Informal fiscal systems in developing countries*

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Abstract

Governments in developing countries have low fiscal capacity yet face pressures to provide public goods and services, leading them to rely on various unusual fiscal arrangements. We document one such - hitherto unexplored - arrangement: informal fiscal systems that rely on local bureaucrats to fund the delivery of public goods and services. Using survey data and government accounts from Pakistan, we show that public officials are expected to cover funding gaps in public services and they do so, at least partially, through extracted bribes. We propose a model of bureaucratic agency to explore when governments benefit from sustaining such systems and investigate welfare implications. Informal fiscal systems are more likely to arise when monitoring corruption is difficult relative to monitoring the provision of public services, and politically-important groups of citizens do not bear the full cost of corruption. The existence of such systems can distort the effective incidence of the tax burden, reduce the incentives of government to fight corruption, and legitimize bribe-taking.

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1 Introduction

Governments in developing countries have low fiscal capacity (Besley and Persson, 2014), particularly at the local level (Gadenne and Singhal, 2014; Bachas et al., 2021; Dzansi et al., 2022; Balan et al., 2022). These fiscal constraints limit the ability of governments to raise revenues to provide public services. Yet public pressure compels governments in developing countries to attempt to provide these services.[1]

These unique forces have led to the rationing of public goods and services in various developing nations (Banerjee et al., 2007), as well as several unusual fiscal arrangements. For example, governments may rely on the local population to informally deliver public goods (Olken and Singhal, 2011); delegate tax collection to private individuals for profit (Stella, 1993; Coşgel and Miceli, 2009); or even abdicate responsibility to non-state groups (Grossman, 1997; Johnson et al., 1997; Alexeev et al., 2004).

In this paper we document the existence of an informal fiscal system: a system in which both taxation and expenditures are managed within the state apparatus but outside its formal fiscal processes. Under the arrangement that we study, central authorities do not provide local public officials with all the resources they need to supply public services: too little petrol for police cars, too few materials for flood control. Instead, local officials are expected to personally fund these public services, with evidence suggesting they rely at least partially on bribes extracted from local communities to do so.

This system is distinct from tax farming, informal taxation, user fees, or the provision of public services by non-state actors. Unlike tax farming, bureaucrats are not officially given the right to collect bribes by the government. In informal taxation, local officials only coordinate the voluntary labor or funding provided by citizens rather than paying for these on their own. Unlike user fees, services for which bribes are paid can differ from the service on which bureaucrats spend the funds in informal fiscal systems: bribes collected for issuing land titles can be used to finance free food to the public. This creates a form of redistribution central to our definition of informal fiscal systems. Finally, in informal fiscal systems, the state itself expects its functionaries to provide for public services rather than competing with non-state groups for their provision.

We start with some examples from around the world and describe in detail the illustra-

[1] Developing democracies such as India, Pakistan, Tanzania, and Kenya established universal adult franchise in the 1940s-1950s, at the same time as or earlier than France or Switzerland, and now have larger welfare states than today's rich countries had at historically comparable income levels (Lamba and Subramanian, 2020).

tive case of policing in India. There, we conduct a detailed accounting exercise comparing the costs required and the government funds available for patrolling, using survey data from 180 police stations in a large state. We find that the most conservative estimate of the petrol expenditure required for these patrols is more than the amount of funds provided by the government. The funding gap is large relative to the salary of police officers, and evidence suggests that police officials are *"supposed to find other means"*[2] to fill this gap; multiple surveys and reports corroborate corrupt behavior by police.[3]

Next, we present a more detailed description of an informal fiscal system in a large bureaucracy in Pakistan, in which local (low level) bureaucrats fund local public services such as flood control and relief, free food to the public, and the logistics of senior officials' visits to their area. A significant portion (82%) of the 750 local bureaucrats we surveyed agree that they provide a range of public services for which they do not receive full official funding. Of these, 100% agree that they personally supply funds to fill the gap. We corroborate these survey responses through an independent survey of the bureaucrats' supervisors. Nearly all supervisors (98%) agree that bureaucrats are involved in delivering these services and 89% of them confirm that local bureaucrats fund a portion of those. This funding represents almost 15% of the bureaucrat's monthly expenditure (7,412 PKR a month). Altogether, the size of this informal fiscal system is approximately 4.3 billion PKR per year, equivalent to 4.5% of the government's main cash transfer program (BISP) in 2015-16 or 558 PKR per eligible family.

We show that there is a significant gap (13,000 PKR or 26% of the bureaucrats' monthly wage) between the cost of providing these services and the share of salary that bureaucrats report spending on them. We confirm from government accounts that this gap is not due to bureaucrats misreporting their income and argue that the gap is filled by bribes received by local bureaucrats. This is consistent with both responses from supervisors – 90% of whom claim that corruption is precisely the reason why the government does not provide sufficient funds – and with the frequency of bribe payments to these bureaucrats reported in a citizen survey.

As Acemoglu and Verdier (2000) note, governments choosing to correct market failures through public officials must accept some corruption, since principal-agent problems here are often intractable. However, in our case, the government is actively expecting

[2] https://www.thehindu.com/news/cities/Hyderabad//article60411103.ece, accessed March 2, 2022.

[3] According to a 2020 Transparency International report, 42% of people in contact with the police in India had to pay a bribe (https://www.transparency.org/en/publications/gcb-asia-2020, accessed April 30, 2021).

public officials to provide services without sufficient official funds for them, implicitly acknowledging the existence and use of bribes to fund these services. Why not just tax more, monitor corruption and spend on public goods? What conditions determine whether informal fiscal systems arise instead?

We develop a model to understand when governments rely on such informal fiscal policies and to assess their welfare effects. We study an agency problem between a politician and a bureaucrat. The bureaucrat chooses an amount of bribe to obtain and what proportion of his income to spend on a public service. Bureaucrats value the provision of public services, particularly so when that provision is publicly observed, because of career concerns or social pressure. They also value keeping bribes but want to avoid getting caught. The politician chooses how much formal taxation to raise to finance public services. Politicians face democratic pressure to both supply public services and reduce corruption while keeping taxes low. A central friction is the lack of perfect information: the government cannot perfectly monitor the delivery of public services and it cannot monitor corruption. We show that the politician's choice of fiscal system depends on the relative difficulty of monitoring public service delivery versus corruption.

In equilibrium, the amount of public services funded by bureaucrats and the bribes they obtain depend negatively on the difficulty of monitoring public service provision, the amount of public services already funded by taxes, and the government's ability to monitor corruption. Anticipating this behavior, the politician sets formal taxes optimally to maximize public service provision while minimizing taxes and bribes. Decreasing taxes reduces the amount of official funding available for public services. This incentivizes bureaucrats to personally fund these services to fill the gap left by the government. These incentives are stronger if public service delivery is more visible and bureaucrats are driven by career concerns or social pressure. However, contributing to public services also leaves bureaucrats relatively poorer which encourages them to take more bribes. The politician therefore faces a trade-off between decreasing taxes to shift the burden of public service provision onto bureaucrats and increasing corruption.

The politician resolves this trade-off by choosing either a completely informal policy with no formal taxes but a high level of corruption or a completely formal policy with no funding from the bureaucrat, higher taxes, and reduced corruption. We show that the informal policy is more likely to be chosen when public service delivery is easier to observe (which encourages the bureaucrat to fund it), corruption is difficult to monitor (which allows the bureaucrat to compensate himself with bribes), and the cost of corruption to citizens is not too high.

We consider several extensions of the model. First, we show that, when corruption is sufficiently easy to monitor, there can be informal policies in which the bureaucrat funds public services without taking bribes. Second, we allow the politician to choose the level of corruption monitoring. We show that she sometimes prefers to deliberately keep monitoring low to encourage the bureaucrat to fund public services. Third, we consider a situation with two groups of citizens, rich and poor, who pay a proportional income tax. We show that, if the rich have more influence on the politician than the poor, the politician prefers an informal system: the rich benefit more from funding services through bribes, which are split across the whole population, than through formal taxes, which fall disproportionately on them. As a result, the effective tax incidence on the poor increases and social welfare decreases relative to the social optimum.

Our model offers a way to rationalize the puzzling existence of informal fiscal systems and provides a number of insights into them. First, when public service delivery is easier to monitor than corruption, it can be better to induce bureaucrats to redistribute the bribes that they obtained than from preventing them from taking those bribes in the first place. This is consistent with evidence from our survey in Pakistan: the share of funding by bureaucrats is the highest for food and logistics for official visits which is easy to monitor, and the lowest for flood control which is more difficult to monitor. Second, these systems are also more likely when politically-important groups of citizens – say the wealthy or pivotal ethnic groups – do not bear the full cost of corruption or do not hold the government accountable for it.

The informal fiscal system we uncover has wide-ranging and long-lasting consequences for state capacity development. On the one hand, rents accruing to bureaucrats may be overestimated since some of the bribes are returned as public services. On the other hand, corruption is costly and more distortionary than taxes (Shleifer and Vishny, 1993; Fisman and Svensson, 2007; Banerjee et al., 2012) and the incidence of bribes as a source of funds is different than that of formal taxes. Moreover, because informal fiscal systems reduce the incentives for the government to monitor corruption, and because they legitimize bribe-taking for the bureaucrats, they might serve as a gateway to more corruption. In fact, supervisors of local bureaucrats in Pakistan indicated that these officials were happy to provide the public services precisely because they saw it as a way to justify collecting bribes.

Our paper contributes to the literature on public finance in developing countries. Broadly, it helps in understanding why developing countries consistently fail to both raise revenues (Gadenne and Singhal, 2014) and to invest in fiscal capacity (Acemoglu et al., 2005; Besley and Persson, 2009, 2010, 2014; Besley et al., 2013). Our work also adds to studies documenting that information frictions are an important determinant of how governments collect taxes (Kiser, 1994; Balan et al., 2022). Narrowly, our paper contributes to the literature on informal taxation (Olken and Singhal, 2011; Gadenne and Singhal, 2014; Jack and Recalde, 2015; Lust and Rakner, 2018; Van den Boogaard et al., 2019) by exploring a new form of informal fiscal policy. In particular, we explore the possibility that decentralized public good provision relies on direct payments from the local bureaucrats (potentially through the redistribution of bribes), rather than on voluntary contributions from the local population. While taxpayers have higher trust in actors levying informal taxes than formal ones (Van den Boogaard et al., 2019), the perception of an informal fiscal system financed through corruption can be different. Another strand of this literature emphasizes the role of political accountability in determining "bureaucratic overload" (Dasgupta and Kapur, 2020), where bureaucrats are expected to complete tasks for which they do not have sufficient resources. We complement these findings by showing that governments expect bureaucrats to use bribes to cover the gap in official funds and hence, the lack of resources might be overestimated.

Our findings also contribute to three strands of the literature on corruption. First, we describe a new force that can explain the persistence of corruption (Tirole, 1996; Dutta et al., 2013). Corruption can persist because it allows the government to target taxes and transfers in a way that might not be feasible with formal taxes. Second, redistribution of bribes through informal fiscal systems makes the welfare calculations related to corruption ambiguous (Shleifer and Vishny, 1993). Third, we explore a new facet of the relationship between corruption and bureaucrats' incentives (Tirole, 1986; Mookherjee and Png, 1995; Niehaus and Sukhtankar, 2013), showing that governments can affect corruption by choosing the level of official funding of public services, in addition to the tools already studied in the literature (Becker and Stigler, 1974; Besley and McLaren, 1993; Di Tella and Schargrodsky, 2003; Olken, 2007; Reinikka and Svensson, 2011; Corbacho et al., 2016; Debnath et al., 2023).

2 Motivating examples

Situations in which state officials are expected to fund public services out of their own pockets are common around the world. Public school teachers even in developed countries like the USA often pay for school supplies.[4] The underlying funds can be provided by parents or the community (e.g. bake sales) or can come out of the teachers' pockets. In developing countries, the source of funds can be more controversial. In the Democratic Republic of Congo, former President Mobutu Sese Seko told the police and army "débrouillez-vous" (live off the land), thereby acknowledging bribe taking as a substitute for salaries (Weigel and Kabue Ngindu, 2023). Prud'Homme (1992) also describes how wages for local officials in the Democratic Republic of Congo are deliberately kept very low by the government who expected officials to fund themselves through other means such as collecting bribes.[5] In this case too, the public good of law and order is expected to be funded by the civil servants.

In India, we document a similar system in the police force. The fact that public service providers in India suffer from severe resource constraints is well-documented (Kapur, 2020). In the case of policing, the Status of Policing in India Reports (SPIR) provide careful annual summaries of the shortages in personnel and resources. The precise nature of the shortfalls, and how providers deal with these constraints is perhaps less well known. We carried out a careful accounting exercise for monthly petrol costs incurred at police stations. In 2018, we surveyed a representative sample of the Station House Officer (head of the police station) in each of 180 police stations with a jurisdiction covering nearly 24 million people in a large state in India. The survey gathers details on the number and type (car or motorcycle) of police vehicles, the average number of kilometers traveled, as well as the monthly budget received for "Petrol, oil and lubricants". We combine the data on the type of vehicle, the car dealer-reported mileage provided by these vehicles, and the average number of kilometers traveled to generate the number of liters of petrol needed. Using the minimum price per liter of petrol in the survey month, we generate an (extremely conservative) estimate of the required petrol budget.

Comparing the budget required with the reported budget received, we find that the average station experiences a monthly shortfall of 14,845 INR (representing 95% of our

[4]See, e.g., https://www.theguardian.com/us-news/2021/dec/13/teachers-scramble-dollar-bills-south-dakota-dash-for-cash, accessed April 8, 2022.

[5]Besley and McLaren, 1993 show the theoretical conditions under which such an arrangement can be efficient.

estimate of expenditure, see Table A1). Not even a single station reports having enough funding to do regular policing patrols, even with these conservative assumptions; less conservative assumptions result in an average shortfall of 15,256 INR (Table A2). Finally, official budget figures for "Petrol, oil, and lubricants" funds allocated to police stations corroborate the survey data, with a shortfall of 8,768 INR even assuming zero leakage.[6] As further evidence , some survey respondents even reported that they have to use their personal vehicles for on-duty responsibilities.

How, then, do the police cover these deficits? Newspaper reports and informal interviews with both senior and junior officials by the authors reveal that junior officers are "supposed to find other means" to support fuel budget shortages.[7] In a direct interview with an Additional Director General of Police, she pointed out that women are much less likely to make it to SHO of the station precisely because they are unable to raise the funds required for things like officials visits, petrol, etc. It is then no surprise that according to a nationally representative survey by Transparency International in 2019-20, 42% of people in India who had contact with the police in the previous twelve months paid a bribe, nearly twice the average rate in Asia, and the highest of all public services in India (Asia Global Corruption Barometer). We next examine the features of such practices in the case of Pakistan where we collected more detailed data.

3 Flood relief and food security in Pakistan

We now document the existence of an informal fiscal system in Pakistan through surveys of bureaucrats. We use data from three sources: 1) a telephone survey of a random sample of 750 local bureaucrats out of a total of 6209 across Punjab in 2020; 2) a telephone survey of 35 direct managers of these local bureaucrats (stratified on districts, randomly sampled 42 of 141) in 2020; and 3) a citizen survey carried out by a private firm for the provincial government in 2009, explicitly surveying individuals that have interacted with the local bureaucrats (comprising 1,402 men that either own or rent land).[8]

[6]These calculations are consistent with the large number of news reports on the lack of funds for petrol across India: see, for example the case of Mumbai https://www.dnaindia.com/mumbai/report-mumbai-cops-inadequate-fuel-for-patrol-vehicles-2781055, accessed June 17, 2021.

[7]https://www.thehindu.com/news/cities/Hyderabad/new-police-vehicles-are-welcome-what-about-fuel/article6146002.ece, accessed June 17, 2021.

[8]The questions for local bureaucrats used here were part of a broader survey of their career background and traits but the survey of managers was carried out specifically for this paper.

3.1 Private funding of public services by local bureaucrats

Table 1 describes the informal fiscal arrangement that funds local public goods and services. Panel A presents the bureaucrats' perspective, while Panel B presents the supervisors' perspective. 82% of local bureaucrats report providing public goods and services outside of their formal budget. Supervisors corroborate the bureaucrats' involvement (98%). 100% of local bureaucrats and 89% of supervisors agree that local bureaucrats supply funds for these services.

Our data also indicates that this funding is not trivial. According to the bureaucrats, the provision of these services represents almost 15% of their monthly expenditure. Their average monthly income is 49,411 PKR. Therefore, local bureaucrats spend on average 7,412 PKR a month on delivering public services.[9] This amount can underestimate their overall rupee contribution as the bureaucrat's total income can be larger if they receive money from other sources such as bribes. The total size of this informal fiscal system is significant and represents around 4.3 billion PKR per year[10] As a comparison, this would represent around 4.5% of the government's main cash transfer program (BISP) in 2015-16.[11]

Finally, these funds are not simply prepayments from the bureaucrats that the state reimburses. Only 8% of supervisors agree that field bureaucrats file to be reimbursed for these expenses.

Table 2 shows details of the system for different types of activities. A large portion of respondents are involved in different types of services: 61% of bureaucrats agree that they provide flood control and relief, 25% agree that they provide free food to the public, and 82% agree that they arrange logistics during official visits. Supervisors confirm the bureaucrats' involvement in these activities: close to 90% of them report that local officials are involved in the provision of these three activities.

The extent to which bureaucrats are financially involved differs by type of service. Table 2 shows the portion of funds coming from bureaucrats relative to other sources such as government funds, local philanthropists or NGOs. While bureaucrats report contributing a majority of the funds in both the provision of free food and the organization of officer visits, they contribute a larger portion for official visits. Instead a large portion of free food to the public is provided by local philanthropists. Supervisors believe that the

[9] While expenditure and income can differ, income will generally be higher than expenditure.

[10] 20,154 PKR per bureaucrat, per Tehsil, per month, multiplied by 12 months and 44 bureaucrats per Tehsil in 404 Tehsils in Pakistan.

[11] https://bisp.gov.pk/Detail/Zjk1OWZkYzEtZWE2Yy00NThlLThhZDAtMzc4MWM1OWIyZjU4

proportion of funds covered by bureaucrats is lower but still significant. They also agree that the rest of the funding is split between the government and local philanthropists. However, their responses reveal differences in how the funds are split. For flood control and relief, they believe that the government contributes 73% while bureaucrats bear 13% of the costs. In the case of provision of free food for the public, they report that local philanthropists bear the largest burden (73%) while bureaucrats fund 15% of the costs and the government only 11%. In the model below, we discuss how the observability of these different types of services may drive these level differences.

