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EMBEZZLEMENT VERSUS BRIBERY

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ABSTRACT

Corrupt officials can use their positions to enrich themselves in two ways. They can steal from the state budget—embezzling or misspending funds—or they can demand extra payments from citizens in return for services—bribery. In many circumstances, embezzlement is less distortionary than bribery. We analyze the tradeoff for governments in deciding how strictly to monitor and punish these two kinds of bureaucratic misbehavior. When bribery is more costly to economic development, governments may tolerate some embezzlement in order to reduce the extent of bribery—even though embezzlement is generally easier to detect. Embezzlement serves as a parallel to the "efficiency wage." This logic appears to hold in China, where misappropriation of public funds by officials appears to be ubiquitous.

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1 Introduction

Corrupt officials can use their positions to enrich themselves in two ways. They can steal from the state budget—embezzling or misspending funds that they control—or they can demand additional payments from citizens in return for services—bribery. Both of these abuses fit the definition of corruption—the misuse of public office for private gain.

From the official's point of view, these two methods of self-enrichment—bribery and embezzlement—are substitutes. From the point of view of society, they can have quite different costs. Bribe-extraction, if it targets firms, as usually assumed, and if the bribe is charged on top of official taxes and levies, increases the cost of doing business. Embezzlement—unless it prompts politicians to increase the tax rate to make up for embezzled revenues—does not increase companies' costs directly.[1]

In this paper, we consider the dilemma politicians face in choosing a strategy to fight corruption in states with weak law enforcement institutions.[2] We argue that when politicians are sufficiently motivated to pursue economic development they will at times prefer to tolerate a certain level of embezzlement by their agents because to fight it more actively would divert corrupt officials into bribe-extraction, at a greater cost to growth. Furthermore, since one of the most significant costs of corruption is the waste of resources spent by officials in concealing their corrupt activities (Shleifer and Vishny 1993), politicians should tolerate this embezzlement even when it is quite open. The level of tolerated embezzlement is analogous to an efficiency wage. We show the logic of this argument in a simple model.

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[1] It may still be indirectly distortionary if it reduces public investment in productivity-enhancing infrastructure.

[2] In this paper, we study embezzlement by *agents* of the political leadership, rather than by the political leaders themselves. Of course, embezzlement by predatory political leaders such as Mobutu in Zaire and Marcos in the Philippines can be enormous in scope. However, such predation does not present the same puzzles we consider here.

Empirically, the paper is motivated by the case of China, where consumption of the state budget by officials—both illegal and tolerated—occurs on a massive scale, with surprisingly feeble attempts to stop it. There is no authoritative accounting of the extent and costs of different types of corruption in China (or in any other state, for that matter).[3] But evidence suggests that the scope of consumption by officials at the budget's expense is immense. In 2007, the respected newspaper the *Legal Daily* estimated that the total bill for such consumption in 2006 came to 1.07 trillion yuan ($143 billion), equal to about one quarter of the government's total tax income and more than five percent of GDP.[4] This included publicly financed spending by bureaucrats on restaurant meals, alcohol, luxury cars, travel, and foreign tourism. At the local level, officials are known to spend lavishly on luxurious office buildings. Many local governments have off-budget revenue accounts for such spending, which are only loosely monitored by the central government (e.g. Qian and Weingast 1997). Some have special slush funds known as "small golden warehouses" (*xiao jin ku*) for dispensing publicly-provided cash and goods to officials.[5]

Such consumption of public funds by local officials is certainly not an objective of the central government. But the center's enforcement against embezzlement is dilatory, especially compared to its efforts to combat bribery. Although high officials have been prosecuted recently

[3] However, see Wedeman (2004) for an attempt to gauge the trends. One cannot simply look at rates of prosecution for different types of crime since if, as we are arguing, embezzlement is tolerated to some extent in order to decrease bribery, prosecutions might still be more frequent for embezzlement because it occurs on a larger scale and because enforcement against bribery has deterred most officials from engaging in it.

[4] *Legal Daily,* March 18, 2007; World Bank, *World Development Indicators,* 2009, gives China's 2006 GDP as $2.66 trillion. For a very rough comparison with the scope of bribery, Cai, Fang, and Xu (2010) found in a large sample of Chinese firms in 2000-03 that "entertainment and travel costs" constituted about 4 percent of value added. They estimated that spending under this accounting category went towards (a) paying bribes to officials, (b) expenditures to build relational capital with suppliers and clients, and (c) managerial excesses. Almost all bribes would presumably be recorded under this heading. Thus, it appears that total spending on bribes in this sample constituted significantly less than 4 percent of value added.

[5] According to a report in *Financial Daily* (*Cai-Jin Daily*), the stock of funds and goods in the "small golden warehouses" of Chinese local governments in 2009 equaled 5 percent of GDP (www.businesstimes.com.hk/a-20090509-10440/china050918).

for both infractions, the amounts embezzled often dwarf those collected as bribes.[6] A famous case targeted the mayor of Beijing, Chen Xitong, in the mid-1990s. Chen was reported to have misappropriated $4.5 million in public funds (embezzlement), and to have accepted gifts worth $60,000 (bribery). His deputy, Wang Baosheng, who was later found with a bullet in his head, reportedly misappropriated about $68 million.[7] The two were said to have built "residential palaces" where they entertained mistresses at public expense. Such cases are not at all exceptional, as suggested by the survey in Sun (2004). In 1996, 479 cases of misappropriation of public funds were prosecuted where the amount in question was at least one million yuan (about $120,000); of these, five involved embezzlement of more than 100 million yuan (about $12 million). There were only nine cases of bribery where the bribes amounted to one million yuan, and none for more than 10 million (Sun 2004, p.89).

One striking illustration of the different attitudes of the leadership towards embezzlement and bribery is the fact that under Chinese law misappropriating public funds is not even illegal if the money is returned within three months.[8] Scholars have reported widespread "temporary misappropriations" by employees of the state banks, who have routinely used large amounts of their banks' funds to speculate on stock and futures markets (Ding 2000). In fact, even the three months limit is not binding. Such misappropriations only become embezzlement if the money has not been returned "by the time the case is formally registered by the law-enforcer," which

[6] Measuring the extent of bribery is extremely difficult. However, much circumstantial evidence suggests it is less widespread. According to the *Procuratorial Daily*, 16,691 public officials were investigated in 2006, with the total corruption amount about 2.3 billion yuan (0.3 billion USD).

[7] Specifically, he was said to have "appropriated" $25 million and 100 million yuan, and to have "embezzled" over 260,000 yuan (Sun 2004, p.130). For our purposes, both "appropriating" and "embezzling" public funds, as defined by Chinese law, constitute theft from the budget.

[8] *Criminal Law of the People's Republic of China*, 1997, Article 384, available at www.asianlii.org/cgi-bin/disp.pl/cn/legis/cen/laws/cl104/cl104.html?query=embezzlement#13.

provides considerable flexibility. Ding reports that: “Numerous misappropriations have lasted for years but are still treated as ‘temporary’” (Ibid., p.673).

One of the strangest features of the phenomenon of consumption from the state budget in China is how open it is. A major cost of corruption is usually thought to be the waste of resources and distortions that result from officials’ efforts to conceal their self-enrichment (Shleifer and Vishny 1993). Yet, despite the prosecution annually of some of the biggest offenders, smaller scale consumption from the budget is almost universal. Even the state’s General Anti-Corruption Bureau was found in 1998 to be diverting confiscated crime funds to its staff (Ding 2000, p.674). By contrast, bribery is prosecuted even when the amounts are much smaller, and extra-harsh sentences are prescribed when the recipient “extorted” the bribe.[9] We argue that China’s political leaders deliberately tolerate a great deal of relatively small-scale embezzlement in order to reduce the incentive for officials to extract bribes, and that they do not always prosecute even quite open misappropriations in order to avoid prompting costly efforts at concealment.

