Bribes, Lobbying and Industrial Structure

Roy Cerqueti[a], Raffaella Coppier[a], Gustavo Piga[b*]

[a] Department of Economics and Law, University of Macerata, Macerata, Italy
[b] Department of Economics and Finance, University of Rome Tor Vergata, Rome, Italy

Abstract

This paper deals with the relationship between regulatory compliance, bureaucratic corruption, lobbying and the industrial structure of a country. We show that lobbying and bureaucratic corruption can coexist at the macro level when we allow for heterogeneity in firm size. Firms with sufficiently low capital level comply with the existing regulation; firms with an intermediate capital level may prefer to engage in bureaucratic corruption, while firms with a high capital level prefer to engage in lobbying. Welfare implications of our model point toward encouraging policies that support the small business sector of an economy and toward flexible regulatory policies meant to suppress regulation for small enough firms.

JEL Code: H26, L51, K42.
Keywords: Bureaucratic Corruption, Lobbying, Industrial Organization.

1 Introduction

Lobbying and bureaucratic corruption have been and still are relevant economic and political phenomena of most societies and political systems. In the United States, for example, political lobbying is as old as the State: indeed lobbying is protected under the right of petition in the First Amendment of the Constitution. The comprehensive reporting of lobbying expenditure required by the 1995 Lobbying Disclosure Act (LDA) is only a final step of regulatory process that started in 1945 with the Federal Regulation of Lobbying Act. The US federal lobbying industry has experienced startling

*Corresponding author: Gustavo Piga, University of Rome Tor Vergata, Department of Economics and Finance, 00133 Rome, Italy. Phone +39 0672595701, Fax +39 062020500, e-mail gustavo.piga@uniroma2.it

growth. Between 1998 and 2009, lobbying expenditures approximately doubled, reaching almost USD 4 billion a year[1].
Corruption is also a widespread and rampant phenomenon, notwithstanding the various prevention and repressive actions taken by governments and civil society. As Pellegrini and Gerlagh (2008) aptly remind us, "corruption is a widespread phenomenon affecting all societies to different degrees, at different times. On the one hand, as corruption scandals have repeatedly shown, bribes are common in all countries notwithstanding differences in income levels and law systems, as they are common in democracies and in dictatorships. Recent scandals over corruption have shown that also supposedly free-from-corruption societies are affected"[2].
In this paper we analyze the relationship between lobbying and bureaucratic corruption. The issue as to whether and why firms choose to implement lobbying or bureaucratic corruption, and the consequences of this choice, is still largely unanswered. Even though they are two different phenomena, often the differences between the two remain blurred. For example, the successful and pioneering Grossman and Helpman's (2001) model on lobbying can be read as one for corruption: in fact, the authors assume that lobbyists influence politicians' policy-making decisions by providing them with resources, which could easily be considered as bribes. One of the most relevant differences between lobbying and bureaucratic corruption is that lobbying is often legal while bureaucratic corruption is not (see the discussions in Lambsdorff 2002 or Begovic 2005) and, rather, detectable and punishable.
In this paper, following Harstad and Svensonn (2011), we define lobbying as campaign contributions or influence buying meant to change existing rules or policies relevant for the lobbying entity. Similarly, we define corruption as the illegal use of public power and resources for personal gain. In this context, bureaucratic corruption is an activity aimed at bending existing rules or policies (see also Damania et al., 2004 and Campos and Giovannoni, 2007 and 2008). As stressed by Giovannoni (2001) "At the conceptual level, the distinction is important because it raises a natural question: if lobbying and corruption are both rent-seeking activities which operate with different targets, are they complements or substitutes?".
Lobbying and bureaucratic corruption can be complementary as in Damania et al. (2004), where the authors consider that lobbying activity is mostly directed at laws that undermine law enforcement, so as to make corruption easier. In their model, firms lobby high-level government politicians in order to resist legal reform directed at improving judicial efficiency and reduce corruption. In this case, lobbying makes the institutions necessary to enforce

[1]Calculation by Centre for Responsive Politics based on data from the Senate Office of Public Records. See http:
wwww.open secrets.org.

[2]Modern researches on the economics of corruption began with Rose-Ackerman (1975, 1978).

compliance weaker, and thus it makes bureaucratic corruption less risky. Harstad and Svensonn (2011) find that lobbying and corruption are substitutes and the choice of the firm between bribing the bureaucrat or lobbying the government depends on the level of development of the considered country.

In this paper, we study the role played by the industrial structure of a country in affecting the relationship between the two phenomena. We proxy the industrial structure[3] with its heterogeneity among firms with respect to size and discuss the connection between lobbying and bureaucratic corruption at two levels: under a microeconomic perspective, by exploring the behavior of the individual firm; under a macroeconomic viewpoint, by aggregating companies and considering the impact of the overall industrial structure.[4]

At the micro level we find that, contrary to what claimed by Harstad and Svensonn (2011), allowing for heterogeneity adds new insights into the relationship between lobbying and bureaucratic corruption. More in detail, we show that, ceteris paribus, in any given country we have the coexistence of very small firms that do comply with regulation, middle-size firms that are most likely to bribe and large firms that engage in lobbying.

The empirical literature confirms such results, i.e. small firms find it worthwhile to engage in bureaucratic corruption while, as the firm's dimension grows, firms find it worthwhile to engage in lobbying. In particular, Campos and Giovannoni (2008) find that larger firms are systematically associated with lobbying, while smaller firms are systematically associated with bureaucratic corruption; Bennedsen et al. (2009), show that larger firms pay bribes less frequently but have more political influence.

At the macro level thus bureaucratic corruption and lobbying may coexist, and the nature of such coexistence is strongly affected by the industrial structure of the country. In particular, countries dominated by small firms should see, in the aggregate, relatively less lobbying and more corruption and compliance than countries where a few large firms dominate the industry. Not allowing for heterogeneity leads, at the macro level, to assimilate countries with a large majority of small firms with countries with low level of development (both, according to this vision, characterized by high level of corruption). Our approach – grounded on the evidence that the small size of the firm may be the expression of the specific country's industrial structure rather than the result of the level of development of the country itself – instead allow us to gather relevant intuition for rich (poor) countries with a high (low) share of small firms. In this respect, Figure 1, where the levels of corruption of developed OECD countries[5] is compared to their in-

[3]Following Dasgupta and Stiglitz (1980), we define industrial structure as the degree of concentration in an industry.

