THE UNIVERSITY OF QUEENSLAND
AUSTRALIA
CREATE CHANGE

Discussion Paper Series
UQ School of Economics

Paper Name: A Model of Corruption and Heterogeneous Productivity:A Theoretical Approach

Date: February 2023

Nhan Buu Phan and Shino Takayama

Discussion
Paper No. 660

A Model of Corruption and Heterogeneous Productivity: A Theoretical Approach*

Nhan Buu Phan† Shino Takayama‡

February 15, 2023

Abstract

We consider a model of corruption in which agents are heterogeneous in their productivity and examine the relationship between productivity and bribery behaviors. There are two types of technologies such that the *good* technology is costly but yields a positive externality to the economy, whereas the *bad* technology is costless but does not generate the positive externality. Because the government cannot perfectly monitor which technology is used, bureaucrats and entrepreneurs may engage in bribes to utilize the bad technology. In equilibrium, there are three regimes possible: (1) all entrepreneurs use good technology; (2) all entrepreneurs use bad technology; and (3) the relatively more productive entrepreneurs use bad technology. We show that the equilibrium is unique, while our dynamic analysis demonstrates that the equilibrium converges to the *clean* regime, where all entrepreneurs employ the good technology as the state capacity increases over time.

*We would like to thank Andrew McLennan, Satoshi Tanaka, and Haishan Yuan for useful discussion, and Premachandra Athukorala, Warwick McKibbin, and other participants at the 2019 Econometric Society Australasian Meeting and 32nd Annual Australian PhD Conference in Economics and Business for their helpful comments. We are grateful to UNU-WIDER and the University of Copenhagen for providing the data from the Vietnam Small and Medium Enterprises survey and Josephine Auer for her excellent research assistance. Any remaining errors are our own.

†Phan; email: b.phan@uq.edu.au; School of Economics, University of Queensland, St Lucia, QLD 4072, Australia.

‡Takayama; email: s.takayama1@uq.edu.au; tel: +61-7-3346-7379; fax: +61- 7-3365-7299; School of Economics, University of Queensland, St Lucia, QLD 4072, Australia.

1 Introduction

Corruption, defined as "the abuse of entrusted power for private gain" (Transparency International, 2020), constitutes one of the world's oldest problems, having persisted since ancient times. Texts dating back to Kautilya's *The Arthashastra* (Rangarajan, 1992), written between 300 BC and 150 AD, have long referred to the problem of state officials harassing merchants for private gains. One common research question to better understand corruption is then which of a firm's characteristics influence its bribing behavior? In this paper, we propose a theoretical model of corruption and heterogeneous agents in productivity and provide equilibrium analysis concerning the relationship between productivity and bribe behavior. Following the literature examining the relationship between productivity and bribery, we ask the key question: Do more productive firms pay bribes, and how does this affect economic outcomes and social welfare?

To motivate our theoretical work, we empirically examine the relationship between bribery and productivity at a firm level using the Vietnam Small and Medium Enterprises (SME) survey and reveal that more productive firms are more likely to pay bribes. We then compare this with different findings in related work, including McArthur et al. (2002), Fisman and Svensson (2007), Dal Bó and Rossi (2007), and Faruq et al. (2013). As we show, seemingly contrasting results have been documented, most notably as an example of the famous *Asian paradox*, which refers to the observation that some Asian countries, such as China, Vietnam, Indonesia, and Thailand have experienced dramatic economic growth along with significant private capital inflow while still being perceived as some of the world's most corrupt countries (see Transparency International, 2020, Campos et al., 1999). This contrasts with many African and Latin American countries, where evidence of widespread corruption coexists alongside poor economic development.

To understand how these contrasting relationships between bribery and productivity exist, and their consequences, in the theoretical analysis, we provide a tractable model of corruption where agents differ in productivity and in equilibrium. Our theoretical framework is based on Acemoglu and Verdier (2000). In the static setting, the government acts as a benevolent social planner and makes job offers as a bureaucrat to some proportion of agents. Agents offered a job can accept and the remaining agents become entrepreneurs. An entrepreneur can choose between the good or bad technology. For its part, the good technology yields a positive externality to the economy. This externality can be thought of as good knowledge or less pollution caused by more advanced technology. There are two types of bureaucrats: honest and corrupt. These bureaucrats are self-interested, and we assume the corrupt type accepts bribes, a situation that is difficult to monitor perfectly. Conversely, the good technology is assumed to be costly and for some entrepreneurs it is more beneficial to use the bad technology and pay bribes when facing a corrupt bureaucrat. Lastly, the government incurs costs auditing both bureaucrats and entrepreneurs.

In equilibrium, we show that different patterns of petty corruption and economic outputs, which we refer to as *regimes*, could arise across nations. We consider in detail one key factor, namely *state capacity*, which is defined as the ability to raise taxes and sustain markets, including the power to enforce regulations and contracts (Besley and Persson, 2010). We demonstrate that the equilibrium is unique and that the equilibrium dynamically converges to an outcome of no corruption as state capacity increases. Our analysis thus contributes to existing research on corruption models in that we provide a tractable model in which in equilibrium, agents make different decisions on bribery depending on their own productivity. Furthermore, our dynamic model comprises a series of single-period models described in a static setting, and therefore allows us to analyze how the proportion of corrupt entrepreneurs in an economy changes when that economy's fundamental variables, including state capacity, evolve over time. We reveal that as state capacity increases over time, the equilibrium regime converges to the clean regime where all agents choose the good technology. We also computationally provide welfare analyses about how social welfare evolves alongside state capacity.

Related Literature

The effect of corruption on economic growth has long been debated, and can be divided into two opposing views, as represented by the "sanding the wheel" and the "greasing the wheel" hypotheses. The former states the convention that corruption is thought to impede economic growth by removing wealth that could have otherwise been redistributed to society (see, for example, Shleifer and Vishny, 1993, Mauro, 1995). In contrast, the latter starts with Leff (1964) who argues that corruption can, in some cases, promote economic growth. This hypothesis has been further supported in both empirical and theoretical analyses, including Huntington (1968), Lui (1985), and Méon and Weill (2010).

Theoretical Literature

The first formal theoretical analysis of corruption was by Rose-Ackerman (1975), whose model consists of many sellers competing for a government contract, and specifies the situations where bribery is likely to occur. Subsequently, many aspects of corruption have been analyzed using different theoretical frameworks. For example, Lui (1985) presents corruption in a queuing model and concludes that some degree of corruption is desirable to none, at least in terms of social welfare. However, the more recent literature has assessed corruption in an asymmetric information setting (for example, see Basu et al., 2016). Strîmbu and González (2018) investigate the effects of government transparency on political corruption within a principal–agent model with an official as the agent and two principals, namely the public and a corruptor.