Distinguishing the consequences of different types of corruption suggests possible answers to long-debated questions about the political economy of development.[10] For decades, scholars have disputed whether corruption is harmful for growth, or, alternatively, “greases the wheels” of commerce, motivating officials to support business activity and waive growth-impeding regulations. Our answer is that it depends what kind of corruption. While some types—extracting bribes in addition to taxes—are clearly distortionary and reduce business activity, others—embezzlement from a government that uses revenues in unproductive ways—are not.

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[9] Ibid, Article 386.

[10] A parallel literature examines the tradeoffs for firms in choosing between alternative ways of influencing government (Gehlbach, Sonin, and Zhuravskaya 2010; Harstad and Svensson 2010).

Still others—extracting bribes from businesses *in place* of taxes, which Shleifer and Vishny (1993) call "corruption with theft"—may even lower the price of government services to businesses below their social cost, resulting in pro-business distortions. From this perspective, the co-existence of some kinds of corruption and rapid growth is not paradoxical and does not conflict with the observation of stagnation in countries with other kinds of corruption. Such a conditional relationship would explain why cross-national estimates of the cost of corruption for growth are relatively small and not always statistically significant (e.g., Mauro 1995).

This would also help explain how China and some other East Asian countries have grown rapidly in recent decades despite apparently widespread corruption. Various explanations have been suggested—for instance, that corruption in China is more centralized than in most places, which reduces the problem of "overgrazing" (e.g. Rock and Bonnett 2004).[11] However, although politics in China is in many ways highly centralized, this does not seem to be the case for corruption. There is no sign of significant upward flows of money or even information about the scale of local graft. We suggest that in China, partly as a result of deliberate policy, the more growth-friendly types of corruption have predominated. The dramatic fall in tax revenues in the 1980s is consistent with the notion that "corruption with theft" was spreading. More recently, as the state's fiscal revenues stabilized, we suspect the balance shifted towards embezzlement. Although the choice by bureaucrats of less distortionary types of corruption is certainly not the only reason for China's ability to grow rapidly despite widespread graft, we think it played a part.

We develop a model that articulates the dilemma for central authorities monitoring agents with opportunities for different types of corruption. The model is related to others that treat the problem of corruption as one of agency (e.g. Rotberg 2003, Dixit 2008). Embezzlement here

[11] For detailed theoretical and empirical analyses of centralized versus decentralized corruption, see for example, Shleifer and Vishny (1993) and Olken and Barron (2009).

becomes analogous to an "efficiency wage."[12] We show that when there are multiple types of corruption, it can be counterproductive to eliminate the types that are easy to monitor.

As is well known, the most efficient way to resolve principal-agent problems usually involves a combination of "carrot" and "stick" strategies (e.g. Lazear 1995, Prendergast 1999). However, for political and other reasons, the "carrot" strategies commonly used by firms, such as the efficiency wage, are often hard to use in the public sector.[13] Setting the salaries of bureaucrats very high can provoke protest even in an authoritarian system such as China's, and the size of premia necessary to deter the officials with the greatest opportunities for extortion would be unpopular in both democracies and dictatorships. (Indeed, the limits on such "carrot" strategies in the public sector may explain why "corruption" in firms is apparently much less widespread than in bureaucracies.) For a regime such as China's, the need to avoid undercutting the egalitarian official ideology too overtly makes paying transparent efficiency wages particularly difficult. In such circumstances, embezzlement serves as an alternative. Besides ideological and political constraints, our model shows that the choice between paying an overt efficiency wage and tolerating embezzlement will depend on the government's efficiency in monitoring embezzlement and bribe taking.

In a way, the logic here mirrors that of Holmstrom and Milgrom's (1991) famous analysis of the multi-task principal-agent relationship. Holmstrom and Milgrom showed that if an agent engages in multiple tasks and if the tasks are complementary for producing output, it is often not optimal for the principal to pay the agent based on performance of the easily measured tasks. Doing so will motivate the agent to devote too much effort to the observable tasks and too

[12] For theoretical discussions of efficiency wages and corruption, see, for example, Becker and Stigler (1974), Besley and McLaren (1993), Waller, Verdier, and Gardner (2002), and Fan (2006).

[13] For a survey of ways in which the principal-agent problem of governments differs from that of firms, see Dixit (2002).

little to the less observable ones. Analogously, we find that punishing officials strictly for engaging in a more observable kind of corruption motivates agents to engage in less observable kinds, which, in this case, are more distortionary. The main difference is that in Holmstrom and Milgrom's model, the agent's inputs all have positive effects on output, whereas in ours the effects are negative.

We introduce our basic analytical framework in Section 2. As a benchmark, in Section 3 we examine the equilibrium if paying an efficiency wage is an option. Section 4 then shows how embezzlement can serve as a substitute for the efficiency wage if the latter is unavailable. Section 5 concludes.

2 The analytical framework

To model corruption, we extend the formulation of Bliss and Di Tella (1997). A large number of potential firms are subject to regulation by a government, which consists of two players—a politician (or ruler) and a bureaucrat (or official).[14] The number of firms is assumed to be a continuum of Lebesgue measure one. The gross profit of a firm, denoted π, is distributed uniformly on the interval [0,1]. To operate, each firm must pay a tax to the ruler (through the official) and also obtain permission from the official. To focus on the central idea of this paper, we assume that tax evasion is impossible.[15] The official receives a fixed wage, w, from the ruler, which can be interpreted as including the prestige of office. We treat w here as a parameter not a variable. The idea is that, as discussed in the Introduction, political or ideological pressures

[14] One can think of the bureaucrat as a group of officials, but to present the ideas as simply as possible we assume a single actor . Thus, we abstract from questions about rent-seeking within the bureaucracy, which are not the focus of this paper and are analyzed elsewhere (e.g. Shleifer and Vishny, 1993).

[15] See Cai and Treisman (2004) for an analysis of the collaboration between firms and local governments in tax evasion.

constrain the government from setting the public sector wage too high. Thus, one can think of w as the maximum wage that these constraints permit, which may not be optimal for deterring bureaucratic corruption. (In Section 3, to provide a benchmark, we relax this assumption and solve the model supposing instead that the ruler can set an additional component of the official's wage without constraint.)

The official can supplement his wage income by demanding bribes from firms and embezzling tax revenues. We model the interaction between the ruler, official, and (potential) firms as a Stackelberg game. The ruler is the Stackelberg leader; at the start of play, he decides the tax rate and announces some anti-corruption measures that will be described later. The official moves next. Then, the (potential) firms decide whether or not to operate.

Consider first the case of bribe extraction. We assume each firm knows the exact value of its π but that the ruler and official know only its distribution. Thus, the tax and the bribe must be the same for every firm entering the market, and we denote the tax and the bribe by t and b, respectively, where $0 \le t, b \le 1$.

Since the total cost of operation is $t + b$, a firm's net profit is:

$$\pi - t - b \tag{2.1}$$

Clearly, a firm will operate if and only if its net profit is positive. Thus, the ruler and the official take the probability that a firm will operate to be:

$$P(\pi - t - b > 0) = 1 - P(\pi < t + b) = 1 - t - b \tag{2.2}$$

From (2.2), the greater is b or t, the fewer firms will enter the market. We assume that all firms make positive gross profits so that the first-best solution is having all firms enter. Thus, bribes reduce economic efficiency.

