Economic Competition and Corruption: the Theory and Evidence from Firm-Level Data

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Abstract

Despite increased amount of scholarly attention in the last two decades, the definitive answer regarding the relationship between corruption and the market competition has not yet been reached. Existing studies find the relationship to be either ambiguous or largely determined by the type of corruption under scrutiny. This paper investigates bribe-seeking behavior of public officials and proposes a theory that relates economic competition to the likelihood of bribe requests from public officials. I start with the analysis of two instructive cases: in the first scenario single firm interacts with public official while in the second scenario public official interacts with two firms. After discussing the generalizations of the proposed model, I conclude that economic competition is expected to increase the likelihood of public official's bribe-seeking behavior. I test this hypothesis using Bayesian hierarchical logistic regression and find strong evidence in favor of the proposed theory.

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Introduction

Given the fact that the market competition is one of the most important phenomena studied in economics and political science, it should be of little surprise that scholars devoted substantial amount of attention to the investigation of the relationship between the market competition and corruption. In addition to purely academic interest, the topic also has profound policy implications since economic reform recipes advocated by the IMF and the World Bank typically include promoting competition as one of the cornerstone points. In the notable research program paper, Svensson (2005) listed the relationship between competition and corruption as one of the 8 pivotal questions pertinent to the study of corruption. Since the publication of two influential papers by Ades and Tella (1999) and Bliss and Tella (1997), increasing amount of papers focused on the existence and the direction of the relationship between the market competition and corruption. Yet, results of these efforts are quite far from definitive. On the one hand, ambiguity in the conclusions of theoretical papers can be largely attributed to either different model assumptions[1] or different corruption types under scrutiny (Shleifer and Vishny, 1993; Shleifer, 1995; Alexeev and Song, 2013). On the other hand, ambiguity in conclusions of empirically-oriented studies is largely driven by the corruption types under investigation. It is clear that academic consensus about the relationship between corruption and the market competition is yet to be reached, on both theoretical and empirical fronts.

Main focus of this paper is bribe-seeking behavior of public officials, specifically bribes demanded from firms operating within specific market. I argue that the competition between firms induces increasing amount of bribe requests from public officials. My empirical research design is similar to the one employed by Pieroni and d'Agostino (2013), with a notable differences of using Bayesian instead of MLE estimation framework and different model (Pieroni and d'Agostino (2013) use ordinal dependent variable which is different from the

[1] Ades and Tella (1999), for instance, assume bureaucrats that are perfectly informed about the surplus received by firms; Bliss and Tella (1997), on the other hand, assume bureaucratic uncertainty about the true level of surplus received by a specific firm.

variable used in this study). The findings strongly support the theory and are robust to different model specifications.

The Market Competition and Corruption

To the best of my knowledge, theoretical models that analyze the relationship between the market competition and corruption has not been introduced in the literature until 1990s. Earlier studies applied economic models to explain why competition between public officials might be beneficial for the quality of public services (Rose-Ackerman, 1978). The logic here is quite straightforward: if consumers of public services have an option to choose between different service providers, they will choose the one that provides the best quality for the lowest cost. This situation pushes public officials to compete for consumers of public services and, therefore, to strive for better job performance. When it comes to competition between consumers of public services, specifically between firms, it is not immediately clear why competition might reduce or increase corruption.

Very few theoretical models explicitly derive equilibria where the relationship between corruption and the market competition can have both negative and positive direction. Bliss and Tella (1997) in one of the early efforts offered the model that produced ambiguous results: contingent on the structure of the public official's uncertainty about firms' profits and costs of production, the market competition could either reduce or increase corruption. Laffont and N'Guessan (1999) present another theoretical model that argues in favor of ambiguous, condition-driven relationship between corruption and the market competition. Studies that posit unambiguous one-directional hypothesis are much more abundant, but the results are very unclear, with the supportive evidence in favor of both directions.

Theories and empirical evidence in favor of the negative link between the market competition and corruption are plenty in the extant research. Ades and Tella (1999) suggested that competition reduces corruption, but, unlike Bliss and Tella (1997), the model assumed

