions are quite similar but since $q(i) > q'(i; M)$ because $q'(i)$ is the probability for θ belonging to $\Theta(i; M)$ with $M \subset N$, we have $\sum_{i=0}^{i=l} q'(i; M) \frac{i}{n} B < \sum_{i=0}^{i=l} q(i) \frac{i}{n} B$. Moreover, partial verification cannot prevent full stealing in the complementary set U while under full information, l HQ services can be guaranteed in good states $(1 - Q(l)) \frac{l}{n} B$. So partial verification does much better than uniform random verification but much less well than the optimal full information P-rule. Interestingly the performance of the optimal APV resembles the performance of the zero tolerance P-rule under complete information $EV = \sum_{i=0}^{i=l} q(i) \frac{i}{n} B$. It is smaller though since $q(i) > q'(i; M)$.

In the following we shall investigate whether and how the no information optimal P-rule can be

improved upon by the use of information about the services delivery.

5 Accountability with observable service delivery

In this section we investigate a number of natural P-rules feasible when information about service delivery is available. We start with a simple target rule with no verification. We next consider two types of conditional APV rule. In the first, the set of services subjected to verification depends on the information about service delivery. In the second the choice as to whether or not to implement verification depends on the service delivery.

For the case when $I^0 = S$ so the P-rule includes $f : S \rightarrow P$ and $d : S \times X_k \rightarrow \{K, D\}$. Potentially the set of P-rules is very large but it seems reasonable to focus on rules that makes use of ex-post information in a simple way. More precisely we focus on P-rules of the form $p_i(s_i, \hat{s})$ with $\hat{s} = \#s_i, s_i \in S; s_i = \bar{s}$ i.e., we allows the probability of verification to depend on the own delivery status (i.e., HQ or LQ) while other services affect the probability through an aggregate measure only, \hat{s} , the total sum of HQ services.¹⁴ This precludes complex rules that use information about the combination of HQ and LQ services in the vector of service delivery. Similarly, we limit attention to decision rules $d : S \times X_i \rightarrow \{K, D\}$ of the form $d(s_i, \hat{s}, x_i)$.

5.1 Target rules

Although the focus of the paper is on P-rule with information revelation. We start with some results about a simplest rule with no verification. The first mapping $f : S \rightarrow P$ is void since no verification is performed: - $f(\mathbf{s}) = (0, \dots, 0) \forall \mathbf{s} \in \mathbf{S}$. The second mapping $d : S \rightarrow \{K, D\}$ is defined as follows: $d(\hat{s}) = K$ if $\hat{s} \geq y$ and $d(k, \hat{s}) = D$ if $\hat{s} < y$ where y is a pre-announced target. In plain language, the P-rule boils down to a decision determined by the number of high quality services: if he meets the target, the PO is reconducted, if it does not he is dismissed.

the PO's incentives will depends on the state as follows: if $\theta_i \in \Theta(k)$ with $k < y$, the PO's payoff writes

$$\frac{\hat{x}}{n}B + prob(K; \hat{s}), \hat{x} \leq k$$

where $\hat{x} = \sum x_i$ is the number of services where the PO steals. Since the P-rule for $\hat{s} < y$ entails $prob(K; \hat{s}) = 0 \forall \hat{x}$, the payoff boils down to $\frac{\hat{x}}{n}B$ which is trivially maximized at $\hat{x} = k$. So when the target is not feasible ($k < y$) the the PO steals the whole discretionary budget. In states $\theta_i \in \Theta(k)$ with $k \geq y$, and since $prob(K; \hat{s}) = 0$ for $k - \hat{s} < y$ and $prob(K; \hat{s}) = 1$ for $k - \hat{s} \geq y$ the IC constraint

¹⁴Can we develop a formal argument about the limitation.

induced by the target rule in those states is

$$\frac{k-y}{n}B + w \geq \frac{k}{n}B, \quad (8)$$

which simplifies $w \geq \frac{y}{n}B$. As we know this is satisfied for $y \leq l$. Hence for $y \leq l$, in all $\theta_i \in \Theta(k)$ with $k \geq y$ the PO will deliver any target $y \leq l$ and steal the whole budget for any target $y > l$. The outcome will then be exactly the threshold in all states where it is achievable and LQ service everywhere else.

Recalling our notation $q(y) = \text{prob}\{\theta_i \in \Theta(y)\} = \frac{n!}{y!(n-y)!}p^y(1-p)^{n-y}$ and $Q(y) = \sum_{i=0}^{i=y} q(i)$ is the probability that the target is not feasible After substituting for the PO's optimal response CI's objective to maximize saved budget writes

$$\begin{aligned} \max_y \sum_{k=y}^{k=n} q(k)y &= \max_y (1 - Q(y))y \\ \text{s.t } y &\leq l \end{aligned}$$

Denote by y^* the largest integer value of y that maximizes the programme above. We derive wrt y $\frac{d}{dy} [(1 - Q(y))y] = (1 - Q(y)) - Q'(y)y$ using the definition of $Q(y) : 1 - \sum_{i=0}^{i=y-1} q(i) - q(y) = q(y)y \Leftrightarrow 1 - \sum_{i=0}^{i=y-1} q(i) = (1 + y)q(y)$