Of these studies, our analysis is most related to Acemoglu and Verdier (2000), which considers the alternatives between corruption and market failure. In their model, a firm is presented with two technological choices, one of which is costly to implement but creates positive externalities and is then the "good" technology, while the alternative, the "bad" technology, is free but does not create any externalities. In the absence of government intervention, all firms choose the bad technology, thereby creating market failure. When the government steps in to correct market failure, it then must rely on self-interested bureaucrats, who in turn can demand bribes from firms to misreport their inspections, which is possible given imperfect monitoring by the government. This creates the opportunity for corruption, as well as the possibility of misallocating resources. However, given some conditions, some degree of corruption remains preferable to the alternative of market failure. In this case, corruption can be considered a necessary evil to address market failure, and thus is not entirely harmful. We extend this analysis to allow for heterogeneous productivity, thereby connecting empirical findings in the literature about the relationship between productivity and corruption to our theoretical analysis.

Our work also follows another strand of literature that examines the dynamics of bribery behaviors. Using a sequential game between an individual and an auditor that can potentially receive a bribe from the individual, Banerjee and Vaidya (2019) examine the effects of penalties for corruption and tax evasion between a tax-paying citizen and an auditor. Hong and Yin (2019) identify an optimal anti-corruption policy when a bribe-taking bureaucrat can strategically demand an optimal bribe schedule. Harstad and Svensson (2011) formulate a dynamic model comprising firms, bureaucrats, and the government. In this model, firms, when facing a government regulation, can either comply, bend, or change the rule, the latter two through bribery and lobbying, respectively. The subgame perfect equilibrium then depends on the country's level of development, such that firms in countries with a lower (higher) level of development bribe (lobby) more.

We augment this literature by introducing state capacity into a model that extends the canonical analysis in the literature across two dimensions, time horizon and productivity, and show how the equilibrium regime converges to the clean regime where no corruption arises as state capacity increases. Elsewhere, Besley and Persson conduct a series of analyses of state capacity (Besley and Persson, 2008, 2009, 2010, 2011), examining internal political conflicts (Besley and Persson, 2009, 2010), state fragility (Besley and Persson, 2011), and external wars (Besley and Persson, 2008) in relation to the level of state capacity. Overall, they show that when state capacity is low, a nation continues to be poor.

Empirical Literature and the Asian Paradox

In general, empirical work on the relationship between firm productivity and bribe behavior has revealed it to be primarily negative when using African or South American data (see McArthur et al., 2002, Faruq et al., 2013, Dal Bó and Rossi, 2007, Fisman and Svensson, 2007). However, in contrast, some studies have concluded a positive relationship, mostly in Asian countries, including Indonesia and Vietnam. This forms the so-called *Asian paradox*, which refers to the simultaneous existence of high levels of corruption and economic output. For example, using Indonesian data between 1975 and 1995, Vial and Hanoteau (2010) find a positive and significant correlation between productivity and bribery. Our paper also relates to the Asian paradox literature, with our analysis of a sample of Vietnamese small and medium-sized enterprises (see Appendix A), which also exhibits a positive and significant relationship between productivity and bribery.

There has been much discussion about the precise cause of this Asian paradox (see Campos et al., 1999, Wedeman, 2003, Rock and Bonnett, 2004, Vial and Hanoteau, 2010). Campos et al. (1999) define *corruption predictivity* as how firms perceive how much to bribe, and once they do, what benefits they can gain. They classify countries into three categories: (i) a high level of corruption and low corruption predictability; (ii) a high level of corruption but higher corruption predictability than in the first group; and (iii) a low level of corruption and a high level of corruption predictability. It was found that countries exemplifying the Asian paradox lie in category (ii), whereas developed countries are in category (iii).

According to Wedeman (2003), in Africa and Central America, corruption diverts resources from the private sector to political leaders, who then move the resources outside the country to safe havens, while in many East Asian economies, corruption provides connections between the government and the private sector. For this reason, Wedeman (2003) describes the Asian corruption model as "developmental corruption." All of these factors provide strong evidence for the Asian paradox, leading to the question of how these contrasting relationships can coexist. Our model aligns with analyses concerning the Asian paradox in the sense that corruption is predictable, and agents compare the costs and benefits of paying or receiving bribes. We assume the government is concerned about the level of economic output and attempts to maximize social welfare. We first examine the level of corruption in equilibrium, and how corruption changes when there is a change in state capacity. We then computationally demonstrate how the equilibrium regime converges to the clean state, which can be considered as category (iii) using the classification in Campos et al. (1999), when state capacity increases.

Organization of the Paper

The remainder of the paper is structured as follows. Section 2 develops our model of corruption. Section 3 provides the equilibrium analysis and some numerical simulations. Section 4 concludes.

2 The Model

Our dynamic model is a series of single-period models described in a static setting. We first focus on explaining the static economy. In the model, there is a benevolent government, and a continuum of risk-neutral agents of mass one. Suppose that all agents live only for one period. The set of all agents is denoted by $\mathcal{I}$. Agents choose between two jobs: they can become an entrepreneur or a bureaucrat. They can then choose either a bad or a good technology. Suppose that each agent i is associated with productivity a_i. The density of a_i is given by a continuous function f with support $[0, 1]$.

Entrepreneurs choose between two types of technology, bad or good. Both technologies generate the same output equal to $a_i y$ for agent i with productivity a_i for a possible maximal production level of $y > 0$, but their cost to the firm and externalities posed for the wider economy differ. Following Acemoglu and Verdier (2000), we refer to the two technologies as "good" and "bad" because of the assumption that the former creates a positive externality for the economy. More formally, we assume that there is a positive nonpecuniary effect on the payoff of all agents equal to $U(n \cdot x)$ for a strictly concave $U : [0, 1] \to I\!R_+$ and $U(0) \leq 0$. We assume $\lim_{z \to 0} U'(z) = +\infty$ for technicality.

While the outputs for the two technologies are identical, their costs differ. The bad technology does not cost anything, whereas the good technology generates a fixed cost $\bar{e} > 0$ and a variable cost ey in producing output y, where we assume $0 < e < 1$. Intuitively, the fixed cost $\bar{e}$ is the initial investment cost, while the variable cost ey is the reduction in firm performance from adopting the good technology. The choice of using the bad (or good) technology is denoted by B (or G). Let $\Psi = \{B, G\}$.

In the economy, there is a benevolent government that has an initial endowment of L. This government hires bureaucrats to inspect the technology choices made by entrepreneurs. We assume that the government offers an inspection wage w for a bureaucrat for each inspection conducted. If the entrepreneur is found using a good technology, the entrepreneur obtains a subsidy s following the inspection. Alternatively, when an entrepreneur i is found to be using a bad technology, the entrepreneur loses production $a_i y$. When this arises, we denote this confiscation of $a_i y$ as a *tax*. We assume that all entrepreneurs will be inspected. Because the ratio of entrepreneurs and bureaucrats is n to $1 - n$, the average frequency of inspection per bureaucrat is given by $\frac{n}{1-n}$, which is the population share of entrepreneurs divided by the population share of bureaucrats. When there are more entrepreneurs than bureaucrats, a bureaucrat is randomly assigned to multiple entrepreneurs.