[4]We consider that firm size is measured through its capital level.

[5]Mexico, Hungary and Turkey are excluded from the sample, because they are upper-middle income countries. The corruption level is measured by the CPI index of Trans-

dustrial structures. A country with an industrial structure which consists

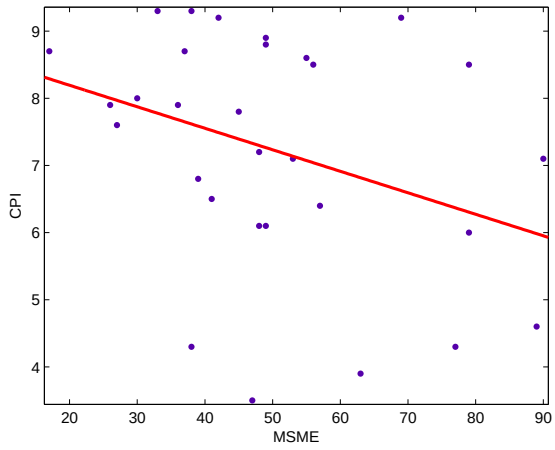

Figure 1: Scatter plot of the CPI index versus MSME density for the OECD countries.

mainly of small firms will be more inclined to engage in bureaucratic corruption, regardless of the level of development of the considered country. Viceversa, a country with an industrial structure consisting mainly of large firms, will be more inclined to engage in lobbying, regardless of the level of development of the considered country. This result, which shows a high degree of heterogeneity even among developed economies, is also coherent with Pellegrini and Gerlagh's (2008) above-mentioned quote, that even in rich countries corruption can be pervasive.
The paper is organized as follows. In Section 2, we present the model. In Section 3, we describe the timing of the game and provide the main results. Section 4 concludes. All proofs of Propositions are in the Appendix.

2 Theoretical model

The economy is assumed to be populated by three players: a high–level public official (politician), a low level public official (bureaucrat) and firms. Following the mainstream political economy, we assume that firms, bureaucrats and politicians are not affected by psycho-biases and do not have bounded rationality.

parency International and the industrial structure is proxied by the MSME density of the World Bank.

Firms are assumed to be open to non compliant behavior with respect to the existing legislation, even if compliance is mandatory. The firm can try to change existing legislation in its favor by lobbying the politician. Moreover, it may seek to avoid the application of the law by bribing a bureaucrat (bureaucratic corruption).
The paradigmatic example we have in mind is that of polluting firms, whose emissions are constrained by environmental laws which identify a suitable pollution tax[6]. Although our model is presented in terms of environmental policy, our results may have more general applicability. In order to manage pollution emissions, there are two levels of public official: a high-level public official, i.e. politician, who decides environmental policies, and a low-level public official, i.e. a bureaucrat, who is responsible for the application of the environmental law and for controlling the behavior of firms[7]. To be more precise, we assume that the government cannot directly observe the level of pollution emitted by the firm and therefore uses bureaucrats to monitor pollution levels in order to reduce environmental evasion.
Time is an ingredient of our model. In fact, an important difference between bureaucratic corruption and lobbying is the time-span of the two actions: while the former activity applies temporarily (for one period in our model) – since firms deal with different officials over time (in each period) – the latter one implies a legislative change and, therefore, alters the *status quo* for a longer period. To capture this fact, in our model we consider that the effects of the lobbying, i.e. the change of the rule, refer to a period which goes from $t = 0$ to $t = T$, while the effects of bureaucratic corruption apply to a single period.
The production of the j-th firm is:

$$y_j = f(k_j) = rk_j \tag{1}$$

where r is a productivity parameter and k_j is the specific capital level of the j-th firm. If the j-th firm complies with the regulation, it has to pay a proportional cost c on production, i.e. proportional to k_j, plus a fixed cost C_0.

$$\pi_j = rk_j - ck_j - C_0. \tag{2}$$

The presence of fixed and variable costs is in accord with the regulation on the emissions of polluting firms (see e.g. the waste management activities). In order to describe the heterogeneity of capital, we consider the cumulative probability function F which defines the distribution of individual capital levels k's. The shape of the relative density function f provides information

[6]Cerqueti and Coppier (2014) present a game where environmental protection acts as a tool for morally persuading firms to be compliant with the regulation.

[7]For a more detailed analysis on the bureaucrat's behavior see also Cerqueti and Coppier (2013) who discuss the role of incentives for tax evasion controllers open to bribery, and study the problem through a Bayesian game.

on the level of firm capitals, and it is used as a proxy for the industrial structure. In particular, the symmetry properties of the function f provide information on the distribution of firms in the economic context in terms of high or low capital levels[8].

We assume that lobbying and bureaucratic corruption are both directed at eliminating the proportional compliance cost of regulation ck_j. Firms affect the costs of compliance in two possible ways either through lobbying, a legal activity leading to the removal of the variable cost by a long-term change of the regulation or through bureaucratic corruption, an illegal activity that leads to the removal of the same cost but only for one period.

The effect of the lobbying activity concerns only those firms which participate in it: in other words, we assume that a change of regulation produced by lobbying affects only the firms which have paid the contribution to the politician[9].

At time $t = 0$, the politician wants a contribution (for electoral scope) p_j –from each j-th firm– for changing the current regulation, i.e. removing the proportional cost of compliance. All firms which, in equilibrium, find it worthwhile to engage in lobbying, pay individually the negotiated cost of their lobbying activity. Since, as we said, firms are heterogeneous with respect to their capital level k_j, the politician asks for a contribution p_j which is the Nash solution of a bargaining game between the j-th firm and the politician, taking into account of the firm's participation constraint given by the possibility of remaining compliant.

Critically, we assume that capital markets are imperfect and, therefore the firms must have at time $t = 0$ all the necessary resources to pay the contribution for the politician p_j. This implies that the only reason in our model for a firm not to lobby is that by being liquidity constrained (a less likely outcome for large firms) it opts for either compliance or (risky) corruption.[10]. Other firms, which cannot take part in the lobbying activity, must decide whether to comply with the existing regulation or bending the rule in order to avoid to pay the proportional part of compliance cost ck_j. In the latter case, facing a bureaucrat that may decide to ask for a bribe, the j-th firm

[8]See Section 4 for a discussion on this.