The existence of such practices raises two questions: why do bureaucrats agree to provide these funds and do these funds come exclusively out of their official wages?

3.2 Bureaucrats' motivations

Bureaucrats indicate two main reasons for agreeing to pay for these services: pressure from colleagues and altruism. Table 3 shows that 62% of officials are willing to fund the provision of the public services due to social pressure from colleagues while 30% cite altruism towards citizens as a reason. Supervisors believe that self-interest plays a bigger role than the bureaucrats want to admit: 76% of supervisors think that officials are willing to spend out of their pocket due to career concerns, while only 20% cite social pressure and none of them mention altruism. Moreover, 39% of supervisors think that officials are happy to sustain this informal fiscal arrangement because it allows them to continue engaging in corruption.

We can relate these motivations to the heterogeneity in the source of funds across different types of services. If bureaucrats are motivated by social pressure, then they should be more likely to provide services that are easier to observe for their colleagues. For instance, supervisors can directly observe the success of senior officials' visits. By contrast, assessing whether the correct flood control measures were implemented is more difficult.[12] In Section 4, we show how the observability of the service provision can affect the incentives of the bureaucrat and the likelihood of an informal fiscal system.

[12]These differences are less consistent with the altruism motivation: altruistic bureaucrats would be more involved in activities that help citizens directly such as flood control or food provision than official visits.

3.3 Sources of funds used by bureaucrats

While our data reveals that bureaucrats finance local public goods from their own funds, rather than official government funding, these funds could either come from the bureaucrats' personal wages or from bribes.

While plausible, it seems unlikely that the funds used for public services come exclusively from the bureaucrats' official wages. The officials in this context are not part of an elite civil service and their average salary (PKR 49,411) is relatively low. The funding could account for up to 40% of their income.[13] This would bring their net salary close to the minimum wage of PKR 25,000, suggesting that the bureaucrats could be better off taking jobs in the private sector. Yet, we do not see a high turnover in the bureaucracy.

We present three pieces of evidence that suggest that bribes extracted from the local population could be a key source of funding: (1) results from the supervisor survey, (2) an accounting exercise comparing the salary of the bureaucrat with the cost of providing the public services and (3) results from a citizen survey.

Table 1 Panel B shows that 90% of the supervisors believe that the government does not fully fund services as it knows that the local bureaucrats earn bribes. Only 27% think that the shortfall in funds is due to difficulty in raising money through taxes and borrowing by the government. The supervisors also highlight that a cost of such an informal fiscal system is the perpetuation of corruption: 39% of them agree that local bureaucrats are willing to spend out of pocket as it makes them less likely to be held accountable in the future. Being expected by the government to fund public services provides local officials with a justification for engaging in bribery.

Supervisors had little incentives to openly report that their subordinates are involved in corruption. Acknowledging this reflects badly on their management skills or puts them at risk of being blamed for not preventing this corruption. Therefore, their responses constitute an important piece of evidence that the funding gap is filled through corruption.

Next, we carried out a back-of-the-envelope calculation: we calculate the share of the costs of these activities that are borne by local bureaucrats, and compare these costs with the share of *official* income that they claim to spend on these activities. The funding

[13] Using the supervisor survey, we estimate that the total costs per Tehsil of public services borne by local bureaucrats is PKR 886,757 per month. Given an average of 44 officials in each Tehsil, the spending amounts to PKR 20,154 per official per month. We used the supervisor survey for these estimates as they have less incentives to misreport the costs and because the data on costs of flood control is missing in the bureaucrat survey.

required is 20,154 PKR per official per month. This is much higher than the 7,415 PKR per official per month that the bureaucrats report spending out of their official income.

This funding gap of approximately PKR 13,000 (PKR 20,154 minus 7,415) can be due to either bureaucrats misreporting the size of their official income or the fraction of their expenditure. We corroborated the average income of these bureaucrats from the AGPR, the government body responsible for paying salaries, and did not find a discrepancy. Moreover, surveyor demand effects would likely push bureaucrats to report a larger - rather than smaller - fraction of their expenditure spent for providing services.

Finally, a citizen survey corroborates the payment of bribes to these local bureaucrats (Table A3). Sixty-five percent of citizens report that services are denied to them unless they make unofficial payments to these local officials and 82% state that they pay bribes to overcome difficulties in accessing services.

This evidence, along with the previously discussed cases, suggests that bribes can explain part of the gap between the costs of funding public services and the amount provided by the government. This provides the basis for an informal fiscal system. The government appears to be aware of the corruption by local bureaucrats, and expects them to pay for public goods and services in return. In turn, these bureaucrats appear to support this system because it allows them to engage in corruption with reduced accountability. In the following section we present a theoretical framework to rationalize why such systems exist and the conditions under which they are more likely than formal taxation.

4 Model

We consider a stylized model with a politician and a bureaucrat. The politician moves first and chooses a lump-sum tax $\tau \in [0, +\infty)$. The bureaucrat is responsible for delivering public services. He observes τ, chooses how much bribe to take $b \in [0, +\infty)$ and how much public services to privately fund, denoted e. The bureaucrat cannot spend more than his total income, which equals his wage (w) plus the amount of bribes he obtains (b): $0 \leq e \leq w + b$. The total amount of public services, y, is $y = \tau + e$. Taxes and personal funding by the bureaucrat are substitutes to produce public services.

The politician cannot perfectly observe whether the bureaucrat delivered the optimal amount of public services and cannot perfectly monitor bribe-taking.[14] These information

[14] For instance, the politician might not be able to assess the severity of a flood.

frictions create an agency problem and constrain the government's ability to implement the optimal level of public service provision.

The politician's objective is to maximize the utility of a subset of voters. These voters have utility $G(y)$ over public services, bear a cost ηb from bribes, and pays taxes τ.[15] Let $g(y)$ denote the derivative of $G(y)$. We assume that $G(y)$ is increasing, continuously differentiable and satisfies Inada conditions so $g(y) > 0$, $g'(y) < 0$, $\lim_{y \to 0} g(y) = +\infty$ and $\lim_{y \to +\infty} g(y) = 0$. The politician therefore maximizes:

$$V(\tau) = G(y) - \tau - \eta b \tag{1}$$

The bureaucrat gets a base wage w and a reward $\phi F(y)$ as a function of public service provision. The reward $\phi F(y)$ captures the bureaucrat's personal benefits from delivering public services, such as career concerns, and is discussed in more details below. The bureaucrat has concave utility $H(\cdot)$ over consumption c, where c is simply equal to the bureaucrat's income (wage plus bribes) minus the funding he allocates to public services, that is, $c = w + b - e$. Let $f(\cdot)$ denote the derivative of $F(\cdot)$, and $h(\cdot)$ the derivative of $H(\cdot)$. We assume that both $F(\cdot)$ and $H(\cdot)$ are increasing, continuously differentiable and satisfy Inada conditions so $f(\cdot), h(\cdot) > 0$, $f'(\cdot), h'(\cdot) < 0$, $\lim_{x \to 0} f(x) = \lim_{x \to 0} h(x) = +\infty$ and $\lim_{x \to +\infty} f(x) = \lim_{x \to +\infty} h(x) = 0$.

The bureaucrat potentially gets punished for taking bribes. The bureaucrat is caught with probability p, where $p \in (0, 1)$ captures the effectiveness of corruption monitoring. We first take p as given and make it an endogenous choice by the politician in Section 4.2. If caught, the bureaucrat faces punishment proportional to the bribes taken. The cost of taking bribes is therefore $p \times b$.[16] Given $y = \tau + e$, the bureaucrat's expected utility is therefore:

$$U(e, b) = H(w + b - e) + \phi F(\tau + e) - pb \tag{2}$$

Interpretation. The parameter ϕ denotes the probability that public service delivery is publicly observed. The reward $F(y)$ can capture the bureaucrat's career concerns, his need to conform to norms, or peer pressure, all of which are heightened when his performance

[15]The function $G(\cdot)$ also captures any difficulties the government might face in raising taxes or transforming taxes into public goods.

[16]We abstract away from the possibility that the bureaucrat's wage is lower than his outside option and that the government allows bribes as a form of capitulation wage (Besley and McLaren, 1993).

is publicly observed and the bureaucrat delivered more public services. The *observability* of the public service depends on the type of good provided and the environment. For instance, the absence of flood damage can be due to less severe floods or to better emergency response by local bureaucrats. The easier it is to observe the severity of floods, the easier it is to infer the performance of the bureaucrat. In appendix section A.2, we propose a simple career concerns model to micro-found the interpretation of ϕ as the observability of public services and of $F(y)$ as career concerns. In the model, the bureaucrat can be of two types, unknown to his superior. Only high ability types are able to deliver public services that meet the needs of the population. The bureaucrat's superior wants to promote high ability types but only observes whether the needs were met with probability ϕ. The parameter ϕ therefore affects the probability of promotion for the bureaucrat and hence his effort.

The parameter η captures how the voters that the politician cares about are affected by corruption. If the politician cares about all citizens equally and corruption is more distortionary than taxes, then the marginal cost of paying bribes is higher than the marginal cost of paying taxes: $\eta > 1$. On the other hand, if corruption is less distortionary than taxes or if the subset of voters that the politician cares about is not the most affected by corruption, then $\eta < 1$. In the extreme case where the voters that the politician cares about are not the ones paying bribes, we have $\eta = 0$.

4.1 Analysis

We solve for the Subgame Perfect Nash Equilibrium of this game. We first determine the bureaucrat's best response, in terms of bribes and redistribution, to a choice of tax by the politician. We then determine the optimal tax for the politician, anticipating the bureaucrat's best-response. To simplify the exposition, we assume throughout this section that corruption monitoring, p, is never high enough to completely eradicate corruption, even when the bureaucrat does not redistribute any funds. This is the case whenever $p < h(w)$. We discuss the case of high monitoring ($p \geq h(w)$) in subsection 4.1.3 and provide formal results in the appendix. All proofs are also provided in the appendix.

4.1.1 Bureaucrat.

Given some tax τ, the bureaucrat chooses b and e to solve:

$$\max_{b,e} \quad H(w+b-e)+\phi F(\tau+e)-pb \quad \text{s.t.} \quad 0 \le e \le w+b,\ 0 \le b$$

Since bribe monitoring is low ($p < h(w)$), the marginal cost of taking a unit of bribe (p) is lower than the marginal benefit of the first unit of bribe, ($h(w)$). Therefore, the bureaucrat always takes some bribes independently of whether he redistributes them or not. However, if the bureaucrat does redistribute funds, his incentives to extracts bribes are higher, because his marginal benefit of doing so is higher: after redistributing, the bureaucrat has less to consume and therefore values more an additional unit of money ($h(w-e) > h(w) > p$ if $e > 0$). Whether he redistributes depends on the level of public services funded by the government. The following Lemma characterizes the bureaucrat's best response.

Lemma 1. *If monitoring is low ($p < h(w)$), the bureaucrat always takes bribes and redistributes some of them as long as taxes are not too high:*

$$e^*(\tau) = \begin{cases} f^{-1}\left(\frac{p}{\phi}\right) - \tau & \text{if } \tau < f^{-1}\left(\frac{p}{\phi}\right) \\ 0 & \text{if } \tau \ge f^{-1}\left(\frac{p}{\phi}\right) \end{cases} \quad \text{and} \quad b^*(\tau) = h^{-1}\left(p\right) - w + e^*(\tau)$$

There are two interesting takeaways from this result. First, the bureaucrat will only personally fund public services if the amount of formal taxation is too low. If he does, every additional rupee of formal taxation reduces the informal funding by one rupee. Moreover, an increase in tax reduces bribes. As taxes increase, the baseline amount of public services funded increases (τ goes up). This decreases the marginal value of funding services to the bureaucrat ($\phi f(\tau+e)$ goes down). As the bureaucrat funds less public services (e goes down), his disposable income, and therefore his consumption, increase ($w+b-e$ goes up). This decreases the marginal value of further consumption and therefore the marginal benefit of taking bribes ($h(w+b-e)$ goes down).

Second, the amount of bureaucrat funding depends negatively on the monitoring of corruption (p) relative to the observability of public services (ϕ). Intuitively, the bureaucrat sets the marginal benefit of funding public services ($\phi f(\tau+e)$) equal to its marginal cost in terms of lost consumption ($h(w+b-e)$). He also sets the marginal benefit of bribes in terms of additional consumption ($h(w+b-e)$) equal to its marginal cost p. As the marginal cost of taking bribes, p, increases, the bureaucrat reduces the amount of bribes he takes. This reduces his consumption and therefore increases his marginal cost of redistributing money towards public services. As a result, an increase in corruption monitoring decreases the bureaucrat's funding of public services. Conversely, an increase in the observability of public services (ϕ) increases the marginal benefit of redistributing, and through the same process, increases the incentives of taking bribes. Therefore, Lemma 1 implies that taxes and monitoring are substitutes to control corruption: either increasing monitoring or increasing taxes can reduce bribes.

Finally, if bribes are partially redistributed, measuring corruption through bribes can overstate the extent of corruption. A more relevant measure is the rents appropriated by the bureaucrat: $r = b^* - e^*$. From Lemma 1, we can directly see that rents are equal to $r = h^{-1}(p) - w$. Rents decrease as the wage and corruption monitoring increase.

4.1.2 Politician.

The politician chooses a tax level τ, to maximize the citizens' expected utility, given the bureaucrat's best-responses $b^*(\tau)$, $e^*(\tau)$:[17]

$$\max_{\tau} \quad G(\tau + e^*(\tau)) - \tau - \eta b^*(\tau)$$

The politician faces the following trade-offs. If there were no bribes and no redistribution, she would simply increase taxes until the marginal benefit to voters of public services $g(\tau)$ equals the marginal cost of taxes, which is 1. We denote by $\bar{\tau} = g^{-1}(1)$ the optimal amount of taxes in the absence of corruption and redistribution. When the bureaucrat is willing to redistribute some of the bribes, an increase in taxes decreases the amount funded by the bureaucrat. The politician therefore only chooses high taxes if the marginal cost of funding public services through taxes is lower than the marginal cost of funding them through corruption, or if the bureaucrat's voluntary public service provision is too low to satisfy the demand from voters.

In equilibrium, two types of policies can arise:

[17] If the politician is indifferent between several level of taxes, we assume that she chooses the highest level among those. This is just a tie-breaking rule for the knife-edge cases where parameters are such that there are several maxima.

1. **A formal fiscal policy:** the bureaucrat does not contribute to public services: $e^* = 0$ and taxes are positive $\tau^* > 0$.

2. **An informal fiscal policy:** the bureaucrat contributes to public services: $e^* > 0$ and taxes are lower than under a formal policy.

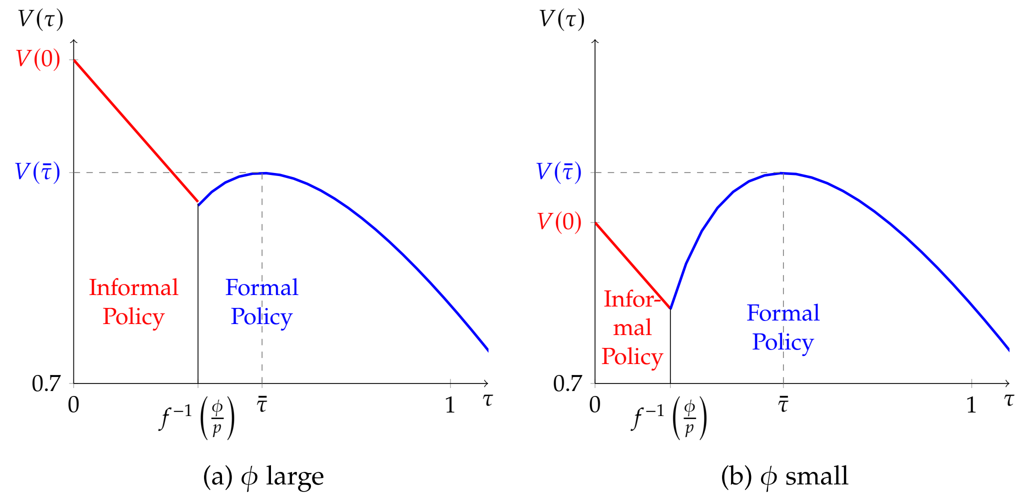
Our main result is that the ease of monitoring public service provision, ϕ, relative to that of monitoring corruption, p, as well as the cost of corruption on voters, η, determine which of the two policies is optimal.

Proposition 1. *If the marginal cost of corruption is less than the marginal cost of tax: $\eta < 1$, there exists a threshold $\bar{\phi}(p)$ on the observability of public services such that the politician chooses an informal policy if $\phi > \bar{\phi}(p)$. Otherwise, if $\phi \leq \bar{\phi}(p)$ or $\eta \geq 1$, the politician chooses a formal policy. As corruption monitoring (p) increases, the politician becomes more likely to choose a formal policy: $\bar{\phi}(p)$ weakly increases in p.*

Figure 1 illustrates that both formal and informal policies are possible when η is less than 1, depending on the observability of public services, ϕ. In the left panel, ϕ is large and an informal policy is better, while the reverse is true in the right panel. Figure 2 shows that when η is greater than 1, a formal policy is always optimal. In both figures, the vertical solid line corresponds to the level of tax above which the bureaucrat does not want to fund any public services (that is, $\tau = f^{-1}\left(\frac{p}{\phi}\right)$). If the politician chooses a tax below that level, the bureaucrat's funding is positive, as per Lemma 1. The red line captures the expected utility of the citizens under an informal policy and the blue line captures the expected utility of the citizens under a formal policy.