Let $\mathcal{N}$ denote the set of agents that become an entrepreneur and $|X|$ the size of a set X and suppose $|\mathcal{N}| = n$. The government selects the size $(1 - n)$ of bureaucrats offered a job. In what follows, we interchangeably say that the government chooses n because it is equivalent. Let $\mathcal{N}^C \equiv \mathcal{I} \setminus \mathcal{N}$ be the set of bureaucrats. We assume that the government offers a job prior to the realization of each agent's productivity as an entrepreneur or the realization of an honest or dishonest type as a bureaucrat.

Once an agent becomes a bureaucrat, they discover whether they are good at taking bribes b or not. The probability that an agent is good at taking bribes (the "dishonest" type) is m. Each time an agent conducts an inspection, they obtain wage w. If the entrepreneur is using a bad technology, the agent offers to bribe the bureaucrat. If the bureaucrat accepts the bribe, they obtain both a salary w and a bribe b, otherwise the agent receives only the salary w.

Once an agent becomes an entrepreneur, they discover their productivity. Conversely, Acemoglu and Verdier (2000) assume that once an agent becomes a bureaucrat, they discover their bribe-taking type. Here, we apply the assumption to the heterogeneous productivity of agents as well as their honest or dishonest type as a bureaucrat; that is, we assume that agents do not know their type or productivity before choosing their profession.[1] Agents only know the average productivity of the population. Therefore, the selection of agents that the government offers a job is uniform across and independent of their productivity as an entrepreneur. Thus, the density of a_i itself is not affected by the choice of government offers.

Finally, we assume that the government can organize an audit of bureaucrats and entrepreneurs at the end of the game. Dishonest-type bureaucrats are detected with probability $\hat{q} \geq 0$ by the audit, while those that are not good at taking bribes (the "honest" type) are caught with probability $q > \hat{q}$. When a bureaucrat is found to receive a bribe from the entrepreneur using the bad technology, they lose their wage. Let $w = (1 - q)(w + b)$, such that the honest type of bureaucrat does not accept bribes, which implies $b = \frac{q}{1-q} w$. We also assume $w > m\hat{q}(w + b)$, or $1 > \frac{m\hat{q}}{1-q}$, so that the expected amount a dishonest type of bureaucrat loses when being found does not exceed what they already have. In our dynamic setting, an agent lives for one period, and this is the maximum the government can confiscate from each agent. Without loss of generality, suppose that if a bureaucrat is indifferent between taking and not taking a bribe, they do not take the bribe.

If an entrepreneur chooses the bad technology, they face a dishonest bureaucrat with probability m. They are then detected by the audit with probability $\hat{q}$. If the entrepreneur faces an honest bureaucrat,

[1] Note that in Acemoglu and Verdier (2000), all entrepreneurs are homogeneous in output. Intuitively, it is possible to assume that agents know their type or productivity before they choose their profession. This would add additional complication about their job selection, particularly by introducing some adverse selection features without affecting the general intuition about the equilibrium.

they are reported with probability $1 - m$. We assume that the auditing cost for each entrepreneur is $M(n)$, which we call the unit audit cost. Let $M : [0,1] \to I\!R_+$ be an increasing and strictly convex function of the size of entrepreneurs n and $M(0) = 0$ and $\lim_{n \to 1} M'(n) = +\infty$. Because the effectiveness of detecting a dishonest type of entrepreneur is constant in the sense that m is given, we assume that the more entrepreneurs there are, the greater is the effort needed to maintain this level of audit effectiveness. Thus, we assume that the unit cost of auditing $M(n)$ is strictly convex in n.

When an agent is offered a job by the government, they do not know their productivity. We assume that each agent faces an equal probability of receiving an offer from the government (independent of their productivity). Let $\mathcal{A} = \{bur\} \cup \Psi$ denote the set of actions possible for agents where bur denotes the action for an agent to accept an offer from the government and become a bureaucrat.

Similarly, the technological choices are determined by each entrepreneur and the selection of n by the government does not affect this technological choice. In other words, the choice of becoming a bureaucrat and the technological choices of entrepreneurs are independent of any realization of their own productivity. We suppose that the economy is scaled at degree one by the government's choice of n.

Because $\mathcal{I} \cap \mathcal{N} = \mathcal{N}$, $\int_{i \in \mathcal{N}} a_i = n \int_{i \in \mathcal{I}} a_i$. Furthermore, let $\mathcal{G}$ and $\mathcal{B}$ denote the set of *agents* that would choose the good and bad technology if they became an entrepreneur, respectively. As such, $\mathcal{G} \cup \mathcal{B} = \mathcal{I}$, because these sets are defined over the set of agents, not only entrepreneurs. Recall that the choice to become a bureaucrat is independent of the productivity distribution. Let $|\mathcal{G}| = x$ and then $|\mathcal{B}| = 1 - x$ for $x \in [0,1]$. In addition, $\int_{i \in \mathcal{N} \cap \mathcal{G}} a_i = n \int_{i \in \mathcal{G}} a_i = n \cdot x$ and $\int_{i \in \mathcal{N} \cap \mathcal{B}} a_i = n \int_{i \in \mathcal{B}} a_i = n \cdot (1 - x)$.

We assume that if $n \in \{0, 1\}$, the government does (does not) conduct an audit. More formally, let $\iota_n = 1$ for $n \in (0,1)$ and $\iota_n = 0$ for $n \in \{0,1\}$. When $n \in \{0,1\}$, $\iota_n = 0$, which indicates that when there are no bureaucrats that conduct inspections, there are no inspections. Overall, when $n = 0$, there is no bureaucrat that conducts an inspection ($\iota_0 = 0$), and when $n = 1$, there is no entrepreneur to inspect ($\iota_1 = 0$). In either case, the government does not organize the audit.

Let $\phi_n = 1 - m + \iota_n m \hat{q}$ and $\phi = 1 - m + m\hat{q}$. Then ϕ_n is the ex ante probability of an entrepreneur to be found that they are using the bad technology after choosing that technology, and ϕ is the probability for an entrepreneur to be found when there is an audit by the government.

The expected payoff of becoming an entrepreneur and choosing a good technology is

$$\pi_G(a_i) = a_i y + U(nx) - \bar{e} - e a_i y + s.$$

The expected payoff of becoming an entrepreneur and choosing a bad technology is

$$\pi_B(a_i) = a_i y + U(nx) - mb - \phi_n \cdot a_i y.$$

The entrepreneur choosing the good technology receives an output dependent on their productivity as well as the positive externalities $U(nx)$. However, the entrepreneur must pay both the fixed and variable costs associated with the good technology. At the same time, the government pays a subsidy s to the entrepreneur. Similarly, the entrepreneur choosing the bad technology produces outputs depending on their productivity, as well as receiving the positive externalities. However, they do not need to pay the costs associated with the good technology. Furthermore, the entrepreneur faces a dishonest type of bureaucrat with probability m, in which case they pay bribe b to the bureaucrat. Finally, once found, which occurs with probability ϕ_n, the production of the entrepreneur is confiscated.

