Entrepreneurship and Rent Seeking under Credit Constraints *

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Abstract

In many countries, stringent regulations constrain firm efficiency and present opportunities for bribing. Still, little is known about the economy-wide consequences of corruption. I study the aggregate effects of business regulations that encourage bribery through the lens of a model in which financially constrained entrepreneurs are subject to both idiosyncratic productivity shocks and a policy distortion that reduces the optimal size of the firm. These entrepreneurs have access to a rent-seeking technology that allows them to bribe to mitigate the policy distortion. While bribery eliminates some of the “sand in the gears,” its full private benefits accrue to the richest—and not necessarily to the most productive entrepreneurs. This misallocation magnifies the aggregate productivity losses from financial frictions and slows down both capital and wealth accumulation. Further, my results suggest that reducing the regulatory burden on firms achieves far better results than “crackdowns” on corruption, which are aimed at reducing bribery without changing the underlying regulations that motivate it. Finally, holding constant the economy’s access to external financing, I show that a low external debt-to-GDP ratio can arise from policies that restrict firm size and encourage bribery. Thus, inefficient institutions potentially dampen the gains from financial development.

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1 Introduction

Dysfunctional political institutions often trouble developing countries. Financial markets allocate funds inefficiently across productive units due to poor contract enforcement, and firms frequently face policies that distort their incentives to invest, hire labor, and grow. In many instances, firms are allowed to influence these policies through bribes, litigation, or lobbying. The possibility of influencing institutions creates rents, and scarce resources are then diverted from productive uses in favor of rent-seeking ones. Because these rent-seeking practices usually require an ongoing commitment of financial resources, their benefits accrue to those with the deepest pockets, and not necessarily to those with the best ideas. Thus, rent seeking can potentially exacerbate the losses from financial frictions.

This paper makes three contributions. First, I quantify the aggregate costs arising from business regulations that encourage bribery. To this end, I develop a model of a small, open economy where financially constrained entrepreneurs are subject to idiosyncratic productivity shocks and a policy distortion that affects the optimal size of the firm. These entrepreneurs have access to a rent-seeking technology that allows them to redirect resources from production to mitigate the scale distortion, which stands in as an idealization of taxes, licenses, permits, and other regulatory barriers. The rent-seeking technology captures many methods that expedite the operations of the firm, including bribery and the use of lawyers. Compared to an economy where credit constraints are the only distortion, I find that bribing magnifies the aggregate productivity losses from financial frictions, and slows down both capital and wealth accumulation. My theory is largely consistent with the findings of Svensson (2003), who finds that the incidence of corruption in Uganda can be explained by the variation in policies/regulations across industries, and that firms’ “ability to pay” and firms’ bargaining power can explain a large part of the variation in bribes across firms.

Second, my model represents the first analysis of the effects of bureaucratic corruption

\[1\text{See, for instance, Amaral and Quintin (2010), who study the effects of limited enforcement on access to finance and development. Restuccia and Rogerson (2008) and Hsieh and Klenow (2009) analyze the effects of firm-specific policy distortions on aggregate productivity.}\]
on heterogeneous firms in a dynamic general equilibrium context. Thus, I contribute to the broader literature on corruption and economic development by providing a theory in which the combination of strict regulation and bribery have both static and dynamic effects. I show that, while bribery eliminates some of the “sand in the gears,” its interaction with credit frictions is conducive to an unequal environment that disproportionally benefits the most unproductive firms. My theory also suggests that reducing the regulatory burden on firms achieves far better results than “crackdowns” on corruption, which are aimed at reducing bribery without changing the underlying regulations that motivate it. I use data on firm regulations and corruption from the World Bank Enterprise Survey to calibrate the rent-seeking parameters, and conduct two counterfactual policy experiments for Colombia and Mexico. I find that eliminating the regulatory burden increases aggregate productivity in Colombia (Mexico) by 8% (7%), the aggregate capital stock by 34% (35%), and GDP by 22% (21%). In contrast, driving the returns to bribery close to zero increases aggregate productivity by only 1.5% (1%), has virtually no effect on the capital stock, and increases GDP by less than one percent.

Third, I contribute to the literature on idiosyncratic policy distortions and misallocation, including the large body of work stemming from Lucas (1990), by providing a theory in which these distortions arise endogenously from the interaction between rent seeking and financial frictions. I show that a low ratio of external debt to GDP, which is often used as a measure of financial development (see, for instance, Midrigan and Xu 2012), can arise from policies that restrict firm size and encourage bribery, even with the same access to external financing. In my model, capital flows from the small open economy—the poor country—to the rest of the world as a result of hostile domestic institutions. Thus, inefficient institutions potentially dampen the gains from financial development. I find that the elimination of business regulations that allow bribery increases net capital inflows by 110% and 100% of GDP for Colombia and Mexico. These numbers are approximately double those observed in the data.
There are many channels through which rent-seeking practices, such as corruption, can damage the economy. In a classic paper, Krueger (1974) discusses different environments that are conducive to competitive rent seeking, inducing the economy to operate inside the efficiency frontier. She argues that competitive rent seeking distorts production decisions along two margins: the allocation of talent and the allocation of other productive inputs. The former has been the focus of important papers by Baumol (1990), Murphy et.al. (1991), and Acemoglu (1995). Most of Krueger’s analysis, however, focuses on the latter: She considers the reallocation of homogeneous workers from production to rent seeking as a result of import licensing. This paper extends that analysis by considering the reallocation of borrowed funds from capital purchases to bribing. In my model, firms engage in both production and rent seeking, since bribing reduces the policy distortion affecting the firm. This specification also borrows from Krueger, who states that

“In most cases, people do not perceive themselves to be rent seekers and, generally speaking, individuals and firms do not specialize in rent seeking. Rather, rent seeking is one part of an economic activity, such as distribution or production, and part of the firm’s resources are devoted to the activity (including, of course, the hiring of expediter).”