[9]We do not enter into the debate of how much lobbying trickles down generating benefits even for firms that have not spent resources on it. We simply assume realistically that the benefits and impact of lobbying are stronger for firms that do lobby. See for example the cases cited in https://www.americanprogress.org/issues/economy/report/2014/05/02/88917/how-campaign-contributions-and-lobbying-can-lead-to-inefficient-economic-policy/ It is worth pointing out that such an assumption can be removed, analysing the effect of lobbying propagating to the other firms in the same industry. This would lead to the disappearance of bureaucratic corruption once one of the firms has engaged in lobbying activity. In this case the model becomes unavoidably trivial.

[10]In fact, since lobbying is a legal activity, if lobbying is presented as an economic decision of the firm, then it will be always preferred to bureaucratic corruption.

must decide whether to engage or not in a negotiation on the bribe. In the case in which the agreement between the bureaucrat and the j-th firm is not achieved, the bureaucrat denounces the non–compliant firm. We also assume that firms must pay a fine mk proportional to their capital level in either one of these two cases: first, when the bureaucrat does not find it convenient to ask for a bribe or, second, in the case in which the agreement between the bureaucrat and the j-th firm is not achieved. In addition, with an exogenous probability q, the corrupt transaction between the bureaucrat and the firm is controlled and detected. In this case, not only the j-th firm must pay a fine m on the capital level, but also the corrupt bureaucrat is fined with a penalty λ^B. The value of the bribe is the result of a bargaining process between the firm and the bureaucrat performed in each period. The j-th firm can play a game with the politician or the bureaucrat. The game played between the j-th firm and the politician is a trivial game. In fact, as lobbying is a legal activity that can give only advantages to the politician, the latter will always be willing to ask for a contribution p_j to change the existing legislation. For this reason, the paper will concentrate on the game between the bureaucrat and the firms, i.e. the bureaucratic corruption game. We now proceed to describe bureaucratic corruption through a sequential game.
Given the heterogeneity of firms, their behavior will vary according to their capital level k_j. The payoff vectors will be indicated with a couple

$$\underline{\pi} = (\pi^{(F)}, \pi^{(B)}), \qquad t = 0, 1, \ldots, T, \tag{3}$$

where $\pi^{(F)}$ and $\pi^{(B)}$ represent the payoffs of the firm and of the bureaucrat, respectively.
The bureaucrat earns a salary equal to w^B[11].

3 The game: description and solution

As mentioned above, we assume that there is a lobby in this industry which pays a politician in order to change regulations. Firms belong to this lobby only if they have enough capital to pay the contribution to the politician. If the j-th firm engages in lobbying activity, (Lobbying -L-), then the one

[11]It is assumed that no arbitrage is possible between the bureaucrats and politicians careers and that therefore there is no possibility of the bureaucrats becoming politicians, even if their salary w^B were lower than the politician's net return. This assumption allows us to abstract from the issues linking to the occupational choice and is based on the assumption that Nature divides the agents into two separate groups, as Arsenis and Varvarigos (2010), or considering that agents are differentiated at birth according to their abilities and skills. Therefore, as in Blackburn and Sarmah (2008), politicians are individuals who lack the skills necessary to become bureaucrats and bureaucrats are agents who possess these skills.

period payoff vector given by:

$$\underline{\pi}_L = (rk_j - p_j - C_0; w^B) \tag{4}$$

Thus, the necessary condition for the j-th firm to engage in the lobbying activity is that the payoff of engaging in lobbying is positive. This leads to:

$$\underline{\pi}_L = rk_j - p_j - C_0 \geq 0 \tag{5}$$

Inequality (5) is equivalent to

$$k_j \geq \frac{C_0 + pj}{r} = k_j^{(0)}. \tag{6}$$

We take condition (6) as the requirement to be satisfied by the capital of the j-th firm to engage in lobbying activity. Therefore, the j-th firm with capital k_j greater or equal to $k_j^{(0)}$ belongs to the lobby and engages in lobbying.
As we said, the j-th firm which does not have a sufficient capital level to engage in lobbying, i.e. $k_j < k_j^{(0)}$, must decide whether to comply with environmental regulation or try to bend the rules. In the latter case, the j-th firm must decide whether to bribe the bureaucrat in order to avoid being reported for having violated the rules.
To describe bureaucratic corruption for the firms which have a capital level $k_j < k_j^{(0)}$, we use a three-stage game with incomplete information. The steps are the following:

First stage

In this stage, the j-th firm must decide whether to comply with the environmental regulation (no corruption -NC-) or to bend the rule in order to not pay the proportional cost ck_j. In the latter case, the game continues to the second stage. If the j-th firm decides to comply with the rule (no corruption -NC-), then the game ends with the following one period payoff vector:

$$\underline{\pi}_{1,NC} = (rk_j - C_0 - ck_j; w^B). \tag{7}$$

If the j-th firm decides to bend the rule, the game continues to the second step.

Second stage

The bureaucrat, who inspects the j-th firm, must decide whether to report the violation of the environmental law or to ask for a bribe $b > 0$.
In the case in which the bureaucrat decides not to ask for a bribe, i.e. to report the rule violation, the j-th firm must pay a fine mk_j. If the bureaucrat

decides not to ask for a bribe, i.e. to report the bending of the rule (reported corruption- RC-), the game ends with the following one period payoff vector:

$$\underline{\pi}_{2,RC} = (rk_j - ck_j - C_0 - mk_j; w^B). \tag{8}$$

Otherwise, the game continues to stage three.