bureaucrats that are perfectly informed about firms' profits. Empirically, Ades and Tella (1999) found support for their hypothesis, though the gap between the theory and empirics was quite substantial[2]. Emerson (2006) presents yet another model that argues for the negative relationship between the market competition and corruption and finds support for the hypothesized form of the relationship with cross-country regressions. Clark and Lixin (2004) advance the literature empirically by testing the hypothesis that relates the market competition and corruption using the sample of firms that conduct business in infrastructure sector; they find that the market competition in telecommunications sector reduces corruption. Pieroni and d'Agostino (2013) also find that competition reduces corruption, though the strong institutions might be necessary for the effect to be realized. In addition, a number of studies tested the relationship between various indicators and indexes of economic freedom and corruption. Since higher levels of the market competition are typically associated with higher levels of economic freedom, these tests can be considered indirect tests of the relationship between the market competition and corruption. Gokcekus and Knorich (2006) find that level of economic openness (component of economic freedom) as well as the quality of openness reduce corruption, thereby providing another cross-country evidence in favor of the argument that negatively links market competition to corruption[3]. Other components of economic freedom have also been found to negatively influence the level of corruption (Saha, Gounder, and Su, 2009; Gerring and Thacker, 2005), with some studies arguing for the conditional link[4].

There is a number of notable studies that find support for the positive link between market competition and corruption as well. Alexeev and Song (2013) provide both the

[2]On the one hand, they used cross-country regressions to test the model that was designed at the level of firms and bureaucrats. On the other hand, they used series of aggregate competition indicators like the distance from export centers and share of imports as % of GDP. Regardless of the problems of testing micro-theories with aggregate-level indicators, these indicators also capture only one, international, dimension of competition.

[3]Similar argument can be found in Sung and Chu (2003). Torrez (2002) finds some mixed support in favor of the negative relationship between corruption and trade.

[4]E.g. Graeff and Mehlkop (2003) finds that the effect of economic freedom might differ for rich and poor countries, with rich countries actually benefiting from lower freedom induced by the higher amount of government regulations.

theory and firm-level evidence in favor of the positive link between the market competition and cost-reducing corruption[5]. Diaby and Sylwester (2015) find the evidence in favor of the positive link using the sample of firms from post-communist countries. It is clear that the number of studies that find the support for the positive link between the market competition and corruption is much lower.

This study differs from the ones in the literature in a two notable ways. First, I do not focus on corruption in general, but rather on specific subset of corruption - bribe-seeking behavior. Therefore, I do not make any firm claims about "goodness" or "badness" of market competition for corruption overall and instead build a theory that analyzes the relationship between market competition and bribe requests made by public officials. Given this focus on bribe-seeking behavior, the second difference of this study from the previous research is different dependent variable. I employ bribe request dependent variable, not the variable that encodes annual % of sales paid in bribes. Besides the fact that bribe request variable provides direct correspondence between my theory and the data, it is also less noisy than % of sales paid in bribes[6].

Theoretical Argument

The theory I am going to suggest analyzes behavior of firms and public officials in different market competition environments. By competition environment here I understand simply the number of firms operating within a certain market (can be anything, from an industry to a local consumer market). Before I proceed to the main analysis, I will outline and justify basic assumptions that are used in the argument and the model.

First, I assume that, all else equal, firms prefer having less corrupt public controllers.

[5]Corruption with theft in terms of Shleifer and Vishny (1993)

[6]Self-reported annual % of sales paid in bribes has two main sources of noise: incentives to misrepresent the answer to the sensitive topic and the lack of accurate records (it's hard to imagine a typical firm recording accurately % of sales that goes to bribe payments, though in a very corrupt environments firms have been known to put "bribes" article in their operating budgets). The noise in the bribe request variable, on the other hand, most likely comes only from the topic's sensitivity.

There are two main reasons why I believe this assumption is valid. On the one hand, corruption increases uncertainty. Corruption inherently involves substantial informal component based largely on the relationship between a firm and a public controller. Because of this, it's hard for a firm to predict with certainty whether the level of bribes demanded will stay the same in the future or not. In other words, while corruption may indeed be appealing in a short run, in a long run it almost surely promises far greater costs and headaches than obeying the legal procedures and demands. On the other hand, engaging in corruption might be harmful for firms' reputation, especially international reputation. Even in corrupt countries, firms have been found to suffer material consequences from scandals involving corruption (see Enikolopov, Petrova, and Sonin (2018) for the evidence that firms lose market capitalization after major corruption scandals in Russia); in democratic countries, these consequences are even more severe. Overall, while in some cases it is conceivable for a firm to prefer corrupt environments, typically this is not the case, and business owners prefer a predictable, transparent public regulation rules.

Second, I assume that public officials are constrained in their power to punish those firms that do not comply with bribe requests. For example, public official cannot "kill" the industry by closing all firms if they all fail to comply with the bribe requests. There are number of different reasons why "killing" the industry might be bad for a public official, but perhaps the most important is political cost: closing all firms will result in job loss for many people which is not a desirable situation. In addition, it is easier to punish smaller firms than bigger firms: smaller firm employs less people and is unlikely to cause problems for public official if he is to use punishment against it.