To build intuition for the main mechanism in the model, imagine an entrepreneur who starts out with an idea. In a frictionless world, the quality of his idea alone determines the size of his venture, that is, how much capital and labor to hire for production. This entrepreneur can hire labor in a competitive market, and pays his workers the market wage after production takes place. If he is relatively poor, he can only finance his capital purchases using his current wealth as collateral. Therefore, the amount he can raise in the financial market determines his capital stock. Now suppose further that a portion of the entrepreneur’s output is seized by the government, and that he can pay a bribe to some bureaucrat, or hire a lawyer (or some other “expediter”) to exploit institutional loopholes and reduce the “tax.”
The entrepreneur now rationally allocates some of his scarce resources to exploit the rents created by the regulatory environment.

In an economy populated by many of these individuals, wealthy entrepreneurs with mediocre ideas can operate at full scale, while poor, inventive entrepreneurs are limited by the credit constraint. Thus, capital and labor are not efficiently allocated across firms. Moreover, the full benefits from rent seeking accrue to the wealthiest—but not necessarily the most productive of these entrepreneurs. That is, the presence of competitive rent seeking introduces another margin of misallocation of resources. I find that this margin, which has remained largely unexplored in the recent literature, has negative, and potentially large effects on aggregate productivity and capital accumulation.\(^2\) Moreover, I show that the interaction between the credit constraint and the scale distortion, along with the possibility of bribing, act as a highly regressive tax on the returns to entrepreneurship.

\section{Evidence on rent seeking}

\subsection{Corruption}

The World Bank Enterprise Survey provides a window into the bribing practices in different developing countries. The dataset contains firm-level observations for 135 countries and includes sections on corruption and government regulations, along with traditional variables such as labor and capital expenditures. It includes, for example, the “percentage of annual sales going to informal gifts to get things done.” Bluntly put, this variable represents bribes as a percentage of revenues. A major shortcoming of this data source is that it does not include any developed nations, so cross-country comparisons are limited to the developing world. But, as shown in Figure 1, there appears to be a negative relationship between bribery and TFP even among developing countries.

\(^2\)See Banerjee et.al. (2012), who also make the claim that the combination of corruption and finance constraints can cause productivity losses from misallocation.
A second measure of corruption is Transparency International’s Corruption Perception Index (CPI), which allows a comparison between developing and developed countries and is widely used by international financial institutions such as the World Bank and the IMF. The index is scaled from 0 (“highly corrupt”) to 10 (“very clean”). Figures 1a-1d show striking correlations between the CPI and TFP, output per worker, capital-to-output ratios, and debt-to-output ratios.

2.2 Lobbying

Rent-seeking practices also take legal forms. American companies spend hundreds of millions of dollars per year trying to influence legislation by decision-making bodies such as the U.S. Congress, the Securities and Exchange Commission, and the Supreme Court. Using U.S. firm-level data on registered lobbying expenses and financial statements, Kelleher et.al. (2005) find that increasing lobbying expenditures by 1% seems to reduce tax rates in the range of 0.6 to 1.5 percentage points for the average firm that lobbies. In a more recent paper, Chen et.al. (2013) use an updated version of that dataset and find a positive correlation between lobbying intensities and different measures of market and financial performance, suggesting that on average more productive firms tend to spend more on rent seeking.

3 A model economy

The model combines features of the well-known environment of firms with diminishing returns to scale and heterogeneous productivities, as in Lucas (1978), with more recent models of financing constraints, as in Buera et.al. (2011), Midrigan and Xu (2012), and Moll (2012). The novel feature of this model is the inclusion of the rent-seeking technology.

Time is discrete and infinite. There is a continuum of homogeneous workers of total size \( \eta \), endowed with one unit of labor per period, which they supply inelastically. These workers

\[ ^3 \text{See Tanzi (1998).} \]
are hand-to-mouth: They consume their wage each period. A unit continuum of firms operated by managers with time-varying productivities use capital and labor to produce a homogeneous good. Output by firm $i$ at time $t$ is given by

$$Y_{it} = A_{it}^{1-\theta} \left( K_{it}^\alpha N_{it}^{1-\alpha} \right)^\theta,$$

where $A_{it}$ is the manager’s productivity, and $K_{it}$ and $N_{it}$ are the amount of capital and the number of workers hired by the firm, respectively. Firms face an output distortion $\tau$, meaning they only keep $1 - \tau$ of their revenues. This distortion increases with the number of workers hired by the firm, but firms can pay bribes $B_{it}$ to reduce it. I sacrifice generality for the sake of exposition and assume that the rent-seeking technology faced by all firms takes the following functional form:

$$\tau_{it} = \tau_0 \exp \left( -\phi \frac{B_{it}}{N_{it}} \right),$$

where $\tau_0 \in [0, 1]$ and $\phi \geq 0$ are parameters that summarize the institutional environment. This formulation is motivated by two observations. The first is that many countries—both rich like France and poor like India—impose obstructive regulations on production that increase with firm size. The second observation is that firms indeed take actions trying to circumvent regulations and other distortions either legally (through accountants, litigation, lobbying, etc.) or illegally (through bribes and other forms of corruption).

We can think of $\tau_0$ as the prevailing distortion if the firm chooses not to engage in rent seeking, i.e., a statutory tax, and of $\phi$ as measuring the returns to the entrepreneur’s rent-seeking efforts. Colloquially, $\phi$ measures how much bang a firm gets for its buck. Thus, the

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4 Garicano, et.al. (2012) look at the case of France where Employment Protection Laws increase substantially when firms reach 50 employees. Shrivadi and Torrini (2008) study a similar problem for Italy, where these laws become more stringent when firms reach hire number 15. Hsieh and Klenow (2012) suggest that scale distortions that depend on size and productivity could explain the life cycle differences between the U.S. and India and Mexico. These differences themselves imply high TFP losses. Levy (2008) cites payroll taxes, which are more stringently enforced on large firms, as one of the main reasons for the proliferation of small firms in Mexico.
higher $\tau_0$, the more stringent the regulations, while the higher $\phi$, the easier it is for firms to circumvent them. In general, the pair $(\tau_0, \phi)$ can vary across countries, across sectors, or even across firms. In what follows I assume that each economy has a unique pair $(\tau_0, \phi)$, so the only cross-sectional variation in firm-specific wedges is caused by heterogeneity in wealth. Notice that scaling the bribe by $N$ means that in a world without financial constraints all firms face the same $\tau$, regardless of their productivity. When credit frictions are present, however, entrepreneurs who have accumulated enough assets procure the unconstrained optimal $\tau$, while those with high productivity relative to their assets are unable to bribe to the full desirable extent and therefore face a higher $\tau$. The interaction between bribery and credit constraints provides higher benefits to those with relatively deeper pockets than to those with relatively better ideas. In the terminology of Svensson (2003), I am holding constant bargaining power across firms ($\phi$), and focus on how the firms’ ability to pay determines bribes.