Third stage

If the bureaucrat asks the j-th firm for a bribe, then the firm must decide whether to negotiate the bribe or refuse the negotiation. When the agreement between the j-th firm and the bureaucrat is not achieved, the bureaucrat denounces the non–compliant firm which must pay a fine m on the capital level. The game ends with the following one period payoff vector:

$$\underline{\pi}_{3,RC} = (rk_j - ck_j - C_0 - mk_j; w^B). \tag{9}$$

If the agreement between the j-th firm and the bureaucrat is achieved, then the two parties will find an agreement on the bribe b_j^{NB}, which corresponds to the Nash solution to a bargaining game. The corrupt transaction may be inspected with probability q. If corruption is discovered, then the j-th firm pays a fine m on the capital and the bureaucrat a fine λ^B. Otherwise, we have undetected corruption.
The game ends with the following random one period payoff vector:

$$\underline{\pi}_C = \begin{cases} (rk_j - C_0 - b_j^{NB}; w^B + b_j^{NB}), & \text{with probability } 1-q; \\ (rk_j - C_0 - ck_j - mk_j; w^B - \lambda^B), & \text{with probability } q. \end{cases} \tag{10}$$

3.1 Solution of the game

In order to proceed to the solution of the game, we first provide an explicit expression of the bribe b_j^{NB} for the bureaucrat and the contribution p_j^{NB} for the politician. As we will see, we assume, without loss of generality, that the bargaining strength of the firm is equal to β and is the same versus both politicians and bureaucrats.
As for the corruption game, reserved to those firms that are not able to lobby, Proposition 3.1 illustrates the outcome of our Nash–bargaining game between the firm and the bureaucrat.

Proposition 3.1. *For each period $t = 0, 1, \ldots, T$, there is a unique bribe b_j^{NB}, as the Nash solution to the bargaining game, given by:*

$$b_j^{NB} = (1-\beta)(c+m)k_j + \frac{\beta q \lambda^B}{(1-q)}. \tag{11}$$

where β and $1-\beta$ are the parameters in $[0,1]$ that can be interpreted as measures of bargaining strength, of the firm and the bureaucrat, respectively.

By computing this derivate we observe that:

$$\frac{\partial b_j^{NB}}{\partial q} > 0$$

Increasing monitoring increases the risk of corrupt transaction for the bureaucrat who asks, to support this increased risk, greater bribe. Also computing:

$$\frac{\partial b_j^{NB}}{\partial k_j} > 0$$

Greater capital level of the firm means more savings in compliance costs for the firm and therefore a greater surplus to be shared between the firm and the bureaucrat.

As for the politician in the lobbying game, we need to determine the amount of the contribution p_j by each firm. As we saw, if $k_j \geq k_j^{(0)}$, then the j-th firm engages in lobbying and the politician asks for a contribution p_j which is the Nash solution of a bargaining game between the j-th firm and the politician. The j-th firm and the politician share a surplus which derives from the difference between the compliance case, where the firm pays both the full and variable costs of the regulation, and the lobbying case throughout the period during which the lobbying performs its effects $(T+1)$. Indeed, as we said above, there is an important difference between lobbying and bureaucratic corruption: bureaucratic corruption can violate the rules only temporarily (for one period in our model) because firms deal with different officials over time (in each period); *viceversa*, lobbying activity implies a legislative change and, therefore, alters the *status quo* for a period which goes from $t = 0$ to $t = T$.

If the j-th firm does not engage in lobbying, (No Lobbying -NL-), then the aggregate (over time) payoff vector is:

$$\underline{\Pi}_{NL} = \sum_{t=0}^{T} [(rk_j - ck_j - C_0)] = rk_j(T+1) - ck_j(T+1) - C_0(T+1). \tag{12}$$

If the j-th firm engages in lobbying activity, (Lobbying -L-), then the payoff vector given by:

$$\underline{\Pi}_{L} = \sum_{t=0}^{T} [(rk_j - C_0)] - p_j = (T+1)rk_j - (T+1)C_0 - p_j. \tag{13}$$

Proposition 3.2. *For each $t = 0, 1, \ldots, T$, there is a unique contribution p_j^{NB}, as the Nash solution to the bargaining game, given by:*

$$p_j^{NB} = (T+1)(1-\beta)ck_j. \tag{14}$$

where β and $1-\beta$ are the parameters in $[0,1]$ that can be interpreted as measures of bargaining strength of the firm and the politician, respectively.

In other words, the contribution p_j represents $(1-\beta)$, i.e. the bargaining strength of the bureaucrat, the saving coming from not paying proportional compliance cost for $T+1$ periods[12]. We can observe that:

$$\frac{\partial p_j^{NB}}{\partial c} > 0$$

Increasing compliance cost c increases the surplus derived by not paying compliance cost and, therefore increases the contribution. Also computing:

$$\frac{\partial p_j^{NB}}{\partial k_j} > 0$$

Greater capital level of the firm means more savings in compliance costs for the firm and therefore a greater surplus to be shared between the firm and the politician.
By (14), we can rewrite condition (6) for finding the lobbying activity sustainable for the firm as:

$$k_j \geq \frac{C_0}{r - c(1-\beta)(T+1)} = k^{(0)}. \tag{15}$$

As we say above, the credit markets are imperfect and therefore so the firms are able to engage in lobbying, they must have resources sufficiently to cover the saving deriving from not paying proportional compliance cost for $T+1$ periods.
We now present the solution of the game.(see the Appendix for the proof).

Proposition 3.3. *Consider the capital threshold*

$$k^{(1)} = \frac{q\lambda^B}{(1-q)(c+m)} \tag{16}$$

such that:

[12]Notice that in our model we assume a unitary discount rate $e^{-\delta t}$, with $\delta = 0$ for each t. This assumption slightly simplifies the treatment of the model and allows to gain more intuitive outcomes. However, it can be removed. The presence of a discount rate with $\delta > 0$ reduces the role played by future amounts. Formula (12) becomes

$$\underline{\Pi}_{NL} = (rk_j - ck_j - C_0)\sum_{t=0}^{T} e^{-\delta t} = (rk_j - ck_j - C_0)\frac{1-e^{-\delta(T+1)}}{1-e^{-\delta}} < (rk_j - ck_j - C_0)(T+1).$$

Also in the subsequent analysis, as in the expressions of p_j^{NB} in (14) and $k^{(0)}$ in (15), the term $(T+1)$ should be substituted with $\frac{1-e^{-\delta(T+1)}}{1-e^{-\delta}}$. Thus, the outcome of the introduction of a discount rate smaller than one is that politicians obtain less by the lobbying activity, because the value of the contribution p_j^{NB} and of the threshold $k^{(0)}$ is reduced. Lobbying becomes cheaper as the term $e^{-\delta}$ becomes smaller, and more firms have a capital large enough to engage in lobbying activity.

(I) Assume that $k^{(0)} \geq k^{(1)}$.