Third, I assume that the level of market competition and the size of a firm are negatively related: the higher is competition, the lower is the firm's size. This assumption mostly follows along the lines of conventional economic theory. Firm's size is directly related to the demand it faces. Consider now two markets with the same aggregate demand, but the first market is controlled by only 2 firms while the second market is controlled by 1000 firms. It

is clear that in the latter case the size of a single firm will be smaller since in the first case the demand pie is divided between 2 firms while in the second case it is divided between 1000 firms.

Fourth, I assume specific form of utility function that a single firm i derives from paying a bribe:

$$U_i(Bribe) = T - N_p * C_p + N_{np} * B_{np} \tag{1}$$

where T is an immediate reward (e.g. getting a license issued) from paying a bribe, N_p is the number of firms paying bribes, C_p is a cost these payments impose on a firm i, N_{np} is the number of firms not paying bribes, and B_{np} is a benefit from a single firm non-payment. The most important thing here is that firm's i utility grows with the number of non-payers (in the best case scenario, only firm i pays the bribe and receives all pie of corruption benefits that public official has to offer) and declines with the number of bribe payers (here, the higher is the number of payers, the lower is the share of corruption benefits pie that a single firm expects to receive). Now, having all these assumptions in mind, I first outline the intuition behind the theoretical model and then the model itself.

To understand why competition might be conducive to bribe-seeking behavior, consider two cases: in case one, public official interacts with only one firm that operates within his control jurisdiction; in case two, public official interacts with two firms. In the first case, since there is only one firm, public official does not have a credible threat of punishment: he cannot close the firm due to the second assumption. In this scenario, firm will have no incentives to comply with bribe request, and public official, therefore, will avoid requesting a bribe in the first place since bribe request is in itself a costly action (e.g. corruption is a criminal offense). In the second case, we have two firms interacting with a public controller. Here, situation is quite different: due to the fourth assumption, first firm now gets an additional benefit from paying a bribe if the second firm does not pay. Of course, the second firm is

aware of this, and has incentives to pay as well.

In order to elaborate the logic of the argument more precisely, I provide a simple formal model that follows along the lines outlined above and analyze equilibria that arise in this model. Before we proceed further, I'd like to outline notations that might cause confusion. In the model presented below $\sim$ stands for "not", P stands for "Pay", $C_i, i \in \{1, 2\}$ stands for "Close Firm i", and P.O. stands for public official. Once again, I am analyzing two scenarios, but I'll also discuss extensions afterwards. First, consider "one firm - one public official" case. Figure 1 depicts the relevant game tree.

[Figure 1 is about here]

Payoffs in the game tree follow from three assumptions outlined in the beginning of the section. As can be seen, sub-game perfect equilibrium of this game is $\{Do\ Nothing, \sim C; \sim P\}$: public official does not have a credible punishment threat, leading the firm to refrain from paying a bribe and public official to avoid requesting it.

In the second scenario, illustrated by the game tree in Figure 2[7], we have two firms interacting with a public official. Once again, payoffs here follow from assumptions. This game has two sub-game perfect equilibria: $\{Req.\ a\ bribe, C_2, C_1, C_1, \sim C_2; P; P\}$ and $\{Req.\ a\ bribe, C_2, C_1, \sim C_1, C_2; P; P\}$; in both equilibria, we see that public offical exhibits bribe-seeking behavior.

[Figure 2 is about here]

While the two cases I've already considered are instructive, one might inquire what happens if the number of competitors on the market exceeds 2. From a formal-theoretical perspective, this extension changes nothing: adding firms to the game tree in Figure 2 increases the number of possible equilibria, but they will all include public official seeking a bribe. This logic, however, seems somewhat paradoxical since it essentially states that all competitive markets induce the same bribe-seeking behavior from a public official. However,

[7]Game tree was "split" in two parts for presentational convenience, but it is one game: after the bribe request by a public official, game continues to the second part.

