Bribery, Plant Size and Size Dependent Distortions *

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Abstract

This paper studies the relationship between bribery, plant size and economic development. Bribery is a transfer from one private party to government officials in order to 'get things done'. Enterprise Surveys data shows that small plants spend a higher fraction of their output on bribery than big plants. In this paper, a one-sector growth model is developed in which size-dependent distortions, bribery opportunities, and different plant sizes coexist. Two sets of exercises are conducted in order to quantify the interplay of size-dependent distortions and bribery. First, the model parameters are calibrated to generate the plant size distribution of the U.S., by assuming the U.S. is free of distortions. Then, size-dependent distortions are introduced to the undistorted economy, and their effects with and without bribery opportunities are compared. Counterfactual exercises show that size-dependent distortions become less distortionary in the presence of bribery opportunities since plants are able to avoid distortions by paying larger bribes. Second, the model is calibrated with distortions and bribery opportunities using Turkish data. The results indicate that the inferred level of distortions are sizable for all plants. The removal of distortions can have a substantial effect on both the output and the mean plant size: Output and mean plant size in Turkey could increase by 63.6% and 82.5% respectively.

Keywords: Bribery, Plant Size, Development, Corruption, Distortion
JEL Classification: E23, L25, O41, O49

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1 Introduction

A growing literature has focused on the misallocation of resources in order to answer why some countries are poorer and have lower productivity levels.[1][2] Guner *et al.* (2008) identify size- dependent policies as one of the direct sources of misallocation. The size-dependent policies favor small establishments and levy higher regulations or taxes on bigger establishments. In this paper, I study the relationship between size-dependent distortions and economic development in the presence of bribery opportunities.

I define bribery as a transfer from a private party to government officials in order to 'get things done'. These 'things' can include acquiring valuable licenses and permits to operate or avoiding taxes. In this paper, I ask and quantitatively answer the following questions: What is the inferred magnitude of distortions when a model is disciplined to account for the plant size distribution and bribery data? What are the aggregate consequences of an increase in the size dependency of the distortions under the presence of bribery opportunities? Finally, how large are the possible gains from removing the distortions with and without the bribery opportunities? These questions have not been answered by the previous literature, even though bribery is prevalent among developing countries. Answers to these questions provide a better understanding of the relationship between bribery, plant size distribution, GDP per capita, and the effects of various policies, such as removing the bribery mechanism and distortions in an economy.

Firstly, I document the facts related to bribery and the plant size distribution in a typical developing country, Turkey. Using representative, plant-level data for the World Bank's Enterprise Surveys (WBES), I show that while bigger enterprises pay higher bribes, they spend a lower fraction of their value added (VA) on bribery. More specifically, 6.8% of big plants and 8.7% of small plants[3] in Turkey experienced a bribe request in 2013. However, big enterprises spent 5.2% of their VA on bribery, whereas small enterprises spent 18.3% of their VA on bribery. Moreover, according to the Annual Industry and Services Statistics of Turkey, 99.6% of all plants are small. Although big plants constitute only 0.45% of the total plants, they account for 43.6% of all formal employment.

Given these facts, this paper asks what the effects of the interplay between size-dependent distortions and bribery are on the plant size distribution and aggregate output. To answer this question, I build a model based on the environment of Guner *et al.* (2008) which uses

[1] See Restuccia & Rogerson (2008), Guner *et al.* (2008) and Hsieh & Klenow (2009).

[2] See Restuccia & Rogerson (2017) for a survey of literature.

[3] Big plants refer to the plants who employ more than 100 workers and small plants refer to the plants with fewer than 100 employees.

a Lucas (1978) span of control framework. Agents in the model are heterogeneous in terms of their managerial ability and they can either be a worker or a manager. My innovation to the span-of-control model is that agents are assigned to a corrupt official with some probability. Managers who encounter the corrupt official, face size-dependent distortions as well as the fixed cost of dealing with corrupt officials. In other words, managers who encounter the corrupt official have to pay the fixed cost and they are subject to a distortion (output tax) depending on their production level. However, since there is a bribery opportunity (the official is corrupt), managers can choose to decrease the distortion level by paying a bribe to evade distortionary size-dependent policies. Although the existence of the corrupt official is exogenous, the amount of the bribe paid by a manager is endogenously chosen by each manager.

There are two key mechanisms that govern an optimal bribe for a plant: the return on the bribe and the distortion rate. The return on the bribe shows how effective the bribery mechanism is. For example, a high return on a bribe indicates an effective bribery mechanism, where managers are able to 'get things done' with comparatively smaller bribes. On the other hand, a low return on a bribe implies that managers need to spend more resources on bribery to solve the problems they face. Similarly, high distortion rates lead managers to spend more resources on bribery activities, because there are more problems to solve. Since managers of plants with high levels of output face distortion rates proportional to plant size, they pay higher bribes than managers with low output levels.

The existence of the corrupt official creates a misallocation of resources via two different channels: First, it distorts managers' optimal input decisions. To be more specific, managers who are assigned to the corrupt official demand less inputs because the corrupt official creates distortions. Second, the corrupt officials distort the optimal occupational sorting of agents. Since agents who are assigned to the corrupt official, have to pay an output tax and a fixed cost, their managerial income would be smaller than the agents who have the same ability level but who are not assigned to the corrupt official. Therefore, some of the agents become workers instead of managers.

In order to quantify the interplay between the size-dependent distortions and bribery, I design two quantitative experiments. First, I calibrate model parameters to generate the U.S. plant size distribution by assuming the U.S. is free of distortions. Then I introduce the size-dependent distortions with and without bribery opportunities separately. The purpose of this exercise is to measure the effect of size-dependent distortions in the presence of bribery and to compare it with the previous literature. In the second quantitative exercise, I calibrate model parameters including distortion rates and the fix cost of bribery by taking advantage of the bribery payment data for Turkey from the WBES. The goal of this exercise is to measure the level of distortions as well as the role of bribery in an economy with distortions.

The U.S. exercise shows that bribery opportunities decrease the negative effects of size-dependent distortions on the mean plant size and on the output. Since bigger plants have more resources to spend on bribery, they are able to circumvent size dependency of distortions. Hence both small and big plants are subject to similar distortion levels after bribes.

For the second quantitative exercise, I use the data on bribery payments of big and small plants, as well as the plant size distribution of Turkey, in order to calibrate key parameters of the model including the size-dependent distortion rate and the return on the bribe parameter.

My results indicate that the inferred distortion levels are sizable: plants are subject to a distortion rate of 28.3% after the inclusion of bribery payments. Small plants pay almost all of their bribe for the associated fix costs since their estimated return on bribe is low. On the other hand, the return on bribes is high enough for big plants since they are subject to higher distortion rates.

Finally, removing size-dependent distortions results in substantial increases in output and mean plant size. Since the size-dependent distortions affect bigger plants more than small plants, bigger plants increase their input demand more than small plants by the removal of distortions. As a result, if distortions associated with being assigned to a corrupt official were removed, aggregate output and mean plant size would grow by 63.6% and 82.5% respectively.

The rest of the paper is organized as follows. The next section provides a concise literature review. Section 3 describes the datasets used and summarizes descriptive facts related to bribery and plant size in the US and Turkey. Section 4 presents the model and derives key equations to compare the different steady-state equilibria. Section 5 describes the calibration of the parameters and discusses the model's behavior with the calibrated values. Section 6 presents counterfactual experiment results, and Section 7 concludes.