This gives us the following result

Proposition 4 *i. The optimal target P-rule entails a target $y^* = \min\{l, \arg \max(1 - Q(y))y\}$;*

ii. In equilibrium the PO delivers y^ high quality services iff $\theta \in \Theta(k)$ with $k \geq y^*$ while he steals the whole discretionary budget whenever $\theta \in \Theta(k)$ with $k < y^*$;*

iii. the optimal target P-rule yields a total saved budget of $EV^T = (1 - Q(y^))\frac{y^*}{n}B$.*

Proof. See above ■

The optimal target rule trades off the loss of the whole budget in states where the target is not feasible with the gain of an additional unit in states where the target is feasible. The saved budget is under the optimal target rule

$$EV^T = (1 - Q(y^*))\frac{y^*}{n}B \quad (9)$$

Compared with the full information case $EV^{fi} = \sum_{i=0}^{i=l} q(i)\frac{i}{n}B - (1 - Q(l))\frac{l}{n}B$, we note that *i.* the first term of EV^{FI} representing the gain in the worse states is fully absent with the target rule; *ii.* the second term is quite similar in structure but $y^* \leq l$ because the CI trades off the loss of the whole budget in states where the target is not feasible against the level of requested service delivery where it is feasible.

Remark 2 *The target rule is a simple and transparent P-rule. It exhibits a number of unattractive features however. First, it puts all the risk on the public official. Next it induces stealing in all states but $\theta \in \Theta(y^*)$ and poor states are worst hit.*

Target with non-deterministic reappointment rule

As a short parenthesis we consider a non-deterministic reappointment rule that uses information about service delivery and achieves the complete information payoff. The rule is as follows:

$$d : S \rightarrow \Delta \{K, D\} :$$

- $d(\hat{s}) = K, \hat{s} \geq l,$
- $d(\hat{s}) = \min \{1, \frac{\hat{s}}{l}\} K + (1 - \min \{1, \frac{\hat{s}}{l}\}) D$ for $\hat{s} < l.$

The PO's payoff writes

$U = \hat{x} \frac{B}{n} + \min \{1, \frac{k-\hat{x}}{l}\} w,$ implying $\frac{\partial U}{\partial \hat{x}} < 0$ for $k < l$ so $\hat{x}^* = 0$ and $\frac{\partial U}{\partial \hat{x}} > 0$ for $k \geq l.$ The P-rule achieves the first best complete information outcome : $\hat{x}^* \max \{0, k - l\}.$ ¹⁵. In contrast with the complete information scheme, the PO is dismissed with positive probability when the state is poor.

This scheme features a number of highly unattractive features:

- In equilibrium honest PO are systematically dismissed while a PO who steals is never dismissed.
- The lower the wage, the smaller l and the more often the PO is dismissed.
- The smaller $l,$ the larger embezzlement $\hat{x}^* = k - l$

The most unattractive feature is that dismissal is not a signal of embezzlement but of honesty! As a consequence the assumption that the PO loses (his continuation wage) w because he finds no job is not sustainable. Especially with a high turnover: unlucky PO will be easily hired again which reduces the differential continuation wage when remaining in place. This in turn increases the extent of embezzlement. Thus providing us with an additional argument (see Introduction) for confining attention to deterministic reappointment rules.¹⁶

5.2 Conditional verification

In this section we investigate We next consider the possibly most intuitive P-rule that uses ex-post information: focus verification resources on LQ services since only they may hide stealing. We call it conditional random verification (CV) because the verified set depends on performance in terms of the observed service delivery. More formally

$$f : S \rightarrow P; p(s_i, \hat{s}) = \frac{1}{n-\hat{s}} \text{ for } s_i = \underline{s}$$

$$\text{and } p_i(s_i, \hat{x}) = 0 \text{ for } s_i = \bar{s}$$

$$d : X_i \rightarrow \{K, D\} \text{ is : } d(0) = K \text{ and } d(1) = D.$$

¹⁵For $l < n/2,$ we have $\hat{x}^* = k - l$ that is for a small wage relative to the budget, it does not achieve the complete information outcome

¹⁶The question of interest is whether the optimal target rule improves upon the optimal APV :

$\sum_{i=y^*}^{i=n} q(i) \frac{y^*}{n} B \geq (<) \sum_{i=0}^{i=l} q'(i; M^*) \frac{l}{n} B$ which is equivalent to comparing $\sum_{i=l}^{i=n} q(i) y^*$ and $\sum_{i=0}^{i=l} q'(i; M^*)$ where $y^*(w, p)$ and $M^*(w).$ I expect that the relative value of the two rules to depend on w and $p.$ Intuitively, the target rule will outperform the APV rule when p is large for given $w.$ In contrast the PA rule may be better when l large. Develop!