in reality it makes little sense: surely it's a different situation for a public official when market is controlled by 2 firms and when market is controlled by 1000 firms. To resolve this paradox, I will rely on assumptions specified in the beginning of this section and intuitions from collective action theory. In the model above public official wants to request a bribe only if he has a credible punishment threat. We've already seen in the "one firm - one public official" scenario that, if the threat of punishment is not credible, no bribe is requested. But what happens when there are two firms? First, from the game it is clear that firms are jointly better off by refraining from bribe payments, but end up paying because of the fear of being 'cheated off" by another firm. However, it is conceivable to imagine that firms may somehow attempt to establish bribe-avoiding cooperation, the thing a public official certainly would like to prevent. Now, we have all the pieces that we can put together. Bribe-avoiding cooperation is certainly easier to maintain when the number of firms is small - this follows from the standard logic of collective action theory (Olson, 1971). In addition, public official's potential to disrupt cooperation is much smaller in case of markets with low level of competition: due to assumption two, punishing bigger firm for non-payment is harder while assumption three guarantees that low level of competition increases the size of a firm. Therefore, when the number of competitors grows, it is both harder for firms to maintain bribe-avoiding cooperation and easier for a public official to punish firms that do not pay. Putting everything together, I can now state the main hypothesis of this study:

The link between bribe-seeking behavior and the market competition is positive: high levels of market competition increase the probability of a public official requesting a bribe from a firm.

The Data

In order to test the hypothesis, I use the World Bank Enterprise Surveys conducted from 2006 to 2016. The dependent variable is the binary indicator of bribe-seeking behavior,

the crucial independent variable is the number of competitors. Following Alexeev and Song (2013), I use the natural logarithm of the number of competitors since self-reported numbers go as high as 5000, and it is reasonable to expect that the marginal effect of the variable should be decaying.

I use one firm-level control variable, % of the firm owned by the state, and a number of control variables that were found to be good predictors of corruption in the previous empirical studies (Serra, 2006; Treisman, 2000). Specifically, I use natural logarithm of GDP per capita, % of people practicing protestant religion, British common law system, ethnolinguistic fractionalization index, and polity 2 autocracy-democracy measure. Description of all variables is presented in the Table 1.

[Table 1 is about here]

The data has multilevel structure, with the number of competitors and firm's ownership vary at the firm level, log of GDP per capita and polity 2 vary at the country-year level, and the other three variables vary at the country level. Multilevel structure of the data calls for an empirical model that takes this hierarchical structure into account. I describe this model in the next section.

Empirical Strategy and Results

In order to test the hypothesis under investigation, I ran multilevel Bayesian logistic regression. I've estimated four models: Models 1 and 3 include controls that vary at the firm level and the country-year level, Model 2 includes controls that vary only at the country-year level, and Model 4 includes controls that vary at the firm level and the country level. All 4 models are random intercept models, with Models 1-3 using country-year random intercepts and Model 4 using country random intercepts. The primary alternative to this design is the model with random intercepts and random slopes. My choice of the random intercept design is primarily dictated by theoretical considerations: model with random slopes expects

differential effects of firm-level covariates for different countries (or country-years). Given the theory this paper presents, there are little reasons to believe this is the case. Random intercepts, on the other hand, is a justified research design since the baseline level of bribe-seeking behavior can be quite different for different countries. Random intercepts allow to incorporate this variation in the baseline level of corruption by modelling intercepts as a function of country-year (or country in case of Model 4) covariates.

Another important consideration is related to the choice between MLE and Bayesian framework. MLE versions of random intercept models were used in the literature before (Pieroni and d'Agostino, 2013). Due to the number of observations in this study (4677 in each model), the difference between MLE and Bayesian models will likely be small due to the likelihood contribution to the estimation of the posterior distribution. My argument in favor of Bayesian framework is mostly philosophical and rests on the idea that in the setting of this paper it is better to treat the data as fixed and parameters of the model as the source of uncertainty. Below I provide a mathematical description of the model. Since all 4 models are 2-level hierarchical models, the general structure of the models is the same, with Models 1-3 having country-year variation at the second level and Model 4 having country variation at the second level.

I start with the dataset where Y_{ij} is a binary indicator of corruption, $\mathbf{x}_{ij}$ is a vector of firm-level covariates, $\mathbf{z_j}$ is a vector of second-level covariates; i stands for a firm and j stands for the second-level identifier (country or country-year). I assume Y_{ij} follows Bernoulli distribution with parameter p_{ij} and will also use logistic link function:

$$Y_{ij} \sim \text{Bern}(p_{ij})$$

$$p_{ij} = [1 + exp(-(\alpha_j + \mathbf{x}_{ij} * \boldsymbol{\beta}^{\intercal}))]^{-1}$$

where α_j stands for the second level intercepts that are modeled as follows:

$$\alpha_j \sim \mathcal{N}(\mu_j, \sigma^2)$$
$$\mu_j = \delta + \mathbf{z_j} * \boldsymbol{\gamma}^\intercal$$