2 Related Literature

This paper links the misallocation literature with the corruption-bribery literature. I contribute to the misallocation literature by estimating the level of size-dependent distortions, differentiating by plant size. There are also other studies that try to identify direct sources of the misallocation. For example, Guner *et al.* (2008), Bhattacharya *et al.* (2013) and Guner *et al.* (2015) study the effect of size-dependent policies that limit plant size. Bachas *et al.* (2019) study the aggregate implications of size dependent tax enforcement policies. Ranasinghe (2017) uses the fraction of plants who are exposed to extortion in order to identify the misallocation. He shows that weak property rights that increase extortion can be associated with a 10% decrease in aggregate output. In addition to the direct approach, many researchers have studied plant size distributions across countries. Bento & Restuccia (2017) and Poschke (2014) demonstrate that there is a positive correlation between plant size and GDP per capita. Garcia-Santana & Ramos (2015) measure distortions with the Ease of Doing Business Index. They show that countries with larger distortions have more unproductive and smaller plants.

Corruption can be defined as the misuse of public power for private gain (Svensson (2005)). There are two sides of corrupt activities, corrupt officials that are asking for bribes to 'get things done' and bribe payers. Bribery as defined in this paper is the activity of bribe payers to solve their 'problems'. These problems can be any rule or regulation as well as they can be erected for extracting a bribe. Early examples of the rent-seeking literature focus on a choice of agents that either want to be a (corrupt) official or an entrepreneur (Krueger (1974), Ackerman (1978), Murphy *et al.* (1991), Murphy *et al.* (1993), Shleifer & Vishny (1993) and Acemoglu (1995)). In addition, Ehrlich & Lui (1999) show that investment in socially unproductive capital (political capital) creates a non-linear negative relationship between growth and bureaucratic corruption by developing an endogenous growth model in which agents choose to invest in either political or human capital. Aghion *et al.* (2016) develop an endogenous growth model where tax revenues cannot be spent on infrastructure due to corruption. Since infrastructure is necessary for firm innovation and productivity, corruption negatively affects economic growth. My paper is different from the literature in the sense that in my model there is no choice in being a corrupt official. I focus on the occupational choice of agents, i.e. being a worker or a manager, and bribery choice by managers, given that there are corrupt officials. Lopez (2014) conducts a similar study to my paper by showing financial frictions that not only prevent some productive agents from being managers, but also prevent managers from paying bribes, since bribery is costly. In this paper, I show that the existence of the bribery distorts the allocation of resources and the entrepreneurial choices, without financial frictions in a closed, one-sector, neoclassical growth model.

My calibration strategy is similar to the strategy in Leal (2014), which investigates the relationship between the informal sector and misallocation. In his model, firms choose to be small for tax evasion purposes, because big firms cannot escape tax enforcement. Leal (2014) calibrates the model for the Mexican economy with distortions. However, the distortion level is defined as the total tax revenue over the value added associated with the formal sector, instead of calibrating the distortion level itself. My calibration strategy differs from Leal (2014) in terms of estimating the distortion levels. I calibrate the distortion level by using firm-level bribery data and plant-size distribution in Turkey. Since bribery is illegal and secret, I cannot use the total tax revenue-value added ratio as the distortion rate. In addition, I focus on 'solving problems' or 'getting things done', instead of only focusing on tax evasion.

3 Bribery and Plant Size in Turkey

3.1 Bribery

There are several corruption and governance indices created by the World Bank and independent institutions, such as the World Governance Indicators and Corruption Perception Index of Transparency International. These indices primarily depend on people's perceptions rather than direct measures of bribery. Those indices can generally be regarded as indicative of underlying corruption, however, they do not provide information on the general rate of bribery, relative to size, including the level of sales. I use WBES data to analyze bribery, because it consists of data on whether a firm was asked to pay a bribe by government officials as well as the amount of bribery paid by a typical firm. The WBES has been conducted by the World Bank throughout the world, and it provides detailed enterprise-level data from interviews with top managers/owners. Questions vary from government-firm relationships to employee-employer relationships. The WBES has interviewed more than 177,000 firms in 153 countries since 2005. There are numerous questions about bribery (i.e., 'informal gift or payment') in the WBES.

I use eight questions in the WBES related to bribery. Six of them are about whether managers have been asked to pay bribes during public transactions over the last two years. These questions ask whether any informal gift or payment was requested during a tax inspection or meeting with tax officials, during the application process for electricity or water connections, for construction-related permits, for import and operating licenses. The percentage of firms that experienced at least one bribe payment request in any of the above six transactions is called the bribery incidence indicator of the WBES.[4] An additional separate question asks whether an informal payment or gift was requested if the manager attempted to secure a government contract. Since all these seven questions are prompted only if managers have recently undertaken these specific transactions, the bribery incidence indicator

[4]This indicator is also being used by U.N. Sustainable Development Goals (See SDG 16.5.2).

plus the bribery indicator on public procurement provide the overall occurrence of bribe demands on the enterprises that have engaged in the included transactions. On the contrary, the last question I use is asked to all the enterprises in the sample. It asks: "It is said that establishments are sometimes required to make gifts or informal payments to public officials to "get things done" regarding customs, taxes, licenses, regulations, services etc. On average, what percentage of total annual sales, or estimated total annual value, do establishments like this one pay in informal payments or gifts to public officials for this purpose?" Managers have an option to answer this question either in percentages or in local currency value. I convert answers in local currency to the percentages of sales using the annual sales information, also available from the survey.

The WBES interviewed 1,344 top managers or business owners in Turkey in 2013. In order to achieve a representative sample of the country, the WBES follows a stratified sampling strategy along dimensions of location, sector, and size. The WBES provide public access to the raw enterprise-level data. Using these data requires some functional choices, including the treatment of missing questions due to item non-response. In this case, all instances where bribery rates exceeded total revenues, as well as "Don't Know" or "Refusal" values for the key variables of the number of permanent full-time workers, the total value of annual sales, or the estimated bribery payment, were removed. This process yielded a sample of 812 enterprises.

Table 1 and 2 report the weighted summary statistics of bribery in Turkey. The first column in the tables indicates enterprise size, which shows whether the statistics belong to small enterprises (enterprises with 5-99 employees) or big enterprises (more than 100 employees). Small plants constitute 95.1% of the sample. The second column of Table 1 shows the percentage of enterprises that encounter a bribery request during a public transaction in the recent years. One point eight percent of the enterprises who have done public transaction in recent years were asked to pay an informal payment or gift when they applied for a license, permit or during inspections. Among the small enterprises, 1.8% were asked to pay a bribe whereas, 2.9% of the big enterprises reported that they were asked to pay a bribe. The third column shows the percentage of enterprises who attempt to secure government contracts through bribes. The last column of Table 1 shows Turkey's the overall bribery rate in 2013. This rate shows the percentage of enterprises that encounter bribe requests during any of the six public transactions included in the bribery incidence index, plus the enterprises who use bribes to secure a government contract and the enterprises who reported positive average bribery spending.

Next, I present the amount of bribery spending in order to 'get things done'. Table 2 summarizes bribery payments along both the intensive and extensive margin. Average bribery payments are reported as the percentages of value added (VA) to be consistent with the model I will present in the next section. Gross output to value added ratio in Turkey is 2.1 according to input-output tables. Therefore, the bribery to value added ratio can be obtained by multiplying the bribery to sales ratio by 2.1. By doing so, I assume that total sales can be interpreted as gross output.

The second column of Table 2 reports the average percentage of VA spent on bribery in the extensive margin. This measure includes the enterprises who state that no such payments or favors are needed 'to get things done'. The last column of Table 2 shows similar statistics in the intensive margin. In other words, bribery amount to VA ratio in the intensive margin indicates the average bribe to VA ratio of the enterprises who admitted that they paid bribes.