(I.A) If $k_j < k^{(1)}$*, then the* j*-th firm does not engage in lobbying and it will find it worthwhile to not bend the rule and the aggregate expected payoff is* $\pi_{1,NL,NC}$

(I.B) If $k^{(1)} \leq k_j < k^{(0)}$*, then the* j*-th firm does not engage in lobbying but engages in bureaucratic corruption and then expected payoff is* π_C.

(I.C) If $k_j \geq k^{(0)}$*, then the* j*-th firm engages in lobbying activity and, then the expected payoff is* $\pi_{1,L}$.

(II) Assume that $k^{(0)} < k^{(1)}$.

(II.A) If $k_j < k^{(0)}$*, then the* j*-th firm does not engage in lobbying and it will find it worthwhile to not bend the rule and the aggregate expected payoff is* $\pi_{1,NL,NC}$.

(II.B) If $k_j \geq k^{(0)}$*, then the* j*-th firm engages in lobbying activity and, then the expected payoff is* $\pi_{1,L}$.

The proposition shows the existence of some capital thresholds beyond which the perfect Nash equilibria in the sub-games are obtained. As already illustrated above, the payoffs describe three different situations:

- $\pi_{1,NL,NC}$ is the payoff describing the case in which there is neither lobbying nor corruption activity.
- $\pi_{1,L}$ is the payoff describing the case in which the j-th firm engages in lobbying activity.
- π_C is the payoff describing the case in which the j-th firm finds it worthwhile to engage in bureaucratic corruption.

The results show that, in line with the theoretical and empirical literature, the size of the firm, i.e. its capital level, is a necessary condition for doing lobbying activity. More precisely, our model predicts that firms with sufficiently low capital level comply with the existing regulation; the firms with an intermediate capital level may prefer to engage in bureaucratic corruption, while firms with a high capital level prefer to engage in lobbying. In particular, the firm will find it more worthwhile to remove the part of compliance costs related to the capital level, through lobbying, as the dimension of the firm grows.

4 Analysis of the solution of the game

This section aims at providing some economic insights that can be obtained by the solution of the game. In particular, we here focus on the aggregation

of levels of capital, to describe a country. Specifically, the assessment of the distribution of the capital gives information on the industrial structure of a country. We then intend here to present the analysis of the relationship between lobbying, bureaucratic corruption and the industrial structure of the Country in which firms are located.
First of all, the identification of a distribution of the firms according to their capitals is needed. We selected a Gamma law, which is particularly versatile in this case, since it can describe different situations. In fact, Gamma depends on two nonnegative parameters h and θ, which represent the shape and the scale, respectively. The variation of h and θ drives the shape of the density function of a Gamma distribution, which serves to describe countries with different industrial structures.
For $h, \theta > 0$, the related Gamma random variables is denoted as $X \sim \Gamma(h, \theta)$, and its probability density function is

$$f(x) = \frac{x^{h-1} \exp\{-x/\theta\}}{\Gamma(\theta, h)}, \qquad x > 0, \tag{17}$$

being $\Gamma(\theta, h)$ the normalizing constant.
The numerical experiments here performed have the aim of assessing the relationship between compliance, bureaucratic corruption and lobbying, as in Propositions 3.3. The industrial structure is then described in three situations: $h = 1.5, \theta = 0.5$; $h = 1, \theta = 5$; $h = 5, \theta = 1$. The graphs of related functions f in (17) are given in Figures 1-3, respectively. The first case represents a country with mostly small firms, the second one is the case of a a balanced proportion of large and small firms while the third one describes a country with a higher percentage of big companies. As in the previous section, we set $r = 100, c = 15, m = 15, \lambda^B = 15, T = 4$. As for C_0, we consider two values which capture the entities of the cost of compliance: $C_0 = 100, 200$.
We also let β and q vary: $q = 0.2; 0.8$ (low and high monitoring activity, respectively), $\beta = 0.15; 0.85$ (asymmetric bargaining strength between bureaucrat/politician and firm, in favor of bureaucrat/politician and firm, respectively). The truncation of the capitals, when needed in the numerical computation of the integrals (see below), is reasonably performed at $H = 200$.
Thus, the aggregation of the capital levels divides the space in three regions, whose sizes are L, BC and C. Such sizes denote lobbying, bureaucratic corruption and compliance, respectively.
Cases (I) and (II) of Proposition 3.3 are considered. Of course, cases (I) and (II) are mutually exclusive, and this depends on the relationship between thresholds $k^{(0)}$ and $k^{(1)}$. We can therefore distinguish two cases in the simulations

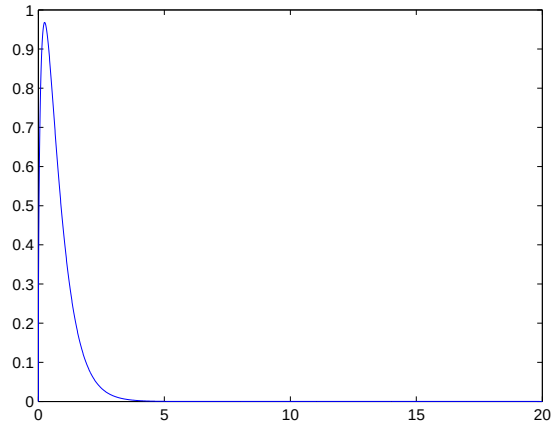

Figure 2: Density function of a Gamma distribution: $h = 1.5$, $\theta = 0.5$

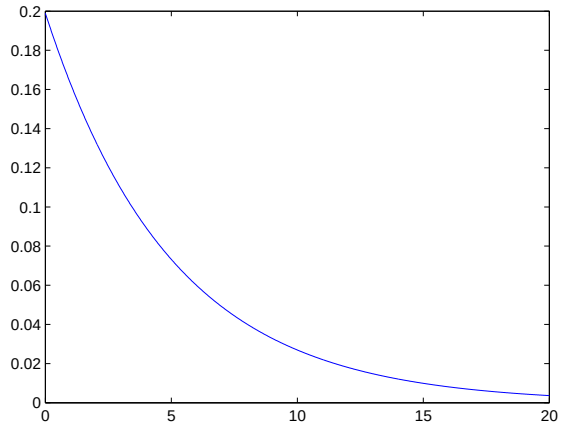

Figure 3: Density function of a Gamma distribution: $h = 1$, $\theta = 5$

- Case (I)

$$\begin{cases} C = \frac{1}{\Gamma(\theta,h)} \int_0^{k^{(1)}} x^{h-1} \exp\{-x/\theta\} dx, \\ L = \frac{1}{\Gamma(\theta,h)} \int_{k^{(0)}}^{+\infty} x^{h-1} \exp\{-x/\theta\} dx, \\ BC = \frac{1}{\Gamma(\theta,h)} \int_{k^{(1)}}^{k^{(0)}} x^{h-1} \exp\{-x/\theta\} dx. \end{cases} \tag{18}$$