Priors are as follows:

$$\boldsymbol{\beta} \sim MVN(\mathbf{b}, \mathbf{V_b})$$
$$\boldsymbol{\gamma} \sim MVN(\mathbf{g}, \mathbf{V_g})$$
$$\delta \sim \mathcal{N}(0, 1)$$
$$\sigma^{-1} \sim \text{Gamma}(0.001, 0.001)$$

where $\mathbf{b}$ is a vector of 0s with the length equals to the number of first level covariates, $\mathbf{g}$ is a vector of 0s with the length equals to the number of second level covariates, $\mathbf{V_b}$ and $\mathbf{V_g}$ are corresponding covariance matrices with 1s on the diagonal and 0s off the diagonal. Prior for the σ^{-1} is uninformative Gamma prior while priors for $\boldsymbol{\beta}$, $\boldsymbol{\gamma}$ and δ are standard normal priors.

One of the common critiques of the Bayesian framework is potential sensitivity of the results to the specified priors. This problem, however, is of very little concern for this paper since the posterior distribution is a trade-off between the prior distribution and the likelihood: the higher is the number of observations, the higher is the role of the data in the resulting posterior; the posterior distribution will be, so to speak, more "informed" by the data with the greater number of observations. The dataset this study employs has 4677 observations, making the influence of priors on the results close to nil. All models were estimated with JAGS program, version 4.0.0 (Plummer, 2015). I have used Gelman and Rubin convergence diagnostics (Gelman and Rubin, 1992) to monitor the Markov Chains produced by the model. The model was considered converged if the Rhat value falls between 1.0 and 1.2. All models

produce Rhat values between 1.00 and 1.05, indicating high confidence in convergence.

Since the model was estimated in the Bayesian framework, it cannot be interpreted using standard frequentist p-value statistic. Instead, statistics reported are the mean of the posterior distribution, the highest posterior density region[8] and % of the posterior distribution below zero[9]. Results are presented in the Table 2.

[Table 2 is about here]

First, it is clear that the positive relationship finds strong support in the data. The sign of the term is positive throughout all model specifications, and all model specifications produce very high confidence in the results. Percentage of the posterior distribution below zero for the number of competitors variable is always 1 %. ICC checks present a good evidence that the random intercept is an appropriate modelling choice since about 32% of the total variation is explained by the variation of random intercepts[10]. Figure 3 illustrates the same conclusion by plotting posterior distributions of parameter corresponding to the log of number of competitors together with the highest posterior density regions.

[Figure 3 is about here]

Since the estimated model is a non-linear model, the best way to interpret the relationship between the number of market competitors and bribe-seeking behavior is to plot predicted probabilities alongside the range of the log of the number of competitors. The procedure that I've used follows the CLARIFY (Tomz, Wittenberg, and King, 2001) simulation algorithm. The results are presented in Figure 4. A reader can see that in all 4 models hypothesis finds support in the simulations, corroborating initial results illustrated by posterior distribution plots in Figure 3.

[8] See Gill (2015, p. 40-48) for a thorough discussion of the topic.

[9] Intuitively, this statistic can be interpreted as the probability of parameter (e.g. coefficient for the number of competitors) being less than 0. For example, 95 % of posterior distribution below zero simply means that probability of parameter being less than 0 is 0.95. Straightforwardly, higher values of this statistic correspond to higher confidence in the direction of the relationship, and vice versa.

[10] The formula to calculate ρ statistic is as follows: $\rho = \frac{\sigma^2_{alpha}}{\sigma^2_{alpha} + \pi^2/3}$

[Figure 4 is about here]

To summarize, the hypothesis found very strong support against empirical tests. Perhaps even more striking is also the level of findings' robustness compared to other variables: country and country-year controls that are usually hypothesized to influence the level of corruption do not demonstrate as high level of robustness as the logged number of competitors. Overall, given the robustness of empirical findings and their correspondence to the hypothesis in question, there are substantial reasons to believe in the veracity of the theory presented in this paper.

Discussion and Conclusion

The findings in this paper are quite intriguing and, I believe, have some significant implications, both for the academic and policy-making debates. First, the suggestion that the market competition is always good for the quality of governance clearly does not hold, implying that policy recipes for developing and developed countries should be quite different. Since in developing countries markets are typically less competitive, increase in market competition may lead to the decline in the quality of governance. Avoidance of this decline can be quite important in countries with fledgling and weak institutions; otherwise, market reforms can lead to spike in bribe-seeking behavior which, in turn, can be harmful for reforms' potential to be successful. Another implication is related to industries: since industries within one country can differ quite drastically in terms of the market competition, levels of corruption within these industries can also be quite different.

