# Predatory States and Failing States: An Agency Perspective *

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**Abstract**

In any non-trivial state, policies decided at the top levels of government are administered by middle-level bureaucrats. I examine whether this agency problem can contribute to explaining state failure in matters of provision of public goods. I find some theoretical arguments to support the view that failure is more likely in states whose top rulers have predatory motives. When the bureaucrats' cost of providing the public good is their private information, rulers must give them incentive rents to achieve truthful revelation. Predatory rulers are less willing to part with such rents; therefore they tolerate more downward distortion in the provision of public goods to reduce the required rent-sharing. When the bureaucrats' actions are also unobservable, there is a synergistic interaction between more benevolent rulers and more caring or professional bureaucrats. However, these effects manifest themselves differently and to different degrees under different conditions of information. Therefore precise explanations or predictions in individual instances require context-specific analyses.

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Fantastic grow the evening gowns;
Agents of the Fisc pursue
Absconding tax-defaulters through
The sewers of provincial towns.
...
Caesar's double-bed is warm
As an unimportant clerk
Writes I DO NOT LIKE MY WORK
On a pink official form.

- W. H. Auden, *The Fall of Rome*

# 1 Introduction

"Nation-states exist to provide a decentralized method of delivering political (public) goods to [their citizens]." So begins the analysis by Rotberg (2004, p. 2) of governments' failures to fulfill this basic purpose. His list of public goods span a broad range: security of persons and property, institutions of dispute resolution, institutions of political participation, central banking, methods of regulating the use of common resources, health care, education, and physical infrastructure. Government failure in these respects leads to economic failure. Insecurity of property and contracts, poor infrastructure, poor health and education, all reduce the return to private effort and destroy private incentives.

Rotberg (*ibid,* pp. 4–10) gives a taxonomy and characterization of various degrees of state failure, labeling the successively worse cases as *weak, failing, failed,* and *collapsed* states; for brevity I will use the term failing states. He finds the phenomenon pervasive in today's world. Applying his criteria for the various degrees of failure, he counts 30 weak states, 7 failing states, 2 failed states, and 3 collapsed states (*ibid,* pp. 46–49).

Rotberg also identifies and discusses various correlates and causes of state failure. Internal conflict and violence rank high in this list. However, Rotberg recognizes (*ibid*, p. 5) that all states contain heterogenous interests, and the failure to manage such conflicts of interest is "more a contributor to, than a root cause of, nation-state failure." It acquires greater importance as one proceeds to worse levels of failure, so it is perhaps best seen as a part of a cumulative process of mutual feedbacks between conflict and failure.

Next comes the intent of the rulers; "[i]n most failed states, regimes prey on their own constituents" (*ibid*, p. 6). Economists have also recognized that the benevolent government that graces many of their models, maximizing social welfare or total social surplus, is at best an ideal against which to contrast actual governments. Buchanan, Herschel Grossman and others have accustomed us to the idea that predatory governments extracting economic rents from the citizenry are perhaps closer to reality than the benevolent ones of the traditional normative theory. Shleifer and Vishny (1998) memorably call this the "grabbing hand" view as opposed to the traditional "helping hand" view of government.

Casual thinking might suggest that the ruler's predatory intent by itself explains state failure; why would a grabbing hand feed public goods to its victims? However, Olson (1993) has taught us that a robber government need not fail when it comes to provision of public goods. If the government is sufficiently stable in its rule to take a long term view, or in Olson's terminology, it is a "stationary bandit" instead of a short-term "roving bandit," it may recognize that its best policy is to "cultivate" the private economy like any productive asset, producing more in order to extract more. Indeed, Coasian intuition suggests that a predatory ruler should strive to maximize total economic output. Olson argues that even his "stationary bandit" will fail to achieve the level of efficiency that a democratic government would, because the citizenry that constitutes or controls the government takes more fully into account, or encompasses, the distortionary effects of taxation. However, he simply assumes that taxation must be proportional at a constant rate $t$, and fails to consider the possibility that less distorting instruments may be available to the predatory ruler.

A better explanation comes from endogenizing the time horizon of the predatory ruler. Olson's classification between stationary and roving bandits is exogenous. But in reality the ruler's actions may affect his longevity; in particular, public goods that improve the citizens' abilities to obtain information and communicate with others may make them better aware of the ruler's shortcomings and facilitate their collective action to topple him. Then the ruler will underprovide such public goods. The classic example of this is the advice that the Mobutu Sese Seko, for many years dictator of Zaire (Congo) supposedly gave to a fellow dictator: "Never to build any roads; that will only make it easier for your enemies to reach the capital." Robinson (2001) analyzes this issue and offers several examples.

I will show in the concluding section how this can be incorporated in my model, but my main focus in this paper is different. It arises from the third characteristic of failing states identified by Rotberg, namely "[t]he bureaucracy has long ago lost its sense of professional responsibility" (Rotberg, p. 7). However, bureaucracy is unavoidable for the governance, or even for misgovernance, in all but tiny states. In any non-trivial state, the process of policy implementation is too complex for the top levels of government to exercise their authority over the citizens directly, regardless of whether their intentions are benevolent or predatory, and whether they wish to supply public goods or to collect taxes. Instead, they must carry out their policy using middle and lower level agents. Rotberg assumes this implicitly in the quote at the start of this section, when he speaks of states as "a *decentralized* method of delivering political (public) goods" (emphasis added).

Some examples of supposedly absolute rulers illustrate the point. Louis XIV of France embodied "royal absolutism"; he was supposed to be "a supreme potentate whose wish was law." But in reality, "[i]t was not like that. Consider first the dead weights on his activities ... the 60,000 or so inferior officials who could not be sacked and at their low-flying level were, really, independent of the king" (Finer, 1997, p. 1332). Even Stalin was not omnipotent (Service, 2004, p. 8). Gregory and Harrison (2005) review and discuss extensive recent archival research highlighting the numerous and complex problems of information, incentives, and rent-seeking he faced in his "hierarchy of 'nested' dictatorship." Finally, Harford (2006, pp. 182–189) gives a picturesque and instructive account of state failure in Cameroon. He accepts that the government led by Paul Biya acts like a bandit, but asks why it does not rob the country efficiently even though Biya's stay in power is long and seemingly permanent: he gets about 75% of the vote in passably fair elections. Harford's answer is that "Biya is not in control as much as it first appears ... [W]hether or not Biya is the bandit-in-chief, there are many petty bandits to satisfy." Biya is the principal and the petty bandits are his agents, but he cannot control them perfectly.

The need to operate through intermediate layer or layers of administration creates the usual agency problems for the rulers. They have to rely on the bureaucracy to access the information that is essential for their policymaking, and can monitor the bureaucrats' actions only by using other bureaucrats.

The implementation of policy is therefore a principal-agent problem, the top ruler being the principal and the bureaucrats the agents. The principal designs the policy mechanism to optimize his own objective, subject to the agent's incentive and participation constraints. As usual, the optimal solution requires sharing some rent with the agent to give him the incentive to reveal the information and to take the appropriate actions. The principal's desire to keep down the cost of giving up this rent also entails some modification or distortion of the actions themselves. How much rent the principal finds it optimal to give to the agent, and how much distortion he tolerates to keep down the rent transfer, depends on the principal's objectives. The agent's malfeasance depends on the degree of his selfishness versus his innate caring for the citizen's welfare, arising from either benevolence or professionalism. Given these distinctions, we should expect the extent of distortion and maldistribution to differ in different states.

Thus we have a new question: Are agency problems in dealing with bureaucrats worse for a predatory ruler than for a benevolent ruler? This can happen in two ways. First, a predatory ruler may have stronger motivations to limit the rent given away to his bureaucrats, and therefore may be more willing to tolerate distortions in order to reduce the rent transfer. Second, interactions arise endogenously if benevolent rulers can selectively attract unselfish or professional bureaucrats, whereas predatory rulers attract selfish ones. Such interactions between the ruler's intent and agency problems are the focus of this paper.

I take the ruler's objectives to be exogenous (embodied in equation (5) below), and compare the outcomes under rulers with different exogenously specified objectives. This differs from other models of politics in some respects.

The focus of much of formal political theory, explicitly or implicitly, is on endogenous explanation of the top ruler's objectives – it models the processes of elections, legislative bargaining, lobbying, and so on, which determine how and what kind of top-level ruler emerges. But most of that theory implicitly assumes that once the political process is complete, the implementation of the ruler's optimal policy will be a relatively routine matter. In this sense, this paper can be regarded as complementary to that literature.

A recent line of formal political modeling assumes that all rulers are at heart bandits seeking to maximize their own take from the economy; different types of polities differ only in the constraints on the rulers' choices. Of the many examples of this, I mention one especially prominent, namely Bueno de Mesquita and coauthors (2003). The key magnitudes in their theory are the sizes of the set of people who have a say in choosing the rulers, called the *selectorate,* and of the subset that is crucial for maintaining the rulers in power, called the *winning coalition*. If the winning coalition is small relative to the selectorate, as in an autocracy, the ruler is secure in power; the current winning coalition is quiescent, knowing that the ruler can easily construct another coalition to replace it. Such a ruler and his clique can enjoy private goods without the need to provide many public goods. But if the winning coalition is large relative to the selectorate, as in a democracy, then replacing the winning coalition is difficult and the ruler's choices are constrained by the need to reward the existing coalition to keep it happy. It is very costly to do so by providing private goods to the large winning coalition; therefore such a ruler will provide more public goods.

My model differs from this in two ways. A relatively minor difference is that the public goods in their theory enter directly into the payoff function of the selectorate, whereas those in my model, and in most of the discussion of failing states, they are intermediate public inputs that are complementary to private effort in providing the ultimate consumption goods. A more important substantive difference concerns the objective function of the ruler. I believe that the assumption that rulers are interested only in office, or are all bandits at heart and are constrained only by the threats of rebellion, is too extreme. History is full of examples of rulers who idealistically valued their citizens' welfare to varying extents, and theory should incorporate this in the rulers' objectives.

In the same vein, I should stress that in this paper the focus is on the distinction between different objectives of the state (benevolent versus predatory), not on the distinction between different forms of the state (democracy versus dictatorship or oligarchy, for example). There is a correlation between the two dimensions of objectives and form, but it is not perfect. So benevolent dictatorial or authoritarian regimes that do a good job of providing many public goods for their subjects do not constitute counterexamples to the model.

The agency problems inherent in economic policy have of course been analyzed extensively in the literature, but mostly within the context of a social-welfare maximizing top level. This includes most three-tier models of corruption, e.g. Becker and Stigler (1974), Tirole (1986), Banerjee (1997) and Guriev (2004), which consider how far a benevolent ruler can control corruption among middle-level bureaucrats. It also includes most Ramsey-Boiteaux type models of regulation, extensively reviewed and discussed in Laffont and Tirole (1993), where the top tier has the "socially correct" objective function, with different specifics of who is supposed to do what and who has what information.

Laffont (2000) regards politicians as selfish and corruptible; his top-level principal is the constitution designer who lays down the rules, constraints, incentive schemes, and checks and balances for politicians, to maximize the fully benevolent objective of maximizing total social surplus, subject to the constraints on instruments arising from various information asymmetries. However, the assumption of benevolence at the top levels of the government seems unrealistic for weak or failing states, and perhaps also for many other states. Many states have a grand-sounding or even well-intentioned constitution, but it is merely a façade behind which the actual top-level rulers make policy at will. Sometimes they can even change the constitution to suit their needs or whims. Therefore the case of predatory rulers is worth more attention in the agency context. Shleifer and Vishny (1998) recognize that governments are not benevolent, and that much of the malfeasance they discuss takes place at the level of the bureaucracy, but they generally regard the government as a single entity and do not analyze the agency problems that arise in multi-tiered governments.

I conduct the analysis using a very simple three-tier model that departs from the basic structure of Laffont, Tirole et al. only in the objectives of the top-level ruler and the middle-level bureaucrat. In the next section I describe this structure; the sections that follow consider different conditions of information and monitoring. In the text I state and interpret the results. The mathematical derivations are in an appendix at the end, whose sections carry the same numbering and titles as the corresponding sections in the text.

Here are some of the main results from the model.

[1] If the ruler has full information about the bureaucrat's technology (or cost function) for providing the public good, and can observe all of the bureaucrat's actions – the amount of the public good he provides, the amount of fee he extracts from the citizen, and the sum he remits to the ruler – then the ruler, regardless of his own benevolence or lack of it, implements the efficient level of the public good. This is Olson's stationary bandit acting in an optimal Coasian manner. The only reason to depart from this under full information is the existence of a dead-weight loss in transfers for some other reason; Olson assumes this by stipulating a proportional income tax.

[2] If the ruler cannot observe the bureaucrat's type, but can observe his actions, then the optimal policy involves a downward distortion in the quantity of public good supplied by the higher-cost types of bureaucrats. The distortion is bigger in the case of a fully predatory ruler than in the case of a fully benevolent ruler; in this sense we should expect predatory states to be more prone to failure when it comes to providing public goods. As an extreme case, if there are no dead-weight losses of monetary transfers, then a fully benevolent ruler does not distort the level of the public good downward at all, but a predatory ruler does so. More generally, under a ruler who wants to extract from the citizen, the distortion is independent of the degree of the bureaucrat's concern for the citizen, and so is the amount of rent the high-cost type bureaucrat gets. Under a ruler who is generous toward the citizen, the distortion is perhaps paradoxically larger when the bureaucrat's concern for the citizen is greater, and such a bureaucrat gets less rent. Thus, in this information condition, the intuition that a generous ruler will be able to attract more concerned bureaucrats is not borne out. However, the citizen and the ruler alike achieve higher levels of utility when the bureaucrat has a greater degree of concern.

[3] Next I consider the cases where the ruler does not know the bureaucrat's cost type, and can observe only one of the two actions of the bureaucrat. First suppose the quantity of public good the bureaucrat provides to the citizen is hidden from the ruler, but the fee the bureaucrat extracts from the citizen is observable. This is the case perhaps closest to reality in many situations – the quantity and especially the quality of public goods is many-dimensional and hard to monitor; financial transactions are more amenable to reporting and auditing procedures. In this case, an extractive ruler can achieve the same outcome as if the quantity of the public good were observable (which admittedly has a substantial downward distortion as was mentioned in item [2] above) by hiring a bureaucrat with minimal direct concern for the citizen's welfare, and forcing him to supply the public good solely to ensure that the fee mandated by the ruler's mechanism can be extracted from the citizen consistently with the citizen's participation constraint. It is actually better for such a ruler if the bureaucrat has little or no direct concern for the citizen's welfare, and the bureaucrat's rent is independent of his degree of concern for the citizen. A highly generous ruler, on

the other hand, does better to rely on the bureaucrat's innate concern for the citizen, and in this situation we find a remarkable confluence of interests – the citizen, the bureaucrat, and the ruler are all better off when this degree of concern is higher. Therefore in this information condition we do have reasons to expect a synergistic matching of predatory rulers with uncaring bureaucrats, and of generous rulers with caring bureaucrats. Moreover, the predatory ruler has greater motive to distort the quantity of public goods downward. Thus Rotberg's observation cited above, that in failing states the bureaucracy "has long ago lost its sense of professional responsibility," may arise because predatory rulers want it to be so.

[4] Now suppose the fee is unobservable because the bureaucrat can extract hidden payments from the citizen, but the public good is observable. Again an extractive ruler can replicate the outcome with observable fees, because he can calculate and therefore knows the maximum fee the bureaucrat can and will extract while satisfying the citizen's participation constraint. But a generous ruler does not like such an outcome. He can achieve benefit for the citizen only if he can hire a bureaucrat with a really high degree of concern for the citizen, perhaps a non-governmental organization with outside resources. Then he can exploit the situation and achieve a level of the public good that is ideal from the citizen's perspective.

[5] Finally, suppose the ruler can only observe the amount the bureaucrat remits to him, but does not know the bureaucrat's cost type and can observe neither the quantity of the public good he provides to the citizen nor the fee he extracts from the citizen. In this case the bureaucrat acts like a Coasian contractor with the citizen, providing an efficient quantity of the public good. A bureaucrat without excessive concern for the citizen extracts all of the consumer's surplus, and the ruler can in turn extract what the high-cost type of bureaucrat gets. A generous ruler can achieve benefit for the citizen only by hiring a bureaucrat with a really high degree of concern for the citizen, perhaps a non-governmental organization with outside resources.

Thus we do find some support for the idea that predatory states are likely to exhibit a greater degree of failure. Moreover, as informational limitations become more severe, it becomes more important for a predatory ruler to hire selfish bureaucrats, and it becomes more likely that benevolent rulers and caring bureaucrats will have a symbiotic relationship.

However, whether the problem of state failure – poor provision of public goods – is aggravated by the presence of the tier of agency between the ruler and the citizen depends on the precise information condition. For example, in the very worst condition when the ruler cannot observe any of the bureaucrat's actions, the bureaucrat acts as a Coasian contractor or an Olsonian stationary bandit to provide efficient levels of the public goods, but takes away all of the consumer's surplus by charging a high fee. Therefore predicting state failure from the ruler's or the bureaucrat's motives is not simple, and needs careful case-specific analysis.

These results obtain even in my extremely simple and basic model of agency. In the concluding section I will suggest extensions to examine some other dimensions of agency from these perspectives.

## 2 The structure of the model

The model has three participants: the citizen, the bureaucrat, and the ruler. The ruler is the principal and the bureaucrat is his agent. The citizen should be thought of as a representative of his class. The bureaucrat may likewise be a representative, although the simultaneous existence of several agents creates opportunities for the ruler in the form of relative performance schemes that are not studied here.

The ruler sets up the policy mechanism subject to the bureaucrat's incentive and participation constraints. There is also a participation constraint for the citizen; this may be interpreted as the payoff level below which the citizenry is likely to rebel. The objective functions of the ruler and the bureaucrat may take some account of the citizen's welfare; these will be specified shortly.