When the bureaucrat is willing to redistribute some funds ($\tau < f^{-1}\left(\frac{p}{\phi}\right)$), a one rupee increase in tax decreases the bureaucrat's funding by one rupee. Therefore, increasing taxes has no effect on the provision of public services but affects how that provision is funded. If the marginal cost of corruption is lower than the marginal cost of taxation ($\eta < 1$), then the politician is always better off decreasing taxes to shift the funding of public services from taxes to bribes and the optimal informal tax is $\tau = 0$. The first segment is therefore decreasing as illustrated in Figure 1. Instead when $\eta > 1$, the first segment is increasing as illustrated in Figure 2 and it is best to set the tax at the maximum possible value on that segment, $\tau = f^{-1}\left(\frac{p}{\phi}\right)$. When the bureaucrat does not redistribute

Figure 1: Low cost of corruption (η<1)



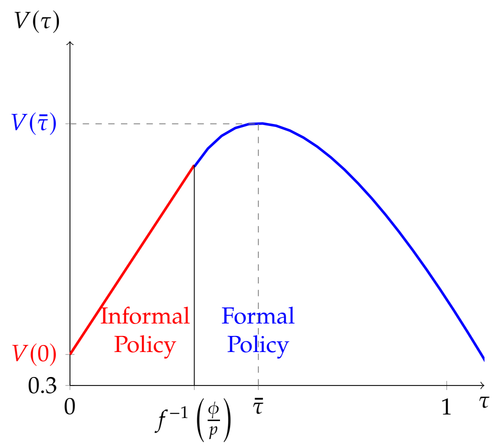
Notes. Objective function of the politician as a function of tax (τ) when $\eta < 1$. The left panel shows the case where an informal policy is better, the right panel shows the case where a formal policy is better. This figure is drawn using the following functional forms: $H(x) = 0.5\ln(x)$, $G(x) = 0.5\ln(x)$, $F(x) = 0.5\ln(x)$, and the parameters $\eta = 0.5$, $\phi = 0.5$ for panel (a) and $\phi = 0.3$ for panel (b).

funds ($\tau \geq f^{-1}\left(\frac{p}{\phi}\right)$), the politician simply chooses the tax that sets the marginal benefit of public services ($g(\tau)$) equal to the marginal cost of tax (1), so $\tau = \bar{\tau}$.

The optimal level of tax can then be found by comparing the maximum utility of citizens under an informal policy (the red line) with the maximum utility under a formal policy (the blue line). When the observability of public service delivery (ϕ) is high and corruption is hard to monitor (p low), the bureaucrat faces strong incentives to obtain bribes and redistribute them. As a result, the maximum of the citizens' utility under an informal policy is relatively high compared to a formal policy. In this case, the politician prefers an informal policy, as illustrated in panel (a) of Figure 1: the maximum utility under an informal policy, achieved at $\tau = 0$ is higher than the maximum utility under a formal policy, achieved at $\tau = \bar{\tau}$. Instead, when the observability is low or the monitoring relatively easy, the maximum utility that can be achieved under an informal policy (at $\tau = 0$) is lower than the maximum under a formal policy (at $\bar{\tau}$), so the politician prefers a formal policy as illustrated in panel (b) of Figure 1. Finally, when $\eta > 1$, the maximum utility under an informal policy is always achieved at the point where the bureaucrat no longer wants to redistribute, so a formal policy is optimal as shown in Figure 2.

Proposition 1 highlights how both information frictions and political frictions can

Figure 2: High cost of corruption (η>1)



Notes. Objective function of the politician as a function of tax (τ) when $\eta > 1$. This figure is drawn using $H(x) = 0.5\ln(x)$, $G(x) = 0.5\ln(x)$, $F(x) = 0.5\ln(x)$, and the parameters $\eta = 1.5$ and $\phi = 0.5$.

sustain informal fiscal systems. Monitoring individual instances of bribe-taking can be more difficult than observing whether public services have been delivered. This makes informal policies more desirable. In addition, the politician is more likely to choose an informal policy when politically important groups bear low costs of corruption (or do not hold the politician accountable for it). If the pivotal group of voters does not bear the full cost of corruption, they support a government which encourages corruption by keeping taxes low, as this allows a relatively high level of public service provision with lower taxes. Before exploring further implications of these results, we briefly discuss the case where monitoring can be sufficiently high to completely eradicate corruption.

4.1.3 High monitoring ($p \geq h(w)$)

Throughout the previous section, we focused on the case where monitoring was too low to completely prevent bribe taking. That case is sufficient to highlight the key intuition of the model in a tractable way. That intuition also holds in the case of high monitoring ($p \geq h(w)$).

High monitoring allows for another interesting possibility: that the bureaucrat funds public services without raising bribes. This happens when the tax is not too high (so that the bureaucrat wants to increase the level of public services) and not too low (as otherwise, the bureaucrat wants to fund such a large amount of public services that it is better to take bribes).[18] This corresponds to another type of informal policy: one in which public services are funded through both personal donations and formal taxes but no bribes are extracted. An example of such a policy could be the case of school teachers in the US paying for school supplies themselves, mentioned at the start of Section 2. While altruism is likely to be an important driver of this behavior, observing the performance of these teachers is also relatively easy by looking at students' tests, and high performance can lead them to obtain valuable promotions. This gives them incentives to increase the quality of public services beyond what is officially funded by the state. However, since bribery is more easily caught and punished, this funding is not compensated by higher corruption.

Finally, we show in the appendix that the existence of informal systems in Proposition 1 is not driven by the assumption that monitoring cannot be too high. Under high monitoring, the politician can still prefer to keep taxes low and to induce a fully informal policy with bribe-taking, despite the possibility of generating personal funding without bribes. This is the case when the observability of public service delivery (ϕ) is high and the cost of corruption (η) is low. We also show that the main results from low monitoring continue to hold in the case of high monitoring: the politician prefers one of the two informal policies if ϕ is sufficiently high and a formal policy if ϕ is sufficiently low.

4.2 Implications for corruption monitoring, welfare, and incidence

In this section, we explore the consequences of informal fiscal systems for the welfare of citizens, the incidence of these systems relative to formal systems, and the role they can play in perpetuating corruption. To obtain additional results in a more tractable way, we impose the following functional forms: $H(x) = \theta \ln(x)$, $F(x) = \ln(x)$, and $G(x) = \gamma \ln(x)$, for some parameters $\theta, \gamma \in (0, +\infty)$.

4.2.1 Incentives to monitor corruption

In our model, the politician sometimes prefers an informal system as it encourages bureaucrats to redistribute the bribes they take. One may wonder whether allowing the politician to choose the level of monitoring could lead her to reduce corruption to a minimum and always prefer a formal system as a result.

[18] One reason we relegate these results to the appendix is that the results and the proof become more complex and less insightful once we introduce the possibility of redistribution without bribes. This is because there is no closed-form solution for the optimal amount of redistribution in this case.

We consider an extension in which the politician can choose both a tax $\tau \in [0, +\infty)$ and a level of monitoring $p \in [0, h(w)]$ but the game is otherwise identical to the one solved in section 4.1. We show that, when she can choose the level of monitoring, the politician might prefer to deliberately keep monitoring low and encourage an informal system. This is the case even when assuming that monitoring is costless and is therefore not driven by the desire to reduce monitoring costs. Instead, it is driven by the possibility of providing public services without raising taxation which informal systems allow. The existence of informal fiscal systems can therefore discourage politician from monitoring bribes and thus help to perpetuate corruption.

Proposition 2. *For η sufficiently low and ϕ sufficiently high, the politician chooses a low level of monitoring, $p_L^* < h(w)$, and an informal policy with $\tau = 0$.*

Therefore, when the costs of corruption are not too high and public service delivery is sufficiently easy to observe, the politician can deliberately decide to turn a blind eye to corruption. This is the case even when the politician could virtually eliminate corruption at no cost, by setting $p = h(w)$ and choosing a formal fiscal system. The existence of informal systems can therefore reduce the incentives of governments to invest in anti-corruption policies, even when these policies are affordable.

4.2.2 Incidence and welfare

To study incidence and welfare, we extend the model and introduce two groups of citizens: the rich, R, and the poor, P. The two groups differ in how much income they have, with the rich earning higher income $W_R > W_P$, and in how much they value the public good, with the rich valuing it less $\gamma_R < \gamma_P$ (for instance because they can access some of these services privately). Finally, we modify the model to allow the politician to choose a proportional income tax, rather than a lump-sum tax: the politician chooses $t \in [0, 1]$ and each group $i \in \{R, P\}$ pays $t \times W_i$ in tax so that the total amount of tax raised is $t \times (W_R + W_P)$. Since we take income as exogenous, a proportional tax does not introduce any distortion and is therefore equivalent to a lump-sum tax.[19] We initially assume that the groups are of equal size and do not differ in any other way. In particular, when they both bear the same cost of corruption, they each pay half of the total bribes raised so $\eta_R = \eta_P = \frac{1}{2}$.

[19] We abstract from the usual distortions on labour supply or consumption that taxes induce to focus on the existence of informal system. Distortions that make formal taxes less desirable would make informal systems relatively more desirable.

We first solve for the optimal tax rate from a benevolent social planner who maximizes the sum of the utilities of the two groups. Next, we solve for the tax rate chosen by a politician who only relies on the rich to stay in power and therefore maximizes the utility of group R. We show that the social planner prefers a formal policy while the politician implements an informal policy provided that ϕ is large enough.

Lemma 2. *In equilibrium, the social planner weakly prefers a formal policy with* $t^* = \frac{\gamma_R+\gamma_P}{W_R+W_P}$ *and* $e^* = 0$*. A politician who needs to cater to group R implements an informal policy with* $t^* = 0$ *and* $e^* = \frac{\phi}{p}$ *provided that* ϕ *is large enough.*

Consider first the effect of raising taxes for the social planner under an informal system. Since the social planner cares equally about both groups, the direct cost of raising total taxes is $t \times (W_R + W_P)$. However, raising total taxes also decreases the bribes taken by the bureaucrat when the bureaucrat funds some services ($e^* > 0$). Since both groups are equally affected by bribes, and since $\eta_R + \eta_P = 1$, the benefit of raising taxes (in terms of decreasing bribes) is also $t \times (W_R + W_P)$, so total welfare is independent of t under an informal system: the same level of public services is either funded by taxes or by the bureaucrat. Instead, in a formal system (when the bureaucrat does not fund any services), total welfare is first increasing and then decreasing around the maximizer t^*. The social planner's problem therefore corresponds to the case $\eta = 1$ in Proposition 1 and thus to the situation where a formal system is optimal.[20]

Consider now the effect of raising taxes under an informal system when the politician maximizes the utility of group R only. In this case, the marginal cost of raising the tax rate is W_R, but the marginal benefit in terms of reducing bribes is only $\frac{W_R+W_P}{2}$. This is because bribes are born by both groups equally but the politician is only concerned about the bribes born by the rich. Since the rich have a higher income, $W_R > W_P$, the marginal cost of raising taxes is higher than the marginal benefit: $W_R > \frac{W_R+W_P}{2}$ under an informal system. The politician's problem therefore corresponds to the case where $\eta < 1$ in Proposition 1 and thus to the situation where an informal system can be optimal, as long as ϕ is large enough. In other words, the rich prefer an informal system because such a system splits the cost of funding public services (through bribes) equally between them and the poor, while formal

[20]The weak preference in the Lemma comes from the fact that if $t^* = \frac{\gamma_R+\gamma_P}{W_R+W_P} \leq \frac{\phi}{p}$, the social planner is indifferent between any level of tax in $t \in \left[0, \frac{\phi}{p}\right]$ and never chooses a level of tax $t > \frac{\phi}{p}$ since her payoff is decreasing beyond this (as this is beyond the maximizer). The social planner therefore chooses a formal policy in this case because of our tie-breaking rule, but does not strictly prefer it. If $t^* = \frac{\gamma_R+\gamma_P}{W_R+W_P} > \frac{\phi}{p}$ the social planner strictly prefers a formal policy.

taxes disproportionately fall on them. While the design of tax policies can be constrained by legal requirements, bribes can often fall on certain groups who do not necessarily exert as much influence on political decisions. For example, Hunt (2010) shows that the poor pay relatively more bribes than the rich, while in Pakistan, corruption disproportionately affects women and more vulnerable groups. The existence of informal fiscal systems, combined with the large gender gaps in voter registration and turnout (Cheema et al., 2019a,b), can explain why politicians have little incentives to address the corruption that these groups face.

Incidence. We first evaluate the proportion of public services that is funded by the different groups. In a formal system, this simply corresponds to the amount of tax each group pays relative to the total amount of taxes:

$$\mathcal{I}_i^{Formal} = \frac{t^* W_i}{t^*(W_R + W_P)} = \frac{W_i}{W_R + W_P}, \ \forall i \in \{R, P\} \tag{3}$$

That is, each group bears a burden of tax proportional to their income. This follows naturally from the fact that we consider a proportional income tax and abstract away from any distortions it might induce. It holds whether the social planner or the politician chooses a formal policy.

Instead, when the politician chooses an informal policy, the proportion of public services funded by a group also depends on the amount funded by bribes. Since the tax rate is zero in the optimal informal system and bribes are split equally between the two groups, the incidence becomes:

$$\mathcal{I}_i^{Informal} = \frac{t^* W_i + \frac{e^*}{2}}{t^*(W_R + W_P) + e^*} = \frac{1}{2}, \ \forall i \in \{R, P\} \tag{4}$$

As a result, when the rich are more politically-influential, an informal system leads the poor to bear a relatively higher fiscal burden ($\frac{1}{2} > \frac{W_P}{W_R + W_P}$) compared to a formal system and the rich to bear a lower fiscal burden ($\frac{1}{2} < \frac{W_R}{W_R + W_P}$). Note that the same result would also hold if the two groups paid the same amount of taxes (e.g. a lump-sum tax) but bribes fell disproportionately on the poor.

While the previous results illustrate how informal fiscal system can be regressive, it is also possible for them to be more progressive than formal systems. If the poor are more politically-influential, then an informal system is also possible, but only if the rich pay a larger proportion of bribes than the poor. If public services are entirely funded by bribes and the rich pay a higher proportion of bribes: $\eta_R > \eta_P$, then the fiscal burden falls disproportionately on the rich (relative to a formal system) if: $\frac{\eta_R}{\eta_R+\eta_P} > \frac{W_R}{W_R+W_P}$.

Finally, informal systems can have a more neutral incidence. This is the case for example when these systems act as de facto user fees. Suppose that only the rich group, R, benefits from the public service y ($G_P(y) = 0$) and that only group R bears the costs of bribery ($\eta_P = 0$). If group P has more political influence, the politician would not provide the public service and keep taxes at zero. However, bribes allow group R to pay for the provision of the service. For instance, if only petrol station owners benefit from additional police patrols, providing free petrol is a way to privately fund the provision of policing. If the informal fiscal system works as a de facto user fee, the incidence of funding falls on the group who accesses the service, which is also the only group that benefits from it, so informal system have no effect on redistribution. While formal user fees could be a more efficient way to provide these services, informal "taxes" offer a second-best option, with little distributional consequences.

These results show that the incidence of public funds in an informal fiscal system may ultimately fall on citizens in the form of bribes. The effective tax burden faced by households may therefore be underestimated by focusing exclusively on formal taxation. The distributional implications, however, depend on the specific context. In the case of free food provision, "donations" extracted from the wealthy can be progressive. On the other hand, providing logistical support for official visits using bribes paid by common citizens can be regressive.

Welfare. Informal fiscal systems introduce welfare distortions for two reasons. First, the amount of public services provided is generally different than the amount that maximizes societal utility. Second, this amount is partially funded through bribes, which can be inefficient for the less politically-influential group. To illustrate the second point more clearly, consider again the case with the two groups in which the politician only cares about the payoff of the rich. However, suppose now that bribes impose extra costs to society, but that cost falls disproportionately on the poor.[21] In particular, assume that $\eta_R = \frac{1}{2}$ and $\eta_P > \frac{1}{2}$.

The results from Lemma 2 still apply. If it were to choose an informal policy, the social

[21] Olken (2006) note that "many have argued that the uncertainty surrounding corruption makes it more costly than an equivalently sized tax".

planner would now benefit even more from increasing the tax rate as the marginal cost of tax, $W_P + W_R$, is now strictly less than the marginal benefit in terms of reducing corruption, $(\eta_R + \eta_P)(W_R + W_P)$. Therefore, the policy chosen by the social planner is a formal policy with $t^* = \frac{\gamma_R+\gamma_P}{W_R+W_P}$. The resulting social utility is:

$$V_R(t^*) + V_P(t^*) = \sum_{i\in\{R,P\}} \left[\gamma_i \ln(\gamma_R + \gamma_P) - (\gamma_R + \gamma_P)\frac{W_i}{W_R + W_P}\right] - (\eta_R + \eta_P)\left(\frac{\theta}{p} - w\right) \quad (5)$$

Compared to this benchmark, in informal systems, political pressure can distort the provision of public services. If group R is more politically-influential, and the observability of public service delivery (ϕ) is sufficiently large relative to corruption monitoring (p), the politician prefers to finance public goods through bribery rather than taxes. This results in the following social utility:

$$V_R(t = 0) + V_P(t = 0) = \sum_{i\in\{R,P\}} \left[\gamma_i \ln\left(\frac{\phi}{p}\right)\right] - (\eta_R + \eta_P)\left(\frac{\theta}{p} - w + \frac{\phi}{p}\right) \quad (6)$$

While this tax level maximizes the welfare of group R, which is the objective of the politician, the resulting sum of utilities across the two groups is lower than the optimal social welfare level from expression 5. This is for two reasons. First, the level of public services provided, $\frac{\phi}{p}$, is different than the social optimal, $t^* \times (W_R + W_P)$, since, by definition, t^* maximizes the social welfare function. Second, the amount of public services provided, $\frac{\phi}{p}$, is funded through bribes, so the cost of funding it, $(\eta_R + \eta_P)\left(\frac{\phi}{p}\right)$, is higher than if it had been funded through taxes (which would simply be $\frac{\phi}{p}$).

Proposition 3. *Suppose that $\eta_R = \frac{1}{2}$ and $\eta_P > \frac{1}{2}$. If the rich are more politically-influential and ϕ is sufficiently large, the social welfare when the politician is in charge is always strictly lower than in the first-best.*

When $\frac{\phi}{p} < \gamma_R + \gamma_P$, the amount of public services is strictly lower under the equilibrium informal policy than under the social optimum. This decrease in public service provision affects particularly the poor since they value the public service relatively more ($\gamma_P > \gamma_R$), and because they bear a higher cost of funding these services through bribes ($\eta_P > \eta_R$).