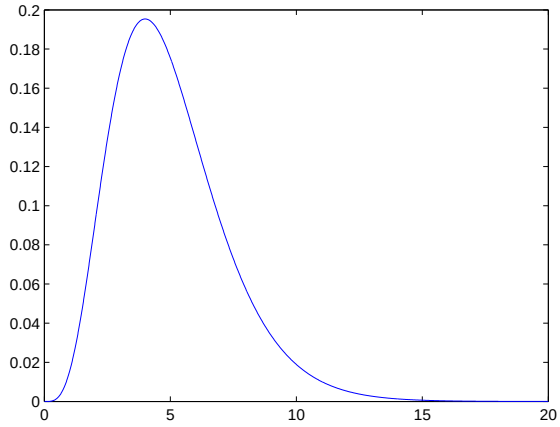

Figure 4: Density function of a Gamma distribution: $h = 5$, $\theta = 1$

Table 1: Labels of the case (I), with the values of $k^{(0)}$ and $k^{(1)}$.

Label of the case	q	β	C_0	$k^{(0)}$	$k^{(1)}$
I-1	0.2	0.85	100	1.1268	0.125
I-2	0.2	0.85	200	2.2535	0.125
I-3	0.8	0.85	200	2.2535	2
I-4	0.2	0.15	100	2.7586	0.125
I-5	0.2	0.15	200	5.5172	0.125
I-6	0.8	0.15	100	2.7586	2
I-7	0.8	0.15	200	5.5172	2

- Case (II)

$$\begin{cases} C = \frac{1}{\Gamma(\theta,h)} \int_0^{k^{(0)}} x^{h-1} \exp\{-x/\theta\} dx, \\ \\ L = \frac{1}{\Gamma(\theta,h)} \int_{k^{(0)}}^{+\infty} x^{h-1} \exp\{-x/\theta\} dx. \end{cases} \tag{19}$$

The different cases are labeled, for the convenience of the reader, according to Tables 3 and 4. Results are presented in Tables 3 and 4. In order to better clarify the results, let us rename the thresholds found for the capital critical level:

- $k^{(0)}$. We call this threshold the *Lobbying Threshold (LT)* because this is the necessary and sufficient capital level for lobbying: in fact, if the firm capital level k_j is less than $k^{(0)}$, the j-th firm does not have the

Table 2: Labels of the case (II), with the values of $k^{(0)}$ and $k^{(1)}$.

Label of the case	q	β	C_0	$k^{(0)}$	$k^{(1)}$
II	0.8	0.85	100	1.1268	2

Table 3: Values of L, BC, C in case I

Label	$h = 1.5$, $\theta = 0.5$			$h = 1$, $\theta = 5$			$h = 5$, $\theta = 1$		
	BC	C	L	BC	C	L	BC	C	L
I-1	0.713	0.080	0.207	0.113	0.0162	0.8708	0.006	0	0.994
I-2	0.894	0.080	0.026	0.214	0.016	0.77	0.078	0	0.92
I-3	0.017	0.954	0.029	0.021	0.21	0.769	0.026	0.053	0.921
I-4	0.912	0.080	0.008	0.253	0.016	0.731	0.146	0	0.854
I-5	0.92	0.080	0	0.407	0.016	0.577	0.64	0	0.36
I-6	0.035	0.95	0.011	0.06	0.20	0.74	0.093	0.053	0.854
I-7	0.046	0.954	0	0.21	0.21	0.58	0.59	0.053	0.357

necessary capital to lobby; if the firm capital level k_j is greater than $k^{(0)}$, the j-th firm engages in lobbying;

- $k^{(1)}$. We call this threshold the *Bureaucratic Corruption vs Compliance Threshold (BCT)* because if the firm capital level k_j is lower than $k^{(1)}$, the j-th firm will find it worthwhile to comply with the rule; if the firm capital level k_j is more than $k^{(1)}$, the j-th firm will find it worthwhile to bribe the bureaucrat.

Tables 2-4 shows the results. Regarding the role of β we consider two different values: $\beta = 0.85$ means the bargaining power of the firm is higher than that of both the bureaucrat and the politician. In such cases, *ceteris paribus*, the firm will have a high incentive to engage in lobbying or bureaucratic corruption. Conversely, when $\beta = 0.15$, the bargaining strength of the firm is low and therefore, the firm has a low economic incentive, *ceteris paribus*, to engage lobbying or corruption.
For what concerns the role of the monitoring level q, a great level of control ($q = 0.8$ in our model) implies that it is less convenient for the firm, *ceteris paribus*, to engage in bureaucratic corruption; the opposite applies for low levels of monitoring ($q = 0.2$).

Table 4: Values of L, BC, C in case II

Label	$h = 1.5$, $\theta = 0.5$			$h = 1$, $\theta = 5$			$h = 5$, $\theta = 1$		
	BC	C	L	BC	C	L	BC	C	L
II	0	0.74	0.26	0	0.115	0.885	0	0.0038	0.962