The bureaucrat supplies a public good $K$ to the citizen at a cost $\frac{1}{2}\gamma K^2$. In later sections $\gamma$ will be the bureaucrat's private information, and the quantity of the public good he supplies may also be unobservable to the ruler. The ruler must ensure fulfillment of the bureaucrat's participation constraint, which may reflect the bureaucrat's alternative employment opportunities in the private sector or even in some other country, or, especially if the bureaucracy is taken to include the military, it may be the level of utility below which the bureaucrat would rebel.

The citizen supplies labor $L$ at a subjective cost $\frac{1}{2}L^2$ to produce gross output $Q = \min(K, L)$. Thus I am assuming that the public good and the citizen's labor are perfect complements. This captures in the sharpest and simplest way the idea that if the state supplies less of the public good, the citizen's private economic incentives are also weakened. The qualitative results will generalize to less extreme complementarity between the two. The citizen also has a participation constraint; this captures the need to ensure his survival or to prevent his emigration, or the level of utility below which the citizens would rebel. I will discuss this in more detail later.

There are financial transfers. Denote the amount the bureaucrat receives from the citizen by $F$, and the amount the ruler receives from the bureaucrat by $R$. The ruler may value $R$ for private consumption as in the case of Mobutu and many other dictators; however, Stalin and some others used it for investment (Gregory and Harrison, 2005, p. 741), sometimes in projects valued for the prestige they gave to the ruler or the country, or for military expenditures. I require $R \geq 0$; the zero can be replaced by any constant, positive or negative, with no significant change in the analysis. The constraints on $F$ are less clear. The bureaucrat's cost of supplying the capital good may be a monetary cost that must be covered. Alternatively, the cost may be a utility cost, but the bureaucrat's net monetary receipts must be non-negative. Sometimes, the bureaucrat may actually be a non-governmental organization with access to outside resources that can be transferred to the citizen or milked by the ruler. I will consider various possibilities at appropriate times in the analysis.

Under fully ideal conditions, namely a benevolent ruler, complete information, and non-distorting transfers, the choices that maximize total social surplus are

$$L^* = K^* = \frac{1}{1+\gamma}\,. \tag{1}$$

The bureaucrat is allowed a fee that exactly compensates him for his cost, and the ruler extracts nothing from the bureaucrat. The maximized total social surplus is $1/[2\,(1+\gamma)]$.

In reality, various problems preclude attainment of this ideal, and in this paper I focus on two:

[1] Transfers from the citizen to the bureaucrat and from the bureaucrat to the ruler may occur in leaky buckets. I assume that to deliver $F$ to the bureaucrat, the citizen must pay $(1+\lambda_C)\,F$, and to deliver $R$ to the ruler, the bureaucrat must pay $(1+\lambda_B)\,R$, where $\lambda_C$ and $\lambda_B$ are exogenous parameters. This closely follows, as does much of my model, Laffont (2000, pp. 23-27) and Laffont and Tirole (1993, pp. 55-63). The standard motivation for $\lambda_C > 0$ in the literature is that it is the shadow cost of public funds, stemming from some (here unspecified) Mirrlees-type model of informational limitations in taxation. The motivation for $\lambda_B > 0$ is more complex; it may be the cost of hiding side-transfers through gifts or perks, or psychic costs of illegal or unethical behavior. In a thoroughgoing kleptocracy the ruler and the bureaucracy may face no such costs and $\lambda_B$ may be close to zero. I leave the endogenization of these parameters outside the model, even though it would be preferable to explain the leakiness. However, I do allow the special cases where $\lambda_B$ and/or $\lambda_C$ equal zero. My main purpose is to contrast predatory and benevolent rulers. I will show that when the ruler has at least some predatory purpose, agency remains a problem and the ruler's complete-information ideal is unattainable even if $\lambda_C = \lambda_B = 0$. By contrast, I will confirm that in conventional normative models of policy where the top ruler wants to maximize social welfare, leakiness is essential; the agency problem entails no cost and the first-best is attainable if $\lambda_C = \lambda_B = 0$.

[2] The bureaucrat's cost parameter $\gamma$ may be his private information. As in Laffont (2000, pp. 23-27) and Laffont and Tirole (1993, pp. 55-63), I assume that the bureaucrat can be one of two types $L$ and $H$, with probabilities $\theta_L$ and $\theta_H$, and cost parameters $\gamma_L < \gamma_H$, respectively. Also, the bureaucrat's choice of $K$ may or may not be observable to the ruler. Thus the agency problem may involve both moral hazard and adverse selection. I examine various possibilities. Where distinction between types and information asymmetry are not pertinent issues, I suppress the subscript on $\gamma$ for notational convenience.

When the dead-weight losses from the leaky buckets enter the picture, the citizen's surplus is

$$S_C = K - \tfrac{1}{2}\,K^2 - (1+\lambda_C)\,F\,, \tag{2}$$

and the bureaucrat's surplus is

$$S_B = F - (1+\lambda_B)\,R - \tfrac{1}{2}\,\gamma\,K^2\,. \tag{3}$$

The citizen's payoff or utility $U_C$ is simply his surplus. However, the bureaucrat, whether from benevolence or from professionalism, may internalize some of the citizen's payoff. Therefore I write the bureaucrat's payoff or utility as

$$U_B = S_B + \beta\,S_C \tag{4}$$

where $\beta \geq 0$ is a parameter. The top-level ruler may internalize some of the citizen's and the bureaucrat's surpluses. I write the ruler's payoff or utility as

$$U_R = R + \rho_B\,S_B + \rho_C\,S_C\,, \tag{5}$$

where $\rho_B,\ \rho_C \geq 0$ are parameters.[1]

In reality, some of these concern parameters, especially $\beta$ and $\rho_B$, will be endogenous as the ruler chooses his bureaucrats. I will comment on this at various points, but leave the full endogenization for future research.

The bureaucrat and the citizen both have participation constraints. In most of the analysis, I normalize the right hand side of each constraint (the outside opportunity or the minimum utility needed to ensure survival or prevent rebellion) to zero. Therefore the bureaucrat's participation constraint is

$$U_B \geq 0\,, \tag{6}$$

and the citizen's is

$$U_C \geq 0\,. \tag{7}$$

The choice of zero instead of some other constant is harmless, but assuming that the right hand side is constant independent of the ruler's actions is restrictive and precludes the cases like Mobutu's, where an increase in $K$ would tighten the participation constraints. In the concluding section I will show how this can be handled by a slight modification of the model.

The conventional model where the ruler is fully benevolent and the bureaucrat is purely selfish has $\rho_B = \rho_C = 1$ and $\beta = 0$. The case where the ruler is purely predatory and the bureaucrat is purely selfish corresponds to $\rho_B = \rho_C = \beta = 0$. I will consider the general case, with only two maintained restrictions:

[1] *Limit to the bureaucrat's concern for the citizen:* The bureaucrat is not so unselfish that he would pass up the opportunity to collect money from the citizen using the leaky bucket, but with no other costs or consequences. Since a unit of money raises the bureaucrat's surplus by 1, but lowers the citizen's surplus by $(1 + \lambda_C)$ which the bureaucrat values at $\beta$ per unit, my assumption becomes

$$\beta\ (1 + \lambda_C) < 1\,. \tag{8}$$

[2] *Limit to the ruler's nepotism:* The ruler's utility rises when less money is transferred from the citizen to the bureaucrat via the leaky bucket, leaving all other things unchanged. Considering the ruler's valuations of the consequences of such a transfer, this assumption translates into the inequality

$$\rho_B < \rho_C\ (1 + \lambda_C)\,. \tag{9}$$

The first of these assumptions seems quite realistic, but some middle-level policy implementing agents may be non-governmental organizations, especially foreign ones, that have great innate concern for the citizens' welfare. The second is also intuitive so long as the bureaucrat is a hireling to whom the ruler has no special attachment. Both assumptions hold

[1] I have assumed that the ruler's utility depends on the bureaucrat's *surplus*, not on the bureaucrat's *utility*. However, the two formulations are equivalent with simple redefinitions of the parameters. Thus, if

$$U_R = R + \rho'_B\ U_B + \rho'_C\ S_C = R + \rho'_B\ S_B + (\rho'_C + \beta\,\rho'_B)\ S_C$$

we need only set $\rho_B = \rho'_B$ and $\rho_C = \rho'_C + \beta\,\rho'_B$.

in the conventional case where the ruler is fully benevolent and the bureaucrat is selfish; both also hold, the second weakly so, in the case where the ruler is totally predatory and the bureaucrat is selfish. The second may fail in a nepotistic situation where the bureaucrat is the ruler's relative or friend.[2] Therefore, although I will maintain both assumptions in most of my analysis unless otherwise stated, in some appropriate contexts I will consider the opposite cases.

A third relationship among these parameters proves important as a dividing line between cases in the analysis that follows. Consider taking one unit of money from the citizen and passing it to the ruler via the bureaucrat. Because of the leaky buckets, the ruler receives $1/[(1+\lambda_B)(1+\lambda_C)]$. He also loses utility $\rho_C$ because of the reduction in the citizen's surplus. The bureaucrat's *surplus* does not change, but his *utility* goes down by $\beta$. This does not directly affect the ruler's utility. But suppose the bureaucrat is being kept down to his participation constraint. Then the ruler must extract $\beta$ less from the bureaucrat to keep meeting that constraint. This has a direct cost $\beta/(1+\lambda_B)$ to the ruler. Also, it increases the bureaucrat's surplus by $\beta$ and therefore the ruler's utility by $\rho_B\,\beta$.

Taking all these effects into account, the ruler wants to extract money from the citizen via the bureaucrat, while keeping the latter just meeting his participation constraint, if

$$\frac{1}{(1+\lambda_B)\,(1+\lambda_C)} - \rho_C - \frac{\beta}{1+\lambda_B} + \rho_B\,\beta > 0\,,$$

or

$$\beta\,(1+\lambda_C) + (\rho_C - \rho_B\,\beta)\;(1+\lambda_B)\,(1+\lambda_C) < 1\,. \tag{10}$$

I will call this the *extractive* case, and its opposite the *generous* case. The conventional model where the ruler is fully benevolent and the bureaucrat is totally selfish obviously belongs to the generous category.

Each of the five sections that follow considers one information condition. The conditions are as follows:

1. Full information – The ruler can observe the bureaucrat's type as well as actions.

2. The ruler cannot observe the bureaucrat's cost type $L$ or $H$, but can observe all actions: the amount of the public good $K$ he supplies, the amount of money $F$ he extracts from the citizen, and the amount $R$ he remits to the ruler.

3. The ruler cannot observe the bureaucrat's type or the provision of the public good $K$, but can observe the financial transactions $F$ and $R$.

4. The ruler cannot observe the bureaucrat's type or the fee $F$ that the bureaucrat extracts from the citisen, but can observe the provision of the public good $K$, and his own remittance $R$.

[2] A relative or friend may in turn care about the ruler's payoff; successive rounds of such mutual interaction can be summed and the reduced form considered, much as one calculates direct and indirect labor requirements in input-output theory by inverting the $(I - A)$ matrix. One may think that the second assumption is also invalid if the bureaucracy includes the military that may threaten the ruler's own position, but that should be taken care of in specifying the right hand side of the participation constraint which I have normalized to zero. This possibility is therefore already included in my formulation.

5. The ruler cannot observe the bureaucrat's type or either of his actions $K$, $F$ dealing with the citizen, but can observe the remittance $R$ he receives from the bureaucrat.

In each case the ruler solves a mechanism design problem, and the information-constrained optimum also depends on whether the ruler is generous $G$ or extractive $E$. To distinguish the optimal $K$, $F$ and $R$ in all these situations, I will use the information condition and the ruler's motive as superscript labels, and the bureaucrat's type as a subscript label. For example, $K_L^{2G}$ is the amount of the public good that is supplied when the bureaucrat's actions but not type are observable, the ruler is generous, and the bureaucrat is the low-cost type.

The basic intuition why the information-constrained optimum entails a downward distortion of the amounts of the public good should be familiar from numerous similar problems in economics, for example Baron and Myerson (1982), and from Laffont and Tirole (1993) and Laffont (2000), on which my paper is based. If the low-cost bureaucrat pretends to be high-cost, he will have to supply $K_H$ of the public good, and be compensated as if his cost were high, but will therefore make an extra profit $\frac{1}{2}(\gamma_H - \gamma_L)(K_H)^2$. He must be given at least this much rent to overcome this temptation and achieve truthful revelation. The ruler then finds it optimal to choose a lower $K_H$ to reduce this rent loss. The qualitative idea is common to the cases of the extractive ruler – satisfying (10) – and the generous ruler so long as he does not unduly favor the bureaucrat – satisfying (9). But for a social-welfare-maximizing ruler the bureaucrat's rent is a transfer from the citizen and therefore costly only to the extent of any dead-weight loss, whereas for a bandit ruler the bureaucrat's rent is a direct reduction from his own take and therefore all of it is a cost. That is why a predatory ruler is keener to avoid rent loss, and distorts the public good quantity downward by more, than a generous ruler.

# 3 Full information

Let us begin by setting up an ideal standard where the buckets are leaky, but the ruler knows the bureaucrat's cost-type and can observe his actions. Thus the ruler can simply instruct the bureaucrat of type $i = L, H$ to implement a policy $(K_i, F_i, R_i)$, subject only to the participation constraints for each type of bureaucrat, which I write as $U_B(i) \geq 0$, and the citizen's participation constraint under each policy, which I write as $S_C(i) \geq 0$.

Here I merely state and interpret the results; the derivations are in the corresponding section of the appendix.

First consider the case when the ruler is extractive. Here the ruler sets

$$K_i^{1E} = \frac{1}{1 + \gamma_i (1 + \lambda_C)} \qquad \text{for } i = L, H\,, \tag{11}$$

and sets the and $R_i^{1E}$ as high as possible, and $F_i^{1E}$ as low as possible, consistently with satisfying the citizen's and the bureaucrat's participation constraints with equality.

A generous ruler's $K_i^{1G}$ is given by the same formula (11), but he sets $R_i^{1G} = 0$, and $F_i^{1G}$ as low as he can consistent with satisfying the participation constraint for each type of bureaucrat. He gives as much benefit to the citizen as he can, so keeps the citizen's participation constraint slack.

The expression for $K_i^{1E}$ is a simple modification of the ideal $K^*$ in (1), to recognize that the bureaucrat's cost must be met by transfers from the citizen using the leaky bucket. This is the stationary bandit in nearly the best of possible circumstances; his solution is as efficient as is feasible constrained only by the technology of monetary transfers.

## 3.1 Limited liability constraints

Even with full information, the transfers that are needed to implement the ruler's optimum may run into some limited liability constraints. In this section I discuss these. The analysis gets somewhat intricate and taxonomic, so in the later sections dealing with information limitations I largely ignore the questions of limited liability. Those readers who wish to focus on information issues can omit this section without significant loss of continuity.

Even the most stringent of limited liability constraints, namely one where the bureaucrat's cost is monetary and must be covered by his net financial receipts, are automatically met in the extractive case.

Next consider the case of a generous ruler. Here the ruler sets $R_i^{1G} = 0$. He would like to set $F_i^{1G}$ sufficiently low to meet the bureaucrat's participation constraint with exact equality, giving all benefits to the citizen. Then the choice of $K_i^{1G}$ is the same as that for an extractive ruler, given by (11), and is again efficient constrained only by the leakiness of the transfer bucket.

However the resulting $F_i$ may violate some limited liability constraints. There are various cases.

*Case 1:* If the bureaucrat's cost of supplying the public good is a monetary cost that must be covered, then this constraint can never be met by the optimal $K_i$ above, while keeping the bureaucrat's participation constraint binding. It turns out that the solution is still to keep the optimal $K_i$ unchanged, but to allow the bureaucrat fees large enough to cover costs. This leaves the bureaucrat with positive utility and a slack participation constraint.

It turns out that the resulting utility for the bureaucrat is an increasing function of $\beta$, the parameter that measures the intensity of his concern for the citizen. In other words, a generous ruler in this case is more likely selectively to attract bureaucrats with greater innate concern for citizens. Contrast this with the case of an extractive ruler, who drives the utility of the bureaucrat to zero, regardless of the degree of the bureaucrat's concern for the citizen.

*Case 2:* If the bureaucrat's monetary transfer receipts must merely be nonnegative, this constraint binds when $K_i$ is chosen at its constrained optimal level (11) if the bureaucrat's concern for the citizen exceeds a threshold:

$$\beta > \frac{\gamma_i}{1 + 2\,\gamma_i\,(1 + \lambda_C)}\,. \tag{12}$$

In that case, the ruler must solve a constrained optimization problem with $F_i = 0$. That yields a different solution:

$$K_i = \frac{\rho_C}{\rho_C + \gamma_i\,\rho_B} = \frac{1}{1 + \gamma_i\,(\rho_B/\rho_C)}\,. \tag{13}$$

This value is higher than that in (11). The intuition is as follows. The limited liability constraint forces the ruler give more to the bureaucrat than he would like to. He tries to offset this by requiring the bureaucrat to provide more of the public good. The direct cost of a small excess above the previous optimal is of the second order of smallness, while the ruler's valuation of the transfer of utility from the bureaucrat to the citizen is positive of the first order; therefore such a change is desirable to the ruler up to a point.

*Case 3:* The bureaucrat, who may in this case be a non-governmental organization, especially a foreign one, has funds that the ruler can require it to transfer to the citizen. Then one might think that a limited liability constraint would simply be irrelevant. However, we cannot use the $(1 + \lambda_C)$ factor; it would be unreasonable to suppose that the leakage from the bucket reverses and the bucket gets fuller when it is traveling from the bureaucrat to the citizen. It is more likely that there is some leakage in the opposite direction, too. Therefore suppose that of each unit of money taken from the bureaucrat, only $1/(1 + \mu_C)$ reaches the citizen. Despite this, the transfer (holding all other things unchanged) would raise the ruler's utility if $\rho_C/(1 + \mu_C) > \rho_B$. Proceeding on this assumption, the generous ruler sets $R_i = 0$, and finds that the optimal $K_i$ is given by

$$K_i = \frac{1}{1 + \gamma_i/(1 + \mu_C)} \,. \tag{14}$$

This is higher than the value (11) when limited liability constraints are irrelevant; it is even higher than the ideal in (1). But it is not as high as the value (13) when transfers are constrained to zero. Thus when the ruler has the ability to benefit the citizen by direct transfers, albeit costly ones, he finds it less necessary to distort the level of the public good upward.