The economy is small and open, and borrowers and savers face an exogenous, risk-free interest rate $r$. Firms in this economy have to purchase capital and choose the level of rent-seeking expenditures (bribes) before production takes place, and have access to intra-period debt. However, they are financially constrained and can borrow only in proportion to their current wealth, which is used as collateral. Specifically, a manager with total assets $S > 0$, can spend no more than $\lambda S$, where $\lambda \geq 1$. Thus, $\lambda = 1$ is interpreted as the case in which the entrepreneur cannot borrow externally and $\lambda = \infty$ as the case in which the entrepreneur is not financially constrained.

### 3.1 Static problem

The entrepreneur’s static problem is to choose $(K, N, \hat{b})$, given $(S, A)$ and factor prices $(w, r)$, to maximize end-of-period profits,

$$
\Pi(S, A) \equiv \max_{K,N,\hat{b}} \left[ 1 - \tau_0 e^{-\phi \hat{b}} \right] \left( K^\alpha N^{1-\alpha} \right)^{\theta} A^{1-\theta} + (1 - \delta) K - (1 + r) \left( K + \hat{b} N \right) - w N,
$$
where \( \hat{b} = B/N \) is the bribe per employee, and the up-front payments \( K + B \) are adjusted by foregone interest. Let \( n \equiv N/A \), and \( k \equiv K/A \). In the intensive form, given \( s = S/A \) and \( (r, w) \), choose \( (n, k, \hat{b}) \) to solve

\[
\pi(s) \equiv \max_{n,k,\hat{b}} \left[ 1 - \tau_0 e^{-\phi \hat{b}} \right] \left( k^\alpha n^{1-\alpha} \right)^\theta - (r + \delta) k - \left[ (1 + r) \hat{b} + w \right] n,
\]

s.t. \( k + \hat{b} n \leq \lambda s \),

Let \( \mu(s) \) denote the Lagrange multiplier on the firm’s collateral constraint, and define the interest rate \( \tilde{r}(s) \equiv r + \mu(s) \), which represents the actual cost of funds. If the collateral constraint does not bind, then \( \mu(s) = 0 \), meaning that the entrepreneur is not financially constrained. Solving (2) subject to (3) gives the following system of four nonlinear equations in the four unknowns \( k, n, \hat{b}, \tilde{r}(s) \), all as functions of rescaled assets \( s \):

\[
k(s) = \left( \frac{(1 - \tau)\alpha \theta}{\tilde{r}(s) + \delta} \left[ \left( \frac{\alpha}{1 - \alpha} \right) \frac{w + (1 + \tilde{r}(s))\hat{b}}{\tilde{r}(s) + \delta} \right]^{-\theta(1-\alpha)} \right)^{\frac{1}{1-\theta}},
\]

\[
n(s) = \left( \frac{(1 - \tau)(1 - \alpha)\theta}{w + (1 + \tilde{r}(s))\hat{b}} \left[ \left( \frac{\alpha}{1 - \alpha} \right) \frac{w + (1 + \tilde{r}(s))\hat{b}}{\tilde{r}(s) + \delta} \right]^{-\theta(1-\alpha)} \right)^{\frac{1}{1-\theta}},
\]

\[
\hat{b}(s) = \frac{1}{\phi} \ln \left( \tau_0 \phi \frac{(k^\alpha n^{1-\alpha})^\theta}{n(1 + \tilde{r}(s))} \right),
\]

\[
k(s) + \hat{b}(s)n(s) \leq \lambda s, \text{ with equality if } \tilde{r}(s) > r.
\]

### 3.1.1 Partial equilibrium static analysis of the firm

Consider the problem of a firm that has access to the rent-seeking technology and full access to credit (\( \lambda = \infty \)), taking \( (w, r) \) as given. The system in (4)-(6) does not have
a closed-form solution, but it can be easily verified that the profit function \( (2) \) is strictly quasi-concave, so the problem is well-behaved, and the optimal values of \((k, n, \hat{b})\) are unique. Figure 2 shows that the factor demands \( k \) and \( n \) are decreasing in \((w, r)\). Further, notice that bribe payments are also decreasing in \( r \), since bribes have to be paid up-front.

Bribes are a non-monotonic function of wages. The reason is that very low wage levels make bribes expensive relative to the wage. As wages increase, bribing becomes more attractive and increases up to a critical point, after which bribes start to decline with labor. The range in which bribes are increasing in wages reflects some of the perverse effects of rent-seeking: In that region, firms opt to pay more bribes and hire fewer employees, which increases \( B/N \) and decreases \( \tau \).

Figure 3 shows the effects of the rent-seeking technology on the optimal \((k, n, b)\) and \( \tau \) for an individual firm. As the returns to bribing, measured by \( \phi \), increase, the optimal demands for capital and labor increase. The effect of \( \phi \) on bribes is non-monotonic: This is because when \( \phi \) is very low, bribing “does not pay”. In such cases, \( \tau \) is very close to \( \tau_0 \), and the firm operates at a relatively low scale. As \( \phi \) increases, bribing becomes more attractive. Firms then increase their bribing expenditures and start using more capital and labor. After a critical value of \( \phi \), optimal bribing expenditures start to decline. In that decreasing range firms are getting a lot of “bang for their buck”, so they can significantly lower \( \tau \) with relatively low bribes.