In this paper, I've presented the theory and evidence in favor of positive link between market competition and bribe-seeking behavior of public officials. Theory and findings in this paper do not strictly contradict previous research but rather complement it by analyzing the specific subset of corruption (bribe-seeking by public officials), providing a theoretical argument pertinent to this subset and testing resulting hypothesis against the appropriate

data. Proxying the market competition by the number of competitors, I find empirical evidence that supports the theory presented in this paper. Overall, the paper calls for a more careful evaluation of the relationship between the market competition and bribe-seeking behavior, offering insights to both academic and policy-making community.

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Tables and Graphs

Table 1: Description of Variables

Variable	Description
Bribe	*Survey question*: "In any of these [tax] inspections or meetings was a gift or informal payment expected or requested?" *Answers*: Yes, No, Refusal, Don't know. *Source*: (*The World Bank Enterprise Survey*, 2016).
Number of Competitors	*Survey question*: "In fiscal year [insert last complete fiscal year], for the main market in which this establishment sold its main product, how many competitors did this establishments main product face?" *Answers*: Number of competitors, Refusal, Don't know. *Source*: (*The World Bank Enterprise Survey*, 2016).
% of the Firm Owned by a State	*Survey question*: "What percentage of this firm is owned by the state?" *Answers*: Answers: %, Refusal, Don't know. *Source*: (*The World Bank Enterprise Survey*, 2016).
Ethnolinguistic Fractionalization Index	Estimates probability that two randomly selected people from the same country will not belong to the same ethnic group. *Source*: (*The Quality of Governance Dataset*, 2017).
% of People Practicing Protestant Religion	% of People Practicing Protestant Religion *Source*: (*The Quality of Governance Dataset*, 2017).
British Common Law System	Binary indicator that codes whether the country has British common law legal system *Source*: (*The Quality of Governance Dataset*, 2017).
Log of GDP per capita	Natural Logarithm of GDP per capita in constant 2005 US dollars *Source*: (*The Quality of Governance Dataset*, 2017).
Polity 2	Combined Polity Score, ranges from -10 (the most autocratic) to + 10 (the most democratic) *Source*: (Marshall, Gurr, and Jaggers, 2015).

Table 2: The Market Competition and Bribe-Seeking Behavior

	Model 1				**Model 2**				**Model 3**				**Model 4**			
	Post. mean	95% HPD interval Lower bound	Upper bound	% Post. dist. < 0	Post. mean	95% HPD interval Lower bound	Upper bound	% Post. dist. < 0	Post. mean	95% HPD interval Lower bound	Upper bound	% Post. dist. < 0	Post. mean	95% HPD interval Lower bound	Upper bound	% Post. dist. < 0
Coefficients in Level 1 Equation																
Log(Number of competitors)	0.084	0.018	0.150	1	0.084	0.016	0.150	1	0.082	0.015	0.144	1	0.078	0.017	0.147	1
% Owned by a State	-0.013	-0.037	0.007	89					-0.013	-0.034	0.009	88	-0.013	-0.035	0.010	88
Coefficients in Level 2 Equation																
% Protestant	-0.016	-0.060	0.026	75	0.002	-0.031	0.042	45					-0.029	-0.078	0.017	91
British Common Law System	0.009	-0.911	0.983	50	0.488	-0.618	1.558	18					0.236	-0.762	1.203	33
Log of GDP per capita	-0.442	-0.657	-0.229	100	-0.238	-0.495	-0.012	98	-0.232	-0.463	0.002	98				
Ethnolinguistic frac.	0.876	-0.478	1.998	9	-0.545	-1.940	0.852	78					1.168	-0.226	2.450	5
Polity 2	0.001	-0.067	0.068	48	0.042	-0.064	0.156	21	0.049	-0.045	0.163	17				
Constant	0.524	-1.118	2.195	26	-0.902	-2.601	0.826	85	-0.994	-2.561	0.560	90	-2.847	-3.428	-2.248	100
ICC checks																
σ_α	1.184	0.841	1.600	-	1.078	0.812	1.403	-	1.039	0.752	1.290	-	1.082	0.721	1.500	-
ρ	0.298	0.177	0.438	-	0.261	0.167	0.374	-	0.247	0.147	0.336	-	0.262	0.137	0.406	-
DIC	4198				4210				4206				4221			
N	4677				4677				4677				4677			

Note: Models 1-3 report estimates from Bayesian hierarchical logistic regression with country-year random intercepts; Model 4 reports estimates from Bayesian hierarchical logistic regression with country random intercepts. σ_α stands for the variation of random intercepts; ρ stands for the intraclass correlation coefficient

Figure 1: One firm - one public official scenario.