This solution conforms to its underlying assumption of transfers from the bureaucrat to the citizen ($F_i < 0$) only if the bureaucrat's concern for the citizen is sufficiently high:

$$\beta > \frac{\gamma_i}{1 + \gamma_i/(1 + \mu_C)} \,. \tag{15}$$

If $\beta$ lies between the two thresholds given by (12) and (15), then the ruler chooses to make no monetary transfers in either direction in view of the leakiness of the buckets. The objective function has a kink at the optimum of $F_i = 0$, and the value of $K_i$ is given by (13).

To sum up, with complete information, the ruler would like to preserve efficiency in the provision of public goods, and departs from this only because of leaky transfer buckets and limited liability constraints. When the transfer is from the citizen to the bureaucrat, the quantity of the public good is reduced. When a generous ruler wants to make the transfer is from the bureaucrat to the citizen, and is either unable to do so, or must do so using a leaky bucket, he chooses a higher level of the public good. In the case of zero transfers, a generous ruler has to keep the bureaucrat above his outside opportunity, and a bureaucrat who has greater innate concern for the citizen gets more rent.

I now turn to various situations of asymmetric information. In each of them, limited liability constraints can create complications similar to those analyzed above. To avoid much messy algebra and to focus on problems one at a time, I will mostly disregard limited liability constraints from now on. However, I will retain the leaky buckets, so I can contrast the results in my general cases with those in the conventional case of a benevolent ruler and a selfish bureaucrat.

# 4 Bureaucrat's actions but not type observable

Now suppose the bureaucrat's cost parameter $\gamma_i$, or equivalently his type $i = L,\ H$, is his private information, but the ruler can observe his choice $K_i$ of the level of the public good $K_i$, the fee $F_i$ that he extracts from the citizen, and of course his remittance $R_i$ to the ruler. The ruler's policy can then be formally characterized as a revelation mechanism,[3] where he asks the bureaucrat to report his type, and specifies actions $(K_j, F_j, R_j)$ contingent on the reported type $j$. The ruler chooses this to maximize his objective, subject to the bureaucrat's incentive compatibility constraints which require truthful reporting to be optimal, and of course all participation constraints.

Let the utility of a bureaucrat of true type $i$ reporting type $j$ be denoted by $U_B(i, j)$, for $i,\ j = L,\ H$. Then the incentive compatibility constraints are $U_B(L, L) \geq U_B(L, H)$ and $U_B(H, H) \geq U_B(H, L)$. The bureaucrat's participation constraints become $U_B(L, L) \geq 0$ and $U_B(H, H) \geq 0$. Denoting the citizen's utility when the bureaucrat is of type $i$ (and reporting this truthfully to the ruler) by $S_C(i)$, those participation constraints are $S_c(L) \geq 0$, $S_C(H) \geq 0$.

The ruler does not want to transfer from the citizen to the bureaucrat any more than he has to. Therefore the participation constraint of type $H$, and the incentive constraint of type $L$, are kept binding. The participation constraint of type $L$ has to be slack, and with all these, the incentive constraint of type $H$ is automatically satisfied.

The ruler, attempting to reduce the rent $\frac{1}{2}\left(\gamma_H - \gamma_L\right)\left(K_H\right)^2$ that has to be given to the type $L$ bureaucrat, distorts downward the quantity $K_H$ of the public good to be supplied by type $H$. This is also standard in such models. The new feature is that the extent of the distortion depends on the objectives of the ruler. Specifically, an extractive ruler chooses

$$K_H^{2E} = \frac{1}{1 + \gamma_H\left(1 + \lambda_C\right) + \dfrac{\theta_L}{\theta_H}\left(\gamma_H - \gamma_L\right)\,\left(1 + \lambda_C\right)\left[1 - \rho_B(1 + \lambda_B)\right]}, \tag{16}$$

and a generous ruler chooses

$$K_H^{2G} = \frac{1}{1 + \gamma_H\left(1 + \lambda_C\right) + \dfrac{\theta_L}{\theta_H}\left(\gamma_H - \gamma_L\right)\,\dfrac{\rho_C\left(1 + \lambda_C\right) - \rho_B}{\rho_C - \beta\,\rho_B}}. \tag{17}$$

[3]For any readers not familiar with such direct or revelation mechanisms, I should emphasize that this need not be the way in which the ruler's policy is actually implemented. There may be various complex games between the ruler and the bureaucrat, involving stages of communication, instructions, menus of contracts, and incentives (carrots and/or sticks). But the the revelation principle says that the equilibrium outcome of any such process can be characterized as if it arose from the direct mechanism here studied. See Myerson (1982) for details and proofs of this general theory of mechanism design.

Both types of rulers require the $L$-type bureaucrat to supply the full-information levels of the public good, so $K_L^{2E}$ and $K_L^{2G}$ are given by (11).

Let us now interpret and discuss these results.

[1] If the model is extended to allow more than two cost types, then only the least-cost type will be asked to supply the efficient level of the public good; that from all higher-cost types will be distorted downward by successively more. Thus the problem is quite general, and only gets compounded in more complex multi-type models.

[2] In the conventional situation, which is a special instance of the generous case where the ruler is fully benevolent ($\rho_C = \rho_B = 1$) and the bureaucrat is fully selfish ($\beta = 0$), the formula for $K_H^{2G}$ reduces to

$$K_H^{2G} = \frac{1}{1 + \gamma_H \left(1 + \lambda_C\right) + \dfrac{\theta_L}{\theta_H}\, \lambda_C \left(\gamma_H - \gamma_L\right)} \,. \tag{18}$$

There is no distortion if in addition the bucket for transfers from the citizen to the bureaucrat does not leak ($\lambda_C = 0$). These results are familiar from Laffont and Tirole (1993) and Laffont (2000). When the ruler's objective is the total social surplus and transfers do not generate any deadweight losses, giving rent to the bureaucrat is a pure transfer without direct cost to the ruler, so there is no need to distort $K_H$ to reduce the rent. However, in the extractive case, even with $\lambda_C = 0$, the ruler dislikes losing rent to the bureaucrat and therefore distorts $K_H^{2E}$ downward. It remains true that the higher is $\lambda_C$, the greater the distortion.

[3] It is not possible to compare the distortions in the extractive and generous cases simply by comparing the expressions (16) and (17), because the parameters $\rho_C$, $\rho_B$ etc. in the two must satisfy the different inequalities that produce the one case or the other. We can compare the distortion in the conventional case, shown above, to that in the case where the ruler is fully predatory and the bureaucrat is fully selfish ($\rho_C = \rho_B = \beta = 0$), namely

$$K_H^{2E} = \frac{1}{1 + \gamma_H \left(1 + \lambda_C\right) + \dfrac{\theta_L}{\theta_H} \left(\gamma_H - \gamma_L\right) \left(1 + \lambda_C\right)} \,. \tag{19}$$

Comparing (18) and (19), we see that since $1 + \lambda_C > \lambda_C$, we have $K_H^{2E} < K_H^{2G}$; the fully predatory ruler distorts the quantity of the public good downward more than the full benevolent ruler does. Therefore we have reason to think that extremely predatory states will show more failure (less provision of public goods) than very benevolent states.

A sample numerical calculation will illustrate the distinction, and also give us a better feel for the magnitude of the problem. Take $\theta_L = \theta_H = \frac{1}{2}$, and $\gamma_H = 1$, $\gamma_L = 0.5$, so the more efficient type of bureaucrat has half the cost of the other type. Let $\lambda_C = 0.25$, the oft-used figure for the average dead-weight loss per unit of revenue in income taxation even in a relatively advanced tax systems like those in the United States. Contrast two regimes, a fully benevolent one with $\rho_B = \rho_C = 1$, and a totally predatory one with $\rho_C = \rho_B = 0$. Suppose the bureaucrat is purely selfish, so $\beta = 0$.

With these parameters, the optimal levels of the public good in various situations are given in Table 1. We see that the need to offer the bureaucrat an incentive-compatible mechanism has a significant effect on the level of the public good. The effect is of a similar magnitude to that arising from conventional dead-weight losses: the latter alone reduce $K_H$ from 0.500 to 0.444, while the agency issue reduces it further to 0.421 in a benevolent state and all the way to 0.348 in a predatory state. Thus we also see that agency has a substantially bigger effect in a predatory state than in a benevolent state.

Table 1: Comparisons of Optimal Public Good Provision

| Situation | $K_H$ | $K_L$ |
|---|---|---|
| Ideal, ignoring leaky buckets: $K_i^*$ | 0.500 | 0.667 |
| Leaky bucket but no agency problem $K_i^{1G}$, $K_i^{1E}$ | 0.444 | 0.615 |
| Benevolent state; leaky bucket and agency $K_i^{2G}$ | 0.421 | 0.615 |
| Predatory state; leaky bucket and agency $K_i^{2E}$ | 0.348 | 0.615 |

I have only considered the simplest kind of agency problem. In the concluding section I mention other issues raised by the need to use bureaucrats as agents. These mostly operate in the same direction, namely to worsen the provision of public goods, but it remains for future research to examine whether those agency problems are also likely to be worse in predatory states.

[4] For both types of rulers, the higher is $\rho_B$, the smaller is the denominator in the expressions for $K_H$, and therefore the smaller is the downward distortion in $K_H$, that is, the higher is $K_H$. This is obvious from (16) in the extractive case; the calculation for the generous case is in the appendix. The intuition is as follows. If the ruler cares more about the bureaucrat's utility, then he is less concerned about leaving the bureaucrat with more rent, and therefore has less need to distort the action to save on the rent-sharing. In this sense the cause of efficiency in the provision of public goods is paradoxically helped if rulers choose bureaucrats nepotistically! Of course an opposing argument is that $\theta_L$ may be lower among this pool of bureaucrats, so on average the outcome may be worse.

[5] In the generous case, the higher is $\beta$, the lower is $\rho_C - \beta\,\rho_B$. (But it remains positive while $\beta$ stays within the range given by (8): $\beta < 1/(1+\lambda_C)$ implies

$$\rho_C - \beta\,\rho_B > \rho_C - \rho_B/(1+\lambda_C) = [\rho_C\,(1+\lambda_C) - \rho_B]/(1+\lambda_C) > 0\,.)$$

So when $\beta$ is higher, the denominator in (17) is higher, so $K_H$ is lower. A generous ruler distorts the public good downward more when the bureaucrat has greater direct concern for the citizen's utility. This may seem strange, but has a good intuition. The utility of such a bureaucrat increases by less, namely $1 - \beta(1+\lambda_C)$, when a unit of money is transferred to him from the citizen. But an $L$-type bureaucrat's temptation to pretend to be $H$-type is independent of $\beta$. Therefore to induce truthful revelation from a bureaucrat with more direct concern for the citizen, the mechanism must promise him more money for reporting type $L$. This increases the loss to the ruler's utility; to save on this cost of rent-sharing, the ruler must distort the action more.

[6] The bureaucrat's utility in this information situation is zero if he is $H$-type, and equals the rent $\frac{1}{2}(\gamma_H - \gamma_L)(K_H)^2$ if he is $L$-type. In the extractive case $K_H^{2E}$ is independent of beta. Therefore under an extractive ruler, potential bureaucrats fare equally well regardless of their direct concern for the citizen's utility. The extractive ruler similarly is indifferent to his bureaucrat's degree of innate concern for the citizen. But in the generous case $K_H^{2G}$ decreases as $\beta$ increases. Therefore under a generous ruler, bureaucrats with a higher degree of direct concern for the citizen's utility get less surplus! This runs against the intuition that a generous ruler would selectively attract the more concerned bureaucrats. However, numerical calculations suggest that the magnitude of the effect on the bureaucrat is small, whereas the ruler and especially the citizen stand to gain much more from the presence of a more benevolent bureaucrat. The reason is that even though under a more caring bureaucrat the capital good quantity $K_H^{2G}$ must be distorted downward by more, the costly transfers from the citizen to the bureaucrat are also smaller, and that effect proves to be bigger. Table 2 shows a calculation for the same parameters as used above, for the case of a fully benevolent ruler, and varying degrees of the bureaucrat's concern for the citizen's welfare. These calculations suggest that a benevolent ruler would like to attract a more caring bureaucrat, and may be able to find other ways (outside the model) to locate and suitably compensate him.

Table 2: Effects of Varying the Bureaucrat's Concern

| | $\beta$ | | |
|---|---|---|---|
| | 0.0 | 0.3 | 0.6 |
| Capital good quantities | | | |
| $K_L^{2G}$ | 0.615 | 0.615 | 0.615 |
| $K_H^{2G}$ | 0.421 | 0.412 | 0.390 |
| Citizen's utility | | | |
| $S_C^{2G}(L)$ | 0.252 | 0.408 | 1.040 |
| $S_C^{2G}(H)$ | 0.221 | 0.354 | 0.876 |
| Bureaucrat's utility | | | |
| $U_B^{2G}(L)$ | 0.044 | 0.042 | 0.038 |
| Ruler's expected utility | | | |
| $E[U_R^{2G}]$ | 0.259 | 0.341 | 0.664 |

# 5 Type and choice of public good unobservable

In this section I consider an information condition where the ruler does not know the bureaucrat's cost type, and cannot observe the bureaucrat's choice of the public good, but can observe the financial transactions at all levels. Now we must use a form of the revelation principle where the agent's type and some or all of his actions are unobservable (Myerson, 1982). The ruler's direct mechanism asks the bureaucrat to report his type, and specifies the

$(K_j,\, F_j,\, R_j)$ as functions of the reported type, with the constraints that truthful reporting must be optimal for the bureaucrat (the mechanism must be "honest" in Myerson's terminology) and implementing the unobservable action at the level stated by the ruler must also be optimal for the bureaucrat ( the mechanism must be "obedient" in Myerson's terminology). Equivalently, we can think of the ruler choosing the transfers $(F_j,\, R_j)$, and anticipating that for any given magnitudes of these transfers the bureaucrat is going to choose $K$ to maximize his own payoff, knowing his own type and subject only to the citizen's participation constraint.

Using (2), (3), and (4), we see that a bureaucrat whose true type is $i$ and reported type is $j$ will choose $K$ to maximize

$$U_B(i,j) \equiv F_j - (1+\lambda_B)\, R_j - \tfrac{1}{2}\,\gamma_i\, K^2 + \beta\, [K - \tfrac{1}{2}\, K^2 - (1+\lambda_C)\, F_j]$$

subject to

$$S_C = K - \tfrac{1}{2}\, K^2 - (1+\lambda_C)\, F_j \geq 0\,,$$

or

$$F_j \leq F(K) \equiv \frac{1}{1+\lambda_C}\, (\, K - \tfrac{1}{2}\, K^2\, )\,. \tag{20}$$

If the constraint (20) is not binding, the bureaucrat's optimum choice is

$$\widehat{K}_i \equiv \frac{\beta}{\beta+\gamma_i} = \frac{1}{1+(\gamma_i/\beta)}\,. \tag{21}$$

So long as the bureaucrat's concern for the citizen is limited by (8), we have $1/\beta > 1+\lambda_C$, and then $\widehat{K}_i < K_i^{1E} = K_i^{1G}$, the ruler's optimal choices under full information constrained only by the leakiness of the transfer buckets.

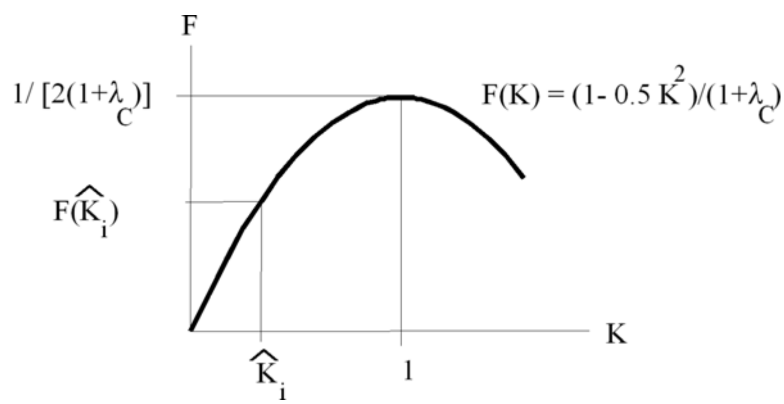


Figure 1: Citizen's Participation Constraint and Bureaucrat's Choice of $K$

Figure 1 shows the citizen's participation constraint and the bureaucrat's optimum ignoring this constraint. If the ruler is happy to extract more from the citizen, then he can induce the bureaucrat to supply a larger quantity of the public good than $\widehat{K}_i$ by the simple device of stipulating a fee larger than $F(\widehat{K}_i)$, which forces the bureaucrat to move to the right along the citizen's participation constraint. In fact, by choosing $F_i$ as high as $1/[2(1+\lambda_C)]$, the ruler can achieve any level of $K$ up to 1. An extractive ruler is happy to use this device to some extent. In fact by this method such a ruler can achieve the same outcome as he could in the previous section where $K$ was observable. All he needs to do is to hire a bureaucrat with a zero or minimal concern parameter $\beta$, and then set levels of fees $F_i$ that will force the desired $K_L^{2E}$ and $K_H^{2E}$. That is obviously optimal for him. The details are again in the appendix.

Thus an extractive ruler can fully overcome the handicap of being unable to observe $K$ by hiring a very selfish bureaucrat. As in the previous section, the bureaucrat's payoff from this (zero for an $H$-type and positive for an $L$-type) is independent of $\beta$, so any type of bureaucrat is equally happy to work for such a ruler. Presumably it is not hard to find selfish people; therefore we should expect predatory rulers to hire selfish bureaucrats.