Finally, informal systems introduce agency costs. Because public services are funded by the bureaucrat rather than directly by the state, the equilibrium level of public services does not generally correspond to the optimal level and some money is lost as rent. These agency issues occur as a result of the fact that the politician favors one group: if the pivotal group bore the full cost of corruption, they would prefer a formal fiscal system and would not rely on the bureaucrat to redistribute funds. This is illustrated best when monitoring is endogenized as in Proposition 2. When the politician chooses an informal system, we know from Proposition 2 that the politician chooses a level of monitoring strictly less than the maximum possible: $p^*_L < h(w)$, if ϕ is sufficiently high. Instead, when the politician chooses a formal policy, a lower p only increases the bribes taken by the bureaucrat, so the optimal monitoring is $p^*_H = h(w)$[22]. As a result, the last term in expression (5) tends to zero. Therefore the informal system that is encouraged by the rich group not only results in a lower level of public service provision than is optimal, but it also introduces some rents for the bureaucrat, $r = h^{-1}(p) - w$. The politician is forced to accept these rents as this is the only way to encourage the bureaucrat to redistribute.

5 Conclusion

Developing countries worldwide face substantial hurdles in their attempts to provide public goods. We describe a method through which some governments handle these constraints: through an informal fiscal system in which local bureaucrats are expected to finance public services out of their own pockets. We document the existence of such systems in a large bureaucracy in Pakistan, showing that bureaucrats most likely make up for these shortfalls in official funds through rent extraction.

Our model describes the conditions under which governments might prefer to implement low formal taxes and encourage bureaucrats to fund public services. We show that these systems are more likely to arise when the costs of monitoring bureaucrats are high relative to those of observing public service delivery, when the costs of corruption can be shifted to politically less powerful groups, and when bureaucrats value the provision of public services (perhaps for career progression reasons).

The existence of informal fiscal systems can explain the joint persistence of corruption and low fiscal capacity. Because governments can rely on corruption to fund public services, they have limited incentives to punish it and to invest in fiscal capacity. The costs of such systems can be large, as (somewhat) legitimized rent extraction and low monitoring may lead to high levels of corruption, even if some funds are returned in the form of public services. Moreover, distributional consequences are unavoidable if only

[22] Or very close to it in the case where p is restricted to $p < h(w)$.

some parts of the population are targeted for rent extraction and the ability of governments to redistribute across space is restricted with necessarily local informal fiscal systems. How and when such discretionary, informal systems transition to programmatic formal systems are questions for future research.

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Table 1: Provision of public goods and services by local bureaucrats without official funds

	Mean (1)	N (2)	SD (3)
Panel A: Bureaucrat perspective			
Whether local bureaucrats provide underfunded public services (proportion who agree)	0.82	750	0.39
Proportion of respondents who reported a positive amount of funds supplied by:			
Local bureaucrats	1.00	618	0.05
Government funds	0.02	618	0.15
Local philanthropists	0.30	618	0.46
NGO	0.21	618	0.41
Other	0.00	617	0.00
Share of local bureaucrat's total expenditure			
Expenditure on unofficial public services	15.45	557	21.77
HH consumption	46.21	556	16.79
Children expenditure	27.44	557	11.49
Travelling	13.60	557	6.60
Other	2.86	703	5.65
Panel B: Supervisor perspective			
Whether local bureaucrats provide underfunded public services (proportion who agree)	0.98	35	0.14
Proportion of respondents who reported a positive amount of funds supplied by:			
Local bureaucrats	0.89	33	0.31
Government funds	0.78	33	0.42
Local philanthropists	0.91	33	0.29
NGO	0.15	33	0.37
Other	0.02	33	0.14
Local bureaucrat ever filed to be reimbursed for amount spent	0.08	28	0.27
Reason the government doesn't provide 100 percent of the funds			
It is the norm	0.94	29	0.25
They know local bureaucrats earn tips (bribes)	0.90	28	0.30
Philanthropists, NGOs can cover difference	0.70	25	0.47
Hard for government to raise funds through taxing and borrowing	0.27	29	0.45

Notes: Data is from two separate surveys of the local bureaucrats and their supervisors in 2020. Questions were closed ended in both cases.

Table 2: Heterogeneity in sources of funds

	Flood control and relief		Free food to public		Food and logistics during officer visits	
	Mean	N	Mean	N	Mean	N
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Bureaucrat perspective						
Whether local bureaucrats provide service (proportion who agree)	0.61	750	0.25	750	0.82	750
Cost each time (PKR)	-	-	148917	53	59022	612
If a 100 PKR is spent, how much of it is funded through:						
Local bureaucrats' pockets	-	-	52.95	55	83.61	613
Government funds	-	-	8.48	56	0.01	613
Local philanthropists	-	-	31.88	56	9.34	613
NGO	-	-	6.54	56	7.08	613
Other	-	-	0.00	54	0.00	611
Frequency of activities						
Once a year	0.00	449	0.09	187	0.07	617
Twice a year	0.00	449	0.12	187	0.10	617
4 times a year	0.00	449	0.01	187	0.12	617
Every month	0.00	449	0.00	187	0.63	617
Daily	0.01	449	0.77	187	0.00	617
Other (as per requirement)	0.99	449	0.00	187	0.08	617
Panel B: Supervisor perspective						
Whether local bureaucrats provide service (proportion who agree)	0.89	33	0.90	34	0.93	35
Cost each time (PKR)	2406250	8	165182	9	138045	9
If a 100 PKR is spent, how much of it is funded through:						
Local bureaucrats' pockets	12.90	21	15.11	30	81.22	30
Government funds	72.98	21	10.55	30	8.50	30
Local philanthropists	12.82	21	73.13	30	9.11	30
NGO	1.76	21	1.21	30	0.50	30
Other	0.00	21	0.00	30	0.67	30
Frequency of activities						
Once a year	0.58	29	0.45	28	0.09	31
Twice a year	0.06	29	0.12	28	0.08	31
4 times a year	0.00	29	0.09	28	0.16	31
Every month	0.00	29	0.00	28	0.33	31
Other	0.37	29	0.34	28	0.35	31

Notes: Data is from two separate surveys of the local bureaucrats and their supervisors in 2020. Except for questions on costs, the rest were closed ended.

Table 3: Reasons local bureaucrats are willing to spend out of pocket and public goods and services

	Mean	N	SD
	(1)	(2)	(3)
Panel A: Bureaucrat perspective			
Most important reason for spending out of pocket			
If I don't, others in the service will have a bad opinion of me	0.62	613	0.49
It is important for people in my area to receive this good or service	0.30	613	0.46
It is part of my job description	0.01	613	0.12
If I don't, my career service progression would be hurt	0.07	613	0.25
If I don't, I can face disciplinary action	0.00	613	0.00
Other	0.00	613	0.00
Panel B: Supervisor perspective			
Reasons local bureaucrats are willing to spend out of pocket			
If they don't, they can face disciplinary action	0.76	28	0.43
Reduced accountability if local bureaucrats engage in corruption	0.39	28	0.50
If they don't, others in the service will have a bad opinion of them	0.20	28	0.41
It is the norm	0.22	28	0.42
If they don't, their career service progression would be hurt	0.11	28	0.32
It is part of their job description	0.06	28	0.24
Other	0.05	28	0.23
It is important for people in their area to receive this good or service	0.00	28	0.00

Notes: Data is from two separate surveys of the local bureaucrats and their supervisors in 2020. Questions were closed ended in both cases except for the option "Reduced accountability if local bureaucrats engage in corruption", which was volunteered by the supervisors.

A Technical Appendix

A.1 Proofs of results in the text

Proof of Lemma 1. Suppose that $p < h(w)$.

The bureaucrat's problem is:

$$\max_{b,e} \quad U(e,b) = H(w+b-e) + \phi F(\tau+e) - pb \quad \text{s.t.} \quad 0 \leq e \leq w+b,\ 0 \leq b$$

Unconstrained problem: Suppose first that none of the constraints bind. The first-order conditions are:

$$\frac{\partial U(e,b)}{\partial e} = -h(w+b-e) + \phi f(\tau+e) = 0$$
$$\frac{\partial U(e,b)}{\partial b} = h(w+b-e) - p = 0$$

Combining them gives:

$$\phi f(\tau+e) = h(w+b-e) = p$$

Therefore, we can obtain e^* as:

$$f(\tau+e) = \frac{p}{\phi} \Rightarrow e^* = f^{-1}\left(\frac{p}{\phi}\right) - \tau$$

Where f^{-1} is the inverse function of f and is well-defined as f is strictly decreasing. Using the solution to e^*, we can then obtain b^*:

$$h(w+b-e) = p \Rightarrow b^* = h^{-1}(p) - w + e^*$$

Where h^{-1} is the inverse function of h and is well-defined as h is strictly decreasing.

Given that $p < h(w)$, then $h^{-1}(p) > w$, so $b^* = h^{-1}(p) - w + e^* > 0$. Moreover, $e^* \leq w + b^* = w + h^{-1}(p) - w + e^* = h^{-1}(p) + e^*$, so the budget constraint is always satisfied.

We can confirm that we found a maximum as the Hessian matrix is negative semidefinite:

$$
\begin{aligned}
|H| &= \frac{\partial^2 U(e,b)}{\partial e^2} \cdot \frac{\partial^2 U(e,b)}{\partial b^2} - \left(\frac{\partial^2 U(e,b)}{\partial e \partial b}\right)^2 \\
&= \left[h'(w+b-e) + \phi f'(\tau+e)\right] \cdot h'(w+b-e) - [-h'(w+b-e)]^2 \\
&= h'(w+b-e) \cdot (h'(w+b-e) - h'(w+b-e) + \phi f'(\tau+e)) \\
&= h'(w+b-e) \cdot \phi f'(\tau+e) > 0
\end{aligned}
$$

since $h'(\cdot) < 0$ and $\phi f'(\cdot) < 0$.

No bureaucrat funding: suppose now that $\tau \geq f^{-1}\left(\frac{p}{\phi}\right)$, which implies that the maximizer of the unconstrained problem would be negative, $e^* \leq 0$. In this case, the non-negativity constraint on e binds and it is optimal to set $e = 0$. The problem becomes:

$$
\max_b \quad U(b) = H(w+b) - pb \quad \text{s.t. } 0 \leq b
$$

The first-order condition then gives $b = h^{-1}(p) - w$, combining it with the non-negativity constraint on b, the optimal bribe is:

$$
b^* = \max\{h^{-1}(p) - w, 0\}
$$

The second-order condition is satisfied as $h'(w+b) < 0$. Given that $h(w) > p$, then $w < h^{-1}(p)$, so the non-negativity constraint on b never binds and the optimal combination of bribes and redistribution is $b^* = h^{-1}(p) - w > 0$ and $e^* = 0$. In this case, the budget constraint is obviously satisfied as $e^* = 0 \leq w + b^*$.

Therefore, if τ is sufficiently low $\tau < f^{-1}\left(\frac{p}{\phi}\right)$, the solution is that of the unconstrained problem, while if τ is too high, $\tau \geq f^{-1}\left(\frac{p}{\phi}\right)$, the solution is that with no bureaucrat funding $e^* = 0$. In either case, the optimal bribes are $b^* = h^{-1}(p) - w + e^*$ (where $e^* = \max\{0, f^{-1}\left(\frac{p}{\phi}\right) - \tau\}$). □

Proof of Proposition 1. Using Lemma, 1 we can substitute the bureaucrat's best-response into the politician's problem. The problem becomes:

$$
\max_{\tau \in [0,+\infty)} V(\tau) = \begin{cases} G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \tau - \eta\left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right) - \tau\right] & \text{if } \tau \leq f^{-1}\left(\frac{p}{\phi}\right) \\ G(\tau) - \tau - \eta\left[h^{-1}(p) - w\right] & \text{if } \tau \geq f^{-1}\left(\frac{p}{\phi}\right) \end{cases}
$$

Note that the inequality is weak as the two parts of the function $V(\tau)$ are equal when $\tau = f^{-1}\left(\frac{p}{\phi}\right)$. To solve this problem, we maximise each separate section of the function piece-wise and then compare the maximum payoff the politician can get on each section of the function.

1. For $\tau < f^{-1}\left(\frac{p}{\phi}\right)$, the derivative of the payoff function with respect to τ is simply $\frac{\partial V(\tau)}{\partial \tau} = -1 + \eta$. Therefore, the function is either always decreasing or always increasing on that segment so the maximum is attained at $\tau = 0$ when $\eta < 1$, at $\tau = f^{-1}\left(\frac{p}{\phi}\right)$ when $\eta > 1$, and the function is constant in τ when $\eta = 1$. The maximum of the function is therefore:

$$\bar{V}^{-} = \begin{cases} G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \eta\left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right] & \text{if } \eta \leq 1 \\ G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - f^{-1}\left(\frac{p}{\phi}\right) - \eta\left[h^{-1}(p) - w\right] & \text{if } \eta \geq 1 \end{cases}$$

   The first case corresponds to an informal policy as $\tau = 0$ and $e = f^{-1}\left(\frac{p}{\phi}\right) > 0$, while the second is a formal policy as $e = f^{-1}\left(\frac{p}{\phi}\right) - f^{-1}\left(\frac{p}{\phi}\right) = 0$ and $\tau = f^{-1}\left(\frac{p}{\phi}\right) > 0$. Note that the inequality on η is weak as the two parts of the function $\bar{V}^{-}$ are equal when $\eta = 1$.

2. When $\tau > f^{-1}\left(\frac{p}{\phi}\right)$, the derivative of the payoff function with respect to τ is $\frac{\partial V(\tau)}{\partial \tau} = g(\tau) - 1$, and the optimal tax level is given by the first-order condition $\tau = g^{-1}(1) := \bar{\tau}$ (the second-order condition is satisfied since $g'(\cdot) < 0$). This optimal amount can only be attained if $\bar{\tau} \geq f^{-1}\left(\frac{p}{\phi}\right)$. Otherwise, if $\bar{\tau} < f^{-1}\left(\frac{p}{\phi}\right)$, the function $V(\tau) = G(\tau) - \tau - \eta\left[h^{-1}(p) - w\right]$ is decreasing everywhere on $\tau \in [f^{-1}\left(\frac{p}{\phi}\right), +\infty)$.

   The maximum of the second part of the payoff function $V(\tau)$ is therefore:

$$\bar{V}^{+} = \begin{cases} G(\bar{\tau}) - \bar{\tau} - \eta\left[h^{-1}(p) - w\right] & \text{if } \bar{\tau} \geq f^{-1}\left(\frac{p}{\phi}\right) \\ G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - f^{-1}\left(\frac{p}{\phi}\right) - \eta\left[h^{-1}(p) - w\right] & \text{if } \bar{\tau} < f^{-1}\left(\frac{p}{\phi}\right) \end{cases}$$

   Both cases correspond to formal policies as $e = 0$ and $\tau > 0$.

Finally, comparing the two functions, we obtain the result in Proposition 1.

A. Suppose first that $\bar{\tau} \geq f^{-1}\left(\frac{p}{\phi}\right)$: This corresponds to values of ϕ such that $\phi \leq \frac{p}{f(\bar{\tau})}$.

1. If $\eta < 1$, then the politician chooses an informal policy ($\tau = 0$ and $e > 0$) if $\bar{V}^- > \bar{V}^+$, that is if:

$$
\begin{aligned}
& G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \eta\left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right] > G(\bar{\tau}) - \bar{\tau} - \eta\left[h^{-1}(p) - w\right] \\
\Leftrightarrow \quad & G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \eta f^{-1}\left(\frac{p}{\phi}\right) > G(\bar{\tau}) - \bar{\tau} \qquad (7)
\end{aligned}
$$

We note that:

(a) The right-hand side of (7) is independent of ϕ.

(b) The left-hand side of (7) is increasing in ϕ since (1) $G(x) - \eta x$ is increasing in x for any $x \leq \bar{\tau}$ (since by definition, $\bar{\tau}$ is the maximum of $G(x) - x$, so $g(x) > 1$ for any $x \leq \bar{\tau}$ and therefore $g(x) > \eta$ for any $x \leq \bar{\tau}$ when $\eta < 1$), and (2) $f^{-1}\left(\frac{p}{\phi}\right)$ is increasing in ϕ given that $f^{-1}(\cdot)$ is decreasing.

(c) Given the Inada conditions on F, $\lim_{\phi \to 0} f^{-1}\left(\frac{p}{\phi}\right) = 0$, so $\lim_{\phi \to 0} G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \eta f^{-1}\left(\frac{p}{\phi}\right) = G(0) < G(\bar{\tau}) - \bar{\tau}$.

(d) $\lim_{\phi \to \frac{p}{f(\bar{\tau})}} G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \eta f^{-1}\left(\frac{p}{\phi}\right) = G(\bar{\tau}) - \eta\bar{\tau} > G(\bar{\tau}) - \bar{\tau}$ (as $\eta < 1$).

Therefore, by the intermediate value theorem, there exists $\bar{\phi}(p) \in \left[0, \frac{p}{f(\bar{\tau})}\right]$ such that $\bar{V}^- = G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \eta f^{-1}\left(\frac{p}{\phi}\right) > G(\bar{\tau}) - \bar{\tau} = \bar{V}^+$, if and only if $\phi > \bar{\phi}(p)$. That is, the politician **chooses an informal policy** if and only if $\phi > \bar{\phi}(p)$.

2. When $\eta \geq 1$, note that the politician never chooses an informal policy. Indeed, for the part of the function $V(\tau)$ where $\tau \leq f^{-1}\left(\frac{p}{\phi}\right)$, it is optimal to set $\tau = f^{-1}\left(\frac{p}{\phi}\right)$ which induces the bureaucrat to choose $e = 0$. For the part of the function $V(\tau)$ where $\tau > f^{-1}\left(\frac{p}{\phi}\right)$, it is optimal to set $\tau = \bar{\tau}$ which also induces $e = 0$. Finally, comparing the two parts of the function, we can show that the politician always sets $\tau = \bar{\tau}$ since $V^- < V^+$:

$$
\begin{aligned}
& G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - f^{-1}\left(\frac{p}{\phi}\right) - \eta\left[h^{-1}(p) - w\right] < G(\bar{\tau}) - \bar{\tau} - \eta\left[h^{-1}(p) - w\right] \\
\Leftrightarrow \quad & G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - f^{-1}\left(\frac{p}{\phi}\right) < G(\bar{\tau}) - \bar{\tau} \qquad (8)
\end{aligned}
$$

Which always holds as $\bar{\tau}$ maximises $G(x) - x$. Therefore, if $\eta \geq 1$ and $\bar{\tau} \geq f^{-1}\left(\frac{p}{\phi}\right)$, the politician **always chooses a formal policy**.