The optimization problem of the government is to maximize social welfare subject to the budget constraint, which is given by

$$W(n) = n(\int_{i\in\mathcal{I}} a_i - e \cdot \int_{i\in\mathcal{G}} a_i) \cdot y - \bar{e}nx - \iota_n nM(n) + U(nx)$$

subject to

$$nw + nxs + \iota_n nM(n) \leq n(1-x)\left(\phi_n \int_{i\in\mathcal{B}} a_i y + m\hat{q}(w+b)\right) + L.$$

Social welfare consists of total production and the positive externalities less the costs associated with the good technologies and auditing costs for n entrepreneurs with unit audit cost $M(n)$. Note that the costs associated with the good technologies include fixed costs $\bar{e}nx$ as well as variable costs $ne \cdot \int_{i\in\mathcal{G}} a_i \cdot y$.

The left-hand side (LHS) of the budget constraint is the government's expenditure, including wages and the costs of the subsidy and auditing. The right-hand side (RHS) is the government's revenue consisting of the confiscated outputs of entrepreneurs using the bad technology and the wages and bribes of dishonest bureaucrats.

Let us start by considering the case where $n(1-x) = 0$ holds in equilibrium. In the model, output confiscated from entrepreneurs using the bad technology is revenue for the government. As such, when $n(1-x) = 0$, there is no revenue for the government save the initial endowment L.

Now, consider the case where $n \notin (0,1)$ and $x < 1$. Then $\phi_n = \phi$ and $\iota_n = 1$. Because there is no motivation for the government to waste resources, the government budget binds and thus the following holds:

$$w = \frac{\phi y(1-x)\int_{i\in\mathcal{B}} a_i - xs - M(n) + \frac{L}{n}}{1-(1-x)m\frac{\hat{q}}{1-q}}. \quad (1)$$

Furthermore, recall that agents do not know their productivity prior to deciding whether they become a bureaucrat when they are offered a job. In addition, the government cannot force them to become a bureaucrat. As such, the wage scheme guarantees that they can at least obtain the worst possible payoff, which corresponds to the case $a_i = 0$. So, we require that the government sets w and s to satisfy

$$w \geq \max\{s - \bar{e}, 0\} = \max\{\pi_g(0), 0\} \tag{2}$$

so that there is always an incentive for agents to become a bureaucrat. We call (2) the *labor allocation constraint*. We note that (2) sets a lower bound for the wage, and the lower bound can be different in the sense that if the government wants to set a higher wage, the RHS of (2), $\pi_g(a_i)$ can be made higher by applying an a_i higher than 0. Here, we assume that the government applies $a_i = 0$ to set an individual rationality constraint for agents to become a bureaucrat.

In Acemoglu and Verdier (2000), the constraint to guarantee that agents are willing to become a bureaucrat is referred to as the *talent allocation constraint*. Here, because we have heterogeneous productivity for each agent and the job offer is made before the realization of productivity, we simply use the term "job allocation," and this follows

$$w \geq s - \bar{e}. \tag{3}$$

In our model, the government is benevolent, but at the same time, has no incentive to pay more than needed. When (3) holds with equality in equilibrium, we call it *an equilibrium with the balanced constraint*, and we particularly refer to this type of equilibrium when $s^* \geq \bar{e}$. As Theorem 1 shows, this type of equilibrium is uniquely determined when the government can actually pay more wages and (2) holds with a strict inequality. In a sense, this type of equilibrium specifies the minimum level of wage that is sufficient to satisfy the labor allocation constraint. Then, combined with (1), we obtain

$$s \quad = \quad \frac{1-(1-x)m\frac{\hat{q}}{1-q}}{1+x-(1-x)m\frac{\hat{q}}{1-q}}\bar{e} + \frac{\phi y(1-x)\int_{i\in\mathcal{B}} a_i - M(n) + \frac{L}{n}}{1+x-(1-x)m\frac{\hat{q}}{1-q}}. \tag{4}$$

The timing of the game is as follows.

1. The government announces the inspection wage, w, the subsidy s, and the size of bureaucrats, n. Those that receive an offer from the government accept to become bureaucrats; the remainder become entrepreneurs. Each bureaucrat then finds out whether they are dishonest or not. Each entrepreneur finds their productivity and chooses a production technology. Their technology choice is not observed by any other agent at this stage.

2. Each bureaucrat inspects the entrepreneurs and discovers whether the entrepreneur has chosen the good or the bad technology if $n \notin \{0, 1\}$. Each bureaucrat decides whether to take the bribe or not and reports on the technology choice of the entrepreneur inspected. If the report is "bad," then the entrepreneur's production is confiscated.

3. The government audits entrepreneurs and bureaucrats if $n \notin (0,1)$ and $x < 1$. Those that have given or received the bribe are found with probability $\hat{q}$ (note that honest bureaucrats do not accept bribes).

Now we formally define an equilibrium of the game in a static setting.

Definition 1. *An equilibrium in the static game consists of agents' actions $(a_i^*)_{i\in\mathcal{I}}$, the proportion of entrepreneurs using good technologies x^*, and the government decisions on the size of bureaucrats, wages, and subsidy (n^*, w^*, s^*) such that*

- *for other agents' actions $(a_{-i}^*)_{i\in\mathcal{I}}$, and the government choices (n^*, w^*, s^*), the agent i does not deviate from their choice $a_i^* \in \mathcal{A}$ to increase their payoff;*
- *for agents' actions $(\psi_i^*)_{i\in\mathcal{N}}$, the government chooses n^*, w^*, and s^* to maximize the social welfare within the budget constraint* (1) *and the labor allocation constraint* (2) *and the talent allocation constraint* (3)*;*
- *the labor market clears in that $|\mathcal{N}| = n^*$, and $|\mathcal{N} \cap \mathcal{G}| = n^* x^*$.*

3 Equilibrium Analysis

This section consists of two parts. First, we present our main theorem in a static setting. The main theorem proves the existence of equilibrium and provides its characterization. Second, we consider the dynamic version of our model. We use this to demonstrate how the equilibrium changes over time as state capacity changes.