The IC constraint applying to the choice of the budget allocation decisions x_i is derived by comparing the payoff when complying (marginally i.e., not stealing $x_i = 0$ and stealing $x_i = 1$.) In any state $\theta \in \Theta(k)$, given the value of the other allocation variables x_{-i} ; $\sum_{j \in N_{-i}} x_j < k$ the choice is between $\mathbf{x}_{i=0} = (x_1, \dots, 0, \dots, x_n)$ and $\mathbf{x}_{i=1} = (x_1, \dots, 1, \dots, x_n)$, denote $\hat{s}_0 = \sum_{j \in N_{-i}} x_j$, $\hat{x}_1 = \sum_{j \in N_{-i}} x_j + 1$:

$$\hat{x}_0 \frac{B}{n} + (1 - p(\hat{s}_0, k)) w \leq \hat{x}_1 \frac{B}{n} + (1 - p(\hat{s}_1, k)) w$$

which simplifies to $[p(\hat{x}_1, k) - p(\hat{x}_0, k)] w > \frac{B}{n}$. The new feature compared with previous P-rules is that the change in the probability for dismissal is a function of the whole vector of budget allocations. In the P-rule under consideration, the probability for detection depends on the number of LQ services which is $n - \hat{s}$. In any state $\theta \in \Theta(k)$. The probability for detection associated with $\hat{s} = k - \hat{x}$ in state $\theta \in \Theta(k)$ is

$$p(\hat{s}; k) = \frac{\hat{x}}{n - k + \hat{x}}.$$

We take the derivative¹⁷ with respect to \hat{x} : $\frac{\partial p(\hat{s}, k)}{\partial \hat{x}} = \frac{n-k}{(n-k+\hat{x})^2} \geq 0$ so in any given class the probability for detection increases with the number of stolen units. But $\frac{\partial^2 p(\hat{x}, k)}{\partial \hat{x}^2} = -2 \frac{n-k}{(n-k+\hat{x})^3} < 0$ the marginal increase in detection risk decreases with the amount stolen. The decreasing marginal detection risk together with constant marginal gain ($\frac{B}{n}$) implies increasing marginal gain of stealing. So in any given class, it may not be IC to steal a single unit, but if it is IC to steal some amount of units, it is optimal to steal the whole discretionary budget. The PO's optimal response is therefore in terms of a binary choice: no stealing or full stealing. We also have that $\frac{\partial p(\hat{x}, k)}{\partial k} = \frac{\hat{x}}{(n-k+\hat{x})^2} > 0$ so the better the state (larger k) the larger the marginal detection risk for any given amount of stolen units. This means that if it is optimal to comply in class (k) it is optimal to comply in any state belonging to $\Theta(k')$, $k' > k$. In each state the IC writes:

$$\frac{B}{n} k + \left(1 - \frac{k}{n}\right) w \leq w \Leftrightarrow B \leq w$$

which is independent of k and which we know is violated. We have the following result:

Proposition 5 *A P-rule that concentrates all verification resources on observed LQ services has no monitoring power whatsoever. in all states the PO steals the whole discretionary budget.*

Proof: See above.

The result in Proposition 5 may at first appear quite surprising because focusing verification on LQ services since the HQ services need not be checked at all seems common sense. The result reveals an essential limitation in the use of information about services in ex-post verification random

¹⁷We thus proceed as if the choice were continuous for simplicity.

mechanisms to monitor the PO. Indeed in any given class, conditional verification reallocates the marginal probability of detection from states with a lot of stealing (and many LQ) to states with less stealing (and few LQ). The marginal detection risk decreases with the number of stolen units which creates perverse incentives. As a consequence the CV P-rule does not relax the liability constraint and therefore it has no more monitoring power than random verification.

Remark 3 *Again the failure of common sense intuition is related to an ex-post view on verification as an instrument to detect diversion. The result shows again (as in APV) that the ex-post objective to maximize detection conflicts with the ex-ante perspective of monitoring budget allocation.*

The conflict is due to the fact that the quality of service delivery is an imperfect signal of diversion, relying on it for verification makes the monitoring power of verification manipulable by the PO. It creates new incentives to divert i.e., to dilute the probability for being caught.

We next consider two other natural ways of using information about services to improve upon APV.

5.3 Accountability with target and verification

In this section we shall investigate simple composite P-rules that combine target with a verification procedure. Two variants are of interest. The first amounts to imposing a *necessary* target so if the target is met the CI proceeds to some verification but if it is not the PO is dismissed. The second type of rule imposes a *sufficient* target so if the target is met the PO is reconducted while if the target is not met the CI proceeds to verification.

5.3.1 verification with necessary target

Since we know that random verification has no monitoring power (see Proposition 2) we address the case of partial verification (equal probability check in $M \subset N$) with necessary target. Specifically, partial verification with target is as follows:

The necessary target P-rule is defined as follows $f : S \rightarrow P$, with $p(s_i, \hat{s})$:

- $p_i(s_i; \hat{s} \geq y) = \frac{1}{m}$, $i \leq m$, $p_i(s_i; \hat{s} \geq y) = 0$ $i > m$;
- $p_i(s_i; \hat{s} < y) = 0$, $\forall i$.