As the number of firms is a continuum, we know from (2.2) that the fraction of firms entering the market is a constant, $1-t-b$. If the official chooses to take bribes, his income from bribery will be:

$$b(1-t-b) \tag{2.3}$$

Bribery increases the official's income, but also increases the chance that the official is fired by the ruler. To reduce the probability of being caught, the official can devote resources to concealing his bribery (Rose Ackerman 1975, Shleifer and Vishny 1993). We assume he spends a fraction, x, of his bribe income on secrecy. Thus, the official's net income from bribery is:

$$(1-x)b(1-t-b) \tag{2.4}$$

Of course, the effectiveness of the agent's concealment measures depends on how much effort the ruler puts into monitoring bribery, which we denote θ. Most generally, the probability that the official is caught taking bribes is an increasing function of θ and a decreasing function of x. To save algebra, we choose the simplest functional form that captures the idea that the waste of resources on secrecy depends on the effectiveness of the ruler's enforcement efforts. Specifically, we assume that the probability that a bribe-taking official is caught equals one if $x<\theta$ and $1-\alpha$, if $x \geq \theta$, where α is a constant and $0<\alpha<1$.[16] Thus, we assume that the official's concealment is never perfect: even if he sets $x=\theta$, there is still a certain probability that he will be caught.[17] Since if $x<\theta$ the official will be caught with certainty, if he chooses to extract bribes he needs to set:

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[16] Essentially similar modeling strategies are used to model firms' hiding in the "informal sector" (e.g. Rausch 1991, de Paula and Scheinkman forthcoming).

[17] Superficially, it may appear to be a strong assumption that α is independent of b and x. However, note that from (2.4) the amount of resources the official spends on secrecy is $xb(1-t-b)$, which tends to increase with b when b is below a certain level. Thus, our assumptions already imply that concealing bribery gets more costly as the bribe increases. Moreover, the probability of getting caught is only independent of x assuming that $x = \theta$. Thus, $1-\alpha$ represents the residual risk of exposure even after the official has done his best to offset the ruler's monitoring.

$$x = \theta \tag{2.5}$$

The official can also enrich himself by embezzling tax revenues. To focus on cases in which embezzlement is harder to conceal than bribery, we assume that in this case the official cannot invest in secrecy. So long as the ruler devotes some resources to monitoring embezzlement, there is a positive probability of exposure, defined as: $e\rho/(1+e\rho)$, where e denotes the amount the official embezzles, and ρ denotes the ruler's monitoring effort. The probability the official is not caught for embezzlement is then:

$$\frac{1}{1+e\rho} \tag{2.6}$$

From the ruler's perspective, the official's embezzlement is costly. We denote this cost:

$$\gamma e \tag{2.7}$$

where $\gamma \geq 1$ is a positive constant. For example, if embezzlement imposes political costs above and beyond the simple loss of revenue, then $\gamma > 1$.

If an official is not caught for corruption, he consumes his full income. We denote the official's utility function from consumption $u()$, and assume it to be strictly increasing and strictly concave. However, if the official is caught, then he is fired and receives neither his wage nor his income from embezzlement and bribery, which is confiscated. To save algebra, we normalize the utility of an official caught for corruption to be zero: $u(0) = 0$. Specifically, we assume that $u()$ takes the functional form:

$$u(z) = z^{\beta} \tag{2.8}$$

where β is a constant and $0 < \beta < 1$.

Now consider the ruler's objective function. Two extreme simplifications common in political economy models are that the ruler aims to maximize (a) the welfare of the public, or (b) his own utility (or that of a ruling group).[18] Here, as in Cai and Treisman (2004), we assume the ruler maximizes some convex combination of these two objectives, specifically:

$$V \equiv \text{(ruler's net revenue)} + \xi\text{(firms' net profits)} \qquad (2.9)$$

where ξ is a non-negative constant. To focus on the issue at hand, we abstract away from public good provision and assume the ruler consumes all his net revenue. Firms' net profits represent the resources available for private consumption, and, in this very simple setup, also social welfare. (Thus, we also abstract from negative externalities of production.) The greater is ξ, the more the ruler cares about social welfare. If $\xi = 0$, the ruler is purely predatory; as ξ gets very large, he approaches pure benevolence. To avoid the uninteresting case of a corner solution in which the ruler effectively only cares about the firms' net profits and not at all about his own revenue, we assume $\xi < 2$.

As the number of firms is normalized to one, the number and proportion of firms that choose to operate are both $(1-t-b)$, so the total tax collected is $t(1-t-b)$. Since π is uniformly distributed on the interval [0,1], the average and total profit of firms is $(1-t-b)/2$, and their total net profit is:

$$(1-t-b)\frac{1-t-b}{2} = \frac{(1-t-b)^2}{2} \qquad (2.10)$$

The ruler can potentially deter the official's bribe extraction by increasing his monitoring effort, θ. But monitoring is costly. We assume the cost function takes the form:

$$\frac{A}{1-\theta} \qquad (2.11)$$

[18] For example, Grossman (2000) provides a summary and assessment of these two views.

where A is a positive constant, which might, for instance, represent the (in)efficiency of law enforcement. This form is chosen for convenience, but has the intuitive properties, familiar from other neoclassical models of enforcement, that its first and second derivatives are positive: the cost of monitoring increases, and at an accelerating rate. Monitoring embezzlement is also costly. Again, for convenience, we assume the cost function takes a simple form with positive first and second derivatives:

$$G\rho^2 \tag{2.12}$$

where G is a non-negative constant. For notational convenience, we define $\lambda \equiv \xi / 2$. Now we can write the ruler's objective function as:

$$V = t(1-t-b) + \lambda(1-t-b)^2 - \gamma e - \frac{A}{1-\theta} - G\rho^2 \tag{2.13}$$

A final simplifying assumption is that the ruler's revenue is always sufficient to cover the level of expenditure on deterring bribery and embezzlement that he chooses, so we can neglect the budget constraint:

$$t(1-t-b) \geq \frac{A}{1-\theta} + G\rho^2 \tag{2.14}$$

3 Deterring bribery with the efficiency wage

In order to show how embezzlement can substitute for the efficiency wage, we must first demonstrate how setting an efficiency wage deters bribe extraction. This will serve as a benchmark against which to compare the case of embezzlement. In this section, we use "*e*" to denote not the amount embezzled but the wage premium paid to the official to bring his wage up to the efficiency wage. In this case, $\gamma = 1$ (the cost of the wage premium is simply the wage premium) and $G = 0$ (no monitoring of embezzlement is needed in equilibrium because the efficiency wage deters embezzlement). In this game, clearly there are two possible subgames and equilibria, in one of which the official takes bribes and in one of which he does not.