B. Suppose instead that $\bar{\tau} < f^{-1}\left(\frac{p}{\phi}\right)$: This corresponds to ϕ such that $\phi > \frac{p}{f(\bar{\tau})}$.

1. If $\eta < 1$, then the politician chooses an informal policy ($\tau = 0$ and $e > 0$) if: $\bar{V}^{-} > \bar{V}^{+}$, that is, if:

$$
\begin{aligned}
& G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \eta\left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right] \\
& \qquad > G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - f^{-1}\left(\frac{p}{\phi}\right) - \eta\left[h^{-1}(p) - w\right] \\
\Leftrightarrow \quad & G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \eta f^{-1}\left(\frac{p}{\phi}\right) > G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - f^{-1}\left(\frac{p}{\phi}\right) \qquad (9) \\
& \Leftrightarrow 1 > \eta \qquad (10)
\end{aligned}
$$

Therefore, in this case, the politician always chooses **an informal fiscal policy**.

2. If $\eta \geq 1$, the politician **never chooses an informal policy** since even when $\tau \leq f^{-1}\left(\frac{p}{\phi}\right)$, the optimal tax is $\tau = f^{-1}\left(\frac{p}{\phi}\right)$ and therefore such that $e = 0$. Given $\bar{\tau} < f^{-1}\left(\frac{p}{\phi}\right)$, $V^{+}(\tau)$ is also decreasing in τ so it is also optimal to set $\tau = f^{-1}\left(\frac{p}{\phi}\right)$ for the case $\tau \geq f^{-1}\left(\frac{p}{\phi}\right)$. Therefore, if $\eta \geq 1$ and $\bar{\tau} \geq f^{-1}\left(\frac{p}{\phi}\right)$, the politician **always chooses a formal policy** with $\tau = f^{-1}\left(\frac{p}{\phi}\right)$.

We can therefore conclude from cases A.1 and B.1 that if $\eta < 1$, the politician chooses an informal policy if and only if $\phi \geq \bar{\phi}(p)$. And we can conclude from cases A.2 and B.2 that if $\eta \geq 1$, the politician always chooses a formal policy (with either $\tau = \bar{\tau}$ or $\tau = f^{-1}\left(\frac{p}{\phi}\right)$). □

Finally, we show that $\bar{\phi}(p)$ is increasing in p. Recall that $\bar{\phi}(p)$ is defined as the value of ϕ such that $G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \eta f^{-1}\left(\frac{p}{\phi}\right) = G(\bar{\tau}) - \bar{\tau}$. Holding everything else constant, an increase in p decreases the left-hand side (for the same reasons as ϕ increases the left-hand side described in point A.1.(b) above). Since the right-hand side is independent of p, the value of ϕ that sets the two sides equal must therefore increase as p increases.

Proof of Proposition 2. From Proposition 1, we know the optimal tax rate for the politician for a given level of monitoring. We can therefore re-state the problem as a maximization over the monitoring level p, given the corresponding optimal tax rate.[23]

[23]Note that it is possible to solve the problem in two separate stages because, when the bureaucrat redistributes ($e^{*} > 0$), the optimal tax is only determined by whether $\eta > 1$ or $\eta < 1$, independently of p. While when the bureaucrat does not redistribute ($e^{*} = 0$), p only affects bribes, not public service provision and is therefore also independent of the tax choice.

The politician solves:

$$\max_p G(e^*(\tau^*(p)) + \tau^*(p)) - \tau^*(p) - \eta b^*(\tau^*(p))$$

From Proposition 1, we know that the politician chooses an informal policy with $\tau = 0$ if and only if $\eta < 1$ and $\phi > \bar{\phi}(p)$. From the proof of Proposition 1, we can see that whenever ϕ appears in the proof, it appears within the expression $f^{-1}\left(\frac{p}{\phi}\right)$. Therefore, the same arguments used to prove that there exists a threshold $\bar{\phi}(p)$ such that the politician chooses an informal policy if and only if $\phi > \bar{\phi}(p)$ can be applied to show that there exists a threshold $\bar{p}(\phi)$ such that the politician chooses an informal policy if and only if $p < \bar{p}(\phi)$.

Using this threshold and substituting the bureaucrat's best-response and the optimal tax rate when $\eta < 1$, the problem becomes:

$$\max_p V(p) = \begin{cases} G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \eta\left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right] & \text{if } p < \bar{p}(\phi) \\ G(\bar{\tau}) - \bar{\tau} - \eta\left[h^{-1}(p) - w\right] & \text{if } p \in [\bar{p}(\phi), h(w)] \end{cases}$$

We can now maximize the two parts of the function separately and compare the maxima across the two parts.

1. If $p < \bar{p}(\phi)$, the first-order condition gives:

$$g\left(f^{-1}\left(\frac{p}{\phi}\right)\right)\left(\frac{(f^{-1})'\left(\frac{p}{\phi}\right)}{\phi}\right) - \eta(h^{-1})'(p) - \eta\left(\frac{(f^{-1})'\left(\frac{p}{\phi}\right)}{\phi}\right) = 0$$

Where $(f^{-1})'$ and $(h^{-1})'$ denote the derivatives of the inverses of $f(x)$ and $h(x)$ respectively.

Substituting the functional forms gives:

$$\frac{\gamma}{\left(\frac{1}{\frac{p}{\phi}}\right)} \times \left(\frac{-1}{\phi \times \left(\frac{p}{\phi}\right)^2}\right) - \eta\left(\frac{-\theta}{p^2}\right) - \eta\left(\frac{-1}{\phi \times \left(\frac{p}{\phi}\right)^2}\right) = 0 \quad \Leftrightarrow \quad p = \frac{\eta(\theta + \phi)}{\gamma}$$

Therefore, the optimal level of monitoring is $p_L^* = \frac{\eta(\theta+\phi)}{\gamma}$.

The solution is interior as long as $p_L^* < \bar{p}(\phi)$. This is the case when, at $p = p_L^*$,

$$G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \eta f^{-1}\left(\frac{p}{\phi}\right) > G(\bar{\tau}) - \bar{\tau}$$

Using the expression for p_L^*, the fact that $\bar{\tau} = \gamma$ (since $g(\bar{\tau}) = 1 \Leftrightarrow \frac{\gamma}{\bar{\tau}} = 1$), and the functional forms, this gives:

$$\gamma \ln\left(\frac{1}{\left(\frac{\eta(\theta+\phi)}{\gamma\phi}\right)}\right) - \eta \frac{1}{\left(\frac{\eta(\theta+\phi)}{\gamma\phi}\right)} > \gamma \ln(\gamma) - \gamma$$

After re-arranging, this condition becomes:

$$\frac{\theta}{\theta+\phi} + \ln\left(\frac{\phi}{\theta+\phi}\right) > \ln(\eta) \tag{11}$$

It is therefore satisfied for η sufficiently low. Otherwise, if this condition is not satisfied, then $p_L^* \geq \bar{p}(\phi)$, and the solution is at a corner: it is optimal to keep increasing monitoring p up to $p = \bar{p}(\phi)$, at which point the politician prefers to switch to a formal fiscal policy.

2. If $p \geq \bar{p}(\phi)$, then the function is always increasing in p since $h^{-1}(p)$ is decreasing in p. It is therefore optimal to set $p_H^* = h(w)$.

3. Comparing across the two local maxima: The politician prefers a lower level of monitoring $p_L^* < p_H^* = h(w)$ if condition (11) is satisfied (so that there exists an interior $p_L^* < \bar{p}$ which maximizes $G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \eta\left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right]$) and if:

$$G\left(f^{-1}\left(\frac{p_L^*}{\phi}\right)\right) - \eta\left[h^{-1}\left(p_L^*\right) - w + f^{-1}\left(\frac{p_L^*}{\phi}\right)\right] > G(\bar{\tau}) - \bar{\tau}$$

Substituting the functional forms and the expressions for p_L^* and $\bar{\tau}$ the last inequality becomes:

$$\gamma \ln\left(\frac{1}{\left(\frac{\eta(\theta+\phi)}{\gamma\phi}\right)}\right) - \eta \frac{\theta}{\left(\frac{\eta(\theta+\phi)}{\gamma}\right)} + \eta w - \eta \frac{1}{\left(\frac{\eta(\theta+\phi)}{\gamma\phi}\right)} > \gamma \ln(\gamma) - \gamma$$

Re-arranging terms, we can show that this is equivalent to:

$$\eta w > -\gamma \ln\left(\frac{\phi}{\eta(\theta+\phi)}\right) \tag{12}$$

If the right-hand side of (12) is negative, that is, if $\frac{\phi}{\eta(\theta+\phi)} > 1$, then the condition is always satisfied so it is optimal to set $p = p_L^*$ and therefore induce an informal policy. If the right-hand side of (12) is positive, that is, if $\frac{\phi}{\eta(\theta+\phi)} < 1$, then setting $p = p_L^*$ (and therefore inducing an informal policy) is optimal if: $\eta w + \gamma \ln\left(\frac{\phi}{\eta(\theta+\phi)}\right) > 0$. This is satisfied for sufficiently high ϕ or sufficiently low η. To see this, let $L(\phi,\eta) = \eta w + \gamma \ln\left(\frac{\phi}{\eta(\theta+\phi)}\right)$ and note that:

$$\frac{\partial L(\phi,\eta)}{\partial \phi} = \frac{\gamma\theta}{\phi(\theta+\phi)} > 0 \quad \text{and} \quad \frac{\partial L(\phi,\eta)}{\partial \phi} = w - \frac{\gamma}{\eta} < 0$$

Where the last inequality holds because $p_L^* < h(w) \Rightarrow \frac{\eta(\theta+\phi)}{\gamma} < \frac{\theta}{w} \Rightarrow \eta w < \frac{\gamma\theta}{\theta+\phi} < \gamma$.

Therefore, when the politician can choose both a tax $\tau \in [0,+\infty)$ and a level of monitoring $p \in [0, h(w)]$, but the game is otherwise identical to the one solved in section 4.1, the politician chooses a low level of monitoring, $p_L^* < h(w)$ and an informal policy with $\tau = 0$ if either

1. η is sufficiently low that $\frac{\phi}{\eta(\theta+\phi)} > 1$,
2. or $\frac{\phi}{\eta(\theta+\phi)} > 1$ but η is sufficiently low and ϕ sufficiently high that inequality 12 is satisfied.

Otherwise, the politician chooses a high level of monitoring $p = h(w)$ and a formal policy with $\tau = \bar{\tau}$ if $\bar{\tau} > f^{-1}\left(\frac{p}{\phi}\right)$ (which holds if $\gamma > \frac{\gamma\phi}{\eta(\theta+\phi)}$) or a formal policy with $\tau = f^{-1}\left(\frac{p}{\phi}\right)$ if $\bar{\tau} \leq f^{-1}\left(\frac{p}{\phi}\right)$ (which holds if $\gamma \leq \frac{\gamma\phi}{\eta(\theta+\phi)}$). □

Proof of Lemma 2.

1. Social planner

The social planner solves:

$$\max_t \gamma_R \ln\left(t(W_R+W_P)+e(t)\right) - tW_R - \frac{b(t)}{2} + \gamma_P \ln\left(t(W_R+W_P)+e(t)\right) - tW_P - \frac{b(t)}{2}$$

We can apply Lemma 1 to substitute the optimal redistribution $e(t)$ and bribes $b(t)$ of the bureaucrat and the maximization problem becomes:

$$\max_t V(t) = \begin{cases} \gamma_R \ln\left(t(W_R+W_P) + \frac{\phi}{p} - t(W_R+W_P)\right) - tW_R \\ \quad -\frac{\left(\frac{\theta}{p} - w + \frac{\phi}{p} - t(W_R+W_P)\right)}{2} + \gamma_P \ln\left(t(W_R+W_P) + \frac{\phi}{p}\right. \\ \quad \left. - t(W_R+W_P)\right) - tW_P - \frac{\left(\frac{\theta}{p} - w + \frac{\phi}{p} - t(W_R+W_P)\right)}{2} & \text{if } \frac{\phi}{p} \geq t(W_R+W_P) \\ \gamma_R \ln\left(t(W_R+W_P)\right) - tW_R - \frac{\left(\frac{\theta}{p} - w\right)}{2} \\ \quad + \gamma_P \ln\left(t(W_R+W_P)\right) - tW_P - \frac{\left(\frac{\theta}{p} - w\right)}{2} & \text{if } \frac{\phi}{p} \leq t(W_R+W_P) \end{cases}$$

Note that the inequality is weak in both cases as the two parts of the function are equal at $\frac{\phi}{p} = t(W_R+W_P)$. Simplifying the first expression gives:

$$\begin{aligned} V(t) &= \gamma_R \ln\left(\frac{\phi}{p}\right) + \gamma_P \ln\left(\frac{\phi}{p}\right) - t(W_P+W_R) - \left(\frac{\theta}{p} - w + \frac{\phi}{p} - t(W_R+W_P)\right) \\ &= \gamma_R \ln\left(\frac{\phi}{p}\right) + \gamma_P \ln\left(\frac{\phi}{p}\right) - \left(\frac{\theta}{p} - w + \frac{\phi}{p}\right) \end{aligned}$$

This is independent of t so choosing any $t \in \left[0, \frac{\phi}{p(W_R+W_P)}\right]$ is optimal, including $t = \frac{\phi}{p(W_R+W_P)}$.

Simplifying the second expression gives:

$$\max_t V(t) = \gamma_R \ln\left(t(W_R+W_P)\right) + \gamma_P \ln\left(t(W_R+W_P)\right) - t(W_P+W_R) - \left(\frac{\theta}{p} - w\right) \tag{13}$$

The first-order condition is:

$$\frac{(\gamma_R+\gamma_P)(W_R+W_P)}{t(W_R+W_P)} = W_P + W_R \Rightarrow t^* = \frac{\gamma_R+\gamma_P}{W_R+W_P}$$

If the total tax, $t^* \times (W_R+W_P) = \frac{\gamma_R+\gamma_P}{W_R+W_P} \times (W_R+W_P)$ is greater than $\frac{\phi}{p}$ then the amount provided under an informal system is lower than the ideal amount of public services, so it is optimal to choose the formal policy and set $t^* = \frac{\gamma_R+\gamma_P}{W_R+W_P}$. Otherwise, the politician cannot set the optimal amount of services without preventing the bureaucrat from providing more services. So the best the politician can do is to set $t = \frac{\phi}{p}$ which gives the same amount of welfare as any informal policy.

2. Politician who favors group R

The politician solves:

$$\max_t V(t) = \begin{cases} \gamma_R \ln\left(t(W_R+W_P) + \frac{\phi}{p} - t(W_R+W_P)\right) & \\ \qquad -tW_R - \frac{\left(\frac{\theta}{p} - w + \frac{\phi}{p} - t(W_R+W_P)\right)}{2} & \text{if } \frac{\phi}{p} \geq t(W_R+W_P) \\ \gamma_R \ln\left(t(W_R+W_P)\right) - tW_R - \frac{\left(\frac{\theta}{p} - w\right)}{2} & \text{if } \frac{\phi}{p} \leq t(W_R+W_P) \end{cases}$$

Note that the inequality is weak in both cases as the two parts of the function are equal at $\frac{\phi}{p} = t(W_R + W_P)$. The first expression can be simplified to:

$$\begin{aligned} V(t) &= \gamma_R \ln\left(\frac{\phi}{p}\right) - tW_R + \frac{tW_R}{2} + \frac{tW_P}{2} - \frac{\left(\frac{\theta}{p} - w + \frac{\phi}{p}\right)}{2} \\ &= \gamma_R \ln\left(\frac{\phi}{p}\right) - \frac{t(W_R - W_P)}{2} - \frac{\left(\frac{\theta}{p} - w + \frac{\phi}{p}\right)}{2} \end{aligned}$$

This function is decreasing in t as $W_R > W_P$. This is therefore equivalent to the case where $\eta < 1$ in Proposition 1: the payoff function is decreasing in tax when the bureaucrat redistributes some funds. Following the logic of Proposition 1, the politician will therefore choose an informal policy with $t^* = 0$ if ϕ is sufficiently high and a formal policy otherwise. The informal policy leads the bureaucrat to redistribute $e^* = f^{-1}\left(\frac{p}{\phi}\right) = \frac{\phi}{p}$. □

Proof of Proposition 3. If the rich are more politically-influential than the poor and ϕ is large enough, then Lemma 2 implies that the politician chooses an informal policy with $t^* = 0$ and the bureaucrat redistributes $e^* = \frac{\phi}{p}$. Indeed, since $\eta_R = \frac{1}{2}$, the choice of optimal policy for the politician is exactly the same as in Lemma 2. This results in the following social welfare:

$$V_R(t=0) + V_P(t=0) = \sum_{i \in \{R,P\}} \left[\gamma_i \ln\left(\frac{\phi}{p}\right)\right] - (\eta_R + \eta_P)\left(\frac{\theta}{p} - w + \frac{\phi}{p}\right)$$

Instead, the social planner would choose a formal policy with $t^* = \frac{\gamma_R + \gamma_P}{W_R + W_P}$. Indeed, the social planner maximizes

$$\max_t V(t) = \begin{cases} \gamma_R \ln\left(\frac{\phi}{p}\right) + \gamma_P \ln\left(\frac{\phi}{p}\right) - t(W_P + W_R) \\ \qquad -(\eta_R + \eta_P)\left(\frac{\theta}{p} - w + \frac{\phi}{p} - t(W_R + W_P)\right) & \text{if } \frac{\phi}{p} \geq t(W_R + W_P) \\ \gamma_R \ln(t(W_R + W_P)) + \gamma_P \ln(t(W_R + W_P)) \\ \qquad -t(W_P + W_R) - (\eta_R + \eta_P)\left(\frac{\theta}{p} - w\right) & \text{if } \frac{\phi}{p} \leq t(W_R + W_P) \end{cases}$$

The derivative of the first part with respect to t is $\frac{\partial V(t)}{\partial t} = (\eta_R + \eta_P)(W_R + W_P) - (W_P + W_R) > 0$ since $\eta_R + \eta_P > 1$. It is therefore optimal to increase tax until $t(W_R + W_P) = \frac{\phi}{p}$. The second part is maximized at $t^* = \frac{\gamma_R + \gamma_P}{W_R + W_P}$ as the first-order condition is the same as in the proof of Lemma 2. It is therefore optimal to set $t = \max\left\{\frac{\gamma_R + \gamma_P}{W_R + W_P}, \frac{\frac{\phi}{p}}{W_R + W_P},\right\}$.