A generous ruler's optimum is somewhat more complicated. He, too, can achieve the quantity of the public good that would be optimal for him if it were directly observable. But this now comes at the cost of forcing the citizen down to his participation constraint. It is still possible that the increase in $K$ toward greater efficiency increases the total social surplus by so much that receiving some of it himself or giving it to the bureaucrat yields the generous ruler a higher payoff despite the leakages involved in these transfers. However, this seems a strange way for the ruler's generosity to manifest itself. Therefore I will exclude it by considering the special case where the ruler has no concern for the bureaucrat's surplus at all ($\rho_B = 0$), and only a relatively minimal concern for his own take from the economy ($\rho_C >> 1$). Then any outcome where the citizen gets zero welfare cannot be optimal. The ruler must leave the citizen's participation constraint slack, relying on the bureaucrat's unconstrained provision of the public good as given by (21).

In this case the ruler's optimum again entails keeping the high-cost type bureaucrat down at his participation constraint, and giving just enough rent to the low-cost type to achieve truthful revelation. However, now the dependence of the payoffs on the bureaucrat's degree of concern $\beta$ for the citizen is very different. We have the remarkable result that *everyone's* payoff is increasing in $\beta$. The ruler, the citizen, and even the low-cost bureaucrat do better when the bureaucrat is more caring! This is a very strong finding of synergy between benevolent rulers and caring bureaucrats.

I do not model the prior process by which bureaucrats get hired by rulers. One possibility is that the ruler auctions the bureaucrat's position; then a candidate with more concern for the citizen is willing to bid more. This may be unrealistic, and other possibilities are worth investigating. If the information condition being analyzed in this section is a reasonable model of reality, we should expect such a process to result in the kind of matching that is often observed in practice, namely, predatory rulers have uncaring bureaucrats (Rotberg, 2004, p. 7), whereas bureaucracies in benevolent states exhibit more concern for citizens, either because of innate motivations or because of the sense of professionalism that is instilled in them during their education and training, as for example captured in mottos like "Princeton in the nation's service."

# 6 Type and fee unobservable

The information condition in this section is a counterpart of that in the previous section. Here the ruler does not know the bureaucrat's cost type, and cannot observe the fee the bureaucrat extracts from the citizen, but can observe the quantity of the public good the bureaucrat supplies, and the remittance he receives from the bureaucrat. So the ruler must choose a direct mechanism specifying $(K_j,\, R_j)$, anticipating that for any given magnitudes of these, the bureaucrat is going to choose $F$ (appropriate to his privately known type) to maximize his own payoff, subject only to the citizen's participation constraint. Here I summarize the various cases and possibilities; the details are in the appendix.

So long as the bureaucrat's concern for the citizen is limited by (8), he is going to extract the maximum fee compatible with the citizen's participation constraint, leaving the citizen with zero surplus. The ruler should anticipate this in his choice of mechanism. If the ruler is extractive, he would want the bureaucrat to extract this maximum fee anyway, and will then extract the most he can from the bureaucrat consistent with the latter's participation and incentive compatibility constraints. This problem is formally identical with that of Section 4 where $F$ was also observable, and the ruler is able to replicate that optimum in this case, too.

A generous ruler, however, has a worse problem even than that of the previous section where $F$ was observable but $K$ was not. There the ruler could benefit the citizen to some extent by setting the fee below what would extract all of the citizen's surplus when the bureaucrat was choosing $K$ according to his own private objective. Now that is not possible. The citizen is going to get zero surplus, and ruler's choice of $K$ and $R$ has to be made to maximize only that part of his objective that depends on his own and the bureaucrat's surpluses. I consider only one case that parallels a corresponding case one in the previous section, namely, one where the ruler does not care for the bureaucrat's surplus, so $\rho_B = 0$. Here it turns out that the generous ruler's choice of the quantity of the public good is the same as that of a totally predatory ruler in the case where all actions are observable, namely (19). However, this appears to be a coincidence without any good intuitive reason.

The only better prospect for a generous ruler is to find a bureaucrat with a sufficiently great concern for the citizen to reverse (8) making $\beta\,(1 + \lambda_C) > 1$. Such a bureaucrat is more likely an aid organization that can bring funds to the table. Then the ruler can use the bureaucrat's generosity and achieve a high level of the public good. Such a bureaucrat will set the fee as low as possible compatible with his own limit on liability. Various limited liability constraints can be analyzed. The appendix analyzes the case $F_i \geq 0$. Here a ruler who cares only about the citizen's welfare may be able to achieve a very high level of the public good, namely $K = 1$.

# 7 Neither actions nor type observable

Now suppose the ruler does not know the bureaucrat's type, and cannot observe either of the bureaucrat's actions: the public good provision $K$ or the fee $F$ extracted from the citizen. The bureaucrat chooses these to maximize his own payoff, constrained only by the citizen's participation constraint. The ruler can only stipulate the remittance $R$ the bureaucrat must deliver to him.

Now the bureaucrat's optimum is a Coasian contract with the citizen. So long as $\beta\,(1+\lambda_C) < 1$, the bureaucrat wants to extract as much as he can from the citizen, and he does not suffer from any informational limitation. Therefore it is optimal for him to provide the same quantity of public good $K_i^{1E}$ given by (11) that would be optimal for the ruler in the full information condition of section 3. However, he extracts all of the citizen's surplus.

This suits an extractive ruler well, up to a point. He can in turn extract from the bureaucrat. The amount extracted, say $R$, must be independent of the bureaucrat's reported type, $R_H = R_L$, for reasons of incentive-compatibility. Otherwise the bureaucrat would report to be of that type $j$ for which the $R_j$ is smaller, while in the background taking actions $K_i$, $F_i$ appropriate for his true type. The ruler then sets the common value $R$ as high as is compatible with the participation constraints for both types of bureaucrats, and the constraint for the $H$-type binds first. The appendix shows that this means giving rent to the $L$-type of the amount

$$U_B(L) = \tfrac{1}{2}\,(\gamma_H - \gamma_L)\;\frac{1}{1+\gamma_L\,(1+\lambda_C)}\;\frac{1}{1+\gamma_H\,(1+\lambda_C)}\,. \tag{22}$$

I said that the extractive ruler is helped only up to a point, because now he must give up more rent than what would be needed if $K$ and/or $F$ were observable. The expression (22) above can alternatively be written as

$$U_B(L) = \tfrac{1}{2}\,(\gamma_H - \gamma_L)\;K_L^{1E}\;K_H^{1E} > \tfrac{1}{2}\,(\gamma_H - \gamma_L)\;(K_H^{1E})^2 > \tfrac{1}{2}\,(\gamma_H - \gamma_L)\;(K_H^{2E})^2$$

the rent when the bureaucrat's actions were observable (and also when only $F$ or only $K$ is observable, because as we saw in the two previous sections, the extractive ruler can replicate that solution with this limited observability).

Thus the unobservability of $F$ removes the downward distortion in $K_H$; both $K_H$ and $K_L$ are efficient constrained only by the dead-weight losses. This moves the state away from failure in the sense of the low provision of public goods. The bureaucrat is acting like Olson's stationary bandit. But it does not help the citizen; all of his surplus is extracted by the bureaucrat by means of the flat fee. And an extractive ruler is not helped by the increased efficiency either, because he has to give away too much rent to the $L$-type bureaucrat.

The only kind of ruler who likes this situation is one who has sufficiently high nepotistic concern for the bureaucrat that he does not want to extract remittances: $\rho_B\,(1+\lambda_B) > 1$. Then the ruler is happy to leave the bureaucrat to exploit the citizen efficiently.

A benevolent ruler whose primary concern is for the citizen ($\rho_B = 0$ and $\rho_C >> 1$) of course dislikes this outcome where the bureaucrat gets all the benefit. Again, such a ruler's only hope is to find a bureaucrat whose degree of concern reverses (8). The appendix analyzes the case where the bureaucrat sets his fee at zero, limited by the constraint on liability $F_i \geq 0$. In this case the bureaucrat's choice of $K_i$ is given by the same expression as that for the unconstrained choice when $F$ is observable, namely (21) in the previous section. But now $1/\beta < 1 + \lambda_C$, therefore this $\widehat{K_i}$ now exceeds the level $K_L^{1E} = K_H^{1G}$ of the full information case. Once again, a higher $\beta$ benefits all parties.

Thus in this case of the most limited observability, therefore, we have the strongest synergy between a benevolent ruler and a caring bureaucrat, and it leads to a supra-optimally high level of public good provision.

# 8 Suggestions for modification and extension

My analysis was motivated by the question: Does the fact that policy must be administered through a bureaucracy contribute to the failure of the state to provide public goods, and does this correlate with the intentions of the top-level rulers? I suggested two ways in which this could happen: predatory rulers may be more averse to giving incentive rents to bureaucrats, and an assortative matching may emerge where predatory rulers employ selfish bureaucrats and benevolent rulers attract caring or professional bureaucrats. The model found some role for both of these, but they operated differently in different conditions. If the bureaucrat's actions are observable, then only the first effect operates: predatory rulers tolerate a greater downward distortion in the provision of public goods to reduce rent-sharing, but under predatory rulers, bureaucrats do equally well regardless of the extent of their selfishness or caring for the citizen, and under benevolent rulers, caring bureaucrats actually do slightly less well. When the ruler cannot observe the quantity of the public good the bureaucrat provides, or vice versa, but can observe the fee he extracts from the citizen, a predatory ruler can use this fee to replicate the optimum when the quantity of the public good is observable. But in the same information conditions, a benevolent ruler must rely on a caring bureaucrat to provide a higher quantity of the public good, and then a bureaucrat with a higher degree of concern for the citizen brings higher payoffs to everyone: the ruler, the citizen and also himself. These associations are further amplified if the ruler cannot even observe the financial transactions of the bureaucrat with the citizen, but here the bureaucrat chooses the quantity of the public good efficiently in a Coasian arrangement with the citizen.

This variety of results suggests that understanding or prediction in any particular case requires more context-specific conceptual and empirical analysis. It also suggests that my simple model of agency needs to be expanded and enriched to bring in further effects. Here I mention some of these.

[1] The most important extension is to incorporate the possibility that a predatory ruler underprovides public goods because that would make it more likely that the bureaucrats (especially the military) and/or the citizens would rebel and overthrow him. In the linear-quadratic framework of this model, a simple way to handle this is to change the right hand side of the bureaucrat's participation constraint (6) to $\delta_B K$ and that of the citizen's participation constraint (7) to $\delta_C K$ for positive constants $\delta_B$ and $\delta_C$. Consider the simplest case, with no dead-weight losses of transfers, and full control over a purely selfish agent. Then a purely predatory ruler maximizes $R$ subject to the bureaucrat's participation constraint

$$F - R - \tfrac{1}{2}\,\gamma\,K^2 \geq \delta_B\,K$$

and the citizen's participation constraint

$$K - \tfrac{1}{2}\,K^2 - F \geq \delta_C\,K\,.$$

This means maximizing

$$(1 - \delta_B - \delta_C)\ K - \tfrac{1}{2}\ (1 + \gamma)\ K^2\,.$$

If $\delta_B + \delta_C < 1$, the optimum is

$$K = \frac{1 - \delta_B - \delta_C}{1 + \gamma}$$

which is just $(1 - \delta_B - \delta_C)$ times the ideal in (1). If $\delta_B + \delta_C \geq 1$, the predatory ruler provides zero public goods. By contrast, a fully benevolent ruler who wants to maximize the total surplus

$$[\,F - R - \tfrac{1}{2}\ \gamma\ K^2\,] + [\,K - \tfrac{1}{2}\ K^2 - F\,] = K - \tfrac{1}{2}\,(1 + \gamma)\ K^2 - R$$

will set $R = 0$, keep both participation constraints slack, and choose the ideal (1). Similar differences will continue in all the subsequent cases of deadweight losses and various information problems of agency.

[2] I distinguished the types of the bureaucrat by his cost of producing the public good and his degree of concern for the citizen. However, only the former was private information contributing to the agency problem; the latter was an exogenous parameter that was taken to be common knowledge. I made some informal remarks suggesting how, from a pool of potential employees with different degrees of concern for the citizen, a ruler might hire a bureaucrat who best suits his purpose, but did not incorporate this formally into the model. Improvement in both these respects is an important task for further research.

[3] In reality there are many public goods, with different degrees of substitution or complementarity between them, and different errors in observing the outcome of the bureaucrats' actions. This can create problems of bias, where the bureaucrat devotes more effort to the goods whose provision is more accurately observable by the ruler, and the ruler's attempt to cope with the problem of bias may force him to attenuate the strength of incentives he offers the bureaucrat for all goods (Holmström and Milgrom, 1991). This effect will exist regardless of the ruler's intention, and it remains to be seen whether it is stronger for a benevolent ruler than for a predatory ruler. However, there are some obvious differences. With a benevolent ruler, a bureaucrat with genuine direct concern for the citizen's welfare will be less prone to the bias, thereby easing the ruler's multitask incentive problem, and perhaps further augmenting the synergy between a benevolent ruler and a caring bureaucrat. A predatory ruler may have specific preferences over multiple public goods; for example, Stalin's and his Soviet successors' priorities were for investment, military, and big projects like the Moscow Metro and space exploration, not for basic transport and utility infrastructure outside the main cities. Then their agents in specific regions or industries are unlikely to share these multidimensional preferences, thereby aggravating the multitask incentive problem.

[4] In reality there is a not just one bureaucrat but a whole bureaucracy. This creates both problems and opportunities for the ruler. If there are several bureaucrats engaged in doing similar things and subject to correlated shocks, then the ruler can use relative performance schemes to improve the outcome according to his own objectives, whether they be predatory or benevolent. However, if each bureaucrat is responsible for providing a different public good, or if different bureaucrats are responsible for providing the public

good and for collecting taxes from the citizen, this creates new problems of moral hazard in teams. Not only may one bureaucrat be unconcerned about making matters harder for others, but each may not internalize the effects of his actions on the other bureaucrat's and the citizen's participation constraints. Then the ruler may have to give additional incentives to ensure his own survival in power in the Nash (non-cooperative) equilibrium of such a bureaucracy.

[5] I assumed that the bureaucrat's outside option was exogenous (and set it equal to zero). However, some types of intermediate-level functionaries have the possibility of seizing power to become top rulers themselves. Such endogenization offers interesting theoretical possibilities with practical relevance.

[6] I assumed the information structure to be exogenous (although I considered alternative possibilities). In reality, rulers go to considerable efforts to improve their information. However, they have to use other agents to obtain and communicate this information. There is also a vertical hierarchy in the bureaucracy, where higher levels monitor the work of the lower levels. Such layers and functions of bureaucracy raise issues of collusion and the need for the ruler to devise his incentive schemes to reduce the incentives to collude (e.g. Laffont and Tirole, 1993, chapter 12, Laffont, 2000, chapter 2).

[7] The top level ruler may actually be a coalition. If this coalition can conclude a bargain in advance and present a united objective, the analysis with a single ruler stands. Otherwise policymaking at the top level becomes a multi-principal (common agency) problem, and this may cause a further and substantial deterioration in the power of incentives (Dixit, 1997). It remains to be seen how this effect operates differently when members of the coalition are mostly predatory and when they are mostly benevolent but each is more concerned about his own constituency of citizens. We also have the intriguing possibility that the weakness of incentives caused by the common agency leads to deteriorating economic outcomes, which further worsens the conflict among the multiple principals, leading to a downward spiral, or a process by which state weakness turns into state failure and eventually into state collapse.

This long list of unsolved problems tells us that this paper should be seen as the mere beginning of a potentially large and rich research agenda. But I hope it makes a modest and useful start to the program.

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# Appendix: Mathematical derivations

The section numberings (A.sectionnumber) below correspond to those in the text for which the algebraic details are supplied here. Equation numbers are in the form (A.equationnumber) consecutively throughout the appendix. When an equation is duplicated in the text (usually under a different number), this is stated.

## A.3 Full information

Substituting the expressions for the surpluses in the text, (2) and (3), into the bureaucrat's utility function (4), the bureaucrat's participation constraints for the two types become

$$U_B(L) \equiv [1-\beta(1+\lambda_C)]\, F_L - (1+\lambda_B)\, R_L + \beta\, K_L - \tfrac{1}{2}(\beta+\gamma_L)\,(K_L)^2 \geq 0\,, \quad (A.1)$$
$$U_B(H) \equiv [1-\beta(1+\lambda_C)]\, F_H - (1+\lambda_B)\, R_H + \beta\, K_H - \tfrac{1}{2}(\beta+\gamma_H)\,(K_H)^2 \geq 0\,. \quad (A.2)$$

The citizen's participation constraints under the two types of policies are

$$S_C(L) \equiv K_L - \tfrac{1}{2}\,(K_L)^2 - (1+\lambda_C)\, F_L \geq 0\,, \quad (A.3)$$
$$S_C(H) \equiv K_H - \tfrac{1}{2}\,(K_H)^2 - (1+\lambda_C)\, F_H \geq 0\,. \quad (A.4)$$

Subject to these, the ruler wants to maximize his expected utility, the expression for which is obtained by substituting the expressions for the surpluses (2) and (3) into the ruler's utility function (5):

$$\begin{aligned} &EU(R) \equiv \quad (A.5)\\ &\theta_L\,\left\{[1-\rho_B(1+\lambda_B)]\, R_L - [\rho_C(1+\lambda_C)-\rho_B]\, F_L + \rho_C\, K_L - \tfrac{1}{2}(\rho_C+\gamma_L\,\rho_B)\,(K_L)^2\right\}\\ &+\theta_H\,\left\{[1-\rho_B(1+\lambda_B)]\, R_H - [\rho_C(1+\lambda_C)-\rho_B]\, F_H + \rho_C\, K_H - \tfrac{1}{2}(\rho_C+\gamma_L\,\rho_B)\,(K_H)^2\right\}. \end{aligned}$$

It is best to solve this problem in stages. First hold the $K_i$, $R_i$ fixed and consider the choices of the $F_i$. The condition of limited nepotism (9) ensures that $F_i$ will be kept as low as possible. Therefore the bureaucrat's participation constraints will be binding:

$$F_i = \frac{1+\lambda_B}{1-\beta(1+\lambda_C)}\, R_i + \tfrac{1}{2}\,\frac{\beta+\gamma_H}{1-\beta(1+\lambda_C)}\,(K_i)^2 - \frac{\beta}{1-\beta(1+\lambda_C)}\, K_i\,. \quad (A.6)$$

Next keep the $K_i$ fixed and consider the choice of $R_i$, bearing in mind the effect on $F_i$ as given by (A.6). We have

$$\begin{aligned} \frac{\partial EU(R)}{\partial R_i} &= \theta_i\,\left\{[1-\rho_B(1+\lambda_B)] - [\rho_C(1+\lambda_C)-\rho_B]\,\frac{1+\lambda_B}{1-\beta(1+\lambda_C)}\right\}\\ &= \theta_i\,\frac{1-\beta\,(1+\lambda_C)-(\rho_C-\rho_B\,\beta)\,(1+\lambda_B)\,(1+\lambda_C)}{1-\beta\,(1+\lambda_C)} \end{aligned}$$

In the extractive case where (10) is fulfilled (and bearing in mind the assumption (8) limiting the bureaucrat's concern for the citizen), this is positive and $R_i$ will be kept as high as possible compatible with the citizen's participation constraints. In the generous case, the $R_i$ will be kept as low as possible, namely zero. We have to consider the two cases separately.