3.1 Subgame 1: The official takes bribes

If the official takes bribes, his objective function can be expressed as follows:

$$\begin{aligned} U^b &\equiv \alpha u[w+e+(1-x)b(1-t-b)]+(1-\alpha)u(0) \\ &= \alpha u[w+e+(1-\theta)b(1-t-b)] \end{aligned} \tag{3.1}$$

The first order condition from (3.1) is:

$$\frac{\partial U^b}{\partial b} = 0 : \alpha(1-\theta)(1-t-b-b)u'() = 0 \tag{3.2}$$

from which:

$$b = \frac{1-t}{2} \tag{3.3}$$

which characterizes the official's best response to the ruler's choices of t, θ and e. Inserting (3.3) and $\gamma = 1$ into (2.13) we get

$$V = \frac{t(1-t)}{2} + \lambda \frac{(1-t)^2}{4} - e - \frac{A}{1-\theta} \tag{3.4}$$

From (3.4), clearly, the ruler will set $\theta = 0$ and $e = 0$. Inserting these into (3.4), deriving the first order condition, and solving for t yields:

$$t = \frac{1-\lambda}{2-\lambda} \tag{3.5}$$

which, inserted into (3.3), implies

$$b = \frac{1}{2(2-\lambda)} \tag{3.6}$$

3.2 Subgame 2: The official does not take bribes

The official will choose not to take bribes if this yields greater utility, given the ruler's choices of t, θ and e. Substituting (3.5) and (3.6) into (3.1), we see that the bribe-taking official's utility is:

$$U^b = \alpha u[w + e + (1-\theta)\frac{(1-t)^2}{4}] \tag{3.7}$$

On the other hand, if the official does not take bribes, his utility, denoted U^{nb}, is:

$$U^{nb} \equiv u(w+e) \tag{3.8}$$

Thus, the official will choose *not* to take bribes if and only if

$$\alpha u[w + e + (1-\theta)\frac{(1-t)^2}{4}] \le u(w+e) \tag{3.9}$$

or, using (2.8) and simplifying, if

$$\theta \ge 1 - \frac{4(\alpha^{-\frac{1}{\beta}} - 1)(w+e)}{(1-t)^2} \tag{3.10}$$

To save on the cost of monitoring, the ruler chooses the smallest θ that satisfies (3.10), in which case (3.10) holds with strict equality:

$$\theta = 1 - \frac{4(\alpha^{-\frac{1}{\beta}} - 1)(w+e)}{(1-t)^2} \tag{3.11}$$

(3.11) is the official's "incentive compatibility constraint" for not taking bribes. That is, if (3.11) is satisfied, then $b = 0$. Inserting $b = 0$, $\gamma = 1$, $G = 0$, and (3.11) into (2.13), the ruler's objective function becomes:

$$t(1-t) + \lambda(1-t)^2 - \frac{A}{4(\alpha^{-\frac{1}{\beta}} - 1)(w+e)}(1-t)^2 - e \tag{3.12}$$

Suppose that the ruler's optimal t is neither 0 nor 1. (In both these cases, his income will be zero, so the corner solutions are of limited interest.) The first order condition of (3.12) with respect to t is:

$$1 - 2t - 2\lambda(1-t) + \frac{2A}{4(\alpha^{-\frac{1}{\beta}} - 1)(w+e)}(1-t) = 0 \tag{3.13}$$

The first order condition of (3.12) with respect to e is:

$$\frac{A}{4(\alpha^{-\frac{1}{\beta}} - 1)(w+e)^2}(1-t)^2 - 1 \le 0 \tag{3.14}$$

(3.14) holds with strict equality if $e > 0$ and with strict inequality if $e = 0$.

3.3 Subgame perfect equilibria

We define

$$\Delta V \equiv V^e - V^b \tag{3.15}$$

where V^e is the ruler's utility when the official does not take bribes and V^b is his utility when the official takes bribes. Clearly the ruler will take measures, including paying an efficiency wage, to eliminate bribery if and only if $\Delta V > 0$.

The model contains several important parameters. But the most important is A, which measures (negatively) the ruler's efficiency in monitoring the official's bribe extraction. Holding all parameters other than A constant, we have the following proposition.

Proposition 1. *There exists a threshold level of A, A^c, such that:*

(1) *If $A > A^c$, there is a unique equilibrium, in which the official takes bribes and the ruler does not monitor bribe extraction and does not pay the official an efficiency wage.*

(2) *If* $A < A^c$ *, there is a unique equilibrium, in which the official does not take bribes and the ruler devotes some resources to monitoring bribe extraction; in addition, the ruler pays the official an efficiency wage if the following condition is satisfied,*

$$[4(1-\lambda)(\alpha^{-\frac{1}{\beta}}-1)w+A]^2 - A(\alpha^{-\frac{1}{\beta}}-1) < 0 \qquad (3.16)$$

For all proofs, see appendix.

Proposition 1 shows that the ruler will implement measures to eliminate bribe taking if and only if the monitoring mechanism is sufficiently powerful—that is, if *A* is small. Also, when $A < A^c$ and when condition (3.16) is satisfied, the ruler pays the official an efficiency wage. It only makes sense to deploy these sticks and carrots, however, if they are effective enough to eliminate bribery. If the monitoring mechanism is not so powerful, using it will merely lead officials to waste more resources on concealing their misbehavior rather than persuade them to reduce their bribe extraction. In this case, the ruler would be better off not monitoring at all. Clearly, the left hand side of (3.16) decreases with λ, and increases with *w*. Also, when *A* is very small, (3.16) will not be satisfied. In summary, we have the following corollary.

Corollary 1. *If* $A < A^c$ *, the ruler is more likely to pay an efficiency wage premium to the official when* λ *is larger, w is smaller, and when A is not too small.*

The intuition for Corollary 1 is straightforward. First, if the official's basic wage, *w*, is already high, the ruler is less likely to need to pay a premium to bring his total compensation up to the efficiency wage level. Second, when λ increases (the ruler cares more about public welfare), the ruler will be more motivated to eliminate the official's bribery, costs of which are predominantly borne by the public. Democracies, where rulers are constrained to place weight on public welfare, and growth-oriented autocracies are more likely to use efficiency wages to deter corruption when such instruments are available.[19] Third, when A is sufficiently small (the monitoring mechanism is highly effective), the ruler will not need to offer carrots as well as sticks.

4 Embezzlement as a substitute for the efficiency wage

Consider now cases in which political, ideological, or other constraints prevent the ruler from providing efficiency wage premia to potentially corruptible officials. Here we show how constrained embezzlement can serve as a substitute.[20]

First, note that if monitoring embezzlement is costless ($G = 0$), then tolerating embezzlement becomes a perfect substitute for paying an efficiency wage. The ruler can costlessly set ρ so high that any embezzlement is almost sure to be detected by him (see (2.6)). Rather than punishing all embezzlement, the ruler will then find it optimal to allow the official to embezzle an amount equivalent to the optimal efficiency wage premium derived in Section 3. If the official embezzles more than this, he is detected and fired. Tolerating embezzlement becomes simply another mechanism for paying the efficiency wage premium, which may enable the ruler to get around political or ideological restrictions that make it costly to pay the premium directly.

[19] This is consistent with the empirical finding that democracy reduces corruption (e.g. Treisman 2000, Lederman, Loayza, and Soares 2005).

[20] To focus on the main point of the paper, we do not study efficiency wages and embezzlement together. Since we assume that rulers pay some political or ideological cost for tolerating embezzlement, if both efficiency wage and embezzlement were available, rulers should always prefer to pay the efficiency wage. If the ruler could pay small efficiency premia—but not ones large enough to deter all bribery—optimal policies would likely involve a combination of efficiency wage premia and tolerated embezzlement.