When $\gamma_R + \gamma_P \geq \frac{\phi}{p}$, the resulting social welfare is therefore:

$$V_R(t^*) + V_P(t^*) = \sum_{i \in \{R,P\}} \left[\gamma_i \ln(\gamma_R + \gamma_P) - \left(\frac{\gamma_R + \gamma_P}{W_R + W_P}\right) W_i\right] - (\eta_R + \eta_P)\left(\frac{\theta}{p} - w\right)$$

Comparing the two expressions, social welfare is strictly higher under the social planner since:

$$\sum_{i \in \{R,P\}} \left[\gamma_i \ln(\gamma_R + \gamma_P) - \left(\frac{\gamma_R + \gamma_P}{W_R + W_P}\right) W_i\right] - (\eta_R + \eta_P)\left(\frac{\theta}{p} - w\right)$$
$$> \sum_{i \in \{R,P\}} \left[\gamma_i \ln\left(\frac{\phi}{p}\right)\right] - (\eta_R + \eta_P)\left(\frac{\theta}{p} - w + \frac{\phi}{p}\right)$$
$$\Leftrightarrow \quad (\gamma_P + \gamma_R) \ln(\gamma_R + \gamma_P) - (\gamma_R + \gamma_P) > (\gamma_P + \gamma_R) \ln\left(\frac{\phi}{p}\right) - (\eta_R + \eta_P)\frac{\phi}{p}$$

This holds as $(\gamma_P + \gamma_R) \ln(\gamma_R + \gamma_P) - (\gamma_R + \gamma_P) > (\gamma_P + \gamma_R) \ln\left(\frac{\phi}{p}\right) - \frac{\phi}{p} > (\gamma_P + \gamma_R) \ln\left(\frac{\phi}{p}\right) - (\eta_R + \eta_P)\frac{\phi}{p}$, where the first inequality follows from the fact that $t^* = \frac{\gamma_R + \gamma_P}{W_R + W_P}$ maximizes $(\gamma_P + \gamma_R) \ln(t(W_R + W_P)) - t(W_R + W_P)$ and the second inequality from the fact that $\eta_R + \eta_P > 1$.

Finally, when $\gamma_R + \gamma_P < \frac{\phi}{p}$, the social planner chooses $t = \frac{\frac{\phi}{p}}{W_R + W_P}$. The social welfare is then:

$$V_R(t^*) + V_P(t^*) = \sum_{i \in \{R,P\}} \left[\gamma_i \ln\left(\frac{\phi}{p}\right) - \frac{\frac{\phi}{p}}{W_R + W_P} W_i \right] - (\eta_R + \eta_P)\left(\frac{\theta}{p} - w\right)$$

This is also greater than social welfare under the politician since: $V_R(t^*) + V_P(t^*) = (\gamma_P + \gamma_R)\ln\left(\frac{\phi}{p}\right) - \frac{\phi}{p} > (\gamma_P + \gamma_R)\ln\left(\frac{\phi}{p}\right) - (\eta_R + \eta_P)\frac{\phi}{p}$ as $\eta_R + \eta_P > 1$. □

A.2 Micro-founding career concerns

A.2.1 Model

We augment the baseline model to introduce an explicit career concerns game between the bureaucrat and a superior who receives a noisy signal of the bureaucrat's performance. We show that the problem solved by the bureaucrat in this augmented model is equivalent to the one solved by the bureaucrat in the baseline model.

Suppose that there are two types of bureaucrats: low ability $\omega = 0$ and high ability $\omega = 1$. The amount of services y is equal to $y = \omega(e + \tau)$. That is, low-ability bureaucrats are not able to convert taxes or their own funding into a productive public service, while high-ability ones always do. As is standard in models of career concerns (Holmström, 1999), we assume that neither the bureaucrat nor his superior knows the bureaucrat's ability. Instead, both share a prior that the bureaucrat is high ability with probability $\mu \in (0, 1)$.

There are two periods. In the first period, the bureaucrat chooses a level of bribes, b, and an amount to redistribute, e, as in the baseline model. At the end of the first period, the superior receives a noisy signal s of the bureaucrat's performance, described below, and updates her beliefs about the bureaucrat's type. The superior then decides whether to promote the bureaucrat or promote another randomly selected bureaucrat. In the second period, the promoted bureaucrat again chooses b and e.

The superior receives a payoff equal to the amount of public services delivered by the bureaucrat, y, in each period. For simplicity, assume that she does not discount future periods. Indexing all variables by the corresponding time period, her inter-temporal utility is:

$$V = \sum_{t=1}^{t=2} \mathbb{P}(\omega_t = 1) \times (\tau_t + e_t) + \mathbb{P}(\omega_t = 0) \times 0 \tag{14}$$

The bureaucrat receives the same payoff as in the baseline function except for two differences: (1) he receives no direct payoff from public service delivery and (2) he receives a reward T in the second period if and only if he gets promoted.[24] Assume therefore that the bureaucrat's payoff is:

$$\begin{aligned} U = {} & H(w + b_1 - e_1) - pb_1 + \mathbb{P}(\text{promoted})(T + H(w + b_2 - e_2) - pb_2) \\ & + \mathbb{P}(\text{not promoted})(H(w + b_2 - e_2) - pb_2) \end{aligned} \tag{15}$$

We want to show that the expected payoff from the second period can be expressed a concave function of the first-period public service delivery multiplied by a parameter capturing the observability of public services, thus recovering the function in the baseline model.

We now turn to the signal received by the superior. Let $\bar{y}$ denote the need for public services faced by the population. This represents for example the severity of a flood (and the need for relief), the lack of food (and the need for food banks), the logistics needed for a supervisor visit, or the level of crime (and the need for patrolling). At the time of choosing e and b, the bureaucrat does not know $\bar{y}$ perfectly. However, he observes a noisy signal of $\bar{y}$ and updates his beliefs about the need. We assume that the posterior belief following this signal is that the level of need follows a half-normal distribution (a standard normal distribution truncated from below at 0) with scale parameter σ_B: $\bar{y} \sim \mathcal{F}$ on $[0, +\infty)$.

The superior receives a signal about whether the needs of the population were met. However, this signal is noisy and does not perfectly reveal this. In particular, her signal $s \in \{0, 1\}$ is generated as follows:

$$s = \begin{cases} 1 & \text{w.p. } \phi \text{ if } y \geq \bar{y} \\ 0 & \text{w.p. } 1 - \phi \text{ if } y \geq \bar{y} \\ 0 & \text{w.p. } 1 \text{ if } y < \bar{y} \end{cases}$$

[24] In this model, promotion does not change the set of tasks of the bureaucrat but simply allows him to receive a fixed reward. Similar results could be obtained by assuming that the bureaucrat gets fired and loses her wage if the superior believes she is more likely to be a low type than a randomly selected replacement.

That is, while the signal perfectly reveals that the needs were not met, it only reveals that the needs were met with some probability ϕ. The easier it is to observe successful public service delivery, the higher ϕ, the more precise the signal is.

A.2.2 Results

We solve for the weak perfect Bayesian equilibrium of this game.

Superior's decision. Given expression (14), the superior only gets a positive payoff in the second period if she promotes a high-ability type. The superior therefore promotes the bureaucrat if and only if her posterior belief that the bureaucrat is high ability is higher than her prior (which is the probability that the randomly selected replacement is high ability). That is, the superior promotes the bureaucrat if and only if:

$$\mathbb{P}(\omega = 1|s) \geq \mu$$

The superior's posterior belief can be derived using Bayes' rule and her belief about the level of public services needed. We assume that her prior about the level of need is that it follows a half-normal distribution with scale parameter σ: $\bar{y} \sim \mathcal{F}$ on $[0, +\infty)$.

Following a favourable signal $s = 1$, her posterior is:

$$\begin{aligned}
\mathbb{P}(\omega = 1|s = 1) &= \frac{\mathbb{P}(s = 1|\omega = 1)\mu}{\mathbb{P}(s = 1|\omega = 1)\mu + \mathbb{P}(s = 1|\omega = 0)(1 - \mu)} \\
&= \frac{\phi\mathbb{P}(\tau + e^* \geq \bar{y})\mu}{\phi\mathbb{P}(\tau + e^* \geq \bar{y})\mu + \phi\mathbb{P}(0 \geq \bar{y})(1 - \mu)} \\
&= \frac{\Phi\mathcal{F}(\tau + e^*)\mu}{\Phi\mathcal{F}(\tau + e^*)\mu + \mathcal{F}(0)(1 - \mu)} = 1
\end{aligned}$$

Since $\mathcal{F}(0) = 0$, where $\mathcal{F}$ denotes the CDF of the half-normal distribution and e^* is the equilibrium funding chosen by the bureaucrat.

Following an unfavourable signal $s = 0$, her posterior is:

$$\begin{aligned}
\mathbb{P}(\omega = 1|s = 0) &= \frac{\mathbb{P}(s = 0|\omega = 1)\mu}{\mathbb{P}(s = 0|\omega = 1)\mu + \mathbb{P}(s = 0|\omega = 0)(1-\mu)} \\
&= \frac{((1-\phi)\mathbb{P}(\tau + e^* \geq \bar{y}) + \mathbb{P}(\tau + e^* < \bar{y}))\mu}{((1-\phi)\mathbb{P}(\tau + e^* \geq \bar{y}) + \mathbb{P}(\tau + e^* < \bar{y}))\mu + ((1-\phi)\mathbb{P}(0 \geq \bar{y}) + \mathbb{P}(0 < \bar{y}))(1-\mu)} \\
&= \frac{\left((1-\phi)\mathcal{F}(\tau + e^*) + 1 - \mathcal{F}(\tau + e^*)\right)\mu}{\left((1-\phi)\mathcal{F}(\tau + e^*) + 1 - \mathcal{F}(\tau + e^*)\right)\mu + \left((1-\phi)\mathcal{F}(0) + 1 - \mathcal{F}(0)\right)(1-\mu)} \\
&= \frac{\left(1 - \phi\mathcal{F}(\tau + e^*)\right)\mu}{\left(1 - \phi\mathcal{F}(\tau + e^*)\right)\mu + (1-\mu)}
\end{aligned}$$

Finally, note that:

$$\mathbb{P}(\omega = 1|s = 1) = 1 > \mu$$

While,

$$\mathbb{P}(\omega = 1|s = 0) = \frac{1}{1 + \frac{1-\mu}{\left(1-\phi\mathcal{F}(\tau+e^*)\right)\mu}} < \mu \Leftrightarrow 0 < \mathcal{F}(\tau + e^*)$$

Which holds as long as $\tau + e^* > 0$.

As a result, if $\tau + e^* > 0$, the superior promotes the bureaucrat if and only she receives a signal $s = 1$.

Bureaucrat's decision. In the second period, the bureaucrat does not care about public service delivery directly and therefore optimally sets $e_2 = 0$. The first-order condition over bribes then gives $b_2 = h^{-1}(p) - w$. His second-period payoff are therefore: $H(h^{-1}(p)) - p(h^{-1}(p) - w)$ if he does not get promoted and $T + H(h^{-1}(p)) - p(h^{-1}(p) - w)$ if he gets promoted.

Given that the superior only promotes the bureaucrat if $s = 1$, the bureaucrat receives the promotion reward T with probability ϕ if $y \geq \bar{y}$ and with probability 0 if $y < \bar{y}$. Her first-period maximization problem is therefore:

$$\begin{aligned}
&\max_{e_1, b_1} \quad H(w + b_1 - e_1) - pb_1 + \mu\phi\mathbb{P}(\tau + e_1 \geq \bar{y})\left(T + H(h^{-1}(p)) - p(h^{-1}(p) - w)\right) \\
&\qquad\qquad + (1 - \mu\phi\mathbb{P}(\tau + e_1 \geq \bar{y}))\left(H(h^{-1}(p)) - p(h^{-1}(p) - w)\right) \\
\Leftrightarrow &\max_{e_1, b_1} \quad H(w + b_1 - e_1) - pb_1 + \phi\mu\mathbb{P}(\tau + e_1 \geq \bar{y})T + H(h^{-1}(p)) - p(h^{-1}(p) - w)
\end{aligned}$$

Finally, note that

$$\mathbb{P}(\tau + e_1 \geq \bar{y}) = \mathcal{F}(\tau + e_1)$$

Since $\tau + e_1 \geq 0$, it is in the support of the half-normal distribution whose CDF that is everywhere concave.

Therefore, by defining $F(y) = \mu\mathcal{F}(y)T$, we have that the bureaucrat solves:

$$\max_{e_1,b_1} H(w + b_1 - e_1) - pb_1 + \phi F(\tau + e_1) + H(h^{-1}(p)) - p(h^{-1}(p) - w)$$

where $F(\tau+e_1)$ is an increasing and strictly concave function and ϕ is a parameter capturing the observability of the public service delivery. This is therefore the same as the baseline problem up to a constant $H(h^{-1}(p)) - p(h^{-1}(p) - w)$ (which is irrelevant to the bureaucrat's decision).

A.3 Results for high monitoring: $p \geq h(w)$

We begin with the bureaucrat's best response. If $p \geq h(w)$, then it is possible for the bureaucrat to prefer not to take any bribes, even when he wants to redistribute some positive amount. In this case, he therefore redistributes funds that come solely from her official income, w.

Lemma 3. *If monitoring is high ($p \geq h(w)$), the bureaucrat only takes bribes if taxes are sufficiently low. Depending on the level of taxes, he either redistributes some of the bribes, redistributes part of his wage, or does not redistribute at all:*

$$e^*(\tau) = \begin{cases} f^{-1}\left(\frac{p}{\phi}\right) - \tau & \text{if } \tau < f^{-1}\left(\frac{p}{\phi}\right) - (w - h^{-1}(p)) \\ \hat{e}(\tau) \in (0, w) & \text{if } \tau \in \left[f^{-1}\left(\frac{p}{\phi}\right) - (w - h^{-1}(p)), f^{-1}\left(\frac{h(w)}{\phi}\right)\right] \\ 0 & \text{if } \tau \geq f^{-1}\left(\frac{h(w)}{\phi}\right) \end{cases}$$

$$b^*(\tau) = \begin{cases} h^{-1}\left(p\right) - w + e^*(\tau) & \text{if } \tau < f^{-1}\left(\frac{p}{\phi}\right) - (w - h^{-1}(p)) \\ 0 & \text{if } \tau \geq f^{-1}\left(\frac{p}{\phi}\right) - (w - h^{-1}(p)) \end{cases}$$

Where $\hat{e}(\tau)$ solves $h(w - e) = \phi f(e + \tau)$.

Proof of Lemma 3. Suppose that $w \geq h^{-1}(p)$.

Unconstrained problem: as in the proof of Lemma 1, the solutions to the unconstrained problem are:

$$e_u^* = f^{-1}\left(\frac{p}{\phi}\right) - \tau$$
$$b_u^* = h^{-1}(p) - w + e_u^*$$

The difference with Lemma 1 is that since $w \geq h^{-1}(p)$, the optimal bribe now hits the non-negativity constraint before the optimal contribution e_u^* does. If $\tau < f^{-1}\left(\frac{p}{\phi}\right) - [w - h^{-1}(p)]$, then $b_u^* = h^{-1}(p) - w + e_u^* = f^{-1}\left(\frac{p}{\phi}\right) - [w - h^{-1}(p)] - \tau > 0$. Moreover, $e_u^* \leq w + b^* = h^{-1}(p) + e_u^*$. Therefore in this case, the solution to the unconstrained problem is interior.

No bribes. Unlike in Lemma 1, it is now possible to have $\tau \geq f^{-1}\left(\frac{p}{\phi}\right) - [w - h^{-1}(p)]$ even when $e_u^* = f^{-1}\left(\frac{p}{\phi}\right) - \tau > 0$. If this inequality holds, then $b_u^* = h^{-1}(p) - w + e_u^* = f^{-1}\left(\frac{p}{\phi}\right) - [w - h^{-1}(p)] - \tau \leq 0$, so the non-negativity constraints on bribes binds and the optimal level of bribes is $b^* = 0$. The problem now becomes:

$$\max_{e} \quad U(e) = H(w - e) + \phi F(\tau + e) \quad \text{s.t.} \quad 0 \leq e \leq w$$

The first-order condition then gives:

$$h(w - e) = \phi f(\tau + e)$$

Let $\hat{e}$ solve $h(w - \hat{e}) = \phi f(\tau + \hat{e})$. The second-order condition is satisfied as $h'(w - e) + \phi f'(\tau + e) < 0$, $\forall \tau, e$. For a solution to exist, we need to confirm two more conditions.

First, we need to check that, when the bureaucrat funding is $\hat{e}$, the bureaucrat does not want to obtain bribes. We showed that the optimal bribe is $b^* = 0$ given bureaucrat funding of $e^* = f^{-1}\left(\frac{p}{\phi}\right) - \tau$. Given a bribe of $b^* = 0$, we showed that the optimal level of bureaucrat funding solves $h(w - e) = \phi f(\tau + e)$. However, we also need to confirm that given bureaucrat funding $\hat{e}$, the optimal bribe is $b^* = 0$.

To see this, note that the optimal level of bribe from the unconstrained problem solves $h(w + b - e) - p = 0$. Second, note that $\hat{e} < e_u^* = f^{-1}\left(\frac{p}{\phi}\right) - \tau$. This is because $\hat{e}$ solves $\phi f(\tau + e) - h(w - e) = 0$ while $e_u^* = f^{-1}\left(\frac{p}{\phi}\right) - \tau$ solves $\phi f(\tau + e) - h(w - e + b) = 0$ so the marginal cost of increasing $\hat{e}$ is higher than the marginal cost of increasing e_u^* $(h(w - e) > h(w - e + b))$ while the marginal benefit is the same.

Combining these two observations, the marginal benefit of increasing bribes, $h(w + b - e)$, is lower when $e = \hat{e}$ than when $e = e_u^* = f^{-1}\left(\frac{p}{\phi}\right) - \tau$: $\hat{e} < e_u^* \Leftrightarrow -\hat{e} > -e_u^* \Leftrightarrow h(w + b - \hat{e}) < h(w + b - e_u^*)$ (since $h(\cdot)$ is decreasing). And since, the marginal benefit of obtaining bribes at $e = e_u^*$ was lower than the marginal cost (so $b = 0$) then this is also true when $e = \hat{e}$, so $b^* = 0$ is indeed optimal when $e = \hat{e}$.