As we mentioned above, the firms must always pay the fixed cost C_0 . When this cost is high, the *Lobbying Threshold (LT)* $k^{(0)}$ is high too and then, *ceteris paribus*, less firms have sufficient capital to engage in lobbying activity. The bureaucratic corruption, *ceteris paribus*, is high when the bargaining power of the firm is high, the monitoring level is low, and the fixed cost of compliance is high. Viceversa, the lobbying activity, *ceteris paribus*, is more likely when the bargaining power of the firm is high and the proportional cost of compliance is high (c).
Differently from Harstad and Svensonn (2011), we have introduced the heterogeneity of the firm capital within the model. Such a hypothesis allows us to analyze different industrial structures. The equilibria are computed in the entire set of cases, and in the four cases of Gamma distributions mentioned above: $h = 1.5, \theta = 0.5$; $h = 1, \theta = 5$; $h = 5, \theta = 1$. As for the Tables, note that, in all the examined cases, at least one of the regions seems to have a prominent role with respect to the others.
As already argued above, *ceteris paribus*, the industrial structures with a significant number of small firms (i.e. $h = 1.5, \theta = 0.5$) show a higher rate of compliant behavior for low capital level of firm. In fact, by reading Tables from left to right, i.e. by going from countries with many small firms to countries with a high number of large firms, we observe progressively a decrease in compliance behavior in favor of bureaucratic corruption and an increase in lobbying. In Table 3, cases $I-1$ and $I-2$ there is a situation conducive to bureaucratic corruption because firms have a high bargaining power and therefore, in such cases, *ceteris paribus*, the firm will have a high incentive not to comply; in addition $q = 0.2$ implies a low probability for the corrupt firm and bureaucrat to be reported. With the same industrial structure, i.e. same h and θ, when the probability of being detected grows (for example row $I-3$) the bureaucratic corruption collapses in favor of compliance. In fact, as rows $I-3$, $I-6$ and $I-7$ show, when there is an high probability of being detected the number of firms which find it worthwhile to comply grows (95%). Therefore, our model predicts a widespread corruption when, *ceteris paribus*, the industrial structure is concentrated on small firms and when the probability of being detected in a corrupted transaction is low. In this case, in the first column of Table 3, i.e. when there are many little firms, the bureaucratic corruption is the prevalent behavior when $q = 0.2$; while when $q = 0.8$ the firms prefer comply with the rules. As the size of the firms grows, the compliance firms and the bureaucratic corruption decreases and the lobbying increases. As in Harstad and Svensonn (2011), bureaucratic corruption, when taking place, is more convenient for low capital levels, while lobbying requires high capital level. In fact, as Table 3 shows, when the industrial structure is concentrated on big firms, i.e. $h = 5, \theta = 1$, the number of firms which comply is near to zero, while the number of firms which engage in lobbying is large. The only exceptions are cases $I-5$ and $I-7$ where the bargaining power is low: in this case the

Lobbying Threshold (LT), $k^{(0)}$, is very high and then, fever firms are able to engage in lobbying activity, about 35% of firms.
Table 4 describes the situation in which the *Lobbying Threshold* is lower than the *Bureaucratic Corruption vs Compliance Threshold*, i.e. $k^{(0)} < k^{(1)}$. In this case, there is no bureaucratic corruption and firms which do not have sufficient capital to engage in lobbying comply with the rule. To conclude, the Tables graphically and forcefully show the close relationship between the industrial structure and the behavior of firms in regards to compliance.

5 Conclusions

This paper deals with the relationship between bureaucratic corruption and lobbying in the context of different industrial structures, a key element of heterogeneity across countries. We demonstrate, contrary to previous literature, that lobbying and bureaucratic corruption can coexist at the macro level. Our results show that, in line with the theoretical and empirical literature, a certain size of the firm, i.e. its capital level, is a necessary condition for the existence of a lobbying activity and firms find it worthwhile to move from bureaucratic corruption to lobbying as the size of the firm grows. In our model, firms with a sufficiently low capital level comply with the existing regulation; firms with an intermediate capital level may prefer to engage in bureaucratic corruption, while firms with a high capital level prefer to engage in lobbying.
The welfare and policy implications of our paper are relevant. Insofar as corruption and lobbying are not merely redistributive activities but impact on welfare through, for example, the under-provision of a public good (e.g. environmental well-being), policies that manage to reduce them are welfare improving. While indeed improving the monitoring technology against corruption may prove to be useful in this sense, we should acknowledge that a sector with, ceteris paribus, more small firms might be relevant in sustaining welfare (e.g. in supporting environmental improvements). If instead regulation is not welfare-improving but merely a red-tape exercise (see Lambsdorff, 2007) that introduces costs, removing it for small firms might prove to be relevant because it lowers costs not only due to red tape but also due to corruption meant to avoid it. Inserting legislation like, in the US, the Regulatory Flexibility Act, which ensures that regulation is imposed only if the size of the firm is large enough might therefore have an additional advantage for society.

References

[1] Andvig, J.C., Moene, K.O., 1990. How corruption may corrupt. *Journal of Economic Behavior and Organization*, 13(1), 63-76.

[2] Begovic, B., 2005. Corruption, Lobbying and State Capture. CDLS Working Paper no. 0106.

[3] Bennedsen, M., Feldmann S., 2006. Informational Lobbying and Political Contributions. *Journal of Public Economics*, 90(4-5), 631-656.

[4] Bennedsen, M., Feldmann S., Lassen D., 2009. Strong Firms Lobby, Weak Firms Bribe: A Survey-Based Analysis of the Demand for Influence and Corruption. Mimeo, Melbourne Business School.

[5] Boycko, M., Shleifer A., Vishny R.W., 1995. Privatizing Russia. Cambridge, MA: MIT Press.

[6] Campos, N., Giovannoni F., 2007. Lobbying, Corruption and Political Influence. *Public Choice*, 131(1), 1-21.

[7] Campos, N., Giovannoni F., 2008. Lobbying, Corruption and Other Banes., William Davidson Institute WP 930.

[8] Cerqueti, R., Coppier, R., 2013. Corruptibility and tax evasion. *European Journal of Law and Economics*, 39(2), 355-373.

[9] Cerqueti, R., Coppier, R., 2014. Corruption, Evasion and Environmental Policy: a Game Theory Approach. *IMA Journal of Management Mathematics*, doi:10.1093/imaman/dpu019.

[10] Damania, R., 2002. Environmental Controls with Corrupt Bureaucrats. *Environment and Development Economics*, 7(3), 407-427.

[11] Damania, R., Fredricksson P. G., Mani M., 2004. The Persistence of Corruption and Regulatory Compliance Failures: Theory and Evidence. *Public Choice*, 121, 363-390.

[12] Ellison, G., 2006. Bounded rationality in industrial organization. Econometric Society Monographs 42, 142.

[13] Fredriksson, P.G., Wollscheid, J.R., 2008. The Political Economy of Investment: The Case of Pollution Control Technology. *European Journal of Political Economy*, 24(1), 53-72.