The second mapping $d : S \times X_i \rightarrow \{K, D\}$ is defined as follows: $d(\hat{s}, x_i) = K$ if $\hat{s} \geq y$ and $x_i = 0$ and $d(x_i, \hat{s}) = D$ otherwise i.e., if $\hat{s} < y$ or if $\hat{s} \geq y$, $x_i = 1$. The game proceeds as follows:

- At the beginning of the period the CI announces a subset M and a target y .
- After the services have been delivered, if $\hat{s} \geq y$ the CI picks one service j at random from the set M , if $s_j = \bar{s}$ or $s_j = \underline{s}$ and a check reveals $\theta_j = \underline{\theta}$ the PO he is reconducted. Otherwise the PO is dismissed.

Recalling earlier results in Proposition 4ii. we know that if $\theta \in \Theta(k), k < y$, the threshold cannot be met and the PO steals the whole discretionary budget $\frac{k}{n}B$ since he will be dismissed anyway. For the case $\theta \in \Theta(k), k \geq y$, consider two situations. Let as before $k' \leq k$ be the number productive services in U when the state is $\theta \in \Theta(k)$. Then if $(k - k') \geq y$, there are enough high quality services in M to meet the threshold, the reasoning is similar to partial verification without threshold, if $m \leq l$, the PO only steals in U .

If $(k - k') < y$ (but $k \geq y$) the PO needs to abstain from stealing on a number $z = y - (k - k')$ of high productive services in U in order to meet the target. Since not meeting the target leads to dismissal, IC for securing the target is :

$$\frac{k - y}{n}B + w \geq \frac{\hat{x}}{n}B$$

since the position of services does not matter we write $(k - y)$ as the number of services that he can steal from unsanctioned (this implies not stealing in M), the rhs is increasing in \hat{x} so we can focus $\hat{x} = k$, the inequality simplifies to $\frac{y}{n}B < w$. Hence, when $(k - k') < y$ (but $k \geq y$) the PO prefers to secure the target and steal what is left to steal in U than steal any larger amount provided $y \leq l$.

The impact of the target is twofold: i. it secures at least y HQ services in all states where that is feasible and thus even in states where $k - k' < y$. ii. That comes at a cost of losing the whole budget in states where $k < y$.

$$EV = (1 - Q(y))\frac{y}{n}B + \sum_{i=y}^{i=m} q'(i; M)\frac{i - y}{n}B \quad (10)$$

where we remind $q'(z; M) = \text{prob}\{\theta \in \Theta(z; M)\}$ it is the probability that $\theta = (\theta_1, \dots, \theta_m)$ has z high productivity parameters. The first thing is that the target is secured whenever feasible (first term in 10). In addition some additional HQ service may be secured if they happen to be in excess of y and in M . We note that y^{**} that maximizes (10) is smaller than y^* on the simple target rule since the second terms decreases with y . We expect that the target can under some circumstances improve upon APV e.g., when w and M is small relative to N . But under a range of circumstances the optimal threshold will be $y^* = 0$.

Proposition 6 *Optimal Partial verification with target*

- i. entails the same pre-announced audited set as partial verification and a lower target than the simple target scheme. Partial verification with target*
- ii. weakly improves upon the partial verification scheme and*
- iii. strictly improves upon the simple target scheme.*

Proof:

i. This follows from proposition 3, the IC constraint within the set M does not depend on the true state and thus does not depend on whether the target is met or not.

ii. This follows from the fact that the expression in 10 has the same structure as (9) but with an additional positive term. In particular, the optimal target of the simple rule y^* is feasible and yields a larger saved budget.

iii. Consider the case with high wage i.e., when l tends to n , in that case imposing a target $y^* > 0$ only brings forth the loss of the discretionary budget in poor states ($k < y$). In contrast for l small e.g., $l = 1$ implying $M = \{s_1\}$, the gain from the target $y = 1$ comes with large probability $(1 - Q(1)) = 1 - (1 - p)^n$ clearly overweighting the cost of *not* meeting the target which comes with a vanishing small probability $(1 - p)^n$.

Proposition 6 shows that the use of ex-post information by means of a necessary target to complement partial verification has some limited value. It is expected to improve slightly accountability in context where the wage is very low relative to the budget i.e., in context where "first best" diversion is very high. On the other side, the simple target rule can be unambiguously improved upon by combining it with a verification procedure.

5.3.2 Verification with sufficient target

In this section we address the case of partial verification (equal probability check in $M \subset N$) with sufficient target. The distinction with the mechanism in the preceding section is that here fulfilling the target secures reappointment. Failing to meet the target does not trigger dismissal instead CI proceeds with a verification procedure. The necessary target P-rule is defined as follows $f : S \rightarrow P$, with $p(s_i, \hat{x})$:

- $p_i(s_i; \hat{x} \geq y) = 0, \forall i.$
- $p_i(s_i; \hat{x} < y) = \frac{1}{m}, i \leq m, p_i(s_i; \hat{x} \geq y) = 0 i > m;$

The second mapping $d : S \times X_i \rightarrow \{K, D\}$ is defined as follows: $d(\hat{x}, x_i) = K$ if $\hat{x} \geq y$ or if $\hat{x} < y$ and $x_i = 0$ and $d(x_i, \hat{x}) = D$ otherwise i.e., if $\hat{x} < y$ and $x_i = 1$.