Second, we need to confirm that $\hat{e} < w$. Since $\lim_{e \to w} h(w - e) = \lim_{x \to 0} h(x) = +\infty$, while $\lim_{e \to w} \phi f(e + \tau) = \phi f(w + \tau) < +\infty$, then there must exist some $e < w$ such that the marginal cost of increasing funding ($h(w - e)$) is strictly higher than the marginal benefit $\phi f(e + \tau)$. Therefore, the point at which the marginal benefit equals the marginal cost, $\hat{e}$, must also be less than w.

Finally, we derive conditions for the solution $\hat{e}$ to be interior, that is, when $\hat{e} > 0$ vs. when $\hat{e} \leq 0$. $\hat{e} \leq 0$ happens when the marginal benefit of bureaucrat funding is lower than the marginal cost at any level of bureaucrat funding and in the absence of bribes: $\phi f(\tau + e) < h(w - e)$, $\forall e \in (0, w]$. Since the left-hand side is strictly decreasing in e for any e and the right-hand side is strictly increasing in e for any e, then the inequality can hold only if it holds weakly at $e = 0$. That is, if $\phi f(\tau) \leq h(w)$, or equivalently $\tau \leq f^{-1}\left(\frac{h(w)}{\phi}\right)$.

Thus, we conclude that:

1. If $\tau < f^{-1}\left(\frac{p}{\phi}\right) - [w - h^{-1}(p)]$, then $e^*(\tau) = f^{-1}\left(\frac{p}{\phi}\right) - \tau$ and $b^*(\tau) = h^{-1}(p) - w + e^*(\tau)$.
2. If $f^{-1}\left(\frac{p}{\phi}\right) - [w - h^{-1}(p)] \leq \tau < f^{-1}\left(\frac{h(w)}{\phi}\right)$, then $e^*(\tau) = \hat{e}$ and $b^*(\tau) = 0$.
3. If $\tau \geq f^{-1}\left(\frac{h(w)}{\phi}\right)$, then $e^*(\tau) = b^*(\tau) = 0$.

□

We now turn to the politician's optimal choice of tax. For this part, we make the following assumption:

Assumption 1. *We assume that $h'(\cdot)$ and $f'(\cdot)$ are both increasing and that $\frac{h'(w - \hat{e}(\tau))}{\phi f'(\hat{e}(\tau) + \tau)}$ is decreasing for all $\tau \in [0, +\infty)$.*

Since $\hat{e}$ is the solution to $h(w - e) = \phi f(\tau + e)$, the last assumption is only an assumption on the shape of $h(\cdot)$, $f(\cdot)$ and the parameters w and ϕ.

Next we define the following thresholds: Recall that $\bar{\tau} = g^{-1}(1)$ is the amount of tax that maximizes the politician's payoff under a formal system and $\hat{e}$ is the optimal amount of funding from the bureaucrat when he does not take bribes and taxes are low enough. Finally, let $\hat{\tau}$ be the optimal amount of tax when the bureaucrat does not take bribes and redistributes $\hat{e}(\tau)$. This value and its properties are defined formally in Lemma 5 below.

Definition 1. *Let*

1. $\bar{\phi}_1$ *be the value of* ϕ *which solves* $G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \eta f^{-1}\left(\frac{p}{\phi}\right) = G(\bar{\tau}) - \bar{\tau}$;
2. $\bar{\phi}_2$ *be the value of* ϕ *which solves* $G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right] = G(\bar{\tau}) - \bar{\tau}$;
3. $\bar{\phi}_3$ *be the value of* ϕ *which solves* $G(\hat{e}(\hat{\tau}) + \hat{\tau}) - \hat{\tau} = G(\bar{\tau}) - \bar{\tau}$.
4. $\bar{\phi}_4$ *be the value of* ϕ *which solves* $\phi = \frac{h(w)}{f(\hat{\tau})}$.

In the proof of the next proposition, we derive conditions for these thresholds to be well-defined.

Proposition 4. *Suppose that* $p \geq h(w)$ *and that assumption 1 is satisfied, then:*

- *If* $\eta < 1$, *the politician chooses an informal policy if* $\phi > \max\{\bar{\phi}_1, \bar{\phi}_2, \bar{\phi}_3\}$ *and a formal policy if* $\phi \leq \min\{\bar{\phi}_1, \bar{\phi}_2\}$.
- *If* $\eta \geq 1$, *the politician chooses an informal policy if* $\phi > \max\{\bar{\phi}_2, \bar{\phi}_3, \bar{\phi}_4\}$ *and a formal policy if* $\phi \leq \min\{\bar{\phi}_1, \bar{\phi}_2\}$.

Proof. Using Lemma, 1 we can substitute the bureaucrat's best-response into the politician's problem. The problem becomes:

$$\max_{\tau \in [0,+\infty)} V(\tau) = \begin{cases} G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \tau & \\ \quad -\eta\left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right) - \tau\right] & \text{if } \tau < h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right) \\ G(\hat{e}(\tau) + \tau) - \tau & \text{if } h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right) \leq \tau < f^{-1}\left(\frac{h(w)}{\phi}\right) \\ G(\tau) - \tau & \text{if } \tau \geq f^{-1}\left(\frac{h(w)}{\phi}\right) \end{cases}$$

We organise the proof as follows: we first solve for the optimal tax level on each of the three parts of the payoff function. We then compare the maximum achievable payoff across the three parts.

1. Low tax: $\tau < h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$**:**

Lemma 4. *If $\tau < h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$, the optimal tax is $\tau = 0$ if $\eta < 1$ and $\tau = h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$ if $\eta \geq 1$.*

Proof. The proof is the same as in Proposition 1. Since $\frac{\partial V(\tau)}{\partial \tau} = \eta - 1$ on that range, then $V(\tau)$ is decreasing everywhere on $\tau \in [0, h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)]$ if $\eta < 1$ and increasing everywhere if $\eta \geq 1$. □

2. Intermediate tax: $\tau \in \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right), f^{-1}\left(\frac{h(w)}{\phi}\right)\right)$**:**

In the middle range, the first-order condition gives: $g(\hat{e}(\tau) + \tau) \times \left(\frac{\partial \hat{e}(\tau)}{\partial \tau} + 1\right) - 1 = 0$. We first show that a solution to this equation exists for $\tau \in [0, +\infty)$. We then solve for the optimal tax rate when the tax is restricted to $\tau \in \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right), f^{-1}\left(\frac{h(w)}{\phi}\right)\right)$. This depends on whether the global maximizer to the function falls within this interval or not and therefore whether the solution is interior or at a corner.

Let $\hat{e}_0 = \lim_{\tau \to 0} \hat{e}(\tau)$ and $\hat{e}'_0 = \lim_{\tau \to 0} \frac{\partial \hat{e}(\tau)}{\partial \tau}$.

Lemma 5. *Suppose that assumption 1 is satisfied so $\frac{\partial \frac{h'(w - \hat{e}(\tau))}{\phi f'(\hat{e}(\tau) + \tau)}}{\partial \tau} < 0$. If $g(\hat{e}_0)(\hat{e}'_0 + 1) \geq 1$, then there exists $\hat{\tau} \in [0, +\infty)$ such that $W(\hat{\tau}) = g(\hat{e}(\hat{\tau}) + \hat{\tau}) \times \left(\left.\frac{\partial \hat{e}(\tau)}{\partial \tau}\right|_{\tau = \hat{\tau}} + 1\right) = 1$. If $g(\hat{e}_0)(\hat{e}'_0 + 1) < 1$, then $W(\tau) = g(\hat{e}(\tau) + \tau) \times \left(\frac{\partial \hat{e}(\tau)}{\partial \tau} + 1\right) < 1, \ \forall \tau \in [0, +\infty)$.*

Proof. If $g(\hat{e}_0)(\hat{e}'_0 + 1) = 1$, then $\hat{\tau} = 0$ trivially solves $W(\tau) = 1$ (since $W(\tau)$ is continuous at $\tau = 0$). We then consider the two other possible cases separately.

1. Suppose first that $g(\hat{e}_0)(\hat{e}'_0 + 1) > 1$. We show that the intermediate value theorem applies as $W(\tau) := g(\hat{e}(\tau) + \tau) \times \left(\frac{\partial \hat{e}(\tau)}{\partial \tau} + 1\right)$ is continuous and decreasing, $\lim_{\tau \to 0} W(\tau) > 1$ and $\lim_{\tau \to +\infty} W(\tau) < 1$.

   First note that $g(\cdot)$ is continuous and decreasing by definition. Second, note that $\frac{\partial \hat{e}(\tau)}{\partial \tau}$ is also continuous and decreasing as long as $\frac{\partial \frac{h'(w - \hat{e}(\tau))}{\phi f'(\hat{e}(\tau) + \tau)}}{\partial \tau} < 0$. Totally differentiating the condition defining $\hat{e}(\tau)$ gives:

$$\begin{aligned}
&\frac{d}{d\tau} h(W - \hat{e}(\tau)) = \frac{d}{d\tau} \phi f'(\hat{e}(\tau) + \tau) \\
\Leftrightarrow\, &h'(w - \hat{e}(\tau)) \left(-\frac{\partial \hat{e}(\tau)}{\partial \tau}\right) = \phi f'(\hat{e}(\tau) + \tau) \left(\frac{\partial \hat{e}(\tau)}{\partial \tau} + 1\right) \\
\Leftrightarrow\, &\frac{\partial \hat{e}(\tau)}{\partial \tau} = \frac{-\phi f'(\hat{e}(\tau) + \tau)}{\phi f'(\hat{e}(\tau) + \tau) + h'(w - \hat{e}(\tau))}
\end{aligned}$$

Since both $f'(\cdot)$ and $h'(\cdot)$ are continuous, then $\frac{\partial \hat{e}(\tau)}{\partial \tau}$ is continuous. In addition, this derivative can be re-arranged as $\frac{\partial \hat{e}(\tau)}{\partial \tau} = \frac{-1}{1+\frac{h'(w-\hat{e}(\tau))}{\phi f'(\hat{e}(\tau)+\tau)}}$, which is decreasing whenever $\frac{\partial \frac{h'(w-\hat{e}(\tau))}{\phi f'(\hat{e}(\tau)+\tau)}}{\partial \tau} < 0$. Therefore, the product of the two functions: $W(\tau) := g(\hat{e}(\tau)+\tau) \times \left(\frac{\partial \hat{e}(\tau)}{\partial \tau}+1\right)$ is continuous and decreasing.

Second, note that $\lim_{\tau \to +\infty} W(\tau) = 0 < 1$. This is because, $\lim_{\tau \to +\infty} g(\hat{e}(\tau)+\tau) = 0$ (since $\lim_{\tau \to +\infty} \hat{e}(\tau) + \tau = +\infty$) and $\lim_{\tau \to +\infty} \frac{\partial \hat{e}(\tau)}{\partial \tau} = \lim_{\tau \to +\infty} \frac{-1}{1+\frac{h'(w-\hat{e}(\tau))}{\phi f'(\hat{e}(\tau)+\tau)}} = 0$ since $\lim_{\tau \to +\infty} h'(w-\hat{e}(\tau)) = h'(w)$ and $\lim_{\tau \to +\infty} \phi f'(\hat{e}(\tau)+\tau) = 0$ (as $\lim_{\tau \to +\infty} \hat{e}(\tau) = 0$).

Therefore, if $g(\hat{e}_0)(\hat{e}_0'+1) > 1$ then by the intermediate value theorem, there exists $\hat{\tau} \in [0, +\infty)$ such that $W(\hat{\tau}) = g(\hat{e}(\hat{\tau})+\hat{\tau}) \times \left(\left.\frac{\partial \hat{e}(\tau)}{\partial \tau}\right|_{\tau=\hat{\tau}}+1\right) = 1$.

Finally, we note that it is possible to have $g(\hat{e}_0)(\hat{e}_0'+1) := \lim_{\tau \to 0} W(\tau) > 1$. As $\tau \to 0$, $\hat{e}$ tends to some finite value $\hat{e}_0 < w$ that solves $h(w-\hat{e}_0) = \phi f(\hat{e}_0)$. Moreover, as $\tau \to 0$, $\frac{\partial \hat{e}(\tau)}{\partial \tau}$ also tends to some finite value equal to $\frac{-1}{1+\frac{h'(w-\hat{e}_0)}{\phi f'(\hat{e}_0)}}$. Therefore, the condition $g(\hat{e}_0)(\hat{e}_0'+1)$ also tends to some finite value which can be strictly greater than 1 for some parameter values.

2. Suppose now that $g(\hat{e}_0)(\hat{e}_0'+1) < 1$, then $\lim_{\tau \to 0} W(\tau) < 1$ and $W(\tau)$ is decreasing everywhere for $\tau > 0$ given $\frac{\partial \frac{h'(w-\hat{e}(\tau))}{\phi f'(\hat{e}(\tau)+\tau)}}{\partial \tau} < 0$. As a result, $g(\hat{e}(\tau)+\tau) \times \left(\frac{\partial \hat{e}(\tau)}{\partial \tau}+1\right) < 1, \ \forall \tau \in [0, +\infty)$.

□

Lemma 6. *If $g(\hat{e}_0)(\hat{e}_0'+1) < 1$, then the payoff function is maximized at $\tau = h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$ on the interval $\left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right), f^{-1}\left(\frac{h(w)}{\phi}\right)\right]$. If $g(\hat{e}_0)(\hat{e}_0'+1) \geq 1$, the payoff function on the interval $\left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right), f^{-1}\left(\frac{h(w)}{\phi}\right)\right]$ is maximized at:*

1. *$\tau = h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$ if $\hat{\tau} \leq h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$.*
2. *$\tau = \hat{\tau}$ if $\hat{\tau} \in \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right), f^{-1}\left(\frac{h(w)}{\phi}\right)\right]$.*
3. *$\tau = f^{-1}\left(\frac{h(w)}{\phi}\right)$ if $\hat{\tau} \geq f^{-1}\left(\frac{h(w)}{\phi}\right)$.*

Proof. If $g(\hat{e}_0)(\hat{e}_0'+1) < 1$ or if $g(\hat{e}_0)(\hat{e}_0'+1) \geq 1$ but $\hat{\tau} \leq h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$, then the payoff function is decreasing everywhere on $\tau \in \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right), f^{-1}\left(\frac{h(w)}{\phi}\right)\right]$. So the solution is a corner solution and it is optimal to choose the lowest tax on this interval: $\tau = h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$.

If $g(\hat{e}_0)(\hat{e}'_0 + 1) \geq 1$ and $\hat{\tau} \in \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right), f^{-1}\left(\frac{h(w)}{\phi}\right)\right]$, then the maximizer $\hat{\tau}$ is within the interval, so the solution is interior and it is optimal to choose $\tau = \hat{\tau}$.

If $g(\hat{e}_0)(\hat{e}'_0+1) \geq 1$ and $\hat{\tau} \geq f^{-1}\left(\frac{h(w)}{\phi}\right)$, then the payoff function is increasing everywhere on $\tau \in \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right), f^{-1}\left(\frac{h(w)}{\phi}\right)\right]$. So it is optimal to keep increasing the tax up to the upper bound of the interval: $\tau = f^{-1}\left(\frac{h(w)}{\phi}\right)$. □

3. High tax: $\tau \geq f^{-1}\left(\frac{h(w)}{\phi}\right)$**:**

Lemma 7. *If* $\tau \geq f^{-1}\left(\frac{h(w)}{\phi}\right)$*, the optimal tax is* $\tau^* = \max\{\bar{\tau}, f^{-1}\left(\frac{h(w)}{\phi}\right)\}$ *where* $\bar{\tau}$ *solves* $g(\bar{\tau}) = 1$.

Proof. This case is the same as the case of $\tau \geq f^{-1}\left(\frac{p}{\phi}\right)$ in the proof of Proposition 1. □

4. Comparing the maximum payoffs across the three segments:

Recall that we want to compare the maxima of the three separate parts of the following function:

$$V(\tau) = \begin{cases} G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \tau \\ \qquad -\eta\left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right) - \tau\right] & \text{if } \tau < h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right) \\ G(\hat{e}(\tau) + \tau) - \tau & \text{if } h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right) \leq \tau < f^{-1}\left(\frac{h(w)}{\phi}\right) \\ G(\tau) - \tau & \text{if } \tau \geq f^{-1}\left(\frac{h(w)}{\phi}\right) \end{cases}$$

CASE 1: suppose that $\eta < 1$**:**

In this case, the optimal tax for the first part is $\tau = 0$.

1. If $\bar{\tau} > f^{-1}\left(\frac{h(w)}{\phi}\right)$

   (a) If $\hat{\tau} < h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$, then the first two parts of the payoff functions are decreasing everywhere on their range, while the third part is maximised at $\bar{\tau}$. The optimal tax is therefore $\tau^* = 0$ if the maximum of the first part (at $\tau = 0$) is larger than the maximum of the third part (at $\tau = \bar{\tau}$):

$$G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \eta\left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right] > G(\bar{\tau}) - \bar{\tau} - \eta\left[h^{-1}(p) - w\right]$$
$$\Leftrightarrow \quad G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \eta f^{-1}\left(\frac{p}{\phi}\right) > G(\bar{\tau}) - \bar{\tau}$$

This is the same as condition (7), so the logic from the proof of Proposition 1 applies. The politician prefers an informal policy if $\phi > \bar{\phi}_1$ and the threshold $\bar{\phi}_1$ is well-defined.

(b) If $\hat{\tau} \in \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right), f^{-1}\left(\frac{h(w)}{\phi}\right)\right]$, then there are two potentially optimal informal policies: one with $\tau = 0$ where there are bribes which are fully redistributed, and one with $\tau = \hat{\tau}$ where there are no bribes and funding comes from the bureaucrat's wage.