In most circumstances, however, embezzlement is an imperfect substitute. Suppose $G > 0$. There are then three subgames, defined by the values of *b* and *e*: (1) $b > 0$ and $e > 0$; (2) $b > 0$ and $e = 0$; and (3) $b = 0$ and $e \geq 0$. It is straightforward to prove that case (1) cannot occur in equilibrium:

Lemma 1. $b > 0$ *and* $e > 0$ *cannot both be true in equilibrium.*

The intuition is as follows. Suppose, on the contrary, that *b* and *e* are both positive, and that the tax rate is low. A marginal tax increase will increase the ruler's tax revenue, but will simultaneously decrease the official's bribe income. To make up for this, the official will embezzle more. But because of the inefficient nature of the competition between taxation and bribery, the increase in the amount the official embezzles will be greater than the ruler's gain in higher tax revenue. Thus, as proved in the appendix, the ruler, anticipating the response of the official, would be best off setting the tax rate at zero: in equilibrium, if $b > 0$ and $e > 0$, $t = 0$. Here, however, we wish to focus on the case in which the ruler collects a positive amount of tax revenue, and so in equilibrium *b* and *e* cannot both be positive.[21]

This leaves two equilibrium possibilities: (2) $b > 0$ and $e = 0$; (3) $b = 0$ and $e \geq 0$. Consider (2) first. In this case, the official's utility maximization problem must yield an interior solution for *b* but a corner solution for *e*. The official's utility is:

$$\begin{aligned} U^{be} &\equiv \frac{\alpha}{1+e\rho}[w+e+(1-\theta)b(1-t-b)]^{\beta} + (1-\frac{\alpha}{1+e\rho})u(0) \\ &= \frac{\alpha}{1+e\rho}[w+e+(1-\theta)b(1-t-b)]^{\beta} \end{aligned} \tag{4.1}$$

[21] If some assumptions in the model are relaxed—for example, if we suppose that the official will never be caught if the amount of bribe is small—then a low level of bribery can coexist with embezzlement in equilibrium. In this case, too, the official will treat embezzlement and bribery as substitutes, and the essential logic of the model will still hold.

where $\alpha / (1+e\rho)$ is the official's survival probability. This is easier to maximize in logarithmic form: $\ln U^{be} = \ln\alpha - \ln(1+e\rho) + \beta\ln[w+e+(1-\theta)b(1-t-b)]$. The first order conditions are:

$$\frac{\partial(\ln U^{be})}{\partial b} = 0: \quad \beta(1-\theta)\frac{1-t-2b}{w+e+(1-\theta)b(1-t-b)} = 0 \qquad (4.2)$$

from which:

$$b = \frac{1-t}{2} \qquad (4.3)$$

and

$$\frac{\partial(\ln U^{be})}{\partial e} < 0: \quad \frac{\beta}{(w+e)+(1-\theta)b(1-t-b)} - \frac{\rho}{1+\rho e} < 0 \qquad (4.4)$$

or, using (4.3), setting *e = 0*, and rearranging:

$$\rho > \frac{4\beta}{4w+(1-\theta)(1-t)^2} \qquad (4.5)$$

Since by assumption *e = 0*, (4.4) and (4.5) are strict inequalities.

From (4.3), b is independent of θ, and so the ruler will set $\theta = 0$. The ruler will also choose the smallest possible ρ to save on the cost of monitoring—namely:

$$\rho = \frac{4\beta}{4w+(1-t)^2} \qquad (4.6)$$

Inserting the equilibrium values of b, e, θ, and ρ into the ruler's objective function (2.13) we get:

$$V^b = t(\frac{1-\mathrm{t}}{2}) + \lambda(\frac{1-t}{2})^2 - A - G\left(\frac{4\beta}{4w+(1-t)^2}\right)^2 \qquad (4.7)$$

The first order condition of (4.7) with respect to t is:

$$\frac{1-2t}{2} - \lambda\frac{1-t}{2} - \frac{64G\beta^2(1-t)}{(4w+(1-t)^2)^3} = 0 \qquad (4.8)$$

We denote the solution to (4.8) t^b. Inserting $t = t^b$ into (4.7) we get a value of V^b, which we denote $(V^b)^*$.

Next consider case (3), in which $b = 0$ and $e \geq 0$. To deter the official from taking bribes, the ruler sets $\theta = 1 - \frac{4(\alpha^{-\frac{1}{\beta}} - 1)(w+e)}{(1-t)^2}$ as in (3.11). Here, however, e is interpreted as embezzlement rather than as an efficiency wage premium, and its level is set by the official, interacting strategically with the ruler. Given that the official is not taking bribes, his objective function is:

$$U^e \equiv \frac{1}{1+\rho e} u(w+e) + (1 - \frac{1}{1+\rho e}) u(0) = \frac{1}{1+\rho e}(w+e)^\beta \tag{4.9}$$

His first order condition with respect to e is:

$$\frac{\beta}{w+e} - \frac{\rho}{1+\rho e} \leq 0 \tag{4.10}$$

Suppose (4.10) holds with strict equality and hence $e > 0$. In this case, from (4.10):

$$e = \frac{\beta - \rho w}{\rho(1-\beta)} \tag{4.11}$$

Note that the analysis here is almost identical to that in Section 3.2 except that now the ruler has to pay a cost of monitoring embezzlement. Thus, as in (3.12), we can write the ruler's objective function as:

$$V^e \equiv t(1-t) + \lambda(1-t)^2 - \frac{A}{4(\alpha^{-\frac{1}{\beta}} - 1)(w+e)}(1-t)^2 - \gamma e - G\rho^2 \tag{4.12}$$

Inserting (4.11) into (4.12), we get

$$V^e = t(1-t) + \lambda(1-t)^2 - \frac{A}{4(1-\alpha^{-\frac{1}{\beta}})(w + \frac{\beta - \rho w}{\rho(1-\beta)})}(1-t)^2 - \gamma \frac{\beta - \rho w}{\rho(1-\beta)} - G\rho^2 \tag{4.13}$$

The first order conditions of (4.13) with respect to t and ρ are:

$$1-2t-2\lambda(1-t)+\frac{A}{2(\alpha^{-\frac{1}{\beta}}-1)(w+\frac{\beta-\rho w}{\rho(1-\beta)})}(1-t)=0 \qquad (4.14)$$

and

$$\frac{\gamma w}{\rho(1-\beta)}+\frac{\gamma(\beta-\rho w)}{\rho^2(1-\beta)}-\frac{A(\frac{\beta-\rho w}{\rho^2(1-\beta)}+\frac{w}{\rho(1-\beta)})}{4(1-\alpha^{-\frac{1}{\beta}})(w+\frac{\beta-\rho w}{\rho(1-\beta)})^2}(1-t)^2-2G\rho=0 \qquad (4.15)$$

We denote the solutions for t and ρ in (4.14) and (4.15) t^e and ρ^e. Now, from (4.11) we know that $e>0$ if and only if

$$\beta>\rho^e w \qquad (4.16)$$

Moreover, inserting $t=t^e$ and $\rho=\rho^e$ into (4.13) we get a value of V^e, which we denote $(V^e)^*$. If (4.16) is not satisfied, we will have $e=0$. In this case, we insert $e=0$ into (4.12), and we can then obtain the optimal solutions of t and ρ, and consequently the optimal solution of V^e, which we continue to denote as $(V^e)^*$.

We define

$$\Delta V^* \equiv (V^e)^*-(V^b)^* \qquad (4.17)$$

where $(V^e)^*$ is the ruler's utility when the official does not take bribes and $(V^b)^*$ is the ruler's utility when the official takes bribes. Clearly the ruler will implement measures, including allowing embezzlement, to eliminate bribery if and only if $\Delta V^*>0$. We now have the following lemma.