Finally, notice that a higher \( \tau_0 \) depresses factor demands for low levels of \( \phi \), but it becomes less relevant as \( \phi \) increases. This is because when \( \phi \) is relatively high, the firm can easily lower \( \tau \) by bribing. The analysis just laid out is, of course, a partial equilibrium description of an individual firm. In general equilibrium, the rent-seeking parameters \((\tau_0, \phi)\) have an effect on the equilibrium wage rate, as well as on the joint distribution of wealth and productivity.


### 3.2 Inter-temporal choice

The entrepreneur's productivity follows a discrete-state Markov chain with transition probability function

$$Pr(A_{t+1} = A'|A_t = A) = f(A', A).$$

In what follows, I assume that $f(A'|A)$ has a unique stationary distribution, $\tilde{f}(A)$. Because all debt is intra-period, there is no debt accumulation. The dynamic problem of the entrepreneur is a variant of the classic income fluctuation problem: Each period, he receives profits that evolve stochastically over time as a result of productivity shocks, for which there is only partial insurance. The agent increases and depletes his stock of assets as he responds to these shocks, subject to a lower bound for asset holdings. In this case, the natural lower bound for the entrepreneur’s assets is zero, because he needs positive wealth to generate his income stream. Hence, his saving motives are more than purely precautionary.

Entrepreneurs are relatively impatient, which slows down asset accumulation. I model impatience as in Aiyagari (1994), assuming that the entrepreneurs’ subjective discount rate is high relative to the interest rate earned on savings. That is, $\beta(1+r) < 1$. This assumption, together with CRRA utility, ensures that there is an upper bound on the desired level of asset holdings, which I will call $S_{max}$.

Each entrepreneur is characterized by his individual states, the pair $(S, A)$. The aggregate state of the economy is the cross-sectional distribution of entrepreneurs across states, call it $\psi(S, A)$. Define the compact set $S \equiv [0, S_{max}]$ of possible asset holdings, and let the countable set $A$ be the set of all possible individual shocks. The state space is then the product $Z \equiv S \times A$, with typical subset $Z \equiv (s \times a)$.

The entrepreneur’s dynamic program is then

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5In fact, it is never optimal to choose the lower bound.
\[ V(S, A; \psi) = \max_{C, S'} \left\{ \frac{C^{1-\gamma}}{1-\gamma} + \beta \sum_{A' \in A} V(S', A'; \psi') f(A', A), \right\}, \] (8)

\[ s.t \]

\[ S' = (1 + r)S + \Pi(S, A; \psi) - C; \] (9)

\[ S' \geq 0, \]

where I have made explicit the dependence of entrepreneur’s profits on the distribution of entrepreneurs, since the equilibrium wage rate will depend on such.

Since \( \Pi \) has CRS in \((S, A)\), the optimal consumption \( C \) is homogeneous of degree one in \((S, A)\), and \( V \) is homogeneous of degree \( 1 - \gamma \) in \((S, A)\). The optimal consumption policy satisfies a standard Euler equation,

\[ C^{1-\gamma} = \beta \sum_{A' \in A} (1 + r + \mu')C'^{-\gamma}f(A', A). \] (10)

Let \( \mathcal{B} \) denote the collection of all subsets of \( Z \), and define the transition function \( Q : Z \times \mathcal{B} \to [0, 1] \), that is, the probability that an individual with current state \((S, A)\) transits into the set \((s \times a)\) next period,

\[ Q((S, A), s \times a) = \sum_{A' \in a} I\{g(S, A) \in a\} f(A', A), \] (11)

where \( I(\cdot) \) is the indicator function and \( g(S, A) \) is the optimal savings policy. Then, the cross-sectional distribution of entrepreneurs over states \((S, A)\) evolves according to

\[ \psi_{t+1}(s \times a) = \int_{S \times A} Q((S, A), s \times a) d\psi_t(S, A). \] (12)
3.3 Stationary Recursive Competitive Equilibrium

I look for a stationary equilibrium in which the joint distribution of wealth and productivity across entrepreneurs is constant. Even though the aggregate state is constant, entrepreneurs accumulate and deplete assets as they respond to idiosyncratic changes in their productivities, in the spirit of the large class of models inspired by Bewley (1977).

Definition 1 Given a unit-continuum of entrepreneurs, a continuum $\eta$ of workers, a world interest rate $r$, and a transition function $f(A', A)$, with an associated unique stationary density of productivities, $\tilde{f}(A)$, a stationary recursive competitive equilibrium consists of capital, labor and bribing policy functions $K(S, A)$, $N(S, A)$ and $B(S, A)$, a consumption policy function $C^*(S, A)$, with its associated savings policy $S' = g(S, A)$, a wage rate $w^*$ and an invariant measure $\psi(S, A)$ such that,

1. The policy functions $K(S, A)$, $N(S, A)$ and $B(S, A)$ solve the entrepreneur’s static problem;
2. The policy functions $C^*(S, A)$ and $S' = g(S, A)$ solve the entrepreneur’s inter-temporal problem;
3. The stationary measure $\psi(S, A)$ is induced by $(f, A)$ and $g(S, A)$

$$
\psi(s \times a) = \int_{S \times A} Q((S, A), s \times a) d\psi(S, A);
$$

4. The labor market clears:

$$
\int_{S \times A} N(S, A) d\psi(S, A) = \eta;
$$

5. The goods market clears:

$$
\int_{S \times A} A^{1-\theta} \left( K^\alpha N^{1-\alpha} \right)^\theta d\psi(S, A) = w^* \eta + \int_{S \times A} [C^* + B + \delta K + r (K - S)] d\psi(S, A).
$$
In what follows, I assume that this equilibrium is unique. The small, open economy environment with an exogenous interest rate relaxes some of the issues that give rise to multiplicity (see Aiyagari 1994). If the stationary distribution $\psi(\cdot)$ is unique, then all that is needed is that the aggregate labor demand is downward-sloping and intersects the aggregate labor supply just once. We know from the analysis of the entrepreneur’s static problem that the firm-level labor demand $N(S, A; w)$ is continuous and strictly decreasing in $w$. Since the labor supply is constant and perfectly inelastic, there is at least some well-grounded intuition for assuming uniqueness.