**Extractive case:**

Now citizen's as well as the bureaucrat's participation constraints are binding. Therefore from (A.3) and (A.4) we have

$$F_i = \frac{1}{1+\lambda_C} \left[ K_i - \tfrac{1}{2} (K_i)^2 \right],$$

and then, from (A.1) and (A.2),

$$\begin{aligned} R_i &= \frac{1}{1+\lambda_B} \left\{ [1-\beta(1+\lambda_C)]\, F_i + \beta\, K_i - \tfrac{1}{2} (\beta+\gamma_i)\, (K_i)^2 \right\} \\ &= \frac{1}{1+\lambda_B} \left\{ \frac{1-\beta(1+\lambda_C)}{1+\lambda_C} \left[ K_i - \tfrac{1}{2} (K_i)^2 \right] + \beta\, K_i - \tfrac{1}{2} (\beta+\gamma_i)\, (K_i)^2 \right\} \\ &= \frac{1}{(1+\lambda_B)\,(1+\lambda_C)} \left\{ K_i - \tfrac{1}{2} [1+\gamma_i\,(1+\lambda_C)]\, (K_i)^2 \right\}. \end{aligned}$$

Finally consider the choice of the $K_i$. Substituting the above expressions for $F_i$ and $R_i$ into (A.5) and differentiating, we have

$$\begin{aligned} \frac{\partial EU(R)}{\partial K_i} &= \theta_i \left\{ \frac{1-\rho_B(1+\lambda_B)}{(1+\lambda_B)\,(1+\lambda_C)} \{1-[1+\gamma_i\,(1+\lambda_C)]\, K_i\} \right. \\ &\qquad \left. - \frac{\rho_C(1+\lambda_C)-\rho_B}{1+\lambda_C} (1-K_i) + \rho_C \; - (\rho_C+\gamma_i\,\rho_B)\, K_i \right\} \\ &= \theta_i \frac{1}{(1+\lambda_B)\,(1+\lambda_C)} \{1-[1+\gamma_i\,(1+\lambda_C)]\, K_i\} \end{aligned}$$

Therefore the optimum choice of $K_i$ is

$$K_i^{1E} = \frac{1}{1+\gamma_i\,(1+\lambda_C)}. \tag{A.7}$$

This is reproduced as (11) and discussed in the text.

We also have

$$\begin{aligned} & F_i - (1+\lambda_B)\, R_i - \tfrac{1}{2}\gamma_i\,(K_i)^2 \\ =\;& \frac{1}{1+\lambda_C} \left[ K_i - \tfrac{1}{2} (K_i)^2 \right] - \frac{1}{1+\lambda_C} \left\{ K_i - \tfrac{1}{2} [1+\gamma_i\,(1+\lambda_C)]\, (K_i)^2 \right\} - \tfrac{1}{2}\gamma_i\,(K_i)^2 \\ =\;& 0\,. \end{aligned}$$

Thus even the most stringent of the limited liability constraints I have considered, namely the one where the bureaucrat's cost of providing the public good is monetary and must be covered by the net transfers he receives, is met (albeit only just). Thus limited liability constraints are not an issue in the extractive case.

**Generous case:**

Here $R_i = 0$, and the $F_i$ is found using (A.1) and (A.2):

$$F_i = \frac{1}{1 - \beta(1 + \lambda_C)} \; [\; \tfrac{1}{2} \, (\beta + \gamma_i) \; (K_i)^2 - \beta \; K_i \; ] \, .$$

Using these in (A.5) and differentiating, we have

$$\begin{aligned} \frac{\partial EU(R)}{\partial K_i} &= \theta_i \left\{ \frac{\rho_C \, (1 + \lambda_C) - \rho_B}{1 - \beta(1 + \lambda_C)} \; [\; \beta - (\beta + \gamma_i) \; K_i] + \rho_C \; - (\rho_C + \gamma_i \, \rho_B) \; K_i \right\} \\ &= \frac{\rho_C - \rho_B \, \beta}{1 - \beta(1 + \lambda_C)} \; \{1 - [1 + \gamma_i \, (1 + \lambda_C)] \; K_i \, \} \end{aligned}$$

Now

$$\begin{aligned} \rho_C - \rho_B \, \beta &> \rho_C - \rho_B \, / \, (1 + \lambda_C) \qquad \text{using(8)} \\ &= [\rho_C \, (1 + \lambda_C) - \rho_B] \, / \, (1 + \lambda_C) > 0 \, . \qquad \text{by(9)} \end{aligned}$$

Therefore the optimum $K_i$ is found by setting $\partial EU(R) / \partial K_i = 0$. This yields the same expression for $K_i^{1G}$ as for $K_i^{1E}$ in the extractive case.

### A.3.1 Limited Liability constraints

However, this choice may violate lower bounds on $F_i$. As discussed in the text, there can be different kinds of "limited liability constraints." As I also said in the text, readers who wish to focus on information issues can omit this section without significant loss of continuity.

Let us consider the various possibilities.

*Case 1: The bureaucrat's monetary cost must be covered:* We are in the generous case, so the $R_i$ are already pushed down to zero. Therefore the bureaucrat's cost must be covered by charging fees to the consumer: $F_i \geq \frac{1}{2} \, \gamma_i \, (K_i)^2$ . Using the above expression for $F_i$, this requires

$$\tfrac{1}{2} \, (\beta + \gamma_i) \; (K_i)^2 - \beta \; K_i \geq [\, 1 - \beta(1 + \lambda_C) \,] \; \tfrac{1}{2} \, \gamma_i \, (K_i)^2 \, ,$$

or

$$\tfrac{1}{2} \, \beta \, [\; 1 + \gamma_i \, (1 + \lambda_C) \; ] \; (K_i)^2 \geq \beta \; K_i \, ,$$

or

$$\tfrac{1}{2} \, [\; 1 + \gamma_i \, (1 + \lambda_C) \; ] \; K_i \geq 1 \, .$$

Using the value of $K_i$ from (A.7), this becomes $\frac{1}{2} \geq 1$, which is impossible. Therefore in this case the constraint on covering the bureaucrat's monetary cost can never be satisfied automatically. The ruler is forced to allow the bureaucrat to charge a sufficiently high fee to cover the cost. This makes the bureaucrat's participation constraint slack.

The ruler must choose the optimal $K_i$ bearing all this in mind. With $R_i = 0$ and $F_i = \frac{1}{2}\gamma_i (K_i)^2$, the expression for the derivative of the ruler's expected utility becomes

$$\begin{aligned}
\frac{\partial EU(R)}{\partial K_i} &= \theta_i \left\{ -[\rho_C(1+\lambda_C) - \rho_B] \frac{\partial F_i}{\partial K_i} + \frac{\partial}{\partial K_i}[\rho_C K_i - \tfrac{1}{2}(\rho_C + \gamma_i \rho_B)(K_i)^2 \right\} \\
&= \theta_i \; \{ -[\rho_C(1+\lambda_C) - \rho_B] \gamma_i K_i + \rho_C - (\rho_C + \gamma_i \rho_B) K_i \} \\
&= \theta_i \; \rho_C \; \{ 1 - [1 + \gamma_i(1+\lambda_C)] \} \; K_i
\end{aligned}$$

Setting this equal to zero yields the same solution for $K_i$ as before. Thus efficiency is not affected, but the distribution of utilities is. The bureaucrat's participation constraint is slack and he gets some rent. Specifically, for the type-$i$ bureaucrat,

$$U_B(i) = [1 - \beta(1+\lambda_C)] \; \tfrac{1}{2}\gamma_i (K_i)^2 + \beta \; K_i - \tfrac{1}{2}(\beta + \gamma_i) \; (K_i)^2 \, .$$

The expression for $K_i$ does not involve $\beta$ explicitly; therefore

$$\begin{aligned}
\frac{\partial U_B(i)}{\partial \beta} &= -(1+\lambda_C)] \; \tfrac{1}{2}\gamma_i (K_i)^2 + K_i - \tfrac{1}{2}(K_i)^2 \\
&= K_i - \tfrac{1}{2} \; [1 + \gamma_i(1+\lambda_C)] \; (K_i)^2 \\
&= \tfrac{1}{2} \; \frac{1}{1 + \gamma_i(1+\lambda_C)} > 0
\end{aligned}$$

using the optimal value of $K_i$. Thus the greater the bureaucrat's concern for the citizen, the more utility he gets.

*Case 2: The bureaucrat must receive non-negative monetary transfers:* With the $R_i$ already pushed down to zero, this requires $F_i \geq 0$. The constraint is automatically fulfilled by the $K_i$ given by (A.7) that was optimal in the absence of such a constraint, if

$$\tfrac{1}{2}(\beta + \gamma_i) \; (K_i)^2 \geq \beta \; K_i \, ,$$

or

$$\tfrac{1}{2}(\beta + \gamma_i) \geq \beta \, / \, K_i = \beta \; [\, 1 + \gamma_i \, (1 + \lambda_C) \,] \, ,$$

or

$$\beta \leq \frac{\gamma_i}{1 + 2\,\gamma_i \, (1+\lambda_C)} \, .$$

If this inequality is violated, then the ruler must set $F_i = 0$. That makes

$$\frac{\partial EU(R)}{\partial K_i} = \theta_i \; [\; \rho_C \; - (\rho_C + \gamma_i \rho_B) \; K_i \; ] \, ,$$

and

$$K_i = \frac{\rho_C}{\rho_C + \gamma_i \rho_B} \, . \tag{A.8}$$

This is duplicated as equation (13) in the text. The level of $K_i$ here is higher than the optimum value of $K_i$ in (A.7) when the nonnegativity constraint on $F_i$ is not binding:

$$\frac{\rho_C}{\rho_C + \gamma_i\,\rho_B} > \frac{1}{1+\gamma_i\,(1+\lambda_C)}$$

corresponds to

$$\rho_C\,\left[\,1+\gamma_i\,(1+\lambda_C)\,\right] > \rho_C + \gamma_i\,\rho_B\,,$$

or $\rho_C\,(1+\lambda_C) > \rho_B$, which is true by assumption.

The bureaucrat's participation constraint is slack. With $R_i = F_i = 0$, type-$i$ bureaucrat's utility is simply his valuation of the citizen's surplus minus his own utility cost of providing the public good:

$$U_B(i) = \beta\,K_i - \tfrac{1}{2}\,(\beta+\gamma_i)\,(K_i)^2\,,$$

where $K_i$ is defined by (A.8); it is $< 1$ and is independent of $\beta$. Therefore

$$\frac{\partial U_B(i)}{\partial \beta} = K_i - \tfrac{1}{2}\,(K_i)^2 = K_i\,\left(1 - \tfrac{1}{2}\,K_i\right) > 0\,.$$

So in this case, too, a bureaucrat who has greater concern for the citizen's welfare gets higher utility.

*Case 3: The bureaucrat can be milked for transfers, but using another leaky bucket:* Here $F_i$ can be negative. However, the citizen received only $1/(1+\mu_C)$ for each unit the bureaucrat gives up. The ruler wants to utilize this way of transferring money from the bureaucrat to the citizen if $\rho_C/(1+\mu_C) > \rho_B$. Let us proceed on this assumption; otherwise the ruler keeps $F_i = 0$ and we are back in Case 2.

Now the ruler can use this avenue of transfer to drive the bureaucrat back to his participation constraint. Once again $R_i = 0$ since the ruler is generous, and now the $F_i$ is found using

$$U_B(i) = [1 - \beta/(1+\mu_C)]\;F_L + \beta\;K_L - \tfrac{1}{2}\,(\beta+\gamma_L)\,(K_L)^2 = 0\,;$$

therefore

$$F_i = \frac{1}{1-\beta/(1+\mu_C)}\;\left[\;\tfrac{1}{2}\,(\beta+\gamma_i)\,(K_i)^2 - \beta\;K_i\;\right].$$

The ruler's objective function (A.5) must be changed to recognize the difference in the leakage. To save algebra I will simply write the part corresponding to the case when the bureaucrat is of type $i$, say $U_R(i)$, and recognizing $R_i = 0$:

$$U_R(i) = -[\,\rho_C/(1+\mu_C) - \rho_B]\;F_L + \rho_C\;K_L - \tfrac{1}{2}\,(\rho_C + \gamma_L\,\rho_B)\,(K_L)^2\,.$$

Therefore

$$\begin{aligned}
\frac{\partial EU_R(i)}{\partial K_i} &= -\,\frac{\rho_C/(1+\mu_C) - \rho_B}{1-\beta/(1+\mu_C)}\;[\,(\beta+\gamma_i)\;K_i - \beta] + \rho_C\; - (\rho_C + \gamma_i\,\rho_B)\;K_i \\
&= \frac{1}{1-\beta/(1+\mu_C)}\;\left\{\;\frac{\beta\,\rho_C}{1+\mu_C} - \beta\,\rho_B + \rho_C - \frac{\beta\,\rho_C}{1+\mu_C}\right.
\end{aligned}$$

$$- \left[ \frac{\beta \rho_C + \gamma_i \, \rho_C}{1+\mu_C} - \beta \rho_B - \gamma_i \rho_B + \rho_C + \gamma_i \rho_B - \frac{\beta \rho_C + \beta \gamma_i \rho_B}{1+\mu_C} \right] K_i \Bigg\}$$

$$= \frac{\rho_C - \beta \, \rho_B}{1 - \beta/(1+\mu_C)} \; \{ \; 1 - [1 + \gamma_i/(1+\mu_C)] \; K_i \; \}$$

We are assuming $\rho_C/(1+\mu_C) > \rho_B$. Also, (8) is a maintained assumption throughout the paper; therefore $1 > \beta \, (1+\lambda_C) > \beta/(1+\mu_C)$. Therefore

$$\rho_C/(1+\mu_C) > \rho_B \, \beta/(1+\mu_C), \quad \text{or} \quad \rho_C > \beta \, \rho_B \,, \quad \text{so} \quad \rho_C - \beta \, \rho_B > 0 \,.$$

Therefore the optimal choice of $K_i$ is given, by solving $\partial EU_R(i)/\partial K_i = 0$, as

$$K_i = \frac{1}{1 + \gamma_i/(1+\mu_C)} \,. \tag{A.9}$$

This is reproduced in the text as (14). The level of the public good in this case is clearly higher than the optimal $K_i$ given by (A.7) when $F_i > 0$. It even exceeds the ideal first best given by the text equation (1) in the absence of leaky buckets, namely $K_i = 1/(1+\gamma_i)$. But it is not as high as the level given by (A.8) when $F_i$ is constrained to equal zero:

$$\frac{\rho_C}{\rho_C + \gamma_i \, \rho_B} > \frac{1}{1 + \gamma_i/(1+\mu_C)}$$

if

$$\rho_C + \rho_C \, \gamma_i/(1+\mu_C) > \rho_C + \gamma_i \, \rho_B \quad \text{that is,} \quad \rho_C/(1+\mu_C) > \rho_B \,,$$

which is the premise of this case. Thus, when the ruler has a preferred way of transferring money from the bureaucrat to the citizen, there is less need to distort the level of the public good upward.

It remains to verify whether, or when, this solution actually yields negative $F_i$. Using the starting formula in this case for $F_i$, we see that we need $\frac{1}{2} \, (\beta + \gamma_i) \; (K_i)^2 < \beta \; K_i$, or $\frac{1}{2} \, (\beta + \gamma_i) \; K_i < \beta$. Substituting for $K_i$ and simplifying, this becomes

$$\beta > \frac{\gamma_i}{1 + \gamma_i/(1+\mu_C)} \,.$$

Finally, suppose we are in the generous case, but the ruler is nepotistic toward the bureaucrat: (9) is violated; $\rho_B > \rho_C \, (1+\lambda_C)$; and the ruler wants to transfer money from the citizen to the bureaucrat even though the bucket leaks. Now the ruler will set $R_i = 0$, but leave the citizen on his participation constraint, so $F_i = [K_i - \frac{1}{2} \, (K_i)^2]/(1+\lambda_C)$, the bureaucrat's utility is

$$U_B(i) = S_B(i) = F_i - \tfrac{1}{2} \, \gamma_i \, (K_i)^2 = \frac{K_i - \frac{1}{2} \, (K_i)^2}{1 + \lambda_C} - \tfrac{1}{2} \, \gamma_i \, (K_i)^2 \,,$$

and the ruler's expected utility is simply his valuation of the bureaucrat's surplus:

$$EU(R) = \rho_B \; [ \; \theta_L \; U_B(L) + \theta_H \; U_B(H) \; ] \,.$$

Then

$$\frac{\partial U(R)}{\partial K_i} = \frac{1 - K_i}{1 + \lambda_C} - \gamma_i \, K_i \, ,$$

which again yields the solution (A.7). Then

$$U_B(i) = \tfrac{1}{2} \, \frac{1}{1 + \lambda_C} \; \frac{1}{1 + \gamma_i \, (1 + \lambda_C)} > 0 \, .$$

Therefore $F_i > \frac{1}{2} \gamma_i (K_i)^2$, that is, any requirement to cover the bureaucrat's monetary cost is automatically satisfied, so no issues of limited liability constraints arise. The bureaucrat's participation constraint is slack, but here the ruler wants it to be.