The bribery data reveals that big enterprises pay larger bribes than small enterprises. However, bigger enterprises' bribery payments, relative to their annual sales is smaller than the small enterprises' bribery payment proportional to their annual sales.[5] On average, 1.4% percent of the annual VA of the enterprises was spent on the bribery. However, if only the enterprises who were asked to pay the bribe are considered, they spent 18.1% of their VA on bribery. The difference between small and big enterprises' bribes to the sales ratio is remarkable. Although 6.8% of large enterprises and 8.7% of the small enterprises experience bribery requests, small enterprises spent 18.3% of their VA on bribery, while big enterprises only spent 5.2% of their VA. This observation concurs with the results in Bai *et al.* (2016) who show that as Vietnamese firms grow, they pay less in bribes relative to their size. Thus, we can conclude that while the amount of the big enterprises' bribery payment is higher than that of the small enterprises, their bribe payment compared to their total annual sales is less than that of the small enterprises.

3.2 Plant Size

The WBES data only interview enterprises with 5 or more employees and Turkish enterprises have 3.6 employees on average. Consequently, the WBES dataset cannot be used to analyze the plant size distribution of Turkey. Instead, I use the Annual Industry and Services Statistics provided by the TurkStat.[6] This data is confidential and contains detailed information for all of enterprises in Turkey. TurkStat annually reports summary statistics, instead of providing

[5] The average VA of bigger plants is 6.23 times higher than that of the smaller plants in WBES.
[6] http://www.turkstat.gov.tr/UstMenu.do?metod=kategorist

micro data. Table 3 reports the plant size distribution in Turkey and the US.[7] Note that these numbers are the average over the period of 2009-2014 for Turkey and 2009-2015 for the US.

The mean plant size in Turkey is almost one fourth of that in the US. Given that the unit of observation in Turkey is the enterprise whereas in the US it is the establishment, this difference would be bigger if establishments were measured in Turkey. This is because enterprises may contain more than one establishment. There are only 3.6 employees in an enterprise, on average, in Turkey. As many as 97.3% of enterprises have 19 employees and 99.6% of enterprises employ fewer than 100 workers. However, enterprises with more than 100 employees employ 43.6% of all workers.

Compared to the US, the plant-size distribution in Turkey is skewed to the left. However, Turkey's total employment size distribution for big plants is similar to that of the US. Turkey's frequency of plants with size between 20 and 99 workers is only 2.2% but it is 13.2% in the US. Turkey's plant size distribution is an example of the "missing middle" literature proposed by Tybout (2000) and Krueger (2007), there are very few middle-sized firms, and employment is concentrated in a few big firms, and there is a large number of small firms.

4 Model

My model's environment is similar to that in Guner *et al.* (2008) which puts forward a Lucas (1978) span-of-control framework in a growth model. The innovation in this paper is the introduction of exogenous corrupt officials who create distortions and that it is possible to decrease some of the distortions by paying (endogenously chosen) bribes. There is a single infinitely-lived representative household which consists of a continuum of members of total size L_t, indexed by time. Household size grows at a constant rate g_n $\left(\frac{L_{t+1}}{L_t} = 1 + g_n\right)$ and household has a preference over the stream of consumption, C_t, discounts the future with $\beta \in (0,1)$ and maximizes:

$$\sum_{t=0}^{\infty} \beta^t L_t \log\left(\frac{C_t}{L_t}\right) \tag{1}$$

Each household member has one unit of time in every period and z units of managerial ability. The managerial abilities are distributed according to a distribution function, $F(z)$, and have a support $\tilde{z}$. Household members can be a worker or a manager. The workers supply labor inelastically and the workers earn W independent of the worker's managerial ability.

[7] https://www.census.gov/programs-surveys/cbp.html

Managers have access to the span-of-control technology and the manager devotes all of their time to production, which is given by the function:

$$y = Az^{1-\gamma}\left(k^{\nu}n^{1-\nu}\right)^{\gamma} \tag{2}$$

where γ is the span-of-control parameter, A is the technology parameter which is common to all managers and grows at a constant rate g_A $\left(\frac{A_{t+1}}{A_t} = 1 + g_A\right)$, k is capital and n is labor used in the production process.

4.1 Distortion, Bribery and Manager's Problem

In this economy, agents are assigned to a corrupt official with some probability depending on their realization of z at birth in order to capture the intensive and extensive margin of the bribery documented in the previous section. That is to say, agents with ability $z < \bar{z}$ are assigned to the corrupt official with probability α_0 and agents with ability $z \geq \bar{z}$ are assigned to the corrupt official with probability α_1. Meeting the corrupt official creates size-dependent distortions in the form of an output tax as well as fixed cost $\bar{b}$. Hence, a manager that is assigned a corrupt official has to pay the fixed cost and the output tax. However, managers have access to a bribery technology which lowers distortions by bribery payments. To be more specific, I assume an average tax rate for the manager who produces output y and pays bribe b, is

$$T(y,b) = 1 - \lambda\left(y - v(y,b)\right)^{-\tau}$$

where τ is the parameter that controls size dependency, $v(y,b) = y\dfrac{\phi b}{1+\phi b}$ is the bribery technology and ϕ is the return on bribe.[8] Notice that when $\tau = 0$ average tax rate becomes $(1-\lambda)$ which is same for all managers regardless of their output level. However, when $\tau > 0$, the managers who produce more, have higher output taxes. If a manager decides not to pay any bribes, she faces an average tax rate of $(1 - \lambda y^{-\tau})$ (because $v(y,0) = 0$). On the other hand, If a manager devotes a large amount of output for the bribery, she will have an average tax rate of $(1-\lambda)$ (because $\lim_{b\to\infty} v(y,b) = y$). To sum up, as the output increases, the managers faces higher distortion rates and they pay higher bribes.

A manager with ability z who faces corrupt official chooses how much labor to hire, how

[8] Size-dependent distortions in the form of $T(y) = 1 - \lambda y^{\tau}$ is first used by Benabou (2002) and it has been used by Guner *et al.* (2015), Bento & Restuccia (2017) and many others in the development literature for size-dependent distortions. Here I introduce the bribery technology to the proposed functional form of size-dependent distortions.

much capital to rent and how much of a bribe to pay in order to maximize her profit. Hence, the managerial income, $\pi_c(z, W, R)$, is:

$$\pi_c(z, W, R) = \max_{\{k,n,b\}} \big(1 - T(y, b)\big)\, y - Wn - Rk - b - \tilde{b} \tag{3}$$

On the other hand, a manager with ability z who is not assigned to the corrupt official chooses only how much labor to hire and how much capital to rent since she does not face any distortions. Therefore, her managerial income , $\pi_{nc}(z, W, R)$ is:

$$\pi_{nc}(z, W, R) = \max_{\{k,n\}} \;\; y - Wn - Rk \tag{4}$$

After the managers choose their optimal bribery amounts, they pay $1 - \lambda(y^* - v(y^*, b^*))$ (effective tax rate) fraction of their output to the government where y^* and b^* are the optimal output and the optimal bribery amount chosen by a manager respectively. The government collects taxes (i.e., the effective taxes) and returns it to the household. That is to say, the government revenue is the net of the tax revenue out of the bribery and this revenue goes back to the household in a lump-sum manner every period:

$$T_t = G_t \quad \forall t \tag{5}$$

where G_t denotes the government revenue and T_t denotes the lump-sum transfers to the household.