3.1 Equilibrium Analysis in a Static Setting

To obtain our main theorem, we start with entrepreneurs' optimal technology choices in the case where $n \in (0,1)$. Then, note that $\iota_n = 1$, and $\phi_n = \phi$. First, consider the difference of the expected payoffs for entrepreneurs between using the good and bad technologies:

$$\mathrm{D}_\pi(a_i) = \pi_G(a_i) - \pi_B(a_i) = (\phi - e)a_i y - \bar{e} + s + mb.$$

Let $\bar{a}$ satisfy $\pi_G(\bar{a}) = \pi_B(\bar{a})$ (namely $\mathrm{D}_\pi(\bar{a}) = 0$). Then, for $b = \frac{q}{1-q}w = \frac{q}{1-q}(s - \bar{e})$,

$$\bar{a} = \frac{s - \bar{e} + mb}{(e-\phi)y} = \left(1 + \frac{q}{1-q}m\right)\frac{s-\bar{e}}{(e-\phi)y}.$$

If $\phi > e$, $\mathrm{D}_\pi(a_i)$ is increasing in a_i, and so for any $a_i > \bar{a}$, $\mathrm{D}_\pi(a_i) > 0$, and thus, agents with $a_i > \bar{a}$ will choose the good technology. If $\phi < e$, $\mathrm{D}_\pi(a_i)$ is decreasing in a_i, and so for any $a_i > \bar{a}$, $\mathrm{D}_\pi(a_i) < 0$, and thus, agents with $a_i > \bar{a}$ will choose the bad technology. In summary, we obtain the following lemma.

Lemma 1. *In equilibrium, if $\phi > e$, agents with $a_i > \bar{a}$ choose the good technology, while if $\phi < e$, agents with $a_i > \bar{a}$ choose the bad technology.*

The interpretation of Lemma 1 is that when ϕ is high, that is, when the government's ability to identify corruption is high, the risk of bribing for an entrepreneur is also high. Then, more productive entrepreneurs use the good technology, because the potential cost associated with the bad technology and bribery is higher relative to the cost associated with the good technology. In contrast, when ϕ is low, by choosing the bad technology and bribe, the potential cost for an entrepreneur is smaller relative to the good technology. So more productive entrepreneurs pay bribes. Conversely, for less productive entrepreneurs, bribing is too expensive, and so they do not pay bribes.

As we show in Theorem 1, in equilibrium, the following three regimes are possible.

1. When $n^* = 1$, all agents become entrepreneurs. Then, $s^* = 0$ and $w^* = 0$. We refer to this equilibrium regime as a *laissez-faire* regime.

2. When $n^* \in (0, 1)$, n^* satisfies the optimality for the government, which is later given by (8), and if $\bar{a} \geq 0$, the equilibrium regime is a *regulatory* regime.

3. When $n^* \in (0, 1)$, n^* satisfies the optimality for the government, which is later given by (8), and if $\bar{a} < 0$, the equilibrium regime is a *clean* regime.

We denote the n^* when the third regime arises by n_1^*. In a regulatory regime, a positive share of entrepreneurs is corrupt, whereas in a clean regime, none are corrupt. When the auditing ability is not high ($e > \phi$) and the government's endowment L is large, a regulatory regime arises in that the government can still choose s^* for which some share of entrepreneurs uses the good technology $x^* \leq 1$. However, when the government's endowment is not so large, a laissez-faire regime arises in which the government cannot provide a wage sufficient for agents to accept the offer and become a bureaucrat. Alternatively, when the auditing ability is high ($e \leq \phi$) and the government's endowment is large, all entrepreneurs use the good technology and a clean regime arises. However, if the government's endowment is not large, the government cannot offer a sufficient wage and all agents become entrepreneurs. Thus, a laissez-faire regime arises.

Now, we formally state our main theorem.

Theorem 1. *An equilibrium always exists, and the equilibrium exists uniquely. In equilibrium, the following holds.*

(I) Suppose that $e > \phi$.

1. If $\phi y \int_{i \in \mathcal{I}} a_i - \bar{e} - M(1) + L > 0$, a regulatory regime arises.

(II) Suppose that $e \leq \phi$.

1. *If $-\bar{e} - M(n_1^*) + \frac{L}{n_1^*} > 0$, a clean regime arises.*
2. *Otherwise, a laissez-faire regime arises.*

Proof of Theorem 1.

Proof of Statement (I): $e > \phi$. By Lemma 1, in this case, more productive firms use the bad technology. So when $\bar{a} \in (0, 1)$, $\bar{a} = x$. Take n arbitrarily. Then we consider whether there is $s > \bar{e}$ to satisfy $w \geq s - \bar{e}$, that is,

$$\phi y(1-x) \int_{i \in \mathcal{B}} a_i - xs - M(n) + \frac{L}{n} = (s - \bar{e})(1 - (1-x)m\frac{\hat{q}}{1-q}) \tag{5}$$

where by letting $k = \left(1 + \frac{q}{1-q}m\right)$,

$$x = \bar{a} = \min\left\{\frac{k(s-\bar{e})}{(e-\phi)y}, 1\right\}. \tag{6}$$

Define $D_0(n)$ and $D_1(n)$ by

$$D_0(n) \equiv d(\bar{e}) = \phi y \int_{i \in \mathcal{I}} a_i - M(n) + \frac{L}{n},$$

and

$$D_1(n) \equiv d(\frac{(e-\phi)}{k}y + \bar{e}) = -\frac{2(e-\phi)y}{k} - \bar{e} - M(n) + \frac{L}{n}.$$

Subcase 1-I. $D_0(1) > 0$. Consider the social welfare function $W(n)$. Let $\iota_n = 1$ and for the purpose of proving the existence of equilibrium, we write $W(n) = F(n, x)$. The function $F(n, x)$ is continuous in $n \in [0, 1]$ and $x \in [0, 1]$. By the maximum theorem, the maximizer $n^*(x)$ is continuous for each $x \in [0, 1]$. In contrast, x defined in (6) is continuous and $x \in [0, 1]$. Then s that satisfies (5) with equality exists and is continuous and belongs to the compact set S. By Kakutani's fixed point theorem, an equilibrium (n^*, x^*, s^*) exists.

Furthermore, note that when s increases, the LHS of (5) decreases while the RHS increases. Define $d(s)$ by the LHS minus the RHS for $s \in [\bar{e}, +\infty)$. Then, $d(s)$ decreases in s. Observe that when $s = \bar{e}$, $x = 0$, and when $s = \frac{(e-\phi)}{k}y + \bar{e}$, $x = 1$. We let $S \equiv [\bar{e}, \frac{(e-\phi)}{k}y + \bar{e}]$. Therefore, there is a unique $s^* \in S$ that satisfies $d(s^*) = 0$. The corresponding s^* satisfies (5), which provides a unique corresponding x^*. So, a regulatory regime arises because $\bar{a} \geq 0$. We now assert that the supporting wage is strictly positive. When $n = 1$, $-M(n) + \frac{L}{n}$ is at a minimum at $L - M(1)$. Because $D_1(n^*) \geq D_1(1) > 0$, $w^* = s^* - \bar{e}$ (with the balanced constraint) is strictly positive to support the employment of $1 - n^*$ bureaucrats and satisfies the equilibrium condition.