Lemma 2. $\frac{\partial(\Delta V^*)}{\partial A}<0$

This lemma implies that as the mechanism of monitoring bribery becomes more efficient, the ruler will tend to favor the "embezzlement scheme" more. Moreover, in the appendix we prove that when A is sufficiently small, $\Delta V^* > 0$, and when A is sufficiently large, $\Delta V^* < 0$. Thus, holding all parameters other than A constant, we have the following proposition.

Proposition 2. *There exists a threshold level of A, A^{cc}, such that*

(1) *If $A > A^{cc}$, there is a unique equilibrium in which the official takes bribes, and the ruler does not monitor bribe extraction but spends enough resources on monitoring embezzlement to deter the official from embezzling.*

(2) *If $A < A^{cc}$, there is a unique equilibrium in which the official does not take bribes, and the ruler devotes some resources to monitoring bribe extraction; if Condition (4.16) is satisfied, the ruler allows the official to embezzle a certain amount.*

Much as in Proposition 1, the ruler can only deter bribe taking if his monitoring mechanism is sufficiently effective. If this is the case, then embezzlement may serve as a substitute for the efficiency wage, providing the carrot that enhances the power of the ruler's stick, the threat of dismissal. Indeed, Proposition 2 parallels Proposition 1, with the condition (4.16) corresponding to (3.16).

Proposition 2 shows how rational behavior can produce the—at first sight paradoxical—outcome that officials engage in quite open forms of corruption and their political bosses largely tolerate this. The alternative would be to drive officials into corrupt activities that are more destructive of economic activity and waste resources on secrecy. Although the Politburo does not publish minutes of its meetings and deciphering the thinking of closed authoritarian regimes is very difficult, we believe that something like this has been occurring in China. The result—in which a principal (the ruler) chooses not to reward or punish an agent (the official) based on his performance at an easily measurable task for fear of changing his effort allocation across tasks—is analogous to that of Holmstrom and Milgrom's (1991) model of multi-task agency.

Analogous to Corollary 1, we have the following proposition.

Proposition 3. *When A is sufficiently small, $e = 0$ if and only if*

$$\gamma w \geq 2G \tag{4.18}$$

When it is possible to pay an efficiency wage premium, we saw in Corollary 1 that the ruler was more likely to do so when the monitoring mechanism was not too effective (A not too small), and the basic wage, w, was lower. Proposition 3 establishes parallel results for when embezzlement serves as a substitute for the efficiency wage. Now, very intuititvely, the ruler will be more likely to permit some embezzlement when the cost of embezzlement, γ, and the basic wage, w, are lower, and when the cost of monitoring embezzlement, G, is higher.

The extent of embezzlement depends on A, the effectiveness of monitoring bribery. A will clearly vary with the effectiveness of the legal and administrative systems. This suggests insights into how the pattern of corruption will tend to change if and when countries develop more effective states. When A is high (enforcement is very weak), countries experience bribery but not much embezzlement. If, at some point, reforms strengthen law enforcement, the country transitions to a phase in which there is not much bribery but more embezzlement. Other things equal, this phase will coincide with faster economic growth, since embezzlement is generally less distortionary than bribery. Further administrative and legal reforms may promote the country to a phase in which enforcement is sufficiently powerful to deter most bribery and embezzlement. The reduction in embezzlement should come earlier (see 4.18) in countries which are not constrained by ideology or politics to pay low wages to bureaucratic officials. In such countries, an efficiency wage premium can be substituted for tolerated embezzlement.

The state reforms that shift countries from the mostly-bribery to the mostly-embezzlement phase are certainly not inevitable. Some countries clearly get stuck in equilibria in which bribery is widespread and economic activity is depressed. We believe that China, with its moderately effective legal-administrative system, is in the embezzlement phase, which is consistent with relatively rapid growth. Were public protests to pressure the government into cracking down on embezzlement, this could prompt substitution into bribery, depressing business activity. The ultimate solution for China's further development is clearly to enhance the effectiveness of the legal and administrative systems for monitoring bribery, while simultaneously increasing the official wages of its civil servants.

Since the first order conditions (4.14) and (4.15) have no closed form solution, we illustrate with a simulation. Setting the following parameter values—$\lambda = 0.4; \alpha = 0.8; \beta = 0.5; \gamma = 1.4; w = 0.1; G = 0.0137; A = 0.000001$—we derive values for the endogenous variables in Table 1. The two columns detail two scenarios: in the first, only bribery occurs; in the second, only embezzlement occurs. In the second, despite the embezzlement, the ruler is better off than in the first, in which stricter enforcement deterred all embezzlement. This is the case even though embezzlement is assumed very costly to the ruler: each dollar embezzled causes $1.40 of losses once the embarrassment of being seen to tolerate embezzlement is taken into account ($\gamma = 1.4$). It is also fiscally costly: about half of the ruler's total tax revenues are embezzled.[22] Although to an uninformed observer, this outcome might therefore appear dysfunctional and paradoxical, it actually represents optimal behavior for the actors given the constraints.

Moreover, it turns out that in this example the public is also much better off when the ruler permits some embezzlement. Because the tax and bribe rates are lower (the bribe rate is set to zero), more output is produced and a larger share of it is retained and consumed by the public. As many have pointed out, uncoordinated predation tends to be more costly to the victims than coordinated predation. Our embezzlement case—in which the ruler sets a tax rate and then shares revenues with the official by allowing him to embezzle a certain share of them—constitutes coordinated predation. The bribery case—in which both ruler and official separately impose a (tax or bribe) levy on firms—constitutes uncoordinated predation, with the familiar distortionary "overgrazing" problem.

Table 1 Simulating outcomes with just bribery and just embezzlement

	Bribery	Embezzlement
t	0.20	0.17
b	0.40	0
θ	0	0.45
ρ	2.15	3.71
e	0	0.07
Ruler's utility	0.09	0.13
Firms'net profit	0.08	.34

Source: Authors' calculations.

The example also shows why it may be hard to distinguish empirically between cases in which embezzlement is tolerated and those in which it is not. Even those regimes that allow some embezzlement as a lesser evil will, for ideological or political reasons, often claim to be

[22] That is, $0.07/t(1 - t) = 0.07/0.14$.

trying to eliminate it. Moreover, as the example shows, they may prosecute a large number of embezzlers. The proportion of officials fired for embezzling funds in this example is: $1\text{-}1/(1 + e\rho) = 0.205$, or 20.5 percent. (By contrast, in the stylized reality of the model, one would see no prosecutions of bribe-takers in this case since the ruler successfully deters all bribery.) Thus, the government "tolerating" embezzlement might, nevertheless, look to outsiders like one that is actively fighting it.

One key parameter in the model is γ, which measures the cost of embezzlement to the ruler. Since embezzlement is relatively visible, it is likely to give the government a reputation for corruption. If the government is sensitive to such reputational effects, γ will be higher. One would expect this to be truer in democracies than authoritarian regimes. Of course, the ruler could always replace embezzlement by an overt efficiency wage—and would do so if this were not constrained. Opposition to paying high wages to bureaucrats is likely to be strongest in countries with an egalitarian or populist official ideology or political culture. Thus, countries where γ is high are likely to be egalitarian or populist democracies. Bearing this in mind, and holding all parameters except γ constant, the following proposition holds.

Proposition 4. $\frac{\partial(\Delta V^*)}{\partial\gamma} < 0$.

Other things equal, rulers with higher γ are more likely to tolerate widespread bribery rather than allowing embezzlement in order to deter such bribery. Of course, many populist democracies in Latin American and elsewhere tend to have high rates of bribery because they tend to be at low or intermediate levels of economic development. But another reason could be that their governments are constrained from compensating officials highly enough—either overtly or by permitting illicit consumption of budget funds—to deter them from taking bribes. They lack the carrots that would make their sticks more effective.