See Figure 5 for a visual representation of the labor-market equilibrium. I have normalized the goods price to be equal to one, so that $w$ is the wage rate in GDP units. By Walras’ law, the goods market also clears. Figure 6 shows the shadow cost of funds, the savings and consumption policies, and the value function, all as functions of rescaled assets $s$. High productivity erodes the entrepreneur’s rescaled assets, which increases his shadow cost of funds. He responds by accumulating wealth, which gradually drives the value of the multiplier down to zero and the cost of finance becomes the risk-free rate. Both consumption and the value function are increasing in $s$. Notice that the presence of the scale distortion decreases the cost of funds, savings, consumption, and the value function, for every possible level of $s$. Finally, Figure 7 shows the stationary joint distribution of assets and productivity, and Figure 8 shows both marginals. The rent-seeking technology decreases the desired scale of the firm, and even though firms need funds to finance both bribes and capital, their collateral needs are diminished, inducing them to accumulate less assets compared to an environment with financial frictions only.

### 3.4 Aggregate effects of rent seeking

#### 3.4.1 TFP losses from financial frictions

Consider the centralized problem of allocating the aggregate stocks of capital and labor across a unit continuum of firms, so as to maximize total output.
$$\max_{K_i, N_i} Y = \int_0^1 A_i^{1-\theta} (K_i^\alpha N_i^{1-\alpha})^{\theta} di,$$

subject to

$$K = \int_0^1 K_i di,$$

$$N = \int_0^1 N_i di.$$

Let $\bar{A} = \int_0^1 A_j dj$. In the absence of frictions, capital and labor will be allocated so as to equalize returns to factors across firms, which satisfies, for all $i$,

$$K_i = \frac{A_i}{\bar{A}} K; \quad (13)$$

$$N_i = \frac{A_i}{\bar{A}} N. \quad (14)$$

Aggregate output is then equal to

$$Y = TFP(K^\alpha N^{1-\alpha})^{\theta},$$

where

$$TFP = \frac{Y}{(K^\alpha N^{1-\alpha})^{\theta}} = \bar{A}^{1-\theta}.$$

Now consider an economy where firms are financially constrained as described in the previous section. The labor and capital allocations of the constrained entrepreneurs will be
given by

\[ K_i = \omega_k^i \frac{A_i}{A} K ; \]
\[ N_i = \omega_n^i \frac{A_i}{A} N. \]

The wedges \( \omega_k^i, \omega_n^i \in [0, 1] \) measure the inefficiency in the allocation of resources due to financial frictions. In an economy with financial frictions only, the wedges are

\[ \omega_k^i = \left[ r + \delta \frac{\tilde{r}(s)}{\tilde{r}(s) + \delta} \right]^{\frac{1-\theta(1-\alpha)}{1-\theta}} ; \tag{15} \]
\[ \omega_n^i = \left[ r + \delta \frac{\tilde{r}(s)}{\tilde{r}(s) + \delta} \right]^{\frac{\theta}{1-\theta}} . \tag{16} \]

When both financial frictions and the rent-seeking technology are present, the wedges become

\[ \hat{\omega}_k^i = \left( \frac{1 - \tau(s)}{1 - \tau^u} \right)^{\frac{1}{1-\theta}} \left[ \frac{w^u + (1 + r)\hat{b}^u}{w + (1 + \tilde{r}(s))\hat{b}(s)} \right]^{\frac{\theta(1-\alpha)}{1-\theta}} \left[ r + \delta \frac{\tilde{r}(s)}{\tilde{r}(s) + \delta} \right]^{\frac{1-\theta(1-\alpha)}{1-\theta}} ; \tag{17} \]
\[ \hat{\omega}_n^i = \left( \frac{1 - \tau(s)}{1 - \tau^u} \right)^{\frac{1}{1-\theta}} \left[ \frac{w^u + (1 + r)\hat{b}^u}{w + (1 + \tilde{r}(s))\hat{b}(s)} \right]^{\frac{\theta}{1-\theta}} \left[ r + \delta \frac{\tilde{r}(s)}{\tilde{r}(s) + \delta} \right]^{\frac{\theta}{1-\theta}} , \tag{18} \]

where \((\tau^u, \hat{b}^u, w^u)\) correspond to equilibrium values in an economy with a scale distortion but without financial constraints.

Aggregate productivity is then

\[ TFP = \frac{\int_0^1 \omega^\theta_i A_i di}{\bar{A}^\theta} , \tag{19} \]

where \(\omega_i = (\omega_k^i)^\alpha (\omega_n^i)^{1-\alpha} \).

A central question of this article is whether firm regulations that encourage bribing exacerbate the aggregate productivity losses arising from financial frictions. To answer this
question, we have to compare the TFP of an economy with only financial frictions to that in an environment in which both financial frictions and the rent-seeking technology are present. When a firm is not financially constrained, \( \mu(s) = 0 \), which implies that \( \omega_i^k, \omega_i^n = 1 \), and there is no misallocation in firm \( i \).

Because constrained firms cannot spend as much in bribes as they would like to, the ratio \( (1 - \tau(s))/(1 - \tau^*) \) is necessarily less than one. It would then seem trivial that adding the rent-seeking technology lowers the wedges, increasing TFP losses, since I am just multiplying the wedges arising in a world with only financial frictions by a number between zero and one. However, notice that the rent-seeking technology distorts the desired scale of the firm: Firms demand less capital, so for every possible realization of rescaled assets they demand less funds. This depresses the multiplier \( \mu(s) \) for all \( s \). Thus, the ratio \( (\delta + r)/(\delta + \tilde{r}(s)) \) is closer to one in an economy with both finance constraints and bribing than in an economy with just credit frictions. A similar argument can be made for the labor cost wedges \( \left[ \frac{w^u + (1 + \hat{b})^u}{w + (1 + \tilde{r}(s))\hat{b}(s)} \right] \), since \( w^u \leq w \), but \( \hat{b}^u \geq \hat{b} \). Therefore, the effect of bribing on productivity depends on the parameters \( (\tau_0, \phi) \). The answer to the question is then a quantitative one. In the numerical exercises I conduct in the next section, I find that productivity losses increase considerably as a result of bribing.