Subcase 1-II. $0 \geq D_0(1)$. In this case, for any $s \geq \bar{e}$, $d(s) < 0$. There is no s that satisfies (5). As a result, $s^* = 0$, and $w^* = 0$. A laissez-faire regime arises with $s^* = 0$ and $x^* = 0$.

Proof of Statement (II): $e \leq \phi$**.** In this case, more productive entrepreneurs use the good technology given Lemma 1. If $s^* > \bar{e}$, then $(e - \phi)y \leq 0 < s^* - \bar{e}$. Thus, $\bar{a} < 0$ and all entrepreneurs use the good technology, and $x^* = 1$, and $n^* = n_1^*$ is obtained by Lemma 2.

We denote the maximum $s \geq 0$ that satisfies (4) when $x = 1$ by $\hat{s}(n)$, that is, from (3) and (4),

$$\hat{s}(n) \quad = \quad \frac{\bar{e} - M(n) + \frac{L}{n}}{2}. \tag{7}$$

Then $w^* = -s^* - M(n_1^*) + \frac{L}{n_1^*}$ by substituting $x^* = 1$ and the corresponding n_1^* into (1), and by (7), $s^* \leq \frac{\bar{e} - M(n_1^*) + \frac{L}{n_1^*}}{2} = \hat{s}(n_1^*)$. When $s^* > \bar{e}$ by the equilibrium condition, we must have $0 < s^* - \bar{e} \leq \frac{\bar{e} - M(n_1^*) + \frac{L}{n_1^*}}{2} - \bar{e} = \frac{-\bar{e} - M(n_1^*) + \frac{L}{n_1^*}}{2}$. Therefore, when $-\bar{e} - M(n_1^*) + \frac{L}{n_1^*} > 0$, a clean type of equilibrium arises because there is an $s^* > \bar{e}$, for which $w^* > 0$.

Otherwise, when $-M(n_1^*) + \frac{L}{n_1^*} \leq 0$, there is no $w^* > 0$ to support a positive number of bureaucrats. Then, $n^* = 1$, $s^* = 0$ and $x^* = 0$. Thus, a laissez-faire regime arises. □

To solve for the equilibrium, we examine the optimal proportion of entrepreneurs $n^* \in (0, 1)$ decided by the government, with respect to the different proportions of entrepreneurs using the good technology x.

Lemma 2. *In equilibrium, suppose $\iota_{n^*} = 1$. Then, the government's optimal choice n^* is unique. Furthermore, the following holds.*

- *If $x \neq 0$, n^* satisfies*

$$U'(n^* x) = \bar{e} + \frac{M(n^*) + nM'(n^*) - (\int_{i \in \mathcal{I}} a_i - e \cdot \int_{i \in \mathcal{G}^*} a_i) \cdot y}{x}. \tag{8}$$

- *If $x = 0$, n^* satisfies*

$$M(n^*) + n^* M'(n^*) = y \int_{i \in \mathcal{I}} a_i. \tag{9}$$

Proof of Lemma 2. Suppose that $\iota_{n^*} = 1$, and $x^* \neq 0$. Let $g(n) = nx$. Note the first derivative of social welfare with respect to n is

$$W'(n) \quad = \quad (\int_{i \in \mathcal{I}} a_i - e \cdot \int_{i \in \mathcal{G}} a_i) \cdot y - g'(n) \left(\bar{e} - U'(g(n))\right) - nM'(n) - M(n).$$

By the condition for the maximization for W, and setting $W'(n^*) = 0$,

$$x \left(U'(nx) - \bar{e}\right) \quad = \quad nM'(n) + M(n) - (\int_{i \in \mathcal{I}} a_i - e \cdot \int_{i \in \mathcal{G}} a_i) \cdot y.$$

When $n \to 0$, the LHS is strictly greater than the RHS because $\lim_{n\to 0} U'(nx) = +\infty$. When $n \to 1$, the LHS is strictly smaller than the RHS because $\lim_{n\to 1} M'(n) = +\infty$.

Thus n^* satisfies (8) because $g'(n^*) = x^*$. Because it is assumed that M is an increasing and convex function and $\lim_{n\to 1} M'(n) = +\infty$, there is a unique n^*.

Second, suppose that $\iota_{n^*} = 1$ and $x^* = 0$. Then, $W(n) = n \cdot y \int_{i\in\mathcal{I}} a_i - nM(n)$. By taking the derivative with respect to n, we obtain $W'(n) = y \int_{i\in\mathcal{I}} a_i - M(n) - nM'(n)$. Setting $W'(n^*) = 0$ results in $M(n^*) + n^* M'(n^*) = y \int_{i\in\mathcal{I}} a_i$. Because $M(0) + 0 \cdot M'(0) = 0 < y \int_{i\in\mathcal{I}} a_i$, there exists such an n^*. Once again, because it is assumed that M is an increasing convex function and $\lim_{n\to 1} M'(n) = +\infty$, there is a unique n^*. $\square$

Because $M(n)$ is strictly convex in n and $\lim_{n\to 1} M'(n) = +\infty$ implying that the additional auditing cost increases from $M(0) = 0$ as n increases, the cost of increasing n eventually exceeds its benefit. The first statement of Lemma 2 proves its unique existence when $x^* > 0$.

When $x^* = 0$, $W(n) = n \cdot y - nM(n) + U(0)$. Because $W(0) \leq 0$ and again M is strictly convex, by increasing n from 0, social welfare increases because it brings about more outputs. However, eventually the cost of increasing the size n exceeds the benefit like the other case. Thus, we also obtain the unique existence of n^* in this case.

In the next subsection, we consider the dynamic version of our model. Theorem 1 provides interesting insights about the dynamic relationship between bribing in equilibrium and the underlying parameters of the model.

As discussed in the introduction, we often observe varying patterns of corruption across different regions. Typically, developed countries have a low level of corruption and developing countries have a higher level of corruption (see Campos et al., 1999). In terms of economic growth, in our model, this could be modeled as the expansion of distribution of a_i. That is, when the economy grows, the distribution of a_i could expand from $[0, 1]$ to say, $[0, d + 1]$ for $d > 0$. We can imagine that the advancement of technologies would increase the upper bound of productivity, while the lower bound could stay at the same level as the business environment becomes more competitive. Theorem 1 indicates that if $e > \phi$, a regulatory regime likely arises in equilibrium. At the same time, we can imagine that the costs associated with the good technology, namely $\bar{e}$ and e, could increase. These changes could make the subsidy s, the wage w, and the cutoff $\bar{a}$ all increase. If M and ϕ continue to be the same, then a regulatory equilibrium becomes more probable than a laissez-faire equilibrium. This is because the wage for bureaucrats increases due to economic growth and the incentive to become a bureaucrat also increases.