The ruler's behavior will also depend on how greatly he values social welfare (and economic output), as shown in Proposition 5.

Proposition 5. $\frac{\partial(\Delta V^*)}{\partial \lambda} > 0$ if

$$2t^e < 1 + t^b \tag{4.19}$$

In words, so long as the tax rate the ruler would set in the equilibrium with embezzlement is not too high, rulers who place relatively greater value on economic output and private consumption will be more likely to tolerate embezzlement. Thus, we should expect to see such bureaucratic embezzlement more often in democracies and growth-oriented autocracies with weak—but not too weak—enforcement systems.

5 Conclusion

Different types of corruption impose different costs on businesses. We argue that this has two implications. First, politicians that strongly favor growth should be motivated to adopt strategies that encourage bureaucrats to substitute less costly for more costly methods of corrupt self-enrichment. Second, in countries where different kinds of corruption predominate, the effect on growth will differ. As a result, in some countries corruption will severely impair growth, while in others it will prove far less damaging.

In particular, we focused on the tradeoff for politicians between fighting embezzlement and bribery. When, as is often the case, bribery is more distortionary, growth-oriented politicians have an incentive to tolerate embezzlement. Furthermore, since secrecy imposes dead-weight costs, it will be efficient to tolerate embezzlement even when it is quite blatant. Embezzlement is then analogous to an efficiency wage, increasing the value to the official of retaining his job, and thus reducing the incentive to risk it by engaging in bribery.

Although we focus in this paper on the tradeoff between embezzlement and the extortion of bribes on top of tax payments, another type of bribery—"corruption with theft," in Shleifer and Vishny's (1993) terms—in which officials collect bribes *instead* of taxes may be even more favorable for business development. We defer analysis of this to future work. An argument similar to the one developed in this paper is likely to apply. Given that officials are extracting bribes, politicians may choose not to enforce tax collection too strictly. To collect taxes in full, given the burden on firms of paying bribes, would drive too many firms out of business.

These considerations help to explain why in China high levels of consumption by officials at the expense of the public budget are tolerated, even when such consumption is perfectly open. They may also help to explain why widespread corruption in China has not prevented extremely rapid growth in recent decades. Accurate measures of the impact of corruption on firms are always hard to come by, and China is no exception. However, the ability of Chinese manufacturers to flourish in highly competitive export markets suggests that the burden of bribery cannot be too high, at least relative to other developing countries with similar or even lower labor costs, such as India or Bangladesh. Were bribes driving up the total production cost of manufactured goods more than elsewhere, Chinese firms would not be able to charge such low prices and win such large market shares. In more developed countries, monitoring will tend to be more effective, allowing politicians to reduce embezzlement without stimulating too great an increase in distortionary bribery. But in other developing and transitional countries where law enforcement institutions are weak, such toleration of certain kinds of corruption may be optimal in a world of the second best.

The analysis in this paper has assumed that bribery is distortionary, discouraging economic activity. However, if firms are able to earn large rents because of monopoly or access to scarce natural resources, even the burden of paying significant bribes may not have much effect on firms' output. At the same time, if rents accruing to private sector firms are large and tax rates low, officials may be able to extract more in bribes than they can obtain through embezzlement. In such cases, tolerating embezzlement may not be an effective means of deterring bribery, and one should expect large-scale bribery to be more widespread.

Finally, it hardly needs to be restated that tolerating embezzlement is very much a second best solution. Two alternatives, when feasible, will reduce bribery at lower cost.. First, if governments are not limited in how much they can pay their bureaucrats, paying efficiency wages accomplishes the same objective with less hypocrisy and subterfuge. Second, increasing the rulers' capacity to monitor and enforce rules against bureaucratic corruption reduces the need to offer such positive inducements.

Appendix: Mathematical Proofs

Proof of Proposition 1. When the official takes bribes, inserting (3.5), (3.6) and $\theta = 0$ into (2.13), we get the ruler's utility as follows:

$$\begin{aligned} V^b &\equiv t(1-t-b) + \lambda(1-t-b)^2 - \frac{A}{1-\theta} \\ &= \frac{1-\lambda}{2-\lambda}(1-\frac{1-\lambda}{2-\lambda} - \frac{1}{2(2-\lambda)}) + \lambda(1-\frac{1-\lambda}{2-\lambda} - \frac{1}{2(2-\lambda)})^2 - \frac{A}{1-0} \\ &= \frac{1}{4(2-\lambda)} - A \end{aligned} \tag{A.1}$$

When the official does not take bribes, we write the ruler's utility in the general form:

$$t(1-t) + \lambda(1-t)^2 - \frac{A}{1-\theta} - e \tag{A.2}$$

First, when A = 0, from (3.13) we have

$$t = \frac{2(1-2\lambda)(\alpha^{-\frac{1}{\beta}} - 1)(w+e) + A}{4(1-\lambda)(\alpha^{-\frac{1}{\beta}} - 1)(w+e) + A} = \frac{1-2\lambda}{2-2\lambda} \tag{A.3}$$

Then

$$\begin{aligned} V^e &= t(1-t) + \lambda(1-t)^2 - \frac{A}{1-\theta} \\ &= \frac{1-2\lambda}{2-2\lambda}(1-\frac{1-2\lambda}{2-2\lambda}) + \lambda(1-\frac{1-2\lambda}{2-2\lambda})^2 - \frac{0}{1-\theta} \\ &= \frac{1}{4(1-\lambda)} \end{aligned} \tag{A.4}$$

Thus, when A = 0

$$V^e = \frac{1}{4(1-\lambda)} > \frac{1}{4(2-\lambda)} - 0 = V^b \tag{A.5}$$

Thus, in this case $\Delta V > 0$.

When A is sufficiently large, the ruler needs to set θ to be sufficiently small. In this case, in order to eliminate corruption, the ruler must set t close to 1 so that the official's bribe income $b(1-t-b)$ will be small even without monitoring. However, when t is close to 1, the ruler's revenue will be close to zero. Thus, in this case we have $V^e < V^b$, which means $\Delta V < 0$.

Second, by the Envelope Theorem, we see that

$$\frac{d(\Delta V)}{dA} = -\frac{1}{1-\theta} + 1 < 0 \tag{A.6}$$

Thus, there exists a threshold level of A, A^c, such that if $A > A^c$, there is a unique equilibrium in which the official takes bribes, and the ruler does not monitor bribe extraction and does not provide the official with an efficiency wage; if $A < A^c$, there is a unique equilibrium in which the official does not take bribes, and the ruler devotes a positive amount of resources to monitoring bribe extraction.

Next, we check under what conditions $e = 0$. Inserting $e = 0$ and (3.13) into (3.14), we get

$$\frac{A}{4(\alpha^{-\frac{1}{\beta}}-1)(w)^2}\left(1-\frac{2(1-2\lambda)(\alpha^{-\frac{1}{\beta}}-1)w+A}{4(1-\lambda)(\alpha^{-\frac{1}{\beta}}-1)w+A}\right)^2 - 1 \le 0 \tag{A.7}$$

namely

$$\frac{A(\alpha^{-\frac{1}{\beta}}-1)}{[4(1-\lambda)(\alpha^{-\frac{1}{\beta}}-1)w+A]^2} - 1 \le 0 \tag{A.8}$$

■

Proof of Lemma 1.