4.2 Household's Problem

In every period, the representative household chooses its consumption, C_t, how much will be carried to the next period, K_{t+1}, what fraction of the household members will be workers and managers among the agents who are assigned to the corrupt official, $\tilde{z}_{c,t}$ and, what fraction of the household members will be workers and managers among the agents who are not assigned to the corrupt official, $\tilde{z}_{nc,t}$ to maximize (1):

$$\max_{\{C_t, K_{t+1}, \tilde{z}_{c,t}, \tilde{z}_{c,t}\}_0^\infty} \sum_{t=0}^{\infty} \beta^t L_t \log\left(\frac{C_t}{L_t}\right)$$

s.t

$$C_t + K_{t+1} = I_t(\tilde{z}_{c,t}, \tilde{z}_{nc,t}, W_t, R_t) L_t + (1 - \delta + R_t) K_t + T_t$$

where $K_0 > 0$ given, $\tilde{z}_{c,t}$ is the threshold level for managerial ability to be a manager for household members who have encountered the corrupt official, $\tilde{z}_{nc,t}$ is the threshold level for managerial ability to be a manager for household members who have not encountered the corrupt official, T_t denotes transfers and $I_t(\tilde{z}_{c,t}, \tilde{z}_{nc,t}, W_t, R_t)$ is the income of the household members:

$$I_t(\tilde{z}_{c,t}, \tilde{z}_{nc,t}, W_t, R_t) = W_t \left(\alpha_0 F(\tilde{z}_{c,t}) + (1-\alpha_0) F(\tilde{z}_{nc,t})\right) + \alpha_0 \int_{\tilde{z}_{t,c}}^{\hat{z}} \pi_c(z_t, W_t, R_t) f(z) dz + (1-\alpha_0) \int_{\tilde{z}_{t,nc}}^{\hat{z}} \pi_{nc}(z_t, W_t, R_t) f(z) dz + \int_{\hat{z}}^{\bar{z}} \left(\alpha_1 \pi_c(z_t, W_t, R_t) + (1-\alpha_1) \pi_{nc}(z_t, W_t, R_t)\right) f(z) dz \quad (6)$$

The first item on the right-hand side in equation (6) represents the wage income of workers.The second and the third items stand for the total profit of the managers whose ability level is less than $\hat{z}$. The last two items denote the total managerial income of household members with ability level more than $\hat{z}$.[9]

4.3 Discussion

In this section, the properties of the model in the steady-state equilibrium are presented in detail. The rental rate is constant and per capita consumption, output, and wage grow at a constant rate of $g(g_A)$, over time. Also, aggregate capital, consumption, and output grow at a constant rate $(1+g_n)(1+g)$. The first observation is that the rental rate, R^*, is constant over the steady-state equilibria. To see this, we can arrange the Euler equation (A.9) as follows:

$$R^* = \frac{1+g}{\beta} + \delta - 1 \quad (7)$$

Next, the capital-labor ratio of managers who are assigned to the corrupt official compared to those who are not, is found dividing equation (A.2) by equation (A.1) and dividing equation (A.5) by equation (A.4)

$$\hat{k} \equiv \frac{k_c^*(z, W, R)}{n_c^*(z, W, R)} = \frac{k_{nc}^*(z, W, R)}{n_{nc}^*(z, W, R)} = \frac{\nu}{1-\nu} \frac{W}{R} \quad (8)$$

Despite the fact that capital-labor ratios are the same for all managers regardless of being assigned to the corrupt official or not, managers who are assigned to the corrupt official

[9] Definition of the equilibrium as well as first order conditions to managers' problem is presented in Appendix 7.

demand less capital and labor than managers who have same ability but are not assigned to the corrupt official. In order to see this, for example, divide equation (A.1) by equation (A.4):

$$\frac{n_c(z,W,R)}{n_{nc}(z,W,R)} = \left[\lambda^{\frac{1}{1-\tau}}\left(\tau\phi\right)^{\frac{\tau}{1-\tau}}(1-\tau)\right]^{\frac{1}{1-\gamma}} < 1$$

This is the first source of the misallocation that the existence of the corrupt official creates. In other words, managers who encounter the corrupt official demand less inputs and produce less output.

The second source of misallocation associated with the existence of corrupt officials is through the selection of managers. Consider the first order conditions of the household, equation (A.8). Since $\pi_c(z,W,R) < \pi_{nc}(z,W,R)$ for any values of z, the threshold value for agents who are assigned to the corrupt official to become managers is higher than the threshold value of agents (to choose to become managers) who are not assigned to the corrupt official: $\tilde{z}_c > \tilde{z}_{nc}$. Therefore, some of the agents who would have become managers if they were not assigned to the corrupt official become workers instead.

The effective tax rate, $1-\lambda(y^*-v(y^*,b^*))$, can be also calculated by using (A.1), (A.2) and (A.3):

$$1-\lambda(y^*-v(y^*,b^*)) = 1-\left(\lambda^{\frac{1}{\tau}}\tau\phi\right)^{\frac{\tau}{1-\tau}} \tag{9}$$

The effective tax rate is constant for managers who chose to pay bribes since the effective tax rate is independent of ability, z. This implies that bigger plants who face higher distortion rates can avoid all the distortions that arise from size-dependency by paying bribes. On the other hand, this doesn't imply that all managers necessarily face the same distortions levels. Some of the managers with lower ability may choose not to bribe because the marginal benefit of bribing can be lower than its marginal cost due to the lower distortion rates.

5 Calibration

First, I calibrate the model in order to match the U.S. plant size distribution by assuming that the U.S. is free of distortions and bribery. Then, I also calibrate this model to match Turkey's plant-size distribution as well as the bribery payments of different size groups as observed in the Enterprise Surveys.

For the U.S. I borrow the following parameters from Guner *et al.* (2008) : $g_n = 0.011$ (population growth rate), $g_A = 0.0255$ (productivity growth rate), $\nu = 0.406$, $\beta = 0.9357$, $\delta = 0.04$

and $\gamma = 0.802$. Then I assume a composite lognormal-Pareto distribution for the distribution of managerial ability, $F(z)$.The composite lognormal-Pareto distribution is characterized by three parameters: a standard deviation of the lognormal distribution, σ,a shape parameter of the Pareto distribution, s, and and a threshold value for distributions, $\hat{z}$.[10] This parameter values are found to match the mean size for plants, the fraction of plants with 1–49 employees, and the proportion of workers in big plants in the US. Table 4 and 5 display the calibrated parameter values and the model performance.

For the calibration of the Turkish economy, I borrow some of the parameters from the literature which are calculated using National Income and Product Accounts. I choose the share of capital, $\alpha\gamma = 0.34$, depreciation, $\delta = 0.055$ and discount rate, $\beta = 0.95$ consistent with Atesagaoglu *et al.* (2017) and Atiyas & Bakış (2014). These parameters are used in the Penn World Tables to make cross-country comparisons. Then, I calculate the average population growth rate, $g_n = 0.0209$, over the period of 1950-2014. I set the productivity growth rate, $g_A = 0.0256$,to match the average annual output growth rate as 4.65% over the same period.

Guner *et al.* (2008) estimate the span of control parameter, $\gamma = 0.802$ for the US in which the mean establishment size is 17.09 employees. In addition, Leal (2014) estimates the same parameter for Mexico whose mean establishment size is 5.5 employees and finds $\gamma = 0.76$. Since Turkey's mean enterprise size is 3.6 employees, I choose $\gamma = 0.7$. Given γ, the value of α can be determined as $\alpha = 0.34/\gamma = 0.486$

Next, I assume a composite lognormal-Pareto distribution for the distribution of managerial abilities in Turkey such that the top 1% of the distribution would follow a Pareto distribution. The introduction of distortions requires seven additional parameters to estimate: λ, τ, ϕ, $\hat{z}$, α_0, α_0 and $\tilde{b}$. Finally, there are nine additional parameters (i.e., two for the distribution of ability and six for size-dependent distortions) to estimate: σ, s, λ, τ ϕ, $\hat{z}$, α_0, α_1 and $\tilde{b}$. I discipline these parameters by matching nine moments from the data: the mean plant size, the fraction of plants with 1–49 employees, the fraction of plants with 50–99 employees, the employment share of plants with 50–99 employees, the employment share of plants with more than 100 employees, bribes as a percentage of the output of small plants and big plants, among the plants who paid bribes, and bribes as a percentage of the total output of small plants and big plants regardless of bribes being paid. I use the average of the 2009-2014 data for the plant size distribution moments and I use the 2013 WBES for bribery moments. Tables 6 and 7 summarize the parameter values and the calibration performance.