3.4.2 Capital and wealth accumulation, and net international investment position

Aggregate wealth is constant in the stationary equilibrium, so net savings are zero: \( \int_S (S' - S) d\psi(S, A) = 0 \). The net international investment position of the economy is

\[
F = \int_{S \times A} (K - S) d\psi(S, A).
\]

If \( F < 0 \), the small open economy is a net borrower with respect to the rest of the world: The wealth accumulated by domestic households is not enough to meet the demand for capital. When \( F > 0 \), the economy is a net lender: The rest of the world provides
better investment opportunities for its extra funds. The scale distortion and the rent-seeking technology reduce the demand for productive factors, which depresses aggregate capital demand. However, it also reduces the need for funds, which decreases aggregate wealth in the stationary state, i.e., the domestic aggregate supply of capital. For very high values of $\tau_0$ or very low values of $\phi$, or a combination of both, the economy can become a net lender. This result is in line with theories of global imbalances as in Caballero, et.al. (2008).

In this environment, business regulations and bribery decrease the returns to entrepreneurship via two channels: lower profits each period, and a lower multiplier, which reduces the incentive to accumulate assets. As mentioned before, the interaction between the credit constraint and the scale distortion, along with the possibility of bribing, act as a regressive tax on the entrepreneur. Figure 9 shows the scale distortion, $\tau$, as a function of assets and productivity. Highly productive entrepreneurs with low assets are subject to a higher distortion than relatively wealthy entrepreneurs with low productivity.

4 Numerical results

4.1 Baseline calibration

I compute the equilibrium under the assumption that the natural logarithm of productivity $a_{it}$ follows an AR(1) process of the form:

$$a_{i,t+1} = \rho_a a_{i,t} + \varepsilon_{i,t+1},$$

where $\varepsilon_{i,t+1}$ is a random productivity innovation drawn from a mixture of two normal distributions: with probability $\kappa$ it is drawn from a normal distribution with mean zero and variance $\sigma_{ah}^2$, and with probability $1 - \kappa$ it is drawn from a normal distribution with mean zero and variance $\sigma_{al}^2$, where $\sigma_{ah}^2 > \sigma_{al}^2$. I approximate the stochastic process for productivity with a finite state Markov chain using the Tauchen (1986) method, and solve the
model via value function iteration using the endogenous grid method described by Barillas and Fernandez-Villaverde (2007). I then compute the consumption and savings decision rules. I solve for the stationary joint distribution of assets and productivity by iterating on the savings decision rule. Details are provided in the Appendix.

Each period is a year. Parameter values are presented in Table 1. With the exception of \((\lambda, \tau_0, \phi)\), all parameter values are taken from Midrigan and Xu (2012). I use their calibration for South Korea—the relatively developed economy—which I take as an economy in which the only friction is credit constraints. This assumption does not imply that South Korea is free of corruption and regulation. Rather, I take Midrigan and Xu’s baseline calibration that matches the size distribution, both the persistence and volatility of growth rates of South Korean firms, as well as the economy’s external debt-to-GDP ratio. I try to stay as close to their calibration as possible and choose Colombia as one of the economies in which both finance constraints and bribery are present. I also calibrate the model to Mexico, a country with recent widely publicized corruption scandals involving bribery. I use information on corporate income tax rates, and set \(\tau_0\) equal to 33% for Colombia, and 30% for Mexico. Reliable data on corruption are elusive, given its secretive nature. The World Bank Enterprise Survey suggests that corruption is a relatively serious issue in Colombia (Mexico), with 53% (50%) of firms identifying it as a major constraint, 13 (10) percentage points higher than the average Latin American country. I calibrate the collateral constraint parameter, \(\lambda\), and the returns to bribing, \(\phi\), to match Colombia’s and Mexico’s ratio of external debt to GDP (51% and 50%) and average bribes as a percentage of revenue (1.6% and 1%). I obtain information on the latter from the World Bank Enterprise Survey.

Results from the baseline simulation are in Table 2. I simulate two versions of the model described above for \(N=20,000\) firms over \(T=150\) periods. The first corresponds to an environment with just financial frictions, while the second is the full model with both financial

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constraints and rent seeking. Financial frictions alone cause TFP losses of 6% for Korea, while the combination of credit constraints and bribing imply productivity losses of 15% for Colombia, and 14% for Mexico. As in Midrigan and Xu (2012), the model overestimates the capital-to-output ratio. In the case of Colombia and Mexico, approximately half of the TFP losses come from the interaction between bribery and credit constraints.

4.2 Counterfactual experiments

A central question in the literature on corruption and economic development is whether bribery hinders or promotes efficiency. In my model, bribery mitigates the effects of regulation, expediting the operations of the firm. However, as explained earlier, the presence of credit constraints creates an environment where bribery disproportionally benefits the most unproductive firms, amplifying the productivity losses from financial frictions. The academic debate notwithstanding, most societies find corruption undesirable and governments, especially those trying to transition into a freer-market environment, often try to implement policies to reduce bribery.

I analyze the effects of two different policies aimed at reducing bribery. The first drives the regulatory burden, as measured by $\tau_0$, close to zero. Because the statutory policy distortion is near zero, there are no incentives to bribe. The second policy is a “crackdown” on corruption: it drives the returns to bribing $\phi$ close to zero. In this case, firms are not getting any “bang for their buck,” so bribes virtually vanish. Thus, both policies achieve the desired first-order result: eliminating bribery.