In the case where both $b > 0$ and $e > 0$, the official's survival probability is

$$\frac{\alpha}{1+e\rho} \tag{A.9}$$

Thus, the official's expected utility is

$$\begin{aligned} U^{be} &\equiv \frac{\alpha}{1+e\rho}u[w+e+(1-\theta)b(1-t-b)]+(1-\frac{\alpha}{1+e\rho})u(0) \\ &= \frac{\alpha}{1+e\rho}[w+e+(1-\theta)b(1-t-b)]^{\beta} \end{aligned} \tag{A.10}$$

from which:

$$\ln U^{be} = \ln\alpha - \ln(1+e\rho) + \beta\ln[w+e+(1-\theta)b(1-t-b)] \tag{A.11}$$

The ruler's utility is

$$V^{bc} = t(1-t-b)+\lambda(1-t-b)^2 - \gamma e - \frac{A}{1-\theta} - G\rho^2 \tag{A.12}$$

We now prove this lemma by contradiction. Suppose that in equilibrium $b > 0$ and $e > 0$. Then,

From (A.11), the first order conditions are:

$$\frac{\partial(\ln U^{be})}{\partial b} = 0: \quad \beta(1-\theta)\frac{1-t-2b}{w+e+(1-\theta)b(1-t-b)} = 0 \tag{A.13}$$

from which
$$b = \frac{1-t}{2} \tag{A.14}$$

and
$$\frac{\partial(\ln U^{be})}{\partial e} = 0: \quad -\frac{\rho}{1+\rho e} + \beta\frac{1}{w+e+(1-\theta)b(1-t-b)} = 0 \tag{A.15}$$

from which, using (A.14):

$$e = \frac{\beta - \rho w - \rho(1-\theta)\frac{(1-t)^2}{4}}{\rho(1-\beta)} \tag{A.16}$$

Plugging (A.14) and (A.16) into (A.12), we get

$$V^{bc} \equiv t(1-t-\frac{1-t}{2})+\lambda(1-t-\frac{1-t}{2})^2-\frac{A}{1-\theta}-\gamma\frac{\beta-\rho w-\rho(1-\theta)\frac{(1-t)^2}{4}}{\rho(1-\beta)}-G\rho^2$$
$$=\frac{t(1-t)}{2}+\lambda\frac{(1-t)^2}{4}-\frac{A}{1-\theta}-\gamma\frac{\beta-\rho w-\rho(1-\theta)\frac{(1-t)^2}{4}}{\rho(1-\beta)}-G\rho^2 \quad \text{(A.17)}$$

The first order conditions of (A.17) with respect to t and θ are:

$$\frac{\partial V^{bc}}{\partial t}=0: \quad \frac{1}{2}-t-\lambda(\frac{1-t}{2})+\frac{\gamma(2\rho-2\rho t-2\rho\theta+2\rho\theta t)}{4\rho(\beta-1)}=0 \quad \text{(A.18)}$$

from which:

$$t=\frac{\gamma(1-\theta)-(1-\beta)(1-\lambda)}{\gamma(1-\theta)-(1-\beta)(2-\lambda)} \quad \text{(A.19)}$$

and

$$\frac{\partial V^{bc}}{\partial \theta}=0: \quad -\frac{\gamma(1-t)^2}{4(1-\beta)}-\frac{A}{(1-\theta)^2}\le 0 \quad \text{(A.20)}$$

A.20 holds with strict equality if $\theta>0$ and with strict inequality if $\theta=0$. Since $-\frac{\gamma(1-t)^2}{4(1-\beta)}\le 0$ and $-\frac{A}{(1-\theta)^2}<0$, the inequality in A.20 must be strict, so $\theta=0$. Inserting this into A.19 yields:

$$t=\frac{\gamma-(1-\beta)(1-\lambda)}{\gamma-(1-\beta)(2-\lambda)} \quad \text{(A.21)}$$

Recalling that by assumption $\gamma\ge 1$, $0<\beta<1$, and $0<\lambda<1$, the numerator of A.21 must be positive. If $\gamma<(1-\beta)(2-\lambda)$, then from A.21, $t<0$, which contradicts the assumption that $0\le t\le 1$. On the other hand, if $\gamma\ge(1-\beta)(2-\lambda)$, then $\gamma-(1-\beta)(1-\lambda)>\gamma-(1-\beta)(2-\lambda)$, implying from A.21 that $t>1$, which also contradicts $0\le t\le 1$. Thus, $b>0$ and $e>0$ cannot both be true in equilibrium.■

Proof of Lemma 2. By the Envelope Theorem (as in A6), we see that

$$\frac{d(\Delta V^*)}{dA} = -\frac{1}{1-\theta^e} + 1 < 0 \tag{A.27}$$

■

Proof of Proposition 2. The proof of this proposition is similar to that of Proposition 1. First, when A is sufficiently large, the ruler needs to set θ to be sufficiently small. In this case, in order to eliminate corruption, the ruler must set t close to 1 so that the official will not take bribes. However, when t is close to 1, the ruler's revenue will be close to zero. Thus, in this case we have $(V^e)^* < (V^b)^*$, which means $\Delta V^* < 0$.

Second, when $A = 0$, the ruler can costlessly set $\theta = 1$, which implies that $b = 0$. In this case, $(V^b)^*$ is the value of V when $b = 0$ and ρ is the value determined by (4.6), in which case $e = 0$. Note that by definition, we know that $(V^e)^*$ is greater than or equal to the value of V when $b = 0$ and ρ is the value determined by (4.6). Moreover, it is easy to verify that when ρ is the value determined by (4.6), it does not satisfy the first order conditions (4.14) and (4.15). Thus, it must be that $(V^e)^*$ is greater than the value of V when $b = 0$ and ρ is the value determined by (4.6), namely $(V^e)^* > (V^b)^*$. Thus, in this case, compared to the case in which the official takes bribes, the ruler is clearly better off: $\Delta V^* > 0$.

From Lemma 2, we know that there exists a threshold level of A, A^{cc}, such that if $A > A^c$, there is a unique equilibrium in which the official takes bribes, and the ruler does not monitor bribe extraction and does not allow the official to embezzle; if $A < A^{cc}$, there is a unique equilibrium in which the official does not take bribes, and the ruler devotes a positive amount of resources to monitoring bribe extraction. Meanwhile, as demonstrated in the text, the ruler allows the official to embezzle a certain amount if Condition (4.20) is satisfied.■

Proof of Proposition 3. When $A = 0$, (4.15) becomes

$$\frac{\gamma w}{\rho(1-\beta)} + \frac{\gamma(\beta - \rho w)}{\rho^2(1-\beta)} - 2G\rho = 0 \tag{A.28}$$

From (A.28), we get

$$\rho = \frac{\gamma\beta}{2G} \tag{A.29}$$

Inserting (A.29) into (4.16) and rearranging, we get

$$2G > \gamma w \tag{A.30}$$

Thus, if (4.18) is satisfied, (A.30) will be not be satisfied, which implies $e = 0$. This is the case when $A = 0$. Then, by continuity, we know that the result will continue to hold when A is sufficiently small. ■

Proof of Proposition 4. From the Envelope Theorem, we get

$$\frac{d(\Delta V^*)}{d\gamma} = -e < 0 \tag{A.31}$$

■

Proof of Proposition 5. From the Envelope Theorem, we get

$$\frac{\partial(\Delta V^*)}{\partial\lambda} = (1-t^e)^2 - \frac{(1-t^b)^2}{4} \tag{A.32}$$

Thus, if (4.19) is satisfied, $\frac{\partial(\Delta V^*)}{\partial\lambda} > 0$ ■

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