The assumed distribution function is able to generate the U.S. plant size distribution.

[10] See Scollnik (2007) for more details.

Moreover, although there is some room for improvement with more data and careful parametrization, the model is able to generate not only the plant size distribution of Turkey but also the relative bribery payments of different size groups. Estimated average effective tax rate for small and big plants are equal to 28.3% which implies that bribing is optimal for all plants at the Turkey's benchmark calibration. Even if one cannot directly relate the fraction of the plants who accept that they paid bribe in the data and the probability of being assigned to the corrupt official in the model, the inferred probabilities are far from the fractions that is calculated from the Enterprise Survey data.

6 Results of Experiments

In this section, the results of the experiments are presented. First, I introduce the size dependent distortions and the bribery opportunities to the U.S. economy. Then I run experiments with Turkey's economy, which is calibrated with the size-dependent distortions and the bribery opportunities. These involve analyzing the effects of changing the size dependency of the distortions, the return on bribes, and the probability of meeting with a corrupt official. Then I discuss the consequences of removing bribery and distortions. I compare the new steady-state values of the output, mean size, the employment share of big enterprises, the tax wedge, average effective tax rate, and bribery expenditure with the benchmark steady-state values. Specifically, the tax wedge is defined as following:

$$\frac{1 - T\left(5\bar{y}, 5\bar{b}\right)}{1 - T\left(\bar{y}, \bar{b}\right)} \tag{10}$$

where $\bar{y}$ and $\bar{b}$ indicate average values of output and bribe, respectively. It was, first, defined by Guner *et al.* (2015) and has the following useful interpretation: The tax wedge compares the distortion rate for the manager who produces 5 times the average output with the distortion rate for the manager who produces the average output level. If the distortions are the same for all managers ($\tau = 0$), the tax wedge is equal to one. Also, the tax wedge decreases with the level of size dependency of distortions.

Tables 8 and 9 report the results of the experiments with the U.S. economy. In each table output at the benchmark steady state is normalized to 100, in order to easily compare the experimental results. In addition, λ equals one in each of the tables. Table 8 shows the results of an increase in size dependency without any bribery opportunity. Table 9displays the same experiment with bribery opportunities. In Table 9 the probabilities of meeting a corrupt official, α_0 and α_1 are equal to one, the return on bribes, ϕ, is set to 1.48 and the fixed cost of being assigned to a corrupt official, $\tilde{b}$, is equal to zero.

As Table 8 illustrates, the increase in size dependency (an increase in τ)results in a greater distortion for bigger plants relative to the small plants. This can be observed by the decrease in the tax wedge or the increase in the difference between the average tax rate for small and big plants. As a result, size-dependent distortions reallocate resources from bigger plants to small plants, which gradually decreases the mean size of plants, aggregate output, and the employment share of big plants. These results are in line with the previous literature such as Guner *et al.* (2008), Bhattacharya *et al.* (2013) and Guner *et al.* (2015) and shows the well known effects of size dependent distortions.

Table 9 shows similar experiments with bribery. Since bigger plants face bigger distortion levels, and they have more resources to pay a bribe, they face lower average effective taxes compared to the previous case where there was no bribery opportunity. Moreover, some of the small plants choose not to pay bribes when $\tau = 0.01$ the marginal benefit of the bribery does not exceed its marginal cost for lower levels of τ as discussed in Section 4.3. While an increase in the degree of size dependency of distortions decreases aggregate variables, such as the mean plant size and aggregate output, the effects are relatively smaller than the case without bribery. For example, when τ increases from 0.02 to 0.05, mean size decreases 12% when there is a bribery opportunity, whereas it decreases 54% when there is no bribery.

The effects of size dependency in the Turkish economy where managers have access to bribery technology are presented in the Table 10. Notice that other than τ, all parameters are held constant at the values shown in the Table 6. which results in 2% of small plants and 96% of big plants being distorted. As size-dependent distortion increases, all the managers especially in bigger plants are exposed to higher distortion rates. Although they increase their bribery payments, the average effective tax rate for both big and small plants increase. Hence some of the managers who cannot afford high tax rates become workers, and the remaining managers decrease their labor demand, which decreases the wage rate. Decrease in the wage rate increases labor demand by managers who are not meeting the corrupt official. Since 98% of the small plants are not meeting the corrupt official and 2% of big plants are not assigned to the corrupt official, an increase in the big plants' labor demand is smaller than the increase in the labor demand by small plants. As a result, the mean size, the employment share of big plants and the aggregate output all decrease as size dependency increases.

Table 11 reports the effect of an increase in the size-dependent distortions without bribery opportunities. That is to say, managers who are assigned to the corrupt official still have to pay fixed cost but they are not able to decrease the tax rate by bribing. The mean size, the aggregate output, and the employment share of big plants have the same trend with the last experiment. Average effective tax rates are higher when managers are not allowed to bribe the corrupt official. In addition, the difference between average taxes for big and small is also higher.

The return on bribes shows the effectiveness of the bribery mechanism. Table 12 shows the effect of a change in the return on bribes. The mean plant size, aggregate output, and the employment share of big plants as well as the average effective tax and the average bribery payments of small plants change slightly as the return on bribes changes. Plants increase their bribery spending as the bribery mechanism becomes more effective, i.e. as the return on bribe increases. In return, they have lower average effective tax rates.

Although the existence of corrupt official is exogenous in this economy, we can see the effect of change in the probability of being assigned to the corrupt official in Table 13.In this experiment, I increase the probability of meeting the corrupt official for both size groups from left to right of the table. As the probability increases, more agents are assigned to the corrupt official in the steady state. The newly assigned managers on the margin become workers and the newly assigned managers with high ability levels decrease their input demands. As a result, the mean size, the employment share of big plants and the aggregate output decreases as more managers are assigned to a corrupt official

Table 14 reports the steady-state values without bribes and distortions. When all bribery opportunities in the economy are removed, the aggregate output, the mean size and the employment share of big plants decrease slightly. Without a distortion, there is no incentive to bribe and no fixed cost. Therefore, the aggregate output increases 63.6%, compared to the benchmark case. While the employment share of big plants decreases, the mean size increases by 82.5%.

6.1 Discussion

Experiments conducted with different returns on bribes, distortion rates, and probabilities for the U.S. and the Turkish economy have three primary conclusions: bribery decreases the size dependency of distortions, if bribery opportunities exist a change in distortion levels has smaller effect on the aggregate output, and removing distortions can increase output substantially. The first conclusion is that size-dependent distortions become less distortionary in the presence of bribery opportunities. Bigger plants face higher distortions, but they are also able to spend more resources on bribery. Hence, they reduce their distortion levels more than the small plants. As a result, the difference in distortion rates of small and big plants becomes negligible in the presence of bribery opportunities. If the return on bribes increases, the effective tax rates decrease to even lower values because the managers can solve whatever problem they face with a small amount of bribery. Therefore, the effectiveness of bribery only determines how much of their output will be spent on bribery.

The second conclusion is that with bribery changes in the distortion levels have smaller impact on the economy. Consider the case when the τ increases from 0.01 to 0.05 in Table 10: the output decreases by 10.2% and the mean size declines to 2.85. As τ increases all the managers face higher distortions but increase in the big plants' distortions is relatively higher than the increase in the small plants distortion rates. That being said, plants can rule out the effects of an increase in the distortion level by a small increase in their bribery expenditures. Since they devote a larger amount of output to bribery, they face lower distortions.

The third conclusion is that removing distortions can increase aggregate output and mean size, while it decreases the employment share of big firms substantially. The aggregate output and the mean size increase more than 60% and 80% respectively, and the employment share of the big plants decreases from 43.4% to 31.5% In the benchmark case, even if the managers are able to bribe, the small plants and the big plants face 28.3% effective tax rates in addition to the fixed cost.