## A.4 Bureaucrat's actions but not type observable

For ease of repeated reference, I will call the incentive compatibility constraints of the two types $L$, $H$ of bureaucrats $BIC_L$ and $BIC_H$ respectively, and their participation constraints $BPC_L$, $BPC_H$ respectively. The participation constraints for the citizen when the bureaucrat is of type $L$ or $H$ will be referred to as $CPC_L$, $CPC_H$ respectively.

Recall that the utility of a bureaucrat whose true type is $i$ and reported type is $j$ is written $U_B(i, j)$. The $U_B(i, i)$ were previously written simply as $U_B(i)$. Substituting the expressions for the surpluses in the text, (2) and (3), into the bureaucrat's utility function (4), we can write $BIC_L$ as

$$\begin{aligned} U_B(L, L) \;\; &\equiv \;\; [1 - \beta(1 + \lambda_C)] \; F_L - (1 + \lambda_B) \; R_L + \beta \, K_L - \tfrac{1}{2} \, (\beta + \gamma_L) \, (K_L)^2 \\ \geq U_B(L, H) \;\; &\equiv \;\; [1 - \beta(1 + \lambda_C)] \; F_H - (1 + \lambda_B) \; R_H + \beta \; K_H - \tfrac{1}{2} \, (\beta + \gamma_L) \; (K_H)^2 \, . \end{aligned} \quad \text{(A.10)}$$

A more compact form of this is

$$U_B(L, L) \geq U_B(H, H) + \tfrac{1}{2} \, (\gamma_H - \gamma_L) \; (K_H)^2 \, . \quad \text{(A.11)}$$

Similarly, $BIC_H$ is

$$\begin{aligned} U_B(H, H) \;\; &\equiv \;\; [1 - \beta(1 + \lambda_C)] \; F_H - (1 + \lambda_B) \; R_H + \beta \, K_H - \tfrac{1}{2} \, (\beta + \gamma_H) \, (K_H)^2 \\ \geq U_B(H, L) \;\; &\equiv \;\; [1 - \beta(1 + \lambda_C)] \; F_L - (1 + \lambda_B) \; R_L + \beta \; K_L - \tfrac{1}{2} \, (\beta + \gamma_H) \; (K_L)^2 \, , \end{aligned} \quad \text{(A.12)}$$

or more compactly,

$$U_B(H, H) \geq U_B(L, L) - \tfrac{1}{2} \, (\gamma_H - \gamma_L) \; (K_L)^2 \, . \quad \text{(A.13)}$$

The participation constraints remain $BPC_L$: (A.1), $BPC_H$:(A.2) for the bureaucrat, and $CPC_L$: (A.3), $CPC_H$: (A.4) for the citizen when the bureaucrat is of the respective types $L$, $H$. The expression for the ruler's expected utility also remains (A.5).

A familiar argument simplifies the constrained maximization problem. I present it in a sequence of short lemmata.

**Lemma 1:** $BIC_L$ and $BPC_H$ together imply $BPC_L$, with slack if $K_H > 0$.

The proof is immediate from (A.11) and (A.2).

**Lemma 2:** If $BIC_L$ is binding and $K_L \geq K_H$, then $BIC_H$ is satisfied, with slack if $K_L > K_H$.

Proof: Using (A.11) with exact equality, substitute for $U_B(L, L)$ on the right hand side of (A.13). This yields

$$U_B(H,H) \geq U_B(H,H) - \tfrac{1}{2}\,(\gamma_H - \gamma_L)\;[\;(K_L)^2 - (K_H)^2\;]\,.$$

This is true if $K_L \geq K_H$, and the inequality is strict if $K_L > K_H$.

**Lemma 3:** If the condition (9) is satisfied, then $BIC_L$ is binding at the optimum.

Proof: Suppose not. Then (A.11) is a strict inequality, and $BPC_H$ ensures $U_B(H, H) \geq 0$; therefore from (A.11) we have $U_B(L, L) > 0$, that is, $BPC_L$ must be slack as well. Consider the effect of lowering $F_L$ slightly, leaving $F_H$ and the $R_i$, $K_i$ unchanged. This lowers $U_B(L, L)$ slightly, but has no effect on $U_B(H, H)$; therefore from $(A.11)$ which is slack by the current assumption, we see that both $BIC_L$ and $BPC_L$ go on being satisfied. The fulfillment of $BIC_H$ and $CPC_L$ is actually helped by the reduction in $F_L$, while $BPC_H$ and $CPC_H$ are unaffected. And (9) ensures that $EU(R)$ increases. Therefore the previous situation with a slack $BIC_L$ cannot have been optimum.

Therefore I solve a "relaxed" problem with fewer constraints pertaining to the bureaucrat, namely $BIC_L$ and $BPC_H$ holding as equations, and verify that in the solution $K_L > K_H > 0$. Then the other two constraints $BIC_H$ and $BPC_L$ will be satisfied, in fact with slack, so the solution will also solve the full problem.

With $BPC_H$ binding, $U_B(H, H) = 0$ and $BIC_L$ in its alternative form (A.11) is simply $U_B(L, L) \geq \frac{1}{2}\,(\gamma_H - \gamma_L)\;(K_H)^2$. Taking this to bind, and using the expression for $U_B(L)$ in (A.1), the constraint becomes

$$[1-\beta(1+\lambda_C)]\;F_L - (1+\lambda_B)\;R_L + \beta\;K_L - \tfrac{1}{2}\,(\beta+\gamma_L)\;(K_L)^2 - \tfrac{1}{2}\,(\gamma_H - \gamma_L)\;(K_H)^2 = 0\,. \quad \text{(A.14)}$$

The other constraint $BPC_H$ is the same (A.2) as before, restated here for convenience:

$$[1 - \beta(1 + \lambda_C)]\;F_H - (1 + \lambda_B)\;R_H + \beta\;K_H - \tfrac{1}{2}\,(\beta + \gamma_H)\;(K_H)^2 = 0\,. \quad \text{(A.15)}$$

The argument now proceeds in the same steps as in the full information case.

**Extractive case:**

Here the citizen is driven down to his participation constraint. Therefore from (A.3) and (A.4) we have

$$F_i = \frac{1}{1+\lambda_C}\;\left[\;K_i - \tfrac{1}{2}\;(K_i)^2\;\right] \qquad \text{for } i = L,\, H\,. \quad \text{(A.16)}$$

Then as much is extracted from the bureaucrat as is compatible with (A.15) and (A.14). Therefore

$$R_H \;=\; \frac{1}{1+\lambda_B}\;\left\{\;[1 - \beta(1 + \lambda_C)]\;F_H + \beta\;K_H - \tfrac{1}{2}\,(\beta + \gamma_H)\;(K_H)^2\;\right\}$$

$$
\begin{aligned}
&= \frac{1}{1+\lambda_B} \left\{ \frac{1-\beta(1+\lambda_C)}{1+\lambda_C} \left[ K_H - \tfrac{1}{2}\,(K_H)^2 \right] + \beta\, K_H - \tfrac{1}{2}\,(\beta+\gamma_H)\,(K_H)^2 \right\} \\
&= \frac{1}{(1+\lambda_B)\,(1+\lambda_C)} \left\{ K_H - \tfrac{1}{2}\,[1+\gamma_H\,(1+\lambda_C)]\,(K_H)^2 \right\}. \qquad \text{(A.17)}
\end{aligned}
$$

This is the same expression as in the full information case. But

$$
\begin{aligned}
R_L &= \frac{1}{1+\lambda_B} \left\{ [1-\beta(1+\lambda_C)]\, F_L + \beta\, K_L - \tfrac{1}{2}\,(\beta+\gamma_L)\,(K_L)^2 - \tfrac{1}{2}\,(\gamma_H-\gamma_L)\,(K_H)^2 \right\} \\
&= \frac{1}{1+\lambda_B} \left\{ \frac{1-\beta(1+\lambda_C)}{1+\lambda_C} \left[ K_L - \tfrac{1}{2}\,(K_L)^2 \right] + \beta\, K_L - \tfrac{1}{2}\,(\beta+\gamma_L)\,(K_L)^2 \right. \\
&\qquad \left. -\tfrac{1}{2}\,(\gamma_H-\gamma_L)\,(K_H)^2 \right\} \\
&= \frac{1}{(1+\lambda_B)\,(1+\lambda_C)} \left\{ K_L - \tfrac{1}{2}\,[1+\gamma_L\,(1+\lambda_C)]\,(K_L)^2 \right\} \\
&\qquad - \frac{1}{1+\lambda_B}\,\tfrac{1}{2}\,(\gamma_H-\gamma_L)\,(K_H)^2. \qquad \text{(A.18)}
\end{aligned}
$$

Therefore

$$
\begin{aligned}
\frac{\partial EU(R)}{\partial K_L} &= \theta_L \left\{ \frac{1-\rho_B(1+\lambda_B)}{(1+\lambda_B)\,(1+\lambda_C)} \{1-[1+\gamma_L\,(1+\lambda_C)]\,K_L\} \right. \\
&\qquad \left. - \frac{\rho_C(1+\lambda_C)-\rho_B}{1+\lambda_C}\,(1-K_L) + \rho_C \;-(\rho_C+\gamma_L\,\rho_B)\,K_L \right\} \\
&= \theta_L\, \frac{1}{(1+\lambda_B)\,(1+\lambda_C)} \{1-[1+\gamma_L\,(1+\lambda_C)]\,K_L\}.
\end{aligned}
$$

Setting this equal to zero yields the same optimum choice of $K_L^{2E}$ as in the full information case, namely (A.7). But

$$
\begin{aligned}
\frac{\partial EU(R)}{\partial K_H} &= \theta_H \left\{ \frac{1-\rho_B(1+\lambda_B)}{(1+\lambda_B)\,(1+\lambda_C)} \{1-[1+\gamma_H\,(1+\lambda_C)]\,K_H\} \right. \\
&\qquad \left. - \frac{\rho_C(1+\lambda_C)-\rho_B}{1+\lambda_C}\,(1-K_H) + \rho_C \;-(\rho_C+\gamma_H\,\rho_B)\,K_H \right\} \\
&\qquad - \theta_L\,[1-\rho_B(1+\lambda_B)]\,\frac{1}{1+\lambda_B}\,(\gamma_H-\gamma_L)\,K_H \\
&= \frac{\theta_H}{(1+\lambda_B)\,(1+\lambda_C)} \left\{ 1 - \left[ 1+\gamma_H\,(1+\lambda_C) \right.\right. \\
&\qquad \left.\left. + \frac{\theta_L}{\theta_H}\,(1+\lambda_C)\,[1-\rho_B(1+\lambda_B)]\,(\gamma_H-\gamma_L) \right] K_H \right\},
\end{aligned}
$$

which yields the optimum

$$
K_H^{2E} = \frac{1}{1+\gamma_H\,(1+\lambda_C) + \dfrac{\theta_L}{\theta_H}\,(\gamma_H-\gamma_L)\,(1+\lambda_C)\,[1-\rho_B(1+\lambda_B)]}, \qquad \text{(A.19)}
$$

This is reproduced in the text as (16). Inspection of the equations verifies $K_L^{2E} > K_H^{2E} > 0$, as is required for the "relaxed" problem to yield a solution to the full problem.

With this solution, the citizen is kept on his participation constraint and gets zero surplus under either type of bureaucrat: $S_C(L) = S_C(H) = 0$. The $H$-type bureaucrat also gets $U_B(H) = 0$, whereas the $L$-type gets rent $U_B(L) = S_B(L) = \frac{1}{2}(\gamma_H - \gamma_L)(K_H)^2$. The ruler's expected utility is

$$EU_R^{2E} = \theta_L\,[\,R_L + \rho_B\,S_B(L)\,] + \theta\,H\,R_H\,,$$

where the formulae for $R_L$ and $R_H$ are given above. All these magnitudes are independent of $\beta$. Therefore the ruler does not care whether he employs a bureaucrat with more or less innate concern for the citizen, nor does the bureaucrat's utility from working for an extractive ruler depend on his (the bureaucrat's) innate degree of concern for the citizen.

**Generous case:**

Here the ruler sets $R_i = 0$, and does not want to drive the citizen down to a binding participation constraint. Therefore $F_H$ is found using (A.15):

$$F_H = \frac{1}{1-\beta(1+\lambda_C)}\,\left[\,\tfrac{1}{2}\,(\beta+\gamma_H)\,(K_H)^2 - \beta\,K_H\,\right]\,,$$

and is the same as the expression as in the full information case. But from (A.14), we have

$$F_L = \frac{1}{1-\beta(1+\lambda_C)}\,\left[\,\tfrac{1}{2}\,(\beta+\gamma_L)\,(K_L)^2 - \beta\,K_L + \tfrac{1}{2}\,(\gamma_H-\gamma_L)\,(K_H)^2\,\right]\,.$$

Using these in (A.5) and differentiating, we have

$$\begin{aligned}\frac{\partial EU(R)}{\partial K_L} &= \theta_L\,\left\{\frac{\rho_C(1+\lambda_C)-\rho_B}{1-\beta(1+\lambda_C)}\,[\,\beta-(\beta+\gamma_L)\,K_L] + \rho_C\;-(\rho_C+\gamma_L\,\rho_B)\,K_L\right\}\\ &= \frac{\rho_C-\rho_B\,\beta}{1-\beta(1+\lambda_C)}\,\{1-[1+\gamma_L\,(1+\lambda_C)]\,K_L\,\}\,,\end{aligned}$$

yielding the same solution (A.7) for $K_L^{2G}$ as in the full information case. But

$$\begin{aligned}\frac{\partial EU(R)}{\partial K_H} &= \theta_H\,\left\{\frac{\rho_C(1+\lambda_C)-\rho_B}{1-\beta(1+\lambda_C)}\,[\,\beta-(\beta+\gamma_H)\,K_H] + \rho_C\;-(\rho_C+\gamma_H\,\rho_B)\,K_H\right\}\\ &\quad -\theta_L\,\frac{\rho_C(1+\lambda_C)-\rho_B}{1-\beta(1+\lambda_C)}\,(\gamma_H-\gamma_L)\,K_H\\ &= \theta_H\,\frac{\rho_C-\rho_B\,\beta}{1-\beta(1+\lambda_C)}\,\{1-[1+\gamma_H\,(1+\lambda_C)]\,K_H\,\}\\ &\quad -\theta_L\,\frac{\rho_C(1+\lambda_C)-\rho_B}{1-\beta(1+\lambda_C)}\,(\gamma_H-\gamma_L)\,K_H\end{aligned}$$

Setting this equal to zero and solving, we have

$$K_H^{2G} = \frac{1}{1+\gamma_H\,(1+\lambda_C)+\dfrac{\theta_L}{\theta_H}\,(\gamma_H-\gamma_L)\,\dfrac{\rho_C\,(1+\lambda_C)-\rho_B}{\rho_C-\beta\,\rho_B}}\,. \tag{A.20}$$

This is reproduced as (17) in the text. The requirement $K_L^{2G} > K_H^{2G} > 0$ is easily verified.

The last fraction in the denominator of (A.20) can be written as $[\delta\,(1+\lambda_C)-1]/(\delta-\beta)$, where $\delta = \rho_C/\rho_B$. It is easy to see that it is increasing in $\lambda_C$ and in $\beta$. Therefore the distortion in $K_H^{2G}$ is larger when the bucket is more leaky, and somewhat surprisingly, when the bureaucrat has greater concern for the citizen. This is discussed in the text. As for the effect of $\delta$, we have

$$\begin{aligned}\frac{\partial}{\partial\delta}\left[\frac{\delta\,(1+\lambda_C)-1}{\delta-\beta}\right] &= \frac{1}{(\delta-\beta)^2}\,\{\,(1+\lambda_C)\,(\delta-\beta)-[\delta\,(1+\lambda_C)-1]\,\}\\ &= \frac{1-\beta(1+\lambda_C)}{(\delta-\beta)^2} > 0\,.\end{aligned}$$

Therefore the distortion is greater when the ruler is more concerned about the citizen (higher $\rho_C$) or less concerned about the bureaucrat (lower $\rho_B$). This is also surprising at first sight, and is discussed in the text.

Since $K_H^{2G}$ decreases as $\beta$ decreases, so does the $L$-type bureaucrat's payoff,

$$U_B(L,L) = \tfrac{1}{2}\,(\gamma_H-\gamma_L)\,(K_H^{2G})^2\,.$$

However, the citizen does get positive surplus under both types of bureaucrats. The expressions are complicated and it is not possible to determine uniquely how they behave as $\beta$ changes. Therefore I leave this to numerical calculations, illustrated in the text.

## A.5 Type and choice of public good unobservable

In this section the ruler does not know the bureaucrat's type $i = L$, $H$, and does not observe the action $K$, but can observe $F$, $R$. Therefore the ruler's direct or revelation mechanism must be both "honest" and "obedient" as in Myerson (1982); it asks the bureaucrat to report his type, and commits to policies $F_j$, $R_j$ as a function of the reported type. The ruler chooses these to maximize his expected payoff, subject to all participation constraints, and the incentive constraints that induce the bureaucrat to report the type optimally, while choosing $K$ privately to optimize his (bureaucrat's) own payoff.