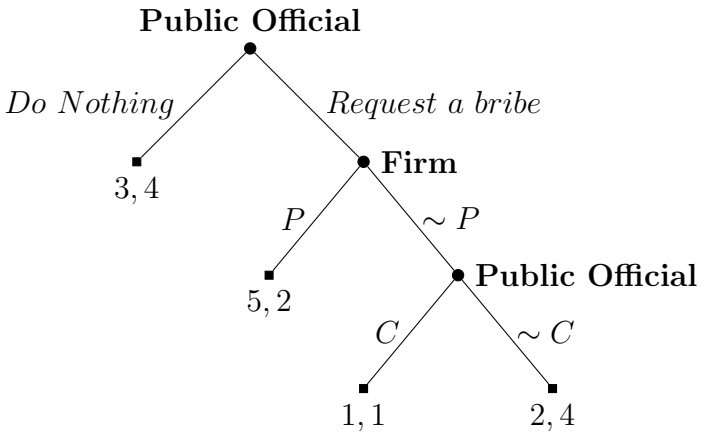


Figure 2: Two firms - one public official scenario.

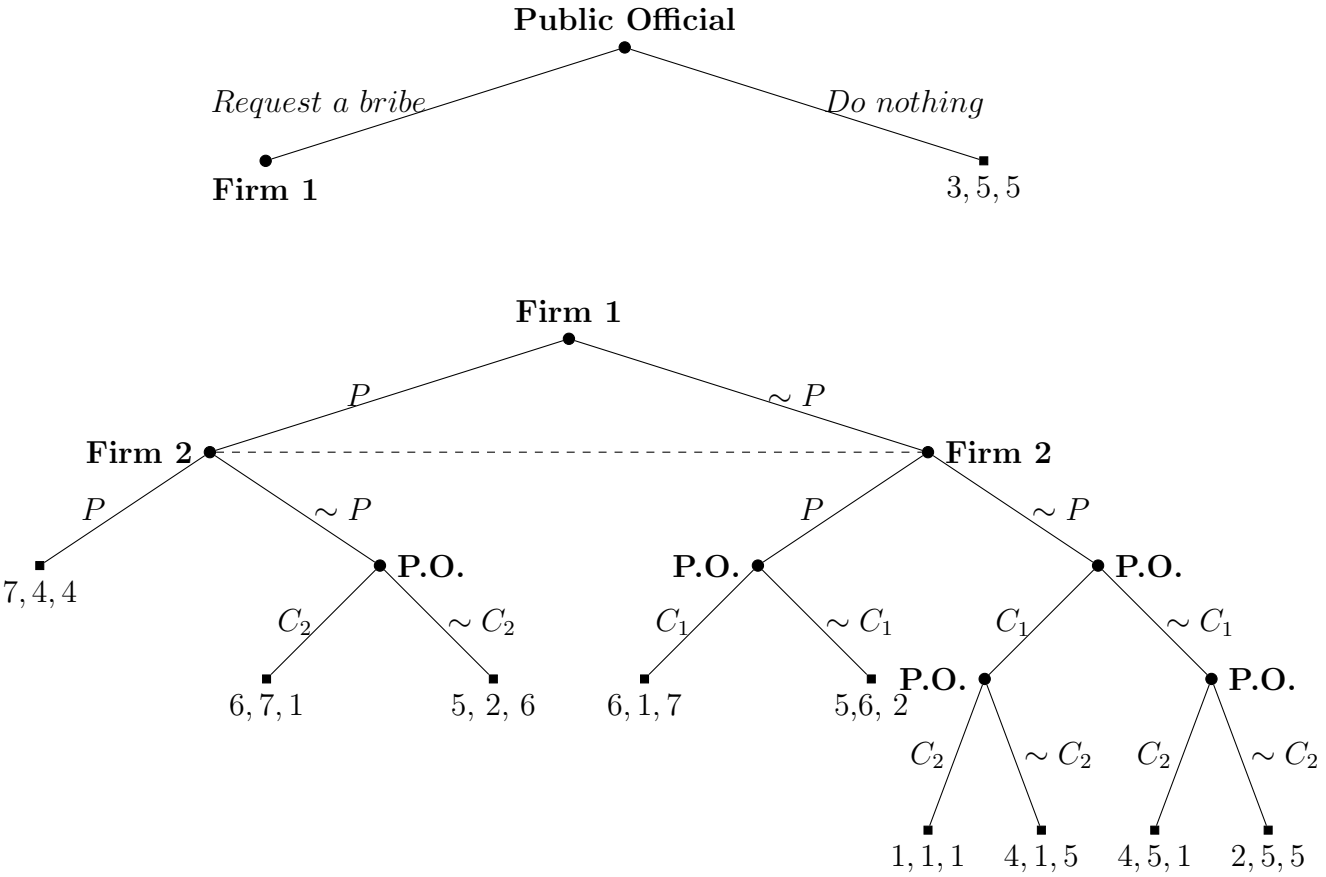
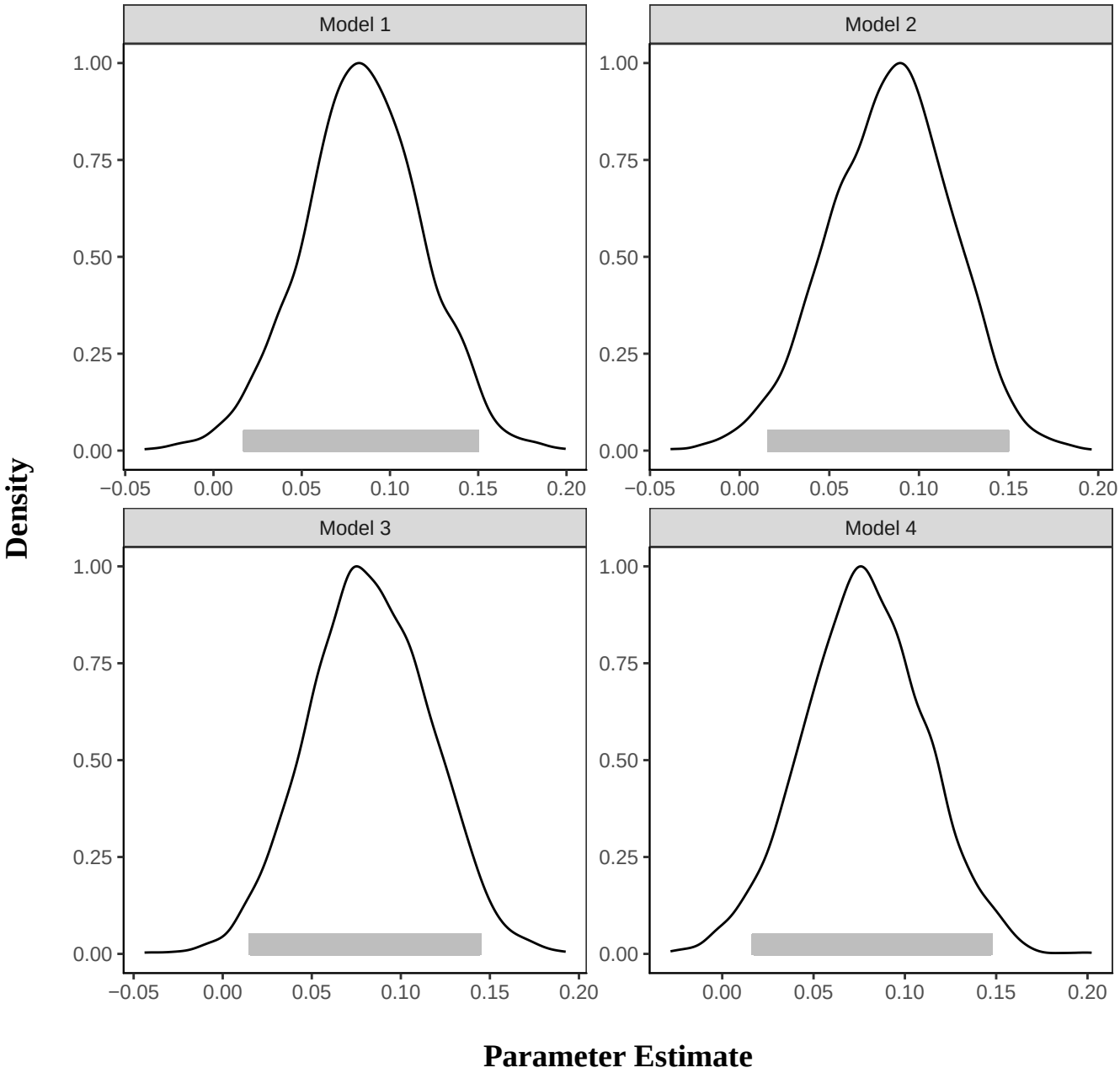


Figure 3: Posterior Distributions of Log(Number of Competitors) Coefficients



Note: gray rectangles show 95 % highest posterior density (HPD) regions.

Figure 4: Predicted Probabilities of Bribe Request | Market Competition