It is interesting to contemplate what Theorem 1 indicates when making changes to the underlying parameters in the model. However, we defer this issue to future research, and here focus on the changes in state capacity following the analysis in Besley and Persson (2010). We consider that both auditing ability ϕ and the inverse of audit cost M can represent state capacity. As state capacity increases, the ability for the government to monitor and detect corrupt activities would increase and thus ϕ would increase and M would decrease. From this viewpoint, in the next subsection, we theoretically show how an equilibrium transitions from one regime to another and further computationally demonstrate how social welfare changes alongside state capacity.

3.2 Equilibrium Analysis in a Dynamic Setting

In this section we describe a dynamic model in which the economy, at each period, is in a static equilibrium, as described in the previous section. We use subscript t to denote each period t for each variable. A dynamic equilibrium is a path in which, at each period, the economy is in a static equilibrium. In the following proposition, and as a direct result of Theorem 1, we obtain the following result.

Proposition 1. *Suppose ϕ_t increases and $M_t(n)$ decreases for every n over periods t. Every dynamic equilibrium then converges to the clean regime.*

Proof. Because ϕ_t increases every t, $\phi_{t_0} \geq e_{t_0}$ holds at some t_0 and $\phi_t \geq e_t$ for every $t \geq t_0$. Similarly, because $M_t(n)$ decreases for every n over periods, $-\bar{e}_{t_1} - M_{t_1}(n^*_{t_1}) + \frac{L_{t_1}}{n^*_{t_1}}$ holds at some t_1, and $-\bar{e}_t - M_t(n^*_t) + \frac{L_t}{n^*_t}$ holds for every $t \geq t_1$. Therefore for every $t \geq \max\{t_0, t_1\}$, a clean regime arises and this is the unique equilibrium regime given Theorem 1. □

Finally, we provide the results of a computer simulation of the dynamic model. For this purpose, we assume that the a_is are uniformly distributed and $\int_{i \in \mathcal{I}} a_i = 1$. Assume $U(x) = \log x$ and $M(n^*) = -\log(1 - n^*)$. Then $M'(n^*) = \frac{1}{1-n^*}$. By (8), we have

$$\frac{1}{n^*} + \log(1 - n^*) - \frac{n^*}{1 - n^*} = \bar{e}x^* - (1 - ex^*)y. \tag{10}$$

Figure 1 depicts the computationally simulated result for $\bar{a}$ when $y = 10$, $\bar{e} = 0.5$, $e = 0.61$, $m = 0.5$, and $q = \hat{q} + 0.01$. We set the starting value of $\hat{q}$ at 0.2. As Theorem 1 implies, a regulatory regime arises. The figure illustrates how the evolution of state capacity ϕ affects the equilibrium cutoff within the regulatory regime. In our simulation, ϕ stochastically changes over time. More specifically, $\hat{q}$ and q increase at a rate of $(1 + r)$ and $100 \times r$ is uniformly distributed in $[r_d, 1 - r_d]$. Basically the two variables change at r % where r is uniformly distributed in $[r_d, 1 - r_d]$.

In the panels of Figure 1, the blue, red, and black lines show the result for the case of $r_d = -0.4, -0.5, and - 0.6$, respectively. The first panel presents the transition of cutoff $\bar{a}$ and the second panel presents the transition of social welfare W over time. We can see that even though the productivity range is the same, because more entrepreneurs use the good technology, social welfare increases over time.

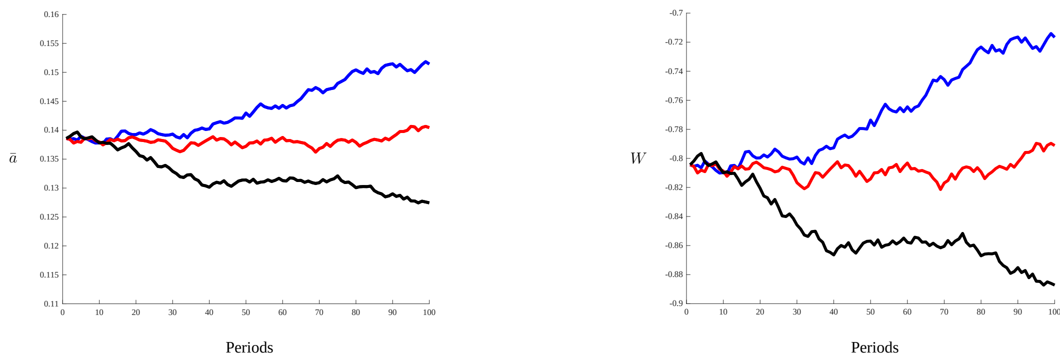

Figure 1: Transition of Cutoffs, and Social Welfare

4 Concluding Remarks

Corruption exists in many forms in countries all over the world. It has persisted since ancient times and has particularly thrived in many developing countries, despite multiple attempts to combat and reduce it. In this paper, we considered the question of how different relationships between firm productivity—an important factor contributing to economic growth—and bribery have come to exist in equilibrium. Our model is built upon the framework in Acemoglu and Verdier (2000) by providing for the heterogeneous productivity of firms.

We showed that while the equilibrium is unique, different equilibrium regimes are possible: all entrepreneurs use the good technology, or the bad technology, or more productive entrepreneurs use the good technology. By studying the dynamic economy, we also showed that the equilibrium regime converges to the clean regime where all entrepreneurs use the good technology as state capacity increases over time.

Because our model is simple, various extensions are possible. Our dynamic model is a series of single-period models described in the static setting. One way to extend our analysis is then to consider the dynamic aspect of capital investment in which once agents invest in the good technology, it continues to be available for future periods, and analyze this dynamic decision-making in relation to corruption.

In the literature, Lambsdorff (2003) identifies four channels of influence through which corruption can adversely affect capital productivity: civil liberties, government stability, law and order, and bureaucratic quality. Moreover, Wei (2000) notes that despite rampant corruption, China remains one of the highest recipients of foreign direct investments among all developing countries. Our model could be extended to this context to reveal how capital productivity affects future investment from other countries.

Furthermore, this model presented a testable hypothesis that is applicable to real-world countries, in both the static and dynamic settings. It would then be interesting to compare what the model predicts in terms of the dynamics of corruption and that obtained from actual data.

A Appendix: The Case of Vietnam

In this section, we examine the relationship between bribery and productivity at a firm level using the Vietnamese SME survey. The results indicate that more productive firms are more likely to bribe and further suggest a positive relationship between output growth and the likelihood of bribery.

The SME survey was conducted biannually between 2005 and 2015 (for details, see CIEM, 2016), and consists of a sample of manufacturing firms across 10 provinces in Vietnam. The survey does not cover either state-owned enterprises or joint ventures with foreign firms, while it includes informal and household enterprises that are not registered with the district authorities. Notably, the survey contains a question about whether the firm has engaged in bribery during the previous two years.