As stated in the text, a bureaucrat whose true type is $i$ and reported type is $j$ will choose $K$ to maximize

$$U_B(i,j) \equiv F_j-(1+\lambda_B)\,R_j-\tfrac{1}{2}\,\gamma_i\,K^2+\beta\,[K-\tfrac{1}{2}\,K^2-(1+\lambda_C)\,F_j]$$

subject to

$$S_C = K-\tfrac{1}{2}\,K^2-(1+\lambda_C)\,F_j \geq 0\,,$$

or

$$F_j \leq F(K) \equiv \frac{1}{1+\lambda_C}\,(\,K-\tfrac{1}{2}\,K^2\,)\,. \tag{A.21}$$

The solution was described in the text in conjunction with Figure 1; here is a more formal statement. Define

$$\widehat{K}_i \equiv \frac{\beta}{\beta + \gamma_i} = \frac{1}{1 + (\gamma_i/\beta)} \,. \tag{A.22}$$

Therefore a bureaucrat of type $i$ reporting type $j$ would choose $K$ equal to

$$K^*_{ij} = \begin{cases} \widehat{K}_i & \text{if } F_j \leq F(\widehat{K}_i) \\ F^{-1}(F_j) & \text{if } F(\widehat{K}_i) < F_j \leq 1/[2(1+\lambda_C)] \end{cases} \tag{A.23}$$

So long as the bureaucrat's concern for the citizen is limited by (8), we have $1/\beta > 1+\lambda_C$, and then

$$\widehat{K}_i < K_i^{1E} = K_i^{1G} = \frac{1}{1 + (1+\lambda_C)\,\gamma_i} \,,$$

the ruler's optimal choices under full information constrained only by the leakiness of the transfer buckets. So these higher levels of $K$ can be achieved only by setting the fee at a level where the citizen's participation constraint will bind.

**Extractive case:**

As explained in the text, I am assuming that $\beta$ is small enough to ensure

$$\widehat{K}_H < K_H^{2E} \,.$$

More precisely, using (A.22) and (A.19), the condition is

$$1 + \gamma_H/\beta > 1 + \gamma_H\,(1+\lambda_C) + \frac{\theta_L}{\theta_H}\,(\gamma_H - \gamma_L)\,(1+\lambda_C)\,[1 - \rho_B(1+\lambda_B)] \,,$$

or

$$\beta < \frac{\gamma_H}{\gamma_H\,(1+\lambda_C) + \dfrac{\theta_L}{\theta_H}\,(\gamma_H - \gamma_L)\,(1+\lambda_C)\,[1 - \rho_B(1+\lambda_B)]} \,,$$

or

$$\beta < \frac{1}{(1+\lambda_C) + \dfrac{\theta_L}{\theta_H}\,\dfrac{\gamma_H - \gamma_L}{\gamma_H}\,(1+\lambda_C)\,[1 - \rho_B(1+\lambda_B)]} \,,$$

so we see that it is a stronger restriction on $\beta$ than the previously maintained (8), namely $\beta < 1/(1+\lambda_C)$. We already know that

$$\widehat{K}_L < K_L^{1E} = K_L^{2E} \,.$$

Therefore attempting to induce either type of bureaucrat to supply the quantity of the public good closer to the ruler's optimum under the condition of observability of $K$ requires the ruler to use higher fees and keep the citizen's participation conditions binding. I now show that the ruler's optimum with these constraints imposed actually coincides with the ruler's optimum when $K$ was observable. As the ruler is able to replicate a better optimum, this must also be optimal with $K$ unobservable.

With $K$ unobservable, the ruler's revelation mechanism can only stipulate $(F_j, R_j)$ as functions of the bureaucrat's reported type $j$. As shown in the text, in the region $F(\widehat{K}_j) \leq F_j \leq 1/[2(1+\lambda_C)]$ there is a monotonic increasing relationship between $F_j$ and the bureaucrat's chosen level of $K$ in the range $\widehat{K}_j \leq K \leq 1$. Therefore we can formally equivalently define the ruler's mechanism by $(K_j, R_j)$ even though $K$ is not observable.

In this range, the citizen is on his participation constraint, so

$$S_C(i) = K_i - \tfrac{1}{2}\,(K_i)^2 - (1+\lambda_C)\;F_i = 0 \qquad \text{for } i = L,\, H\,,$$

and

$$F_i = \frac{1}{1+\lambda_C}\;\Big[\;K_i - \tfrac{1}{2}\,(K_i)^2\;\Big] \tag{A.24}$$

When the citizen gets no surplus, the bureaucrat's utility equals his own surplus regardless of his concern parameter $\beta$, so

$$\begin{aligned} U_B(i,j) &= F_j - (1+\lambda_B)\;R_j - \tfrac{1}{2}\;\gamma_i\;(K_j)^2 \\ &= \frac{1}{1+\lambda_C}\;\Big\{\;K_j - \tfrac{1}{2}\,(K_j)^2\;\Big\} - (1+\lambda_B)\;R_j - \tfrac{1}{2}\;\gamma_i\;(K_j)^2 \\ &= \frac{1}{1+\lambda_C}\;\Big\{\;K_j - \tfrac{1}{2}\,[1+\gamma_i\,(1+\lambda_C)]\;(K_j)^2\;\Big\} - (1+\lambda_B)\;R_j \end{aligned}$$

Then the incentive compatibility condition for the $L$-type bureaucrat, $BIC_L$, is

$$\begin{aligned} & U_B(L,L) = \frac{1}{1+\lambda_C}\;\Big\{\;K_L - \tfrac{1}{2}\,[1+\gamma_L\,(1+\lambda_C)]\;(K_L)^2\;\Big\} - (1+\lambda_B)\;R_L \\ \geq\;\; & U_B(L,H) = \frac{1}{1+\lambda_C}\;\Big\{\;K_H - \tfrac{1}{2}\,[1+\gamma_L\,(1+\lambda_C)]\;(K_H)^2\;\Big\} - (1+\lambda_B)\;R_H\,, \end{aligned} \tag{A.25}$$

and that for the $H$-type bureaucrat, $BIC_H$, is

$$\begin{aligned} & U_B(H,H) = \frac{1}{1+\lambda_C}\;\Big\{\;K_H - \tfrac{1}{2}\,[1+\gamma_H\,(1+\lambda_C)]\;(K_H)^2\;\Big\} - (1+\lambda_B)\;R_H \\ \geq\;\; & U_B(H,L) = \frac{1}{1+\lambda_C}\;\Big\{\;K_L - \tfrac{1}{2}\,[1+\gamma_H\,(1+\lambda_C)]\;(K_L)^2\;\Big\} - (1+\lambda_B)\;R_L\,. \end{aligned} \tag{A.26}$$

More compact forms of these are exactly the same as in the case where $K$ was observable, namely equations (A.11) and (A.13). The participation constraints $BPC_i$ are $U_B(i,i) \geq 0$ for $i = L,\, H$.

Then exactly the same three lemmas as in the case of section A.4, where $K$ was observable, tell us that the solution will have $BIC_L$ and $BPC_H$ binding, and $BIC_H$ and $BPC_L$ slack, so long as the solution to such a relaxed problem has $K_L > K_H > 0$. So I proceed on this assumption and verify it at the end.

Write a binding $BPC_H$ as

$$\frac{1}{1+\lambda_C}\;\Big\{\;K_H - \tfrac{1}{2}\,[1+\gamma_H\,(1+\lambda_C)]\;(K_H)^2\;\Big\} - (1+\lambda_B)\;R_H = 0\,,$$

or

$$R_H = \frac{1}{(1+\lambda_B)(1+\lambda_C)} \left\{ K_H - \tfrac{1}{2}[1+\gamma_H(1+\lambda_C)]\,(K_H)^2 \right\}. \qquad (A.27)$$

Using the compact form, we can write a binding $BIC_L$ as

$$\frac{1}{1+\lambda_C} \left\{ K_L - \tfrac{1}{2}[1+\gamma_L(1+\lambda_C)]\,(K_L)^2 \right\} - (1+\lambda_B)\,R_L = \tfrac{1}{2}(\gamma_H - \gamma_L)\,(K_H)^2,$$

or

$$R_L = \frac{1}{(1+\lambda_B)(1+\lambda_C)} \left\{ K_L - \tfrac{1}{2}[1+\gamma_L(1+\lambda_C)]\,(K_L)^2 \right\} - \tfrac{1}{2}\frac{1}{1+\lambda_B}(\gamma_H-\gamma_L)\,(K_H)^2. \qquad (A.28)$$

Equations (A.24), (A.27), and (A.28) are the same as the corresponding equations (A.16), (A.17), and (A.18) for the case when $K$ is observable. Therefore the expression for the ruler's expected utility in terms of $K_L$ and $K_H$ is also identical, and the same optimum is obtained. In the process the assumption underlying the relaxed problem, namely $K_L > K_H > 0$, is verified.

**Generous case:**

As explained in the text, I analyze only an extreme case where $\rho_B = 0$ and $\rho_C >> 1$. So keeping the citizen's participation constraints binding is not going to be optimal. Accordingly I proceed on the basis that those constraints are slack, and the bureaucrat is going to choose $K_i = \widehat{K_i}$.

Then a bureaucrat of type $i$ reporting type $j$ has payoff

$$\begin{aligned} U_B(i,j) &= F_j - (1+\lambda_B)R_j - \tfrac{1}{2}\gamma_i\,(\widehat{K_i})^2 + \beta\,[\widehat{K_i} - \tfrac{1}{2}(\widehat{K_i})^2 - (1+\lambda_C)F_j] \\ &= [1-\beta(1+\lambda_C)]\;F_j - (1+\lambda_B)\;R_j + \beta\,\frac{\beta}{\beta+\gamma_i} - \tfrac{1}{2}(\beta+\gamma_i)\left(\frac{\beta}{\beta+\gamma_i}\right)^2 \\ &= [1-\beta(1+\lambda_C)]\;F_j - (1+\lambda_B)\;R_j + \tfrac{1}{2}\,\frac{\beta^2}{\beta+\gamma_i} \end{aligned}$$

The incentive constraints become: $BIC_L$

$$\begin{aligned} & U_B(L,L) = [1-\beta(1+\lambda_C)]\;F_L - (1+\lambda_B)\;R_L + \tfrac{1}{2}\,\frac{\beta^2}{\beta+\gamma_L} \\ \geq\;& U_B(L,H) = [1-\beta(1+\lambda_C)]\;F_H - (1+\lambda_B)\;R_H + \tfrac{1}{2}\,\frac{\beta^2}{\beta+\gamma_L} \end{aligned}$$

and $BIC_H$

$$\begin{aligned} & U_B(H,H) = [1-\beta(1+\lambda_C)]\;F_H - (1+\lambda_B)\;R_H + \tfrac{1}{2}\,\frac{\beta^2}{\beta+\gamma_H} \\ \geq\;& U_B(H,L) = [1-\beta(1+\lambda_C)]\;F_L - (1+\lambda_B)\;R_L + \tfrac{1}{2}\,\frac{\beta^2}{\beta+\gamma_H} \end{aligned}$$

These collapse to

$$[1-\beta(1+\lambda_C)]\ F_L-(1+\lambda_B)\ R_L=[1-\beta(1+\lambda_C)]\ F_H-(1+\lambda_B)\ R_H\equiv Z\,, \tag{A.29}$$

where the symbol $Z$ is introduced to simplify some subsequent expressions.

The bureaucrat's participation constraints can then be written as

$$\begin{aligned} BPC_L: \qquad U_B(L,L) &= Z+\tfrac{1}{2}\ \frac{\beta^2}{\beta+\gamma_L}\geq 0\,,\\ BPC_H: \qquad U_B(H,H) &= Z+\tfrac{1}{2}\ \frac{\beta^2}{\beta+\gamma_H}\geq 0\,. \end{aligned}$$

Since $\gamma_H>\gamma_L$,

$$Z\geq -\ \tfrac{1}{2}\ \frac{\beta^2}{\beta+\gamma_H} \tag{A.30}$$

implies

$$Z\geq -\ \tfrac{1}{2}\ \frac{\beta^2}{\beta+\gamma_L}\geq 0\,,$$

or $BIC_H$ implies $BIC_L$. If $BIC_H$ is binding (as it will be at the optimum), then $BIC_L$ is slack and the $L$-type bureaucrat must be given rent

$$\begin{aligned} U_B(L,L) &= \tfrac{1}{2}\ \frac{\beta^2}{\beta+\gamma_L}-\tfrac{1}{2}\ \frac{\beta^2}{\beta+\gamma_H}\\ &= \tfrac{1}{2}\ \beta^2\ \frac{\gamma_H-\gamma_L}{(\beta+\gamma_L)\,(\beta+\gamma_H)}\\ &= \tfrac{1}{2}\frac{\gamma_H-\gamma_L}{[\,1+(\gamma_L/\beta)\,]\ [\,1+(\gamma_H/\beta)\,]} \end{aligned} \tag{A.31}$$

The citizen's participation constraints under the two types of bureaucrats are, for $i=L$, $H$:

$$S_C(i)=\widehat{K}_i-\tfrac{1}{2}\,(\widehat{K}_i)^2-(1+\lambda_C)\ F_i\geq 0$$

or

$$\begin{aligned} F_i &\leq \frac{1}{1+\lambda_C}\ \left[\ \frac{\beta}{\beta+\gamma_i}-\tfrac{1}{2}\ \left(\frac{\beta}{\beta+\gamma_i}\right)^2\ \right]\\ &= \frac{1}{1+\lambda_C}\ \frac{2\,\beta\,(\beta+\gamma_i)-\beta^2}{2\,(\beta+\gamma_i)^2}\\ &= \frac{1}{2\,(1+\lambda_C)}\ \frac{\beta^2+2\,\beta\,\gamma_i}{\beta^2+2\,\beta\,\gamma_i+(\gamma_i)^2}\\ &= \frac{1}{2\,(1+\lambda_C)}\ \left[\ 1-\left(\frac{\gamma_i}{\beta+\gamma_i}\right)^2\ \right] \end{aligned} \tag{A.32}$$

Anticipating again, if $F_i$ is zero, then the same calculation shows that the citizen has positive payoff,

$$S_C(i) = \frac{1}{2} \left[ 1 - \left( \frac{\gamma_i}{\beta + \gamma_i} \right)^2 \right] . \tag{A.33}$$

The ruler's objective function (under the current assumption $\rho_B = 0$) is

$$\begin{aligned} EU(R) &= \theta_L \left\{ R_L - \rho_C (1 + \lambda_C) F_L + \rho_C [ \widehat{K}_L - \tfrac{1}{2} (\widehat{K}_L)^2 ) ] \right\} \\ &\quad + \theta_H \left\{ R_H - \rho_C (1 + \lambda_C) F_H + \rho_C [ \widehat{K}_H - \tfrac{1}{2} (\widehat{K}_H)^2 ) ] \right\} \end{aligned}$$

This is to be maximized by choosing the $R_i$ and $F_i$, subject to (A.29), and the participation constraints (A.30) and (A.32). Substituting for $R_i$ in terms of $F_i$ and $Z$ from (A.29), the objective function becomes

$$\begin{aligned} EU(R) &= \theta_L \left\{ \frac{[1 - \beta(1 + \lambda_C)] F_L - Z}{1 + \lambda_B} - \rho_C (1 + \lambda_C) F_L + \rho_C [ \widehat{K}_L - \tfrac{1}{2} (\widehat{K}_L)^2 ) ] \right\} \\ &\quad + \theta_H \left\{ \frac{[1 - \beta(1 + \lambda_C)] F_H - Z}{1 + \lambda_B} - \rho_C (1 + \lambda_C) F_H + \rho_C [ \widehat{K}_H - \tfrac{1}{2} (\widehat{K}_H)^2 ) ] \right\} \\ &= \theta_L \left\{ \frac{1 - \beta(1 + \lambda_C) - \rho_C (1 + \lambda_B)(1 + \lambda_C)}{1 + \lambda_B} F_L + \rho_C [ \widehat{K}_L - \tfrac{1}{2} (\widehat{K}_L)^2 ) ] \right\} \\ &\quad + \theta_H \left\{ \frac{1 - \beta(1 + \lambda_C) - \rho_C (1 + \lambda_B)(1 + \lambda_C)}{1 + \lambda_B} F_H + \rho_C [ \widehat{K}_H - \tfrac{1}{2} (\widehat{K}_H)^2 ) ] \right\} \\ &\quad - \frac{Z}{1 + \lambda_B} \end{aligned}$$

Under the current assumption $\rho_C >> 1$, all of $F_L$, $F_H$ and $Z$ should be made as small as possible. I will consider only the case where the $F_i$ must be non-negative, leaving other kinds of limited liability constraints for the interested readers. So the optimum has $F_L = F_H = 0$, and $Z$ given by a binding participation constraint for the $H$-type bureaucrat, (A.30). The resulting payoff for the ruler is

$$EU(R) = \theta_L \, \rho_C \, [ \widehat{K}_L - \tfrac{1}{2} (\widehat{K}_L)^2 ) ] + \theta_H \, \rho_C \, [ \widehat{K}_H - \tfrac{1}{2} (\widehat{K}_H)^2 ) ] + \frac{1}{2 (1 + \lambda_B)} \, \frac{\beta^2}{\beta + \gamma_H} . \tag{A.34}$$

Now consider the dependence of the resulting payoffs on $\beta$, the parameter of the bureaucrat's concern for the citizen. From (A.34) the ruler's payoff satisfies

$$\partial EU(R) / \partial \widehat{K}_i = \rho_C \, [ 1 - \widehat{K}_i ] > 0 \qquad \text{because} \qquad \widehat{K}_i < 1 ,$$

and each $\widehat{K}_i$ is increasing in $\beta$. The last term in (A.34) is also increasing in $\beta$: write it as

$$\frac{1}{2 (1 + \lambda_B)} \, \frac{\beta}{1 + \gamma_H / \beta} ,$$

so the numerator increases and the denominator decreases as $\beta$ increases.