There are two consequences of being assigned to the corrupt official: the distortions in the form of an output tax and the fixed cost. Managers are able to decrease the distortion rate but they are not able to avoid the fixed cost associated with meeting the corrupt official. Removal of bribery opportunities does not have big impact on the economy. The mean size, the employment share of the big plants, and the aggregate output slightly decrease. These results show that the effectiveness of the bribery mechanism is low and the effect of the fixed cost is high.

Overall, the results hold when we consider the distortions as given. Since the bribery activities or the existence of bribery opportunities does not affect the level of distortion rates, bribery may look beneficial to the managers. It is important to note that there are no government officials in this model. Hence, I am considering bureaucratic corruption to be exogenous. However, an alternative setting as Svensson (2005)points out that if corruption and distortions are caused by the same set of factors, we cannot remove bribery and keep all the distortions as they are determined at the same time. In fact, corrupt officials may create problems to exploit bribery opportunities (Myrdal (1968)). Therefore, my conclusion would differ if the level of corruption and distortion can be endogenized in a model where government officials create more distortions to exploit bribery and the agents sort themselves into three different careers: worker, manager and government official. This model environment may result in different conclusions because of two reasons: some of the high ability agents may choose to be government officials to enjoy bribery and corrupt officials may increase the distortion levels, as managers pay bribes.

7 Conclusion and Future Work

In this study, I show that big plants in Turkey spend a smaller fraction of their output on bribery compared to small plants. I build a span-of-control model where managers choose to bribe officials to decrease the tax rate, which is imposed based on their output. After I calibrate this model to match the Turkish plant size distribution and bribery payments of different size groups, I quantify the anti-bribery and anti-distortion policies on the aggregate output, mean size, the employment share of big enterprises, the average effective tax, and the average bribe rate response. Given that bribery opportunities exist, the effect of size dependent distortions is reduced, as managers can decrease them with bribery. In addition, changes in the distortion level do not have large effects on the aggregate economy, as they can be ruled out by bribery. By removing the distortions, the output level and the mean size may increase by more than 60% and 80% respectively.

Despite the fact that bribery can lower distortions for bribe payers, it can be costly for those who are not involved in it. For example, politically connected firms rather than the most able firms, can acquire public resources through bribery (Khwaja & Mian (2005); Fisman (2001)). The case of a manager that must pay a bribe to acquire an operating license, can have two social consequences: it can limit some managers from starting a business because of high entry costs and since government officials can delay the administrative process to attract more bribes (Svensson (2005); Myrdal (1968)). In addition, the effects of changes on the government policies in the economy can be different from what is aimed by the government under the presence of bribery opportunities. For instance, the policy that increases tax rates for big enterprises will not have a large impact on neither the aggregate output nor the tax revenues collected, since enterprises can decrease the effective tax rates by increasing bribery payments.

Although this study uses the most detailed data about plant size distribution and bribery payments in Turkey, there is still room for increasing the quality of the dataset by focusing on the size distribution of small enterprises and by having a larger samples by including small firms in bribery surveys. Hence, future studies can conduct more precise calibrations with more detailed datasets for both plant size and bribery payments. Future research can also focus on three different extensions of this model. The first extension is about the relationship between bribery and aggregate variables such as, GDP per capita, mean size and managerial quality at the cross-country level. We know that bribery incidence is negatively correlated with these aggregate variables. Therefore, having a model which incorporates these cross-country facts can provide a better understanding of the relation between development and bribery. Second, the relationship between managerial skill accumulation and bribery is worth investigating. Managers exposed to bribery requests tend to spend more time and resources to 'get things done'. Instead, they could use these resources to accumulate their managerial skills and increase their profits. For example, they could spend their time and income getting an MBA degree, instead of spending time on making connections with officers and bribing them. Thus, if the environment of (Bhattacharya, Guner, and Ventura 2013)- where managers can accumulate skills- and the setup of this paper were integrated, research could focus on the effects of bribery on managerial skill accumulation. Third, the level of distortions can be endogenized by allowing agents to choose whether or not to be (corrupt) government officials. With this extension, some of the high ability agents can choose to be a government official, depending on bribery returns. In addition, they can increase the distortion levels to enjoy more bribery returns. As a result, a bribery opportunity could have the opposite effect from the conclusion of this study.

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Tables and Figures

Table 1: Bribery in Turkey, 2013

Enterprise Size	Bribery during public transactions	Bribe to secure government contract	Overall Bribery Rate
All	1.83%	11.95%	8.61%
5-99	1.76%	12.17%	8.70%
100+	2.94%	10.70%	6.77%

Notes: Each entry shows the percentage of enterprises. Bribery during public transactions column shows the percentage of enterprises who encountered at least one bribery request during public transactions. These public transactions include tax inspection or meeting with tax officials, applying for electricity, water, construction related permits, import and operating licenses. Bribe to secure government contract column shows what percentage of firm are asked bribe to secure government contract. Overall Bribery Rate column shows the percentage of firms who are asked to pay bribes in recent years and who admits paying some amount of bribe. See Section 3 for more details.
Source: Enterprise Surveys.

Table 2: Bribery Payment in Turkey, 2013

Enterprise Size	Bribery to VA Ratio in Extensive Margin	Bribery to VA Ratio in Intensive Margin
All	1.36%	18.09%
5-99	1.42%	18.25%
100+	0.1%	5.18%

Notes: Each entry shows the percentage of sales spent on bribery on average. Bribery to Value Added ratio in extensive margin is the average percentage of bribery payments in terms of value added of all interviewed enterprises. Bribery to value added ratio in intensive margin shows the average percentage of bribes in terms of value added of enterprises who admitted that they pay bribes. See Section 3 for more details.
Source: Enterprise Surveys.

Table 3: Plant Size Distribution in Turkey and US

	Turkey (Enterprises-Average 2009-2014)	US (Establishments-Average 2009-2015)
Mean size	3.62	15.65
Size distribution of plants		
1-19	97.32%	86.13%
20-49	1.75%	8.64%
50-99	0.48%	2.92%
100-249	0.31%	1.65%
250+	0.15%	0.67%
Employment share by plant size category		
1-19	33.07%	24.89%
20-49	14.47%	16.61%
50-99	8.86%	12.79%
100-249	12.77%	15.80%
250+	30.83%	29.92%

Sources: Turkey data is from TurkStat-Annual Industry and Services Statistics. US data is from Census-County Business Pattern.
Notes: This table compares plant size distributions in Turkey and US. Unit of observation is the enterprise in Turkey and the establishment in US. Mean size shows the average number of employees in a plant. Size distribution categories displays what percentage of plants belong to that category. Employment share by establishment size category demonstrates each categories' employment rate as the percentage of total employment.
Sources: TurkStat and County Business Dynamics

Table 4: Parameter Values for the U.S.

Parameter	Value
σ	2.61
s	0.93
$F(\hat{z})$	0.54

Notes: Value column shows the parameters values which generate the plant size distribution in the U.S. economy.

Table 5: Calibration Targets and Model for the U.S.

	Data	Model
Mean size	17.09	17.18
Fraction of enterprises		
1-19	84.7%	85.8 %
20-49	9.4%	8.2 %
50-99	3.2%	2.8 %
100+	2.6%	3.2 %
Employment share of 100+	44.95%	44.11%

Note: This table shows the calibration performance. The data column shows the target moment conditions for the U.S. economy which are borrowed from Guner *et al.* (2008). The model column shows how model results with the calibrated parameters reported in Table 4.

Table 6: Parameter Values for Turkey

Parameter	Value
τ	0.01
λ	0.75
ϕ	1.48
α_0	0.02
α_1	0.96
$\tilde{b}$	60.76
σ	4.80
s	1.82
$F(\bar{z})$	0.74

Note: Value column shows the parameters values which generate the key variables in the Turkish economy.