In any state $\theta \in \Theta(k), k < y$, the PO faces the PA scheme described in section 4.1 and 4.2. We know that if $m \leq l$, the PO only steals in U . So the outcome is the same outcome as with APV.

In states $\theta \in \Theta(k), k \geq y$, the PO's chooses between delivering y services (and stealing $k - y$) or stealing $\hat{x} > k - y$ and facing partial verification. If all high productivity services are in M , the target rule allows him to steal $k - y$ in M and skip the verification which a worse than the APV outcome. Conversely, if all high productivity services are in U , the PO has no incentive to deliver any HQ and he will face the verification in M and be reconducted while stealing all the discretionary budget. So that is the same as in APV. The interesting cases are when not all high productivity services are in either subsets. Consider now the case when some of the y high productivity services are in U in the

sense that delivering y HQ requires refraining from stealing in U . The PO chooses between delivering the target and skipping the verification. Or failing the target and facing the verification in M . Since delivering the target requires the delivery of more productivity service than there are in M , the choice is obvious because the PO can secure reappointment when failing the target but complying in M . He gains nothing from complying with the target. We conclude that the sufficient target rule does worse than the simple PA scheme.

Proposition 7 *A P-rule that combines a sufficient target with partial verification does strictly worse for any $y > 0$ than the partial verification rule.*

Proof: see above

This result is somehow surprising because giving the opportunity to skip the verification has no incentive value whatsoever in this context.

Together with Proposition 5, the result in Proposition 6 and 7 suggest quite unexpectedly that information about service delivery is not of determinant significance for accountability. Indeed as we discussed in section 5.2, using that information to condition the verification probabilities affects incentives in a perverse manner. It leads to systematic stealing, while imposing a target leads to stealing under the target and using the target to condition a verification procedure is strictly dominated. While this is by no means a complete investigation of the value of using information about services quality, performance target and audit are indisputably most relevant classes of accountability mechanisms. The results in Prop. 4-6 reveal significant limitations in the use of information about service delivery.

5.4 On the role of announcements

We here discuss the value of requesting an announcement from the PO about the state of productivity and/or service quality. In the terminology of communication theory we now have an explicit sender, the PO and a receiver the CI. The question we ask is can communication improve upon the APV outcome by using these announcements?

Observable service delivery

Consider first the case with observable service delivery. We focus on announcement that are consistent with the observed vector of service delivery and with the production technology. Such announcements may either bring no new element e.g., announce $\tilde{\theta}_i = \underline{\theta}$ when $s_i = \underline{s}$ and $\tilde{\theta}_i = \bar{\theta}$ when $s_i = \bar{s}$. Or PO effectively announces that he diverted if he claims $\tilde{\theta}_i = \bar{\theta}$ when $s_i = \underline{s}$ for some i .

We start with claims relating to services in M and assume he claims $\tilde{\theta}_i = \bar{\theta}$ when $\tilde{s}_i = \underline{s}$, for some $s_i \in M$. In response to such a claim the P-rule may call either for an increase of the verification probability p_i or leave it unchanged. Assume first it leaves it unchanged. The reappointment rule

must dismiss the PO if verification confirms the claim so diversion took place otherwise it would open a way to steal unsanctioned. The reappointment rule may or may not sanction lies i.e., if verification disconfirm the claim so $\theta_i \neq \bar{\theta}$ so PO did not steal but he lied. Whether it is truthful so he diverted or if he lied but the CI did not change the probabilities, such a claim can never be optimal for the PO and it is strictly dominated if lying is sanctioned. If the mechanism reacts by increasing the verification probability, the claim can be used to manipulate CI's verification resource toward low productivity services $p_i > \frac{1}{T}$ and away from high productivity $p_j < \frac{1}{T}$ thereby reducing the chance to detect diversion and violating the IC constraint on those services. The same reasoning applies to a policy that would reduce verification probability. But that can never be optimal for the CI. But if the mechanism does not react by changing verification probabilities or sanctioning lies than announcements effectively play no role when $s_i = \underline{s}$, $s_i \in M$.

Now how about an announcement with some $\tilde{\theta}_i = \bar{\theta}$ when $\tilde{s}_i = \underline{s}$, $s_i \in U$? If the CI verifies with positive probability but sanctions lies (and diversion of course), there can be no point for PO to make such a claim. If it is true he will be dismissed and if it is false he will be dismissed as well. If CI verifies with positive probability but does not sanction lies then, PO will use the claim $\tilde{\theta}_i = \bar{\theta}$ when $\tilde{s}_i = \underline{s}$ when either $(\underline{\theta}_i, \underline{s}_i)$ (so he won't be sanctioned for diversion) to dilute the verification probability in M and the whole scheme breaks down. So CI could either only request announcement in M or discard announcement in U i.e., allowing PO to claim that he diverted without CI imposing any sanction.