[14] Harstad, B., Svensson, J., 2010. Bribes, Lobbying and Development. *American Political Science Review*, 105(1), 46-63.

[15] Hellman, J., Kaufmann D., 2001. Confronting the Challenge of State Capture in Transition Economies. *Finance & Development*, IMF 38(3).

[16] Kaufmann D., 2009. Corruption And The Global Financial Crisis. http://www.forbes.com/2009/01/27/corruption-financial-crisis-business-corruption09_0127corruption.html

[17] Lambsdorff , J.G., 2007. The Institutional Economics of Corruption and Reform: Theory, Evidence, and Policy, Cambridge: Cambridge University Press.

[18] Rose-Ackerman, S., 1975. The Economics of Corruption. *Journal of Public Economics*, 4, 187-203.

[19] Rose-Ackerman, S., 1978. Corruption: a Study in Political Economy, New York, Academic Press.

Appendix

Proof of Proposition 3.1

Let us fix $t = 0, 1, \ldots, T$ and let $\underline{\phi}_{\Delta}(t) = \left(\phi_{\Delta}^{(F)}(t), \phi_{\Delta}^{(B)}(t)\right)$ be the vector of the differences in the expected payoffs between the case of agreement and disagreement regarding the bribe between the j-th firm and the bureaucrat, i.e.

$$\begin{cases} \phi_{\Delta}^{(F)}(t) = \mathbf{E}[\pi_B^{(F)}(t)] - \pi_2^{(F)}(t), \\ \\ \phi_{\Delta}^{(B)} = \mathbf{E}[\pi_B^{(B)}(t)] - \pi_2^{(B)}(t), \end{cases}$$

where $\mathbf{E}$ indicates the expected value operator.
Follow the generalized Nash bargaining theory, the bribe of agreement comes out from:

$$\max_{b_t \in (0,+\infty)} \left\{\phi_{\Delta}^{(F)}(t)\right\}^{\beta} \cdot \left\{\phi_{\Delta}^{(B)}(t)\right\}^{1-\beta}, \tag{20}$$

i.e.:

$$\max_{b \in (0,+\infty)} \left[(ck_j + mk_j)(1-q) - (1-q)b\right]^{\beta} \cdot \left[-q\lambda^B + (1-q)b\right]^{(1-\beta)}. \tag{21}$$

The objective function in (23) is a reversed U-shaped function in b. Therefore, the first order condition leads to the bribe of agreement:

$$b_j^{NB} = (1-\beta)(c+m)k_j + \frac{\beta q \lambda^B}{1-q},$$

which is the unique bureaucratic equilibrium bribe in the last subgame.

Proof of Proposition 3.2

Let us fix $t = 0, 1, \ldots, T$ and let $\underline{\phi}_{\Delta}(t) = \left(\phi_{\Delta}^{(F)}(t), \phi_{\Delta}^{(P)}(t)\right)$ be the vector of the differences in the aggregated expected payoffs between the case of agreement and disagreement regarding the bribe between the j-th firm and the politician, i.e.

$$\begin{cases} \phi_{\Delta}^{(F)}(t) = \mathbf{E}[\pi_L^{(F)}] - \pi_{NL}^{(F)}, \\ \\ \phi_{\Delta}^{(P)} = \mathbf{E}[\pi_L^{(P)}] - \pi_{NL}^{(P)}, \end{cases}$$

where $\mathbf{E}$ indicates the expected value operator.
Follow the generalized Nash bargaining theory, the bribe of agreement comes out from:

$$\max_{p_j \in (0,+\infty)} \left\{\phi_{\Delta}^{(F)}(t)\right\}^{\beta} \cdot \left\{\phi_{\Delta}^{(P)}(t)\right\}^{1-\beta}, \tag{22}$$

i.e.:

$$\max_{p_j \in (0,+\infty)} \left[(T+1)ck_j - p_j)\right]^{\beta} \cdot \left[p_j\right]^{(1-\beta)}. \tag{23}$$

The objective function in (23) is a reversed U-shaped function in p_j. Therefore, the first order condition leads to the bribe of agreement:

$$p_j^{NB} = (T+1)(1-\beta)ck_j.$$

which is the unique equilibrium political bribe in the last subgame.

Proof of Proposition 3.3

The game is solved by using backward induction, which enables the equilibria to be obtained. Fix a level of time $t = 0, 1, \ldots, T$.

(3) At stage three, the j-th firm negotiates the bribe if and only if:

$$\mathbf{E}[\pi_C^{(F)}] - \pi_{3,RC}^{(F)} > 0. \tag{24}$$

Condition (24) is verified when:

$$k_j > \frac{\lambda^B q}{(c+m)(1-q)} =: k^{(1)}. \tag{25}$$

(2) Ascending the decision-making tree, at stage two the bureaucrat decides whether to ask for a bribe or not. The bureaucrat knows that if she/he asks for a bribe, then the bribe will be negotiated when $k_j > k^{(1)}$, and refused otherwise.

(I) If $k_j > k^{(1)}$, then the bureaucrat asks for a bribe if and only if

$$\mathbf{E}[\pi_{(C)}^{(B)}] - \pi_{(2,RC)}^{(B)} > 0, \tag{26}$$

which is always verified.

(II) If $k_j \leq k^{(1)}$, then the bureaucrat asks for a bribe if and only if

$$\pi_{(3,RC)}^{(B)} - \pi_{(2,RC)}^{(B)} > 0, \tag{27}$$

which is never verified.

(1) At stage one, the j-th firm must decide whether to comply with regulation or to bend the rule. To proceed, we need to observe the cases occurring in the previous stage.

(I) If $k_j > k^{(1)}$, then the j-th firm bends the rule if and only if

$$\mathbf{E}[\pi_{(C)}^{(F)}] - \pi_{(1,NL,NC)}^{(F)} > 0, \tag{28}$$

This condition is verified when:

$$k_j < \frac{\beta\lambda^B q}{\beta(1-q)c - m[1-\beta(1-q)]} = k^{(2)}. \tag{29}$$

(II) If $k_j \leq k^{(1)}$, then the j-th firm bends the rule if and only if

$$\pi^{(F)}_{(3,RC)} - \pi^{(F)}_{(1,NL,NC)} > 0, \tag{30}$$

which is never verified.

It is easy to check that $k^{(1)} > k^{(2)}$. This completes the proof.