Table 7: Calibration Targets and Model for Turkey

	Data	Model
Mean size	3.62	3.63
Fraction of enterprises		
1-49	99.1%	99.2%
50-99	0.48%	0.40%
Employment share of plants 50-99	8.9%	8.2%
Employment share of plants 100+	43.6%	43.4%
Bribe by 100− (as % of VA)	1.42%	2.7%
Bribe by 100+ (as % of VA)	0.1%	3.7%
Bribe by 100− (as % of VA)/given paid bribe	18.25%	17.39%
Bribe by 100+ (as % of VA)/given paid bribe	5.18%	4.06%

Note: This table shows the calibration performance. The data column shows the target moment conditions for Turkish economy. The model column shows how model results with the calibrated parameters reported in Table 6.

Table 8: Size Dependent Distortions in the U.S. economy without Bribery

	Benchmark	$\tau = 0.01$	$\tau = 0.02$	$\tau = 0.05$
Mean Size	17.18	14.51	12.40	7.95
Output	100	96.53	93.13	83.33
Emp. Share 100+ (%)	44.11	38.50	33.33	19.09
Tax wedge	1	0.98	0.97	0.92
Avg tax-small (%)		4.11	7.84	17.02
Avg tax-big (%)		7.49	14.30	31.36

Note: This table summarize the effect of increase in the size dependency of distortions in the U.S. economy when there is no bribery opportunity. The output at the benchmark is normalized 100 so that the numbers in this row compare output with the benchmark case. Tax wedge is calculated according to the equation (10). Small and big refer to the plants with less than 100 workers and the plants with more than 100 workers, respectively.

Table 9: Size Dependent Distortions in the U.S. economy with Bribery

	Benchmark	$\tau = 0.01$	$\tau = 0.02$	$\tau = 0.05$
Mean Size	17.18	15.89	15.48	15.08
Output	100	97.60	95.79	91.57
Emp. Share 100+ (%)	44.11	43.07	43.03	42.92
Tax wedge	1	0.98	0.97	0.92
Avg tax-small (%)		3.83	6.83	12.81
Avg tax-big (%)		4.17	6.93	12.81
Avg Bribe-small (%)		0.49	1.25	3.67
Avg Bribe-big (%)		0.93	1.84	4.33

Note: This table summarize the effect of increase in the size dependency of distortions in the U.S. economy when there a bribery opportunity. The output at the benchmark is normalized 100 so that the numbers in this row compare output with the benchmark case. Tax wedge is calculated according to the equation (10). Small and big refer to the plants with less than 100 workers and the plants with more than 100 workers, respectively.

Table 10: Size Dependent Distortions in the Turkish economy with Bribery

	Benchmark $\tau = 0.01$	$\tau = 0.02$	$\tau = 0.03$	$\tau = 0.05$
Mean Size	3.63	3.52	3.20	2.85
Output	100	95.39	93.70	89.21
Emp. Share 100+	43.38	40.65	36.87	31.01
Tax wedge	0.9996	0.9996	0.9995	0.9996
Avg. tax-small (%)	28.31	30.61	32.49	35.59
Avg. tax-big (%)	28.31	30.61	32.49	35.59
Avg bribe-small (%)	17.39	17.50	17.56	17.67
Avg bribe-big (%)	4.06	4.72	5.34	6.35

Note: This table summarize the effect of increase in the size dependency of distortions in the Turkish economy when there is a bribery opportunity. The output at the benchmark is normalized 100 so that the numbers in this row compare output with the benchmark case. Tax wedge is calculated according to the equation (10). Small and big refer to the plants with less than 100 workers and the plants with more than 100 workers, respectively.

Table 11: Size Dependent Distortions in the Turkish economy without Bribery

	$\tau = 0.01$	$\tau = 0.02$	$\tau = 0.03$	$\tau = 0.05$
Mean Size	3.63	3.14	2.83	2.50
Output	98.09	91.68	87.64	79.77
Emp. Share 100+	43.38	33.60	27.12	18.73
Tax wedge	0.9996	0.9683	0.9529	0.9227
Avg. tax-small (%)	28.31	33.35	37.26	44.60
Avg. tax-big (%)	28.31	34.68	39.12	47.29

Note: This table summarize the effect of increase in the size dependency of distortions in the Turkish economy when there is no bribery opportunity. The output at the benchmark is normalized 100 so that the numbers in this row compare output with the benchmark case. Tax wedge is calculated according to the equation (10). Small and big refer to the plants with less than 100 workers and the plants with more than 100 workers, respectively.

Table 12: Role of return on bribe in the Turkish economy

			Benchmark	
	$\phi = 0.5$	$\phi = 1$	$\phi = 1.48$	$\phi = 2$
Mean Size	3.60	3.60	3.63	3.64
Output	98.74	99.02	100	100.37
Emp. Share 100+	42.99	43.41	43.38	44.10
Tax wedge	0.9986	0.9993	0.9996	0.9997
Avg. tax-small (%)	29.08	28.59	28.31	28.09
Avg. tax-big (%)	29.08	28.59	28.31	28.09
Avg bribe-small (%)	16.91	17.02	17.39	17.64
Avg bribe-big (%)	4.03	4.06	4.06	4.18

Note: This table summarize the effect of increase in the return on bribe in the Turkish economy. The output at the benchmark is normalized 100 so that the numbers in this row compare output with the benchmark case. Tax wedge is calculated according to the equation (10). Small and big refer to the plants with less than 100 workers and the plants with more than 100 workers, respectively.

Table 13: Role of corrupt officials in the Turkish economy

			Benchmark	
	α_0=0.01	α_0=0.02	α_0=0.02	α_0=0.1
	α_1=0.8	α_1=0.9	α_1=0.96	α_1=1.0
Mean Size	5.63	4.64	3.63	3.34
Output	113.60	104.22	100	95.96
Emp. Share 100+	42.66	44.53	43.38	45.05
Tax wedge	0.9996	0.9996	0.9996	0.9995
Avg. tax-small (%)	28.31	28.31	28.31	28.31
Avg. tax-big (%)	28.31	28.31	28.31	28.31
Avg bribe-small (%)	16.28	16.75	17.39	17.85
Avg bribe-big (%)	3.74	3.95	4.06	4.29

Note: This table summarize the effect of increase in the probability of a meeting the corrupt official in the Turkish economy. The output at the benchmark is normalized 100 so that the numbers in this row compare output with the benchmark case. Tax wedge is calculated according to the equation (10). Small and big refer to the plants with less than 100 workers and the plants with more than 100 workers, respectively.

Table 14: Removal of bribery opportunities and distortions in the Turkish economy

	Benchmark	No Bribery	No Distortion
Mean Size	3.63	3.60	6.62
Output	100.00	98.09	163.64
Emp. Share 100+	43.38	40.98	31.46
Tax wedge	1.00	0.98	
Avg. tax-small (%)	28.31	29.23	
Avg. tax-big (%)	28.31	29.95	
Avg bribe-small (%)	17.39		
Avg bribe-big (%)	4.06		

Note: This table summarizes the result of removing bribery and removing distortions. The output at the benchmark case is normalized to 100 so that the numbers in this row compare output with the benchmark case. Tax wedge is calculated according to the equation (10). Small and big refer to the plants with less than 100 workers and the plants with more than 100 workers, respectively.

Appendix

A FOC's and the Equilibrium

In this section, I, first, present the first order conditions of the managers who encounter a corrupt official as well as the first order conditions of the managers who are not assigned to corrupt official. Then I characterize the household's problem. Finally, I provide the definition of the equilibrium.