Service delivery non-observable

We focus on consistent claims that is claims of the form $(\bar{\theta}_i, \bar{s}_i)$ $(\underline{\theta}_i, \underline{s}_i)$. Inconsistent claims can be either punished or discarded. We note that if either claim induces a change in the probabilities for detection, PO can and will use it to manipulate CI in order to reduce detection probability from services where he diverted. For instance if CI verifies $(\bar{\theta}_i, \bar{s}_i)$ claims in M more often than $(\underline{\theta}_i, \underline{s}_i)$ claims (or the other way around) the IC will be violated for some services in M . The argument also applies if a claim prompt a verification in U . Hence again we see that there is no value for announcement in this context.

This short discussion suggests that explicit claims have no role to play in the APV. At least in terms of monitoring. But their may be a value in terms of legitimacy of the sanction in case the PO announces he did not divert but diversion is detected and therefore also lying.

6 Social Accountability

In the previous sections we have established that there could only be limited gain to the use of information about service delivery in the accountability mechanisms that we investigated. In this section we introduce a new instrument that is rapidly spreading: service users' complaints. The idea is to make use of service users' superior information about the true state. We assume that service users are (with some probability) able to identify the reasons for the low quality of the service. They can see when e.g., a school is disfunctioning because the teachers do not receive their wage i.e., basic resources fail to accrue to the school - a situation that corresponds to a high productive state denied resources. They can distinguish that from a situation where only part of the teacher positions have been filled or the teachers have very low qualification - a situation that corresponds to a low productivity state. We do not model service users explicitly at this stage. We do however conjecture that the results will hold for strategic service users with preferences in line with those of the CI.

The objective of this section is to show that when the CI has access to service users' complaints, requesting that the CI makes a public claim of his records allow for significant improvement in accountability and consequently reduces the expected amount of diverted funds compared with the APV.

6.0.1 Social accountability

We shall consider the case when the vector of service delivery is not observable by the CI. The mechanism requests that the sender, PO "defends his records": makes a consistent announcement about both the productivity and the quality of each service. Thereafter, the service users are invited to complain i.e., to refute the announcement with respect to well identified services if they believe it is untrue. The refutation is cheap talk, service users do not provide hard evidence. We assume that they are sincere but they may be lazy and/or mistaken.¹⁸

Complaints are used to generate a signal, we shall not go into the details on how the signal is obtained. The idea is that a suitable algorithm aggregates the complaints received from service users e.g., on an electronic platform. We will show that there exists a P-rule using both announcement and complaints such as to improve upon the outcome of APV and even approach the first best outcome.

The communication phase of the game takes place after the PO made its allocation decision. It includes a public message or claim from the PO and response from service users who may refute the claim. Let $A : \{a_{i=0}^n\}, a_i = (\tilde{\theta}_i, \tilde{s}_i)$ be the set of claims. The PO is requested to declare a state of productivity and a quality level for each service. For simplicity we restrict the set of acceptable

¹⁸We are aware that providing incentives for users to participate to the mechanism maybe an issue in itself. But that is outside the scope of the present paper.

messages to consistent ones.¹⁹ We denote α any claim that confess diversion i.e., irrespective of the combination and the extent of diversion. After having seen the claim, the service users privately post complaints on the platform. The platform accepts two types of complaints, the set of acceptable complaints is C . Type 1: the PO claims the productivity and service quality is high $a_i = (\tilde{\theta}_i, \tilde{s}_i) = (\bar{\theta}, \bar{s})$, but user j posts a complaint $c_i^{1j}(a_i) = (\underline{\theta}, \underline{s})$ i.e., contending $(\theta_i, s_i) = (\underline{\theta}, \underline{s})$. These complaints are not related to diversion and they are assumed perfect signals.²⁰ Type 2 complaints are refutation of the productivity part of a claim $(\tilde{\theta}_i, \tilde{s}_i) = (\underline{\theta}, \underline{s})$ while service user j contend that $(\theta_i, s_i) = (\bar{\theta}, \underline{s})$, i.e., $c_i^{2j}(a_i) = (\bar{\theta}, \underline{s})$. Type 2 complaint implicitly suggest diversion occurred. All other kind of messages by service users are discarded by the platform that processes the announcement and the acceptable complaints to produce a signal $\sigma : A \times C \rightarrow \Sigma$, $\sigma = (\hat{a}, i^*)$. The first term, \hat{a} , is a signal about the number of high quality services. The second, i^* , is a signal about which service is most likely to have been the object of diversion.

More precisely, $\hat{a} = \#\tilde{s}_i; \tilde{s}_i = \bar{s}$ and such $\#c_i^j(a_i) = 0, \forall j$ i.e., no complaint was posted on announced HQ service i . The second signal is i^* , $i^* \in \arg \max_{c_i} (c_i^2, \dots, c_n^2)$ where c_i^2 is the complaint score of service i .²¹ It is (one of) the service(s) that has received the largest amount of type 2 complaints.²² Finally, let $\delta = \text{prob}(\{s_i = \underline{s}\} \cup \{\theta_i = \bar{\theta}\}; i = i^*)$, $\delta \leq 1$ is the probability that the PO diverted on service i conditional on service i having received the highest complaint score. For simplicity δ is independent on the amount of diversion. It captures the informativeness of i^* . $\delta = 1$ implies that i^* is a perfect signal. For simplicity we let δ be independent of the amount of diverted budget.²³