We measure productivity using the two-stage generalized method of moments (GMM) model from Ackerberg et al. (2015) to eliminate the simultaneity bias between inputs and productivity. Then, to test the link between bribery and productivity, we use both logit and probit regression. The list of explanatory variables used in these models includes the productivity term, firm size (as measured by the logarithm of the number of employees), and binary variables indicating the following firm characteristics: if a firm exports, if the firm is formal (by having a tax code), if the owner or manager is a member of the Vietnamese Communist Party, if the firm has borrowed from formal or informal sources, and if the firm submits its financial reports to the government. In addition, we also examine the effects of output growth on bribery in a separate analysis.

Table 1 presents the estimates for the logit and probit regressions. The first two columns contain the full sample size, while the second two columns are for a smaller size to construct the output growth independent variable. We also conduct another separate analysis using only formal firms (i.e., those with a tax code). First, of particular interest is the value of the coefficients for productivity, which are statistically significant and positive in all three analyses, implying that more productive firms are more likely to bribe. For instance, from the logit model in the full sample, a one-unit increase in TFP increases the firm's likelihood of bribery by more than 14%. In the analysis of output growth, although it is not statistically significant, there is also a positive relationship between output growth and bribery likelihood. Furthermore, we also discern a positive relationship between firm size and bribery likelihood.

Finally, there is a clear positive relationship between bribery likelihood and formality status. In other words, if a firm has a tax code, it is more likely to bribe. The same relationship also holds if a firm submits its report to the government. In our separate analysis of only formal firms, the relationship between output growth and bribery is positive and statistically significant at the 90% confidence level.

Table 1: Marginal effects on bribery

Dependent variable:	Full Sample		Output Growth		Formal Firms – Growth	
Bribe Incidence	Logit	Probit	Logit	Probit	Logit	Probit
Productivity	0.1491***	0.0902***	0.2273***	0.1386***	0.2071***	0.1283***
Output Growth	-	-	0.0315	0.0196	0.0706*	0.0440*
Size	0.4024***	0.2440***	0.4323***	0.2627***	0.2506***	0.1536***
Tax Code	0.2532***	0.1555***	0.2001***	0.1238***	-	-
Export	-0.0053	-0.0050	-0.0221	-0.0148	-0.0220	-0.0139
Party	-0.0184	-0.0137	-0.0797	-0.0517	0.0863	0.0510
Formal Lending	0.1570***	0.0957***	0.0811	0.0494	0.1348*	0.0832*
Informal Lending	0.3447***	0.2093***	0.4403***	0.2692***	0.5550***	0.3436***
Audit Report	0.7426***	0.4632***	0.7464***	0.4653***	0.3906***	0.2436***
#Observations	9287		6623		3902	

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The explanatory variable for productivity is the estimated value of total factor productivity (TFP) and size is the logarithm of the number of employees in each firm. All remaining explanatory variables are binary. Explanatory variables are set equal to their mean in the sample.

References

Acemoglu, D. and Verdier, T. (2000). The choice between market failures and corruption. *American Economic Review*, pages 194–211.

Ackerberg, D., Caves, K., and Frazer, G. (2015). Identification properties of recent production function estimators. *Econometrica*, 83(6):2411–2451.

Banerjee, D. S. and Vaidya, S. (2019). Anticorruption reforms, tax evasion, and the role of harassment. *Journal of Public Economic Theory*, 21(1):62–80.

Basu, K., Basu, K., and Cordella, T. (2016). Asymmetric punishment as an instrument of corruption control. *Journal of public economic theory*, 18(6):831–856.

Besley, T. and Persson, T. (2008). Wars and state capacity. *Journal of the European Economic Association*, 6(2-3):522–530.

Besley, T. and Persson, T. (2009). The origins of state capacity: Property rights, taxation, and politics. *American Economic Review*, 99(4):1218–44.

Besley, T. and Persson, T. (2010). State capacity, conflict, and development. *Econometrica*, 78(1):1–34.

Besley, T. and Persson, T. (2011). Fragile states and development policy. *Journal of the European Economic Association*, 9(3):371–398.

Campos, J. E., Lien, D., and Pradhan, S. (1999). The impact of corruption on investment: Predictability matters. *World Development*, 27(6):1059–1067.

CIEM (2016). Characteristics of the vietnamese business environment: Evidence from a sme survey in 2015. *UNU-WIDER*.

Dal Bó, E. and Rossi, M. A. (2007). Corruption and inefficiency: Theory and evidence from electric utilities. *Journal of Public Economics*, 91(5-6):939–962.

Faruq, H., Webb, M., and Yi, D. (2013). Corruption, bureaucracy and firm productivity in africa. *Review of Development Economics*, 17(1):117–129.

Fisman, R. and Svensson, J. (2007). Are corruption and taxation really harmful to growth? firm level evidence. *Journal of development economics*, 83(1):63–75.

Harstad, B. and Svensson, J. (2011). Bribes, lobbying, and development. *American Political Science Review*, 105(1):46–63.

Hong, F. and Yin, Z. (2019). Optimal antibribery policy when bribery type is endogenous. *Journal of Public Economic Theory*, 21(6):1074–1106.

Huntington, S. P. (1968). *Political order in changing societies*. Yale University Press.

Lambsdorff, J. G. (2003). How corruption affects productivity. *Kyklos*, 56(4):457–474.

Leff, N. H. (1964). Economic development through bureaucratic corruption. *American Behavioral Scientist*, 8(3):8–14.

Lui, F. T. (1985). An equilibrium queuing model of bribery. *Journal of Political Economy*, 93(4):760–781.

Mauro, P. (1995). Corruption and growth. *The Quarterly Journal of Economics*, 110(3):681–712.

McArthur, J., Teal, F., et al. (2002). *Corruption and firm performance in Africa*. University of Oxford.

Méon, P.-G. and Weill, L. (2010). Is corruption an efficient grease? *World development*, 38(3):244–259.

Rangarajan, L. (1992). *The Arthashastra*. Penguin Books India.

Rock, M. T. and Bonnett, H. (2004). The comparative politics of corruption: accounting for the east asian paradox in empirical studies of corruption, growth and investment. *World Development*, 32(6):999–1017.

Rose-Ackerman, S. (1975). The economics of corruption. *Journal of Public Economics*, 4(2):187–203.

Shleifer, A. and Vishny, R. W. (1993). Corruption. *The quarterly journal of economics*, 108(3):599–617.

Strîmbu, O. and González, P. (2018). Does transparency reduce political corruption? *Journal of Public Economic Theory*, 20(2):123–135.

Transparency International (2020). Corruption Perception Index. `https://www.transparency.org/cpi2019`. Accessed: 2020-01-29.

Vial, V. and Hanoteau, J. (2010). Corruption, manufacturing plant growth, and the asian paradox: Indonesian evidence. *World Development*, 38(5):693–705.

Wedeman, A. (2003). Development and corruption: the East Asian paradox. In *Political Business in East Asia*, pages 50–77. Routledge.

Wei, S.-J. (2000). How taxing is corruption on international investors? *Review of economics and statistics*, 82(1):1–11.