Results are in Table 3. Setting $\tau_0$ near zero increases aggregate productivity by 7% and 8% for Colombia and Mexico. Capital gains are 35% and 34%, while output increases by 21% and 22%. As I argued previously, the presence of regulations that allow bribery reduces the inflow of foreign capital. The model predicts that the elimination of such regulations, I simulate $N = 20,000$ Markov chains over $T+500$ periods, and discard the first 500 periods, so the results do not depend on initial conditions. I set the initial ($t = 0$) wealth distribution to be uniform and then interpolate from the decision rules obtained from solving the model to generate simulated values for all the endogenous variables in the model for firms $i = 1, \ldots, N$, in periods $t = 1, \ldots, T$. 

20
and thus the incentives to bribe, would increase net capital inflows by 110% and 100% of GDP for Colombia and Mexico. These capital inflows are double those observed in the data.

The second policy, which brings the returns to bribing close to zero, has very modest effects. Aggregate productivity increases by only 1.5% and 1% in Colombia and Mexico. Capital remains virtually unaffected by this policy and output gains are 1% or less for both countries. Net capital inflows increase by 20% and 19%, which are still very modest figures compared to the first policy.

5 Conclusions and speculations

To my knowledge, this paper represents the first attempt to study and quantify both the aggregate and firm-level effects of rent-seeking practices, such as bureaucratic corruption, in the context of a general equilibrium model with heterogeneous agents. I show that heterogeneity in wealth and productivity is crucial to determine the effects of stringent regulations that encourage bribery. Moreover, my results suggest that governments trying to eliminate bribery should tackle the underlying regulations that motivate it, rather than cracking down on corruption by, for example, punishing bureaucrats who receive bribes.

My results also speak to the effects of financial development. A central goal of development policies in the postwar period has been to stimulate the flow of capital from rich to poor countries. The observed low levels of these flows have resulted in a vast literature linking them to inefficient financial markets, which implies that improving creditor’s rights and contract enforcement would increase firms’ access to external financing, thus improving aggregate efficiency and fostering growth. I show that a low debt-to-GDP ratio, which is often used as a measure of financial development, can arise from policies that reduce optimal firm size and encourage corruption, even with the same level of access to external financing. Furthermore, I find that when credit-constrained firms are allowed to spend resources to influence these policies, the aggregate productivity losses from financial frictions
are magnified.

The model I developed here, while novel along some dimensions, leaves out some important aspects of firm behavior. In particular, the decision of firms to enter and exit can be distorted as a result of the scale distortion and the rent-seeking technology. Moreover, because the scale distortion reduces the demand for labor and tends to push the equilibrium wage downward, there can be excessive entry at very low productivity levels, which would further reduce aggregate productivity. This is, of course, pure speculation. But in such a setting, one could think about how regulations and bribery affect the size distribution of firms, the decision between becoming a worker or an entrepreneur, or about the possibility of “purchasing” superior bribing technologies upon entry. The latter can be thought of as a way of modeling the existence of “protected” firms. All of these elements affect the allocation of resources, as well as aggregate efficiency, and open exciting avenues for future research.

References


BECK, THORSTEN, A. DEMIRGUC-KUNT, AND ROSS LEVINE, 2000, “A New Database on


The solution method is as follows

1) I first create a grid for assets $S_p = \{S_1, ..., S_N_s\}$, of size $N_s$, and another for productivities $A_p = \{A_1, ..., A_N_a\}$, of size $N_a$ which I then mesh into a two-dimensional grid (so as to consider all possible combinations of assets and productivities). This generates a $(N_s \times N_a)^2$ mesh, which I call $\{S, A\}$. I then create the set $S/A$, that is, a set that contains every possible value of rescaled assets.

2) The grid for productivities comes from approximating the AR(1) process for log productivity with a finite-state Markov chain using the Tauchen (1986) method as follows: I generate one Markov chain with $N_a/2$ states for the process with parameters $(\rho_a, \sigma^2_{al})$, and another one with $N_a/2$ states for the process with parameters $(\rho_a, \sigma^2_{ah})$. This gives two $N_a/2 \times N_a/2$ transition matrices ($P_{al}, P_{ah}$), which determine the transitions within the high and low transient sets, respectively, and two vectors of $N_a/2$ states each ($a_h, a_l$). The process visits the low transient set with probability $1 - \kappa$, and the high transient set with probability $\kappa$. The resulting $N_a \times N_a$ transition matrix for the process is then

$$P^a = \begin{bmatrix} (1 - \kappa)P_{al} & \kappa P_{al} \\ (1 - \kappa)P_{ah} & \kappa P_{ah} \end{bmatrix}$$

with the corresponding $N_a$-state vector given by
\[
\begin{bmatrix}
al_l \\
ah
\end{bmatrix}
\]

The grid for productivities is then simply \( A_p = \exp(a) \).

3) The static problem of the firm is a nonlinear programming problem which is solved over the two-dimensional grid of assets and productivities using KNITRO. This gives a complete characterization of \( k, n, b, \mu \) for every element in the set \( S/A \), as well as the profit function \( \Pi(S, A) = A\pi(s) \).

4) The solution method for the dynamic problem follows closely that described by Pugsley (2011). I study a Bellman equation of the form:

\[
\tilde{V}_i(s, a) = \max_{s' > s_1} \left\{ \frac{(x - s')^{1-\gamma}}{1 - \gamma} + \beta \sum_j P_{ij}^a V_i(s', a') \right\}
\]

where \( x = \pi(s) + (1 + r)s \) represents all currently available (rescaled) resources to the entrepreneur.

I solve equation (34) via value function iteration using the endogenous grid method described by Barillas and Fernandez-Villaverde (2007), which fixes the values of \( s' \) on the set \( S/A \) and then solves for values of \( x \) such that choosing \( s' \) is optimal.

5) Let \( g^* = \sum_{j'} P_{ij}^a V_i(s', a') \). We start with a guess \( g^*_0 \) for \( g^* \). We can numerically differentiate this with respect to \( s \) and use the familiar envelope condition to obtain consumption

\[
c_0 = (\beta \partial g^*_0 / \partial s)^{-1/\gamma}
\]

We know \( \pi(s) \) from the static problem and so we can solve for \( s_0 \).
Then we can form \( g_1^s = \frac{c_0^{1-\gamma}}{1-\gamma} + \beta g_0^s \). If \( g_1^s \) is “close enough” to \( g_0^s \) stop. Otherwise, start from the top of 5), using \( g_1^s \) as the new starting value.