The idea of the P-rule is as follows. For the case the PO admits that he diverted funds $a = \alpha$, he is fired without verification. If $a \neq \alpha$ so it does not include any "confession" about diversion, we have the following rule applying. If the announced and uncomplained about delivery performance is good: $\hat{a} \geq y$ for some y to be defined, no verification will be performed. Otherwise verification occurs on i^* (one of) the service most subjected to type 2 complaints. If the announced performance is poor $\hat{a} < y$, verification will always take place on i^* . We next show that this scheme nearly achieves the first best complete information outcome. More precisely the Social Accountability P-rule (SAP) is as follows $f : A \times \Sigma \rightarrow P$, with $p(a, \sigma) :$

¹⁹If the claim is inconsistent e.g., $(\underline{\theta}_i, \bar{s}_i)$ for some i , the CI asks the PO to correct it. Not complying producing a consistent claim, is equivalent to refusing to subject oneself to the accountability mechanism and it is sanctioned by dismissal.

²⁰A false claim that everything is fine when it is not is very easy to identify and there will always be a service users outraged by the lie who complains.

²¹All services are assumed to have an equal number of users and those users have an equal propensity to complain and they are identical with respect to their accuracy.

²²When there are more than one service with the highest number of complaints, i^* is drawn at random among them.

²³It is a research task in itself to design the information processing algorithm to make best use of the information in the complaints. We here only consider a very simple technology.

For $a = \alpha$,

$$p_i(\alpha, \sigma) = 0, \forall \sigma.$$

For $a \neq \alpha$

- $p_i(\hat{a}, i^*) = 0$, if $\hat{a} \geq y \forall i$;
- $p_i(\hat{a}, i^*) = 1$, if $\hat{a} < y$ and $i = i^*$;
- $p_i(\hat{a}, i^*) = 0$ if $i \neq i^*$.

The second mapping $d : A \times \Sigma \times X_{i^*} \rightarrow \{K, D\}$ is defined as follows: $d(a, \sigma, x_{i^*}) = K$ if $a \neq \alpha$, $\hat{a} < y$ and $x_{i^*} = 0$ or $\hat{a} > y$ and $d(a, \sigma, x_{i^*}) = D$ otherwise i.e., if $a = \alpha$ or $\hat{a} < y$ and $x_{i^*} = 1$.

We now investigate the PO incentives to take action and make announcement in response to this P-rule for pre-announced y . We shall proceed by backward induction. We distinguish between two cases corresponding to a partition of the set of states into Case 1: $\theta \in \cup_{k=0}^y \Theta(k)$ and Case 2: $\theta \in \cup_{k=y}^n \Theta(k)$.

Case 1: *A PO of type $k < y$*

We consider PO's choice of announcement. First note that there can be no point in announcing $a = \alpha$ since the PO is then dismissed with probability 1. This means that for any $\hat{x} > 0$, $a^* \neq \alpha$, the announcement effectively hides the truth on at least \hat{x} services. Next, whatever \hat{x} , and whatever $a \in A$, $\hat{a} \leq y$ because $a > y$ will be refuted since there cannot be y services not complained about (which would lead to automatic reappointment) because $k < y$. So the PO may just as well announce $a = \hat{a} < y$. The P-rule will induce the verification of $i^* \in N$ with probability δ PO is detected and loses his job. Since the risk of detection is independent of the number of diverted shares, the PO faces a binary choice i.e., whether or not to divert the whole discretionary budget: $\hat{x} = k$:

$$\frac{\hat{x}}{n}B + (1 - \delta)w < w \Leftrightarrow \frac{y}{n}B < \delta w \quad (11)$$

within the set of states the most demanding constraint is at $k = y$ implying that for the IC to be satisfied we need $y \leq \delta l$.

We conclude that for a PO of type $k < y \leq \delta l$, refraining from diversion and announcing the truth is optimal. we note however that what announcement concerns the equilibrium is far from unique. So in particular any a with \hat{a} would do.

Case 2: *A PO of type $k \geq y$*

If PO announces $a > y$ such that $\hat{a} > y$ there are at least y services announced as high quality that have not been refuted, which means that $\hat{x} \leq k - y$. The PO is reconducted without verification. While if $\hat{a} < y$ allowing for $\hat{x} > k - y$ there will be verification and detection with probability δ . With the same reasoning as above the choice is binary diverting $k - y$ or k IC writes:

$$\frac{k - y}{n}B + w > \frac{k}{n}B + (1 - \delta)w \quad (12)$$

$$\frac{y}{n}B - \delta w < 0$$

which we know is satisfied for $y \leq \delta l$. So, for $y \leq \delta l$ it is optimal for the PO to divert on $\hat{x}^* = k - y$, to announce some $a = y$ such that $\hat{a} > y$ and since $a = \alpha$ triggers dismissal, he will not be truthful on the $k - y$ services where he diverts. So in equilibrium we have untruth announcement and complaints that do not lead to verification.