If the informal policy with $\tau = 0$ is better than the one with $\tau = \hat{\tau}$, then the comparison between the formal and informal policies is the same as in the previous case. If instead, the informal policy with $\tau = \hat{\tau}$ is better than the one with $\tau = 0$ (that is, if $G(\hat{e}(\hat{\tau}) + \hat{\tau}) - \hat{\tau} > G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \eta\left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right]$), then the politician chooses the informal policy with $\tau = \hat{\tau}$ over the formal policy with $\tau = \bar{\tau}$ if:

$$G(\hat{e}(\hat{\tau}) + \hat{\tau}) - \hat{\tau} > G(\bar{\tau}) - \bar{\tau} \tag{16}$$

We now proceed to show that there exist two thresholds $\bar{\phi}_2$ and $\bar{\phi}_3$ such that, when $\hat{\tau} \in \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right), f^{-1}\left(\frac{h(w)}{\phi}\right)\right]$, an informal policy is preferred if $\phi \geq \max\{\bar{\phi}_2, \bar{\phi}_3\}$.

First, note that the left-hand side of inequality (16), $\hat{V}(\tau) = G(\hat{e}(\hat{\tau}) + \hat{\tau}) - \hat{\tau}$, is increasing in ϕ. Indeed, using first the envelop theorem, we have $\frac{d\hat{V}(\tau)}{d\phi} = \frac{\partial \hat{V}(\tau)}{\partial \tau}\frac{\partial \hat{\tau}}{\partial \phi} + \frac{\partial \hat{V}(\tau)}{\partial \phi} = \frac{\partial \hat{V}(\tau)}{\partial \phi}$. Second, using the fact that $\frac{\partial \hat{e}}{\partial \phi} > 0$ (since $\hat{e}$ solves $h(w - e) = \phi f(e + \tau)$), we can state that $\frac{\partial \hat{V}(\tau)}{\partial \phi} = \frac{\partial V(\tau)}{\partial \hat{e}}\frac{\partial \hat{e}}{\partial \phi} = g(\hat{e}(\tau) + \tau)\frac{\partial \hat{e}}{\partial \phi} > 0$. Instead, the right-hand side is independent of ϕ.

Next, note that as ϕ increases, the bounds of the interval, $h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$ and $f^{-1}\left(\frac{h(w)}{\phi}\right)$ both increase. In addition, as ϕ increases, $\hat{\tau}$ decreases: $\frac{\partial \hat{\tau}}{\partial \phi} < 0$. This is because $\hat{\tau}$ solves $g(\hat{e}(\tau) + \tau)\left(\frac{\partial \hat{e}(\tau)}{\partial \tau} + 1\right) = 1$ and $g(\hat{e}(\tau) + \tau)\left(\frac{\partial \hat{e}(\tau)}{\partial \tau} + 1\right)$ decreases in ϕ as: (1) $\hat{e}(\tau)$ increases in ϕ for every τ, as shown above, so $g(\hat{e}(\tau)+\tau)$ decreases in ϕ; and (2) $\frac{\partial \hat{e}(\tau)}{\partial \tau} = \frac{-1}{1+\frac{h'(w-\hat{e}(\tau))}{\phi f'(\hat{e}(\tau)+\tau)}}$ decreases in ϕ (both due to the direct effect of ϕ and the fact that ϕ increases $\hat{e}$ and both $h'(\cdot)$ and $f'(\cdot)$ are increasing (assumption 1). Therefore, as ϕ increases, $\hat{\tau}$ gets closer to the lower bound of the interval: $\hat{\tau} \rightarrow h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$, while as ϕ decreases, $\hat{\tau}$ gets closer to the upper bound of the interval: $\hat{\tau} \rightarrow f^{-1}\left(\frac{h(w)}{\phi}\right)$. Let ϕ^+ be the value of ϕ such that $\hat{\tau} = h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$ and ϕ^- be the value of ϕ such that $\hat{\tau} = f^{-1}\left(\frac{h(w)}{\phi}\right)$. This gives us bounds such that, when ϕ tends to one of those bounds, $\hat{\tau}$ tends to one of the bounds of the interval $\left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right), f^{-1}\left(\frac{h(w)}{\phi}\right)\right]$.

As $\phi \to \phi^-$, $V(\hat{\tau}) \to G\left(f^{-1}\left(\frac{h(w)}{\phi}\right)\right) - f^{-1}\left(\frac{h(w)}{\phi}\right)$ which is strictly less than $G(\bar{\tau}) - \bar{\tau}$ since $f^{-1}\left(\frac{h(w)}{\phi}\right) < \bar{\tau}$.

As $\phi \to \phi^+$,

$$\begin{aligned}
V(\hat{\tau}) \to\ & G\left(\hat{e}\left(h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right) + h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right) \\
& - \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right] \\
=\ & G\left(f^{-1}\left(\frac{p}{\phi}\right) - \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right] + \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right]\right) \\
& - \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right] \\
=\ & G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right] \qquad (17)
\end{aligned}$$

The first equality follows from the fact that $V(\tau)$ is continuous around $\tau = h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$, so we can replace it with the expression for $\tau \leq h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$.

Finally, expression (17), which is the limit of $V(\hat{\tau})$ as $\phi \to \phi^+$, is strictly greater than $G(\bar{\tau}) - \bar{\tau}$ as long as $\phi > \bar{\phi}_2$ for some threshold $\bar{\phi}_2$. Indeed, an increase in ϕ brings $f^{-1}\left(\frac{p}{\phi}\right)$ closer to $\bar{\tau}$. Therefore, as ϕ increases, $G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - f^{-1}\left(\frac{p}{\phi}\right) \to G(\bar{\tau}) - \bar{\tau}$. Moreover, as $h^{-1}(p) - w < 0$, $G(\bar{\tau}) - \bar{\tau} - (h^{-1}(p) - w) > G(\bar{\tau}) - \bar{\tau}$. Therefore, there exists $\bar{\phi}_2$ such that $G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right] > G(\bar{\tau}) - \bar{\tau}$ if $\phi > \bar{\phi}_2$.

Therefore, if $\phi > \bar{\phi}_2$, then we have:

i. $\lim_{\phi \to \phi^-} V(\hat{\tau}) < G(\bar{\tau}) - \bar{\tau}$

ii. $\lim_{\phi \to \phi^+} V(\hat{\tau}) > G(\bar{\tau}) - \bar{\tau}$

iii. $V(\hat{\tau})$ is increasing in ϕ.

so there exists $\bar{\phi}_3$ such that $V(\hat{\tau}) = G(\hat{e}(\hat{\tau}) + \hat{\tau}) - \hat{\tau} \geq G(\bar{\tau}) - \bar{\tau}$ if $\phi \geq \bar{\phi}_3$.

Thus, an informal policy is preferred when $\phi \geq \max\{\bar{\phi}_2, \bar{\phi}_3\}$. If $\phi \leq \bar{\phi}_2$, then $G(\hat{e}(\hat{\tau}) + \hat{\tau}) - \hat{\tau} < G(\bar{\tau}) - \bar{\tau}$ for any $\phi \in [0, \bar{\phi}_2]$, so a formal policy is preferred.

(c) If $\hat{\tau} \geq f^{-1}\left(\frac{h(w)}{\phi}\right)$, then the first part of the payoff function is decreasing everywhere, the intermediate part is increasing everywhere, and the last part is maximized at $\tau = \bar{\tau}$. Therefore, the politician would never choose a value of $\tau \in \left[\tau = h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right), f^{-1}\left(\frac{h(w)}{\phi}\right)\right]$. Instead, the politician compares the maximum payoff at $\tau = 0$ to that at $\tau = \bar{\tau}$ and the condition is the same as in case (a).

2. If $\bar{\tau} \leq f^{-1}\left(\frac{h(w)}{\phi}\right)$

   (a) If $\hat{\tau} < h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$, then all three parts of they payoff function are decreasing: the first part because $\eta < 1$, the second and third part because they are past their maximum. Therefore, the optimal tax is $\tau = 0$ and the politician always chooses an informal policy.

   (b) If $\hat{\tau} \in \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right), f^{-1}\left(\frac{h(w)}{\phi}\right)\right]$, then the first part is decreasing, the second is maximised at $\tau = \hat{\tau}$, and the third is decreasing everywhere as it is past its maximum. The only two candidates for a maximum are therefore $\tau = 0$ or $\tau = \hat{\tau}$. Both of them correspond to an informal policy, so the politician always chooses an informal policy.

   (c) It is not possible to have $\hat{\tau} \geq f^{-1}\left(\frac{h(w)}{\phi}\right)$ if $\bar{\tau} \leq f^{-1}\left(\frac{h(w)}{\phi}\right)$. This is because $\hat{\tau} \leq \bar{\tau}$ as $\bar{\tau}$ solves $g(\tau) = 1$, while $\hat{\tau}$ solves $g(\hat{e}(\tau) + \tau)\left(\frac{\partial \hat{e}(\tau)}{\partial \tau} + 1\right) = 1$ and since $g(\hat{e} + \tau) \leq g(\tau)$, $\forall \hat{e} \geq 0$ and $\left(\frac{\partial \hat{e}(\tau)}{\partial \tau} + 1\right) \leq 1$ since $\frac{\partial \hat{e}(\tau)}{\partial \tau} \leq 0$, so that $g(\hat{e}(\tau) + \tau)\left(\frac{\partial \hat{e}(\tau)}{\partial \tau} + 1\right) \leq g(\tau)$.

CASE 2: suppose that $\eta \geq 1$:

1. If $\bar{\tau} > f^{-1}\left(\frac{h(w)}{\phi}\right)$

   (a) If $\hat{\tau} < h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$, then the first part is increasing, the second is decreasing, and the third is maximised at $\tau = \bar{\tau}$. The maximum is therefore either at $\tau = h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$ or $\tau = \bar{\tau}$. The politician chooses an informal policy ($\tau = h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$), if:

$$\begin{aligned}
&G\left(f^{-1}\left(\frac{p}{\phi}\right) - \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right] + \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right]\right) \\
&\quad - \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right] \\
&\quad - \eta\left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right) - \left(h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right)\right] \\
&\quad \geq G(\bar{\tau}) - \bar{\tau} \\
\Leftrightarrow &G\left(f^{-1}\left(\frac{p}{\phi}\right)\right) - \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)\right] \geq G(\bar{\tau}) - \bar{\tau}
\end{aligned}$$

The left-hand side is expression (17) from CASE 1: 1.(b) above, and we have shown in that case that it is greater than the right-hand side, $G(\bar{\tau}) - \bar{\tau}$, if $\phi > \bar{\phi}_2$. Therefore, in this case, the politician prefers an informal policy if $\phi > \bar{\phi}_2$.

(b) If $\hat{\tau} \in \left[h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right), f^{-1}\left(\frac{h(w)}{\phi}\right)\right]$, then the first part is increasing, the second part is maximized at $\tau = \hat{\tau}$ and the third part is maximized at $\tau = \bar{\tau}$. Therefore, the two candidates for global maximizer are $\tau = \hat{\tau}$ and $\tau = \bar{\tau}$. The politician chooses an informal policy ($\tau = \hat{\tau}$) if:

$$G(\hat{e}(\hat{\tau}) + \hat{\tau}) - \hat{\tau} > G(\bar{\tau}) - \bar{\tau}$$

This is the same comparison as in CASE 1, 1.(b), so the politician also chooses an informal policy if $\phi \geq \max\{\bar{\phi}_2, \bar{\phi}_3\}$.

(c) If $\hat{\tau} \geq f^{-1}\left(\frac{h(w)}{\phi}\right)$, then the first part and second part of the function are increasing, while the third part is maximized at $\tau = \bar{\tau}$. Therefore in this case, the politician always chooses a formal policy with $\tau = \bar{\tau}$.

2. If $\bar{\tau} \leq f^{-1}\left(\frac{h(w)}{\phi}\right)$

(a) If $\hat{\tau} < h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$, the first part of the function is increasing, while the second and third parts are decreasing. The maximum is therefore attained at $\tau = h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right)$ where the first and second parts meet. In this case, the politician therefore always chooses an informal policy.

(b) If $\hat{\tau} \in \left[\tau = h^{-1}(p) - w + f^{-1}\left(\frac{p}{\phi}\right), f^{-1}\left(\frac{h(w)}{\phi}\right)\right]$, the first part is increasing, the second part is maximized at $\tau = \hat{\tau}$ and the third part is decreasing. The maximum is therefore attained at $\tau = \hat{\tau}$. In this case, the politician therefore always chooses an informal policy.

(c) As described above, it is not possible to have $\hat{\tau} \geq f^{-1}\left(\frac{h(w)}{\phi}\right)$ if $\bar{\tau} \leq f^{-1}\left(\frac{h(w)}{\phi}\right)$.

To conclude the proof, we therefore note that:

- If $\eta < 1$, then CASE 1 is relevant,

  1. If $\phi > \max\{\bar{\phi}_1, \bar{\phi}_2, \bar{\phi}_3\}$, then the politician prefers an informal policy in case 1.(a) (since $\phi > \bar{\phi}_1$)), in case 1.(b) (since $\phi > \max\{\bar{\phi}_2, \bar{\phi}_3\}$), in case 1.(c) (since $\phi > \bar{\phi}_1$), and in cases 2(a) and 2(b) (since she always prefers an informal policy then).
  2. If $\phi < \min\{\bar{\phi}_1, \bar{\phi}_2\}$, then the politician prefers a formal policy in case 1.(a) (since $\phi < \bar{\phi}_1$)), in case 1.(b) (since $\phi < \bar{\phi}_2$), in case 1.(c) (since $\phi < \bar{\phi}_1$). Cases 2(a) and 2(b) cannot occur then since $\bar{\phi}_1 < \frac{p}{f(\bar{\tau})}$ (from the proof of Proposition 1), so $\phi < \bar{\phi}_1 \Rightarrow \phi < \frac{p}{f(\bar{\tau})} \Rightarrow \bar{\tau} > f^{-1}\left(\frac{h(w)}{\phi}\right)$.

- If $\eta \geq 1$, then CASE 2 is relevant,

  1. If $\phi > \max\{\bar{\phi}_2, \bar{\phi}_3, \bar{\phi}_4\}$, then the politician prefers an informal policy in case 1.(a) (since $\phi > \bar{\phi}_2$)), in case 1.(b) (since $\phi > \max\{\bar{\phi}_2, \bar{\phi}_3\}$), and in cases 2(a) and 2(b) (since she always prefers an informal policy then). Case 1.(c) cannot occur since $\phi > \bar{\phi}_4$.
  2. If $\phi < \min\{\bar{\phi}_1, \bar{\phi}_2\}$, then the politician prefers a formal policy in case 1.(a) (since $\phi < \bar{\phi}_2$)), in case 1.(b) (since $\phi < \bar{\phi}_2$), and in case 1.(c) (since she always prefers a formal policy then). Cases in cases 2(a) and 2(b) cannot occur since $\phi < \bar{\phi}_1$.

□

Appendix: For online publication

A.4 Appendix Tables

Table A1: Funding gap for police patrolling in India

Monthly Petrol Accounting

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
Average Budget	107	627.1	868.4	0	2,083
Vehicle Liters Petrol	169	174.5	79.87	0	567.4
Vehicle Petrol Expenditure	169	13,257	6,069	0	43,115
Vehicle Budget Balance	102	-12,440	5,837	-30,180	0
Motorcycle Liters Petrol	175	31.13	28.30	0	266.7
Motorcycle Petrol Expenditure	175	2,366	2,150	0	20,264
Motorcycle Budget Balance	105	-1,621	1,721	-8,132	2,083
Combined Budget Balance	101	-14,845	6,526	-33,858	-4,685

Authors' calculation from survey data. Estimates assume petrol prices of 75.99 INR per liter, the minimum daily price in Madhya Pradesh during November, 2018. Vehicle fuel mileage estimated at dealer-reported figure of 14.1 kilometers per liter for Tata Safari Storme. Motorcycle fuel mileage estimated at 60 kilometers per liter. Missing budget figures are due to non-reporting during survey interviews.

Table A2: Funding gap for police patrolling in India (treating missing values as zeros)

Monthly Petrol Accounting

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
Average Budget	180	372.8	736.2	0	2,083
Vehicle Liters Petrol	169	174.5	79.87	0	567.4
Vehicle Petrol Expenditure	169	13,257	6,069	0	43,115
Vehicle Budget Balance	169	-12,860	6,147	-43,115	0
Motorcycle Liters Petrol	175	31.13	28.30	0	266.7
Motorcycle Petrol Expenditure	175	2,366	2,150	0	20,264
Motorcycle Budget Balance	175	-1,982	2,255	-20,264	2,083
Combined Budget Balance	167	-15,256	7,004	-53,247	-3,422

Authors' calculation from survey data. Estimates assume petrol prices of 75.99 INR per liter, the minimum daily price in Madhya Pradesh during November, 2018. Vehicle fuel mileage estimated at dealer-reported figure of 14.1 kilometers per liter for Tata Safari Storme. Motorcycle fuel mileage estimated at 60 kilometers per liter. Missing budget figures are due to non-reporting during survey interviews and are counted as zero in this table.

Table A3: Citizen Survey: Are there bribes in this setting?

	Mean	N
How many times did you contact the department during the last year?		
1 to 5 times	0.71	1402
6 to 10 times	0.14	1402
11 to 20 times	0.04	1402
More than 20 times	0.01	1402
Never contacted	0.09	1402
To what extent do you face difficulties in contacting the department?		
To a great extent	0.19	1402
To quite an extent	0.43	1402
Can't say	0.18	1402
To a lesser extent	0.18	1402
Not at all	0.02	1402
What are the difficulties that are most faced while getting the services?		
No service provision without unofficial payments	0.65	1402
Unable to contact the concerned officials	0.55	1402
No clear information on the duration for these services	0.30	1402
Low quality of services	0.31	1402
Incorrect records	0.14	1402
Others	0.02	1402
Normally, what procedure do people adopt to get rid of the difficulties faced?		
Give a bribe	0.82	1402
Get undue favors through the politician	0.42	1402
Consult courts	0.41	1402
Lodge a complaint with the department	0.25	1402
Contact the provincial ombudsman	0.15	1402
Do nothing	0.04	1402
Disputes		
What normally are the reasons for disputes?		
Corruption in the system	0.51	1402
Influential people / land mafia	0.33	1402
Wrong distribution of land in the family	0.62	1402
No organized forum for land related issues	0.32	1402
Lack of education in the people	0.55	1402
What is the normal procedure that is adopted for the solution of these disputes?		
Unofficial means, bribes, and gifts	0.13	1400
Official legal procedure	0.20	1400
Through courts	0.23	1400
Through mutual understanding	0.10	1400
Through panchayat/politically or social investigation	0.20	1400
Through mutual consultation between elders of the families	0.13	1400
Do women and vulnerable groups face fraud and injustice?	0.62	1402