In money terms, the ruler gets

$$R_i = \frac{[1-\beta(1+\lambda_C)]F_i - Z}{1+\lambda_B} = \frac{1}{2\,(1+\ \lambda_B)}\ \frac{\beta}{1+\gamma_H/\beta}$$

from both types of bureaucrat. This is not really what the generous ruler would like; he would rather leave the money with the citizen. But since that would require negative $F_i$ which is infeasible by assumption, he prefers to get the money himself than leave it with the bureaucrat.

The $H$-type bureaucrat gets zero regardless of $\beta$; the $L$-type's payoff given by (A.31) is an increasing function of $\beta$. And from (A.33), the citizen's payoff is also an increasing function of $\beta$.

So in this case a bureaucrat with a greater degree of concern for the citizen yields a Pareto-better outcome – better for the citizen, the ruler, and himself if $L$-type.

## A.6 Type and fee unobservable

In this section the ruler does not know the bureaucrat's type $i = L,\ H$, and does not observe the fee $F$, but can observe $K$, $R$. Therefore the ruler's direct or revelation mechanism commits to policies $K_j$, $R_j$ as a function of the reported type, to maximize his expected payoff, subject to all participation constraints, and the incentive constraints that induce the bureaucrat to report the type optimally, while choosing $F$ privately to optimize his (bureaucrat's) own payoff.

A bureaucrat of actual type $i$ who reports type $j$ and chooses fee $F$ gets payoff

$$U_B(i,j) = F - (1+\lambda_B)\ R_j - \tfrac{1}{2}\,\gamma_i\ (K_j)^2 + \beta\ \Big[\ K_j - \tfrac{1}{2}\,(K_j)^2 - (1+\lambda_C)\ F\ \Big]\ .$$

So long as the bureaucrat's concern for the citizen is limited by (8), he will want $F$ to be as large as possible, constrained only by the citizen's participation constraint

$$K_j - \tfrac{1}{2}\ (K_j)^2 - (1+\lambda_C)\ F \geq 0\,.$$

Therefore a bureaucrat of type $i$ reporting type $j$ would choose $F$ equal to

$$F_{ij} = \frac{1}{1+\lambda_C}\ \Big[\ K_j - \tfrac{1}{2}\ (K_j)^2\ \Big]\ .$$

Substituting this for $F$ in the expression for the bureaucrat's payoff gives

$$U_B(i,j) = \frac{1}{1+\lambda_C}\ \Big[\ K_j - \tfrac{1}{2}\,[\,1+\gamma_i\,(1+\lambda_C)\,]\ (K_j)^2\ \Big] - (1+\lambda_B)\ R_j\,.$$

This yields the incentive compatibility constraints $BIC_L$ for the $L$-type:

$$\begin{aligned} & U_B(L,L) \equiv \frac{1}{1+\lambda_C}\ \Big[\ K_L - \tfrac{1}{2}\,[\,1+\gamma_L\,(1+\lambda_C)\,]\ (K_L)^2\ \Big] - (1+\lambda_B)\ R_L \\ \geq\ \ & U_B(L,H) \equiv \frac{1}{1+\lambda_C}\ \Big[\ K_H - \tfrac{1}{2}\,[\,1+\gamma_L\,(1+\lambda_C)\,]\ (K_H)^2\ \Big] - (1+\lambda_B)\ R_H\,, \end{aligned}$$

and $BIC_H$ for the $H$-type:

$$\begin{aligned} U_B(H,H) &\equiv \frac{1}{1+\lambda_C} \left[ K_H - \tfrac{1}{2} \left[ 1 + \gamma_H \left( 1 + \lambda_C \right) \right] (K_H)^2 \right] - (1+\lambda_B) \, R_H \\ \geq \;\; U_B(H,L) &\equiv \frac{1}{1+\lambda_C} \left[ K_L - \tfrac{1}{2} \left[ 1 + \gamma_H \left( 1 + \lambda_C \right) \right] (K_L)^2 \right] - (1+\lambda_B) \, R_L \, . \end{aligned}$$

These can be written more compactly as

$$\begin{aligned} U_B(L,L) &\geq U_B(L,H) + \tfrac{1}{2} \left( \gamma_H - \gamma_L \right) (K_H)^2 \\ U_B(H,H) &\geq U_B(H,L) - \tfrac{1}{2} \left( \gamma_H - \gamma_L \right) (K_L)^2 \, . \end{aligned}$$

The participation constraints $BPC_L$ and $BPC_H$ are as usual

$$U_B(L,L) \geq 0, \qquad U_B(H,H) \geq 0$$

respectively.

**Extractive case:**

The incentive constraints above have the same form as (A.11) and (A.13) in Section A.4. Therefore the lemmas proved there are valid here, and we can consider a relaxed problem where $BIC_L$ and $BPC_H$ are binding and $BIC_H$ and $BPC_L$ are ignored. This means

$$R_H = \frac{1}{(1+\lambda_B)\,(1+\lambda_C)} \left\{ K_H - \tfrac{1}{2} \left[ 1 + \gamma_H \left( 1 + \lambda_C \right) \right] (K_H)^2 \right\} ,$$

and

$$R_L = \frac{1}{(1+\lambda_B)\,(1+\lambda_C)} \left\{ K_L - \tfrac{1}{2} \left[ 1 + \gamma_L \left( 1 + \lambda_C \right) \right] (K_L)^2 \right\} - \frac{1}{1+\lambda_B} \, \tfrac{1}{2} \left( \gamma_H - \gamma_L \right) (K_H)^2 \, .$$

These are the same as (A.17) and (A.18) respectively in Section A.4. Therefore the solution there goes through; even though only $K$ is observable, the ruler is able to replicate the same outcome as in the case where both $K$ and $F$ are observable.

**Generous case:**

As in the previous section, I consider only the case where the ruler does not care directly about the bureaucrat's welfare: $\rho_B = 0$. However, now the ruler must accept the fact that the bureaucrat with his limited concern for the citizen is going to leave the latter with zero surplus. Then the ruler's objective reduces to

$$EU(R) = \theta_H \; R_H + \theta_L \; R_L \, .$$

Using the above expressions for $R_H$ and $R_L$ implied by the incentive and participation constraints and maximizing with respect to $K_H$ and $K_L$ yields

$$K_L = \frac{1}{1 + \gamma_L \left( 1 + \lambda_C \right)} \, ,$$

and

$$K_H = \frac{1}{1 + \gamma_H\,(1+\lambda_C) + \dfrac{\theta_L}{\theta_H}\,(1+\lambda_C)\,(\gamma_H - \gamma_L)}\,.$$

This is the same as the expression (19) for $K_H^{2E}$, the choice of a totally predatory ruler employing a fully selfish bureaucrat, when both actions are observable. However, this appears to be a coincidence without any deep intuitive significance.

Now suppose the ruler is able to obtain a bureaucrat with sufficiently high concern reversing (8), so $\beta\,(1+\lambda_C) > 1$. Such a bureaucrat extracts the lowest fee from the citizen compatible with the bureaucrat's own liability limit. To avoid proliferation of cases, consider only the case where this implies $F = 0$, and suppose the ruler cares only about the citizen, so his objective becomes

$$EU(R) = \theta_H\;[\,K_H - \tfrac{1}{2}\,(K_H)^2\,] + \theta_L\;[\,K_L - \tfrac{1}{2}\,(K_L)^2\,]\,.$$

The ruler can maximize this by setting $K_H = K_L = 1$; this exceeds the total-surplus-maximizing level because now the ruler's objective does not directly include the bureaucrat's cost $\frac{1}{2}\,\gamma\,K^2$. The ruler can then choose the remittance amounts $R_L$ and $R_H$ to satisfy the incentive and participation constraints $BIC_L$ and $BPC_H$. It is easy to verify that for $K_H = K_L = 1$ they yield

$$R_H = R_L = \frac{\beta - \gamma_H}{2\,(1+\lambda_B)}\,.$$

Even though $\beta > 1/(1+\lambda_C)$, we may have $\beta < \gamma_H$, so $R_H = R_L$ may be negative, and the ruler may have to make some transfers to the bureaucrat. If that is infeasible, then the ruler's choices of $K$ will have to be modified accordingly. I omit the details because the case is already somewhat arcane and the results are uninformative.

## A.7 Neither actions nor type observable

In this section the ruler does not know the bureaucrat's type $i = L,\ H$, and does not observe either of the action $K,\ F$; he can only observe his own receipt $R$. Therefore the ruler's direct or revelation mechanism asks the bureaucrat to report his type, and commits to the $R_j$ the ruler will ask the bureaucrat to deliver, as a function of the reported type, to maximize his (ruler's) expected payoff, subject to all participation constraints, and the incentive constraints that induce the bureaucrat to report the type optimally, while choosing $K$ and $F$ privately to optimize his (bureaucrat's) own payoff for his true type $i$. That means maximizing

$$U_B(i,j) = F_i - (1+\lambda_B)\;R_j - \tfrac{1}{2}\,\gamma_i\,(K_i)^2 + \beta\,[\,K_i - \tfrac{1}{2}\,(K_i)^2 - (1+\lambda_C)\,F_i\,]\,, \tag{A.35}$$

subject to the citizen's participation constraint

$$S_C(i) = K_i - \tfrac{1}{2}\,(K_i)^2 - (1+\lambda_C)\,F_i\,. \tag{A.36}$$

So long as the bureaucrat's concern for the citizen is limited by (8), we see from (A.35) that the bureaucrat will always choose $F_i$ high enough to keep (A.36) binding, that is,

$$F_i = \frac{1}{1+\lambda_C} \left\{ K_i - \tfrac{1}{2}\,(K_i)^2 \right\} .$$

Substituting in (A.35), we have

$$\begin{aligned} U_B(i,j) &= \frac{1}{1+\lambda_C} \left\{ K_i - \tfrac{1}{2}\,(K_i)^2 \right\} - (1+\lambda_B)\; R_j - \tfrac{1}{2}\,\gamma_i\,(K_i)^2 + \beta \; * \; 0 \\ &= \frac{1}{1+\lambda_C} \left\{ K_i - \tfrac{1}{2}\,[1+\gamma_i\,(1+\lambda_C)]\;(K_i)^2 \right\} - (1+\lambda_B)\; R_j \end{aligned}$$

Choosing $K_i$ to maximize this yields

$$K_i = \frac{1}{1+\gamma_i\,(1+\lambda_C)} ,$$

the same solution (A.7) as in the full-information case, $K_i^{1E} = K_i^{1G}$. In other words, the bureaucrat makes a Coasian contract with the citizen, efficient constrained only by the dead-weight losses in the transfer from the citizen to the bureaucrat, and then extracts all of the citizen's surplus. His maximized utility becomes:

$$\begin{aligned} U_B(i) &= \frac{1}{1+\lambda_C} \left\{ \left[\frac{1}{1+\gamma_i\,(1+\lambda_C)}\right] \right. \\ &\qquad \left. -\tfrac{1}{2}\,[1+\gamma_i\,(1+\lambda_C)]\; \left[\frac{1}{1+\gamma_i\,(1+\lambda_C)}\right]^2 \right\} - (1+\lambda_B)\; R_j \\ &= \frac{1}{1+\lambda_C}\; \tfrac{1}{2}\; \frac{1}{1+\gamma_i\,(1+\lambda_C)} - (1+\lambda_B)\; R_j\,. \end{aligned} \qquad \text{(A.37)}$$

The ruler, whether extractive or generous, must operate within this constraint of the bureaucrat's choice. The only thing that changes when the bureaucrat changes his reported type is the transfer the ruler will require from him. Therefore the incentive compatibility conditions reduce to

$$\begin{aligned} BPC_L: &\qquad -\,(1+\lambda_B)\; R_L \geq -\,(1+\lambda_B)\; R_H\,, \\ BPC_H: &\qquad -\,(1+\lambda_B)\; R_H \geq -\,(1+\lambda_B)\; R_L\,. \end{aligned}$$

In each case, all the other lengthy terms involving the true type's choices $(K_i, F_i)$ are common to the two sides and therefore cancel. This leaves simply $R_H = R_L$; call the common value $R$.

The ruler's objective then becomes

$$EU(R) = [\,1 - \rho_B\,(1+\lambda_B)\,]\; R + \text{terms independent of } R\,.$$

Two cases arise.

[1] If $\rho_B(1+\lambda_B) < 1$, the ruler sets $R$ at the maximum possible level, namely the one that drives the $H$-type bureaucrat down to his participation constraint $U_B(H) = 0$. Using (A.37), this is

$$R = \tfrac{1}{2} \, \frac{1}{(1+\lambda_B)(1+\lambda_C)} \, \frac{1}{1+\gamma_H(1+\lambda_C)} \,. \tag{A.38}$$

Then the $L$-type bureaucrat gets rent

$$\begin{aligned} U_B(L) &= \tfrac{1}{2} \, \frac{1}{1+\lambda_C} \, \frac{1}{1+\gamma_L(1+\lambda_C)} - (1+\lambda_B)\, R \\ &= \tfrac{1}{2} \, \frac{1}{1+\lambda_C} \left[ \frac{1}{1+\gamma_L(1+\lambda_C)} - \frac{1}{1+\gamma_H(1+\lambda_C)} \right] \\ &= \tfrac{1}{2} \, \frac{1}{1+\lambda_C} \left[ \frac{(\gamma_H-\gamma_L)(1+\lambda_C)}{[1+\gamma_L(1+\lambda_C)]\,[1+\gamma_H(1+\lambda_C)]} \right] \\ &= \tfrac{1}{2}(\gamma_H-\gamma_L) \, \frac{1}{1+\gamma_L(1+\lambda_C)} \, \frac{1}{1+\gamma_H(1+\lambda_C)} \end{aligned} \tag{A.39}$$

Although the $H$-type bureaucrat sets the levels of the public good without any downward distortion that the ruler found necessary when $K$ was observable, and the ruler can hold this bureaucrat down to his participation constraint, the unobservability of $K$ and $F$ hurts the ruler. He has to give away too much rent to the $L$-type bureaucrat. From (A.39) and (A.7) we see that

$$U_B(L) = \tfrac{1}{2}(\gamma_H-\gamma_L)\; K_L^{1E}\; K_H^{1E} > \tfrac{1}{2}(\gamma_H-\gamma_L)\;(K_H^{1E})^2 > \tfrac{1}{2}(\gamma_H-\gamma_L)\;(K_H^{2E})^2$$

the rent given away at the ruler's optimum when the bureaucrat's actions but not type were observable.

[2] If $\rho_B(1+\lambda_B) > 1$, then the ruler keeps $R_i = 0$ and lets both types of bureaucrats keep the fees they have extracted from the citizens. The participation constraint for both types of bureaucrats is slack.

Observe that this distinction between cases is different from the extractive-generous distinction governed by (10) that mattered in all the previous sections. That is because the ruler now knows that the bureaucrat is not going to leave the citizen with any surplus, and then the only question is whether the ruler wants to extract money from the bureaucrat even though this entails the dead-weight loss $\lambda_B$.

A highly predatory ruler with low or zero $\rho_B$ (or one who has employed a favorite and has a high $\rho_B$ but does not care for the citizen) might be reasonably happy with this situation. Even such a ruler would prefer greater observability, better to control the rent-sharing. The citizen gets more public goods with the current case of poor observability because there is no extra downward distortion for the bureaucrat's incentive compatibility, but does not get any surplus as the bureaucrat extracts it all.

However, consider a very benevolent ruler as in the previous section (with $\rho_B = 0$ and $\rho_C >> 1$) who wants to benefit the citizen. He can achieve such an aim with $K$ and $F$ unobservable only by hiring a super-caring bureaucrat with $\beta(1+\lambda_C) > 1$. Then the ruler sets $R_i = 0$ in the knowledge that the bureaucrat is going to pass on the benefit to the consumer, and lets the bureaucrat maximize

$$\begin{aligned} U_B(i) &= F_i - \tfrac{1}{2}\,\gamma_i\,(K_k)^2 + \beta\,[\,K_i - \tfrac{1}{2}\,(K_i)^2 - (1+\lambda_C)\,F_i\,] \\ &= -\,[\beta\,(1+\lambda_C) - 1]\;F_i + \beta\,K_i - \tfrac{1}{2}\,(\beta+\gamma_i)\,(K_i)^2\,. \end{aligned} \tag{A.40}$$

The bureaucrat chooses $F_i$ as low as possible; I consider only the case where $F_i$ has to be non-negative, leaving cases of other limited liability constraints to interested readers. Now the bureaucrat sets $F_i = 0$ and

$$K_i = \frac{\beta}{\beta+\gamma_i}\,. \tag{A.41}$$

This is the same expression (A.22) that arose in the extreme generous case of the previous section, where $K$ was unobservable to the ruler but $F$ was observable. But there is a difference; there we were limiting $\beta$ to be $< 1/(1+\lambda_C)$, and the generous ruler was enforcing $F_i = 0$. Here the ruler, not being able to set $F_i$, must rely on the bureaucrat's super-caring to achieve that aim.

Substituting $F_i = 0$ and (A.41) into (A.40), the bureaucrat's payoff is given by

$$U_B(i,i) = \tfrac{1}{2}\;\frac{\beta^2}{\beta+\gamma_i}\,,$$

which is increasing in $\beta$. The citizen's payoff is

$$S\gamma_L(i) = K_i - \tfrac{1}{2}\,(K_i)^2\,,$$

which is increasing in $K_i$ in the interval $[0,1]$, and therefore an increasing function of $\beta$. The ruler's payoff is solely his evaluation of the citizen's payoff,

$$EU(R) = \theta_L\;\rho_C\;[\,K_L - \tfrac{1}{2}\,(K_L)^2\,] + \theta_L\;\rho_C\;[\,K_L - \tfrac{1}{2}\,(K_L)^2\,]\,,$$

which is also increasing in $\beta$. Again we have the commonality of interest between a highly caring bureaucrat, a highly benevolent ruler, and the citizen.