The CI's objective function writes

$$\max_y EV^{SAP} = \sum_{i=0}^{i=y} q(i) \frac{i}{n}B + (1 - Q(y)) \frac{y}{n}B \text{ s.t. } y \leq \delta l$$

which is maximized at $y^* = \delta l$, the calculus is the same as in the complete information case (see p.9).

This gives us the following results. Let δ denote the informativeness of the signal generated by the user's complaints,

Proposition 8 *A P-rule using user complaints and announcements can achieve*

- (i) *high quality delivery of all productive services in every state in $\Theta(k)$ for $k < \delta l$ and*
- (ii) *high quality delivery of δl productive services in every state in $\Theta(k)$ for $k \geq \delta l$.*
- (iii) *In equilibrium the expected saved budget is $EV^{SAP} = \sum_{i=0}^{i=\delta l} q(i) \frac{i}{n}B + (1 - Q(\delta l)) \frac{l}{n}B$.*

Proof: The proof follows from the reasoning above.

Remark 4 *In the absence of announcement, a P-rule built on complaints alone allows detecting diversion with probability δ independently of the amount of diversion. Such a P-rule fails to deter diversion in any state belonging to $\Theta(k)$, $k \geq \delta l$.*

Proof: The logic of proof is similar to that of Proposition 1 showing the optimality of leniency.

Proposition 8 and Remark 4 establish that a P-rule that uses information from service users and the PO's announcements can approach the complete information outcome. The role of the announcement in a context where refutation only can be obtained from service users, is to make possible a state contingent leniency rule in a way similar to the optimal full information scheme. In contrast with APV where leniency is state *independent* i.e., it applies fully and within the pre-announced subset U . With PO announcement and refutations, the leniency rule applies only in states where the target is feasible. The SAP (Social Accountability P-rule) secures full compliance (no diversion) in states $\theta \in \cup_{k=0}^m \Theta^m(k)$ and it secures at least δl services in $\theta \in \cup_{k=m}^n \Theta^n(k)$. So because SAP is state depend, for δ close to 1, it dominates the APV even in the absence of announcement (Remark 4). The role of complaints is further to guide verification so as to maximize detection probability. The imperfect informativeness of the signal i^* bounds away the outcome for the first best.

The result in Proposition 8 is consistent with Lipman and Seppi (1995). The parties involved in communication that is the PO and the service users have conflicting interests²⁴ with respect to the CI's decision about reappointment in some state of the world i.e., when the PO has diverted money from the provision of services. If the service users were able to prove their counter claim, the failure of the service users to refute PO's claim with respect to any service could be used as sufficient evidence to prove that the claim is true. No verification by the CI would then be needed. In our context users' complaints are not hard evidence. Instead they are used to guide verification to provide the evidence of diversion. Another issue is that in our context the CI does not care about truth per se. What he cares about is diversion. So in particular false claims that do not hide diversion can be used to manipulate verification as we already noted in section 5.4. By distinguishing between (type 1) complaints against false "good news" hiding low productivity state with low quality service from (type 2) complaints that may hide diversion, the SA P-rule contains PO's incentives to falsely claim good news.

The result in Proposition 8 also underlines the significance of the informativness of the signal produced by the platform. A immediate recommendation is for the CI to devise a platform which processes information in the most efficient way so as to generate the most informative signal about diversion.

7 Concluding Remarks

This paper is concerned with a situation where a public official has been delegated the task to allocate resources for the production and delivery of public services. But he may divert money to his own pocket. The context is that of a principal-agent situation where the principal is limited by on one side a fixed wage and on the other side limited liability: he may only dismiss the agent.

We are interested in the monitoring value of a number of ex-post accountability mechanisms i.e., persuasion rules that rely on limited verification resources and may use communication.

Our first finding is that because of the fixed wage, the first best complete information outcome exhibits diversion of funds in some states. The optimal accountability mechanism departs from the zero tolerance principle. Instead, it is characterized by a satisfaction level (e.g., a number of high quality services) above which the PO is implicitly allowed to divert funds. In the absence of any information about the PO's behavior, the optimal P-rule based on random verification calls for verification in a pre-announced subset of services. Surprisingly, the availability of information about the quality of service delivery (a signal of PO's behavior) is of very little value. In particular we find that a most intuitive mechanism which consists in a rule that calls for the verification of services where diversion

²⁴We identify the service users' interest with those of the CI.

might have occurred i.e., low quality services is a very bad idea. It leads to maximal diversion. The intuition is that such a rule increases the PO's cost of refraining from diversion in the first place. Instead diluting detection probability maximally by diverting whenever possible becomes optimal. We also show that combining random verification with a necessary performance target weakly improves upon the optimal selective random verification outcome. We also find that asking the public official to defend his records is of no value in those mechanisms. However, the picture changes dramatically as we introduce service users and invite them to submit cheap talk complaints. We show that requesting that the public official publicly defends his record and giving service users an opportunity to refute his claim can be exploited in a mechanism that approaches the complete information first best. This result supports the intuition behind social accountability initiatives. It reveals that a well-designed persuasion game involving the public can play a significant role in securing the accountability of public officials and reducing the extent of corruption.

The analysis offers a framework that can be generalized along various dimensions to provide concrete recommendations as to how new technology can be used to improve governance.

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