6) To find the stationary joint distribution of assets and productivity \( \psi(S, A) \), first pick an initial measure \( \psi^0(S, A) \). I initialize the distribution of assets to a uniform over the set \( S_p \) and productivities to its stationary distribution (from the Markov chain). Then, \( \psi(S, A)^{i+1} \) is formed by

\[
\psi^{i+1}(S', A') = \sum_{A \in A_p} \hat{\psi}^i(S^{-1}(S', A), A) F(A'|A)
\]

Where \( S = S(S', A) \) and \( \hat{\psi}^i \) is the measure interpolated on all such \( S \).

7) Repeat 6) until \( \frac{||\psi^{i+1} - \psi^i||}{||\psi^{i+1}||} \) is sufficiently small.
TFP vs. Bribe/Revenue

Data source: TFP from Caselli (2005) and bribe/revenue from World Bank Enterprise Survey
Figure 1: Corruption and macroeconomic performance around the world
Figure 2: Firm-level demand for inputs
Figure 3: Effects of the rent-seeking technology in partial equilibrium
Figure 4: Effects of the rent-seeking technology in partial equilibrium - profits
Figure 5: Labor Market Equilibrium
Figure 6: Shadow cost of funds, decision rules and value function
Figure 7: Stationary joint distribution of assets and productivity
Figure 8: Stationary marginal distributions of assets and productivity

Figure 9: Scale distortion as a function of assets and productivity
Table 1: Parameter Values.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Definition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assigned</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\gamma$</td>
<td>risk aversion</td>
<td>1</td>
</tr>
<tr>
<td>$r$</td>
<td>risk-free rate</td>
<td>0.04</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>capital share</td>
<td>0.33</td>
</tr>
<tr>
<td>$\theta$</td>
<td>span of control</td>
<td>0.85</td>
</tr>
<tr>
<td>$\delta$</td>
<td>depreciation rate</td>
<td>0.06</td>
</tr>
<tr>
<td>$\beta$</td>
<td>discount factor</td>
<td>0.95</td>
</tr>
<tr>
<td></td>
<td>From Midrigan and Xu (2012)</td>
<td></td>
</tr>
<tr>
<td>$\rho_a$</td>
<td>persistence of shocks</td>
<td>0.93</td>
</tr>
<tr>
<td>$\sigma_{al}$</td>
<td>std. dev. of low shocks</td>
<td>0.44</td>
</tr>
<tr>
<td>$\sigma_{ah}$</td>
<td>std. dev. of high shocks</td>
<td>1.90</td>
</tr>
<tr>
<td>$\kappa$</td>
<td>frequency of high shocks</td>
<td>0.065</td>
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<tr>
<td><strong>Calibrated</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\lambda$</td>
<td>collateral constraint</td>
<td>Korea: 3.01, Colombia: 2.27, Mexico: 2.2</td>
</tr>
<tr>
<td>$\tau_0$</td>
<td>statutory tax rate</td>
<td>Korea: 0, Colombia: 0.33, Mexico: 0.3</td>
</tr>
<tr>
<td>$\phi$</td>
<td>returns to bribing</td>
<td>Korea: 0, Colombia: 4.75, Mexico: 4.67</td>
</tr>
</tbody>
</table>
### Table 2: Simulation Results.

<table>
<thead>
<tr>
<th></th>
<th>Korea Data</th>
<th>Korea Model</th>
<th>Colombia Data</th>
<th>Colombia Model</th>
<th>Mexico Data</th>
<th>Mexico Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt/GDP</td>
<td>1.41</td>
<td>1.41</td>
<td>.51</td>
<td>.51</td>
<td>.5</td>
<td>.5</td>
</tr>
<tr>
<td>Bribe/Revenue</td>
<td>-</td>
<td>-</td>
<td>1.6%</td>
<td>1.6%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>K/GDP</td>
<td>2.5</td>
<td>3.4</td>
<td>1.25</td>
<td>2.4</td>
<td>2.06</td>
<td>2.3</td>
</tr>
</tbody>
</table>

**TFP losses:**

<table>
<thead>
<tr>
<th></th>
<th>Korea</th>
<th>Colombia</th>
<th>Mexico</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>6%</td>
<td>15%</td>
<td>14%</td>
</tr>
<tr>
<td>From financial frictions only</td>
<td>6%</td>
<td>7%</td>
<td>7%</td>
</tr>
<tr>
<td>From financial frictions &amp; bribery</td>
<td>-</td>
<td>8%</td>
<td>7%</td>
</tr>
</tbody>
</table>

### Table 3: Counterfactual results.

**Lower regulation—τ₀ = 0.01:**

<table>
<thead>
<tr>
<th></th>
<th>Colombia</th>
<th>Mexico</th>
</tr>
</thead>
<tbody>
<tr>
<td>TFP change</td>
<td>+8%</td>
<td>+7%</td>
</tr>
<tr>
<td>Capital change</td>
<td>+35%</td>
<td>+34%</td>
</tr>
<tr>
<td>Output change</td>
<td>+22%</td>
<td>+21%</td>
</tr>
<tr>
<td>Net capital inflow (% of GDP)</td>
<td>+110%</td>
<td>+100%</td>
</tr>
</tbody>
</table>

**Lower returns to bribery—φ = 0.01:**

<table>
<thead>
<tr>
<th></th>
<th>Colombia</th>
<th>Mexico</th>
</tr>
</thead>
<tbody>
<tr>
<td>TFP change</td>
<td>+1.5%</td>
<td>+1%</td>
</tr>
<tr>
<td>Capital change</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Output change</td>
<td>+1%</td>
<td>+0.75%</td>
</tr>
<tr>
<td>Net capital inflow (% of GDP)</td>
<td>+20%</td>
<td>+19%</td>
</tr>
</tbody>
</table>