A.1 FOC's

A.1.1 Solving a manager's problem who face a corrupt official

Consider a manager with ability z who face a corrupt official. Optimal labor and capital demand and bribery payments can be derived from the first order conditions of (3)

$$n_c(z,W,R) = \left[A\gamma\nu\lambda^{\frac{1}{1-\tau}}\left(\tau\phi\right)^{\frac{\tau}{1-\tau}}(1-\tau)\right]^{\frac{1}{1-\gamma}}\left(\frac{1-\nu}{\nu}\right)^{\frac{1-\nu\gamma}{1-\gamma}}\left(\frac{1}{R}\right)^{\frac{\nu\gamma}{1-\gamma}}\left(\frac{1}{W}\right)^{\frac{1-\nu\gamma}{1-\gamma}} z \tag{A.1}$$

$$k_c(z,W,R) = \left[A\gamma\nu\lambda^{\frac{1}{1-\tau}}\left(\tau\phi\right)^{\frac{\tau}{1-\tau}}(1-\tau)\right]^{\frac{1}{1-\gamma}}\left(\frac{1-\nu}{\nu}\right)^{\frac{\gamma(1-\nu)}{1-\gamma}}\left(\frac{1}{R}\right)^{\frac{1-\gamma(1-\nu)}{1-\gamma}}\left(\frac{1}{W}\right)^{\frac{\gamma(1-\nu)}{1-\gamma}} z \tag{A.2}$$

$$b(z,W,R) = \left[\lambda\tau^{1-\gamma(1-\tau)}\phi^{\tau}A^{1-\tau}\right]^{\frac{1}{(1-\tau)(1-\gamma)}}\left[\gamma(1-\tau)\nu\right]^{\frac{\gamma}{1-\gamma}}\left(\frac{1-\nu}{\nu}\right)^{\frac{\gamma(1-\nu)}{1-\gamma}}\left(\frac{1}{R}\right)^{\frac{\nu\gamma}{1-\gamma}}\left(\frac{1}{W}\right)^{\frac{\gamma(1-\nu)}{1-\gamma}} z - \frac{1}{\phi} \tag{A.3}$$

A.1.2 Solving a manager's problem who doesn't face a corrupt official

Consider a manager with ability z who is not assigned to a corrupt official. Optimal labor and capital demand for this manager again can be derived from first order conditions of (4):

$$n_{nc}(z,W,R) = \left[A\gamma\nu\right]^{\frac{1}{1-\gamma}}\left(\frac{1-\nu}{\nu}\right)^{\frac{1-\nu\gamma}{1-\gamma}}\left(\frac{1}{R}\right)^{\frac{\nu\gamma}{1-\gamma}}\left(\frac{1}{W}\right)^{\frac{1-\nu\gamma}{1-\gamma}} z \tag{A.4}$$

$$k_{nc}(z,W,R) = \left[A\gamma\nu\right]^{\frac{1}{1-\gamma}}\left(\frac{1-\nu}{\nu}\right)^{\frac{\gamma(1-\nu)}{1-\gamma}}\left(\frac{1}{R}\right)^{\frac{1-\gamma(1-\nu)}{1-\gamma}}\left(\frac{1}{W}\right)^{\frac{\gamma(1-\nu)}{1-\gamma}} z \tag{A.5}$$

A.1.3 Solving Household's Problem

Let λ_t be the Lagrangian multiplier associated with the households budget constraint at time t. The first order conditions with respect to C_t, K_{t+1}, $\tilde{z}_{c,t}$ and $\tilde{z}_{nc,t}$ are

$$\beta^t L_t \frac{1}{C_t} = \lambda_t \tag{A.6}$$

$$\lambda_{t+1}(1-\delta+R_{t+1}) = \lambda_t \tag{A.7}$$

$$W_t = \pi_c(\tilde{z}_{c,t}, W_t, R_t) = \pi_{nc}(\tilde{z}_{nc,t}, W_t, R_t) \tag{A.8}$$

by combining equation (A.6) and (A.7), we can derive the usual intertemporal Euler equation:

$$\frac{C_{t+1}/L_{t+1}}{C_t/L_t} = \beta(1-\delta+R_{t+1}) \tag{A.9}$$

Equations (A.8) and (A.9) characterize the household's problem. Equation (A.8) requires that the agent with managerial ability $\tilde{z}_c$ and $\tilde{z}_{nc}$ (threshold ability levels for being a manager or being a worker for agents who are assigned to a corrupt official and who are not assigned, respectively) must be indifferent between becoming a manager or a worker. Equation (A.9) has a well-known interpretation: the household must be indifferent between consuming one more unit this period and saving and consuming that unit in the next period.

A.2 Equilibrium

In the equilibrium, given prices, distortions and transfers $\{W_t^*, R_t^*, \lambda, \tau, T_t^*\}_0^\infty$, the household maximizes her utility by choosing optimal $\{C_t^*, K_{t+1}^*, \tilde{z}_{c,t}^*, \tilde{z}_{nc,t}^*\}_0^\infty$ such that the allocation solves the mangers' problem. The government budget is balanced and all of the markets clear. The market clearing condition for the labor market is:

$$\alpha_0 F(\tilde{z}_{t,c}^*)+(1-\alpha_0)F(\tilde{z}_{t,nc}^*) = \alpha_0 \int_{\tilde{z}_{t,c}^*}^{\hat{z}} n_c^*(z, W_t^*, R_t^*) f(z)dz + (1-\alpha_0)\int_{\tilde{z}_{t,nc}^*}^{\hat{z}} n_{nc}^*(z, W_t^*, R_t^*) f(z)dz + \\ + \int_{\hat{z}}^{\bar{z}} \left(\alpha_1 n_c^*(z, W_t^*, R_t^*) + (1-\alpha_1) n_{nc}^*(z, W_t^*, R_t^*)\right) f(z)dz \tag{A.10}$$

where $F(\tilde{z}_{c,t}^*)$ and $F(\tilde{z}_{nc,t}^*)$ are the labor supply of household members who are assigned to the corrupt official and who are not assigned to the corrupt official respectively, and $n_c^*(z, W_t^*, R_t^*)$

is the labor demand by a manager with ability z who is encountered to the corrupt official and $n^*_{nc}(z, W^*_t, R^*_t)$ is the labor demand by a manager with ability z who is not encountered to the corrupt official. Therefore the right hand side of the equation (A.10) is the labor demand in the economy. The market clearing condition for the capital is :

$$K^*_t = \alpha_0 \int_{\tilde{z}^*_{t,c}}^{\hat{z}} k^*_c(z, W^*_t, R^*_t) f(z) dz + (1-\alpha_0) \int_{\tilde{z}^*_{t,nc}}^{\hat{z}} k^*_{nc}(z, W^*_t, R^*_t) f(z) dz + \int_{\hat{z}}^{\bar{z}} \left(\alpha_1 k^*_c(z, W^*_t, R^*_t) + (1-\alpha_1) k^*_{nc}(z, W^*_t, R^*_t)\right) f(z) dz \quad \text{(A.11)}$$

where K^*_t is the supply of the capital and $k^*_c(z, W^*_t, R^*_t)$ is the demand for the capital by a manager with ability z who is encountered to the corrupt official and $k^*_{nc}(z, W^*_t, R^*_t)$ is the capital demand by a manager with ability z who is not encountered to the corrupt official. Hence the right hand side of the equation (A.11) is the total demand for the capital in the economy. The goods market equilibrium is:

$$C^*_t + K^*_{t+1} = \alpha_0 \int_{\tilde{z}^*_{t,c}}^{\hat{z}} y^*_c(z, W^*_t, R^*_t) f(z) dz + (1-\alpha_0) \int_{\tilde{z}^*_{t,nc}}^{\hat{z}} y^*_{nc}(z, W^*_t, R^*_t) f(z) dz + \int_{\hat{z}}^{\bar{z}} \left(\alpha_1 y^*_c(z, W^*_t, R^*_t) + (1-\alpha_1) y^*_{nc}(z, W^*_t, R^*_t)\right) f(z) dz + (1-\delta) K^*_t \quad \text{(A.12)}$$