Favoritism in case of endogenous entry in public auctions[1]

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Abstract

Governments of different countries try to lower entry costs in public procurement in order to decrease pubic spending. Although corruption is one of the main factors that may intervene into this process, few studies research this link. The purpose of this paper is to examine how entry costs influence favoritism and procurement prices in the corrupt environment. We base on selective model of endogenous entry and find that lower entry costs always decrease the contract price paid by the benevolent procurer, but at the same time they make favoritism more stable. Thus entry costs do not affect the contract price paid by the corrupt procurer or, on the contrary, have positive impact on it. We illustrate this result using case study on gasoline procurement in Russia where reform decreased entry costs of companies and this allows us to examine how changed costs influence entry and contract prices in auctions.

JEL Classification: H57, D73

Key words: public procurement; endogenous entry; favoritism; e-auctions

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1. Introduction

To enter a public auction each company has to carry out non-zero entry costs. For instance, Russian legislation presumes that a company should fill out the application form, submit technical documentation, provide an actionist with the financial guarantee and finally make a bid. High entry costs may prevent companies from entry in public procurement leading to public waste, but it is still an open question – do lower entry costs decrease public spending.

Models of endogenous entry deal with this question. They assume that the number of companies in auction is not exogenous, but depends on different factors, such as entry costs, reserve price etc. inside the model. One can identify two key models of endogenous entry: the model of informative entry by Samuelson (1985) and the model of non-informative entry by Levin and Smith (1994). Although these papers model the decision-making process differently, they agree upon idea that more bidders may decrease or increase the contract price. Successive theoretical and empirical models (Hubbard, Paarsch, 2009; Krasnokutskaya, Seim, 2011; Kjerstad, Vagstad, 2000; Li, Zheng, 2009) adapt one of these models to various environmental settings or examine their differences and applicability to data analysis. Yet to the best of our knowledge none of them researches how corruption affects entry and bidding of companies. As corruption is wide-spread in public procurement of different countries (Bandiera, Prat, Valletti, 2009; Boehm, Olaya, 2006; Søreide, 2002), we are going to fill this gap in the literature.

The purpose of this paper is to examine how entry costs affect the sustainability of corruption and the level of contract prices paid by procurer. We are mainly interested in the market of a simple homogeneous product where each company knows its production costs before it enters the auction, therefore we adapt Samuelson's model of endogenous entry to potentially corrupt environment. We focus on such type of corruption, as favoritism, which means that the public procurer can extract a bribe only from one company – a potential favorite company.

Unlike preceding studies on endogenous entry, in our model the public procurer can manipulate contract terms in favor of this company. A simple example of gasoline procurement illustrates this idea. For instance, the procurer knows such unique characteristics of one company, as the distance to the procurer's office, the number of gasoline stations in the district, a specific working hours or payment methods. If the procurer sets this terms only one company enters the auctions and receives high profit. The corrupt procurer can use this manipulation to offer his favorite company a public contract at the reserve price in exchange for a bribe. The benevolent procurer can manipulate contract terms to guarantee the delivery of the gasoline.

The main conclusions of the model are as follows. Reducing entry costs leads to lower contract price paid by the benevolent procurer, while the contract price paid by the corrupt procurer may change in any direction depending on the initial size of entry costs and the magnitude of their decline. For instance, if entry costs initially are at medium or high level and then drop dramatically, the contract price paid by the corrupt procurer increases and becomes equal to the reserve price. A negative link between entry costs and the bribe is the driving force for this change. The lower entry costs are, the more favoritism is attractive to the public procurer. Thus, an exogenous change in entry costs, such as the reform of public procurement, may lead to opposite changes in prices paid by benevolent and corrupt procurers.

The rest of the paper is organized as follows. In the Section 2 we present main assumptions and description of the game and in the Section 3 – the solution to the basic model. Then we analyze the impact of entry costs on contract prices in the Section 4 and provide ideas for extensions of the basic model in the Section 5. The Section 6 analyzes two cases in Russian public procurement of gasoline and the Section 7 concludes.

2. Main assumptions and the description of the game

2.1 General description of the game

A public procurer wants to buy one homogeneous indivisible product that gives him the contract value $v, v = 1$. The market consists of $n \geq 2$ companies[4] capable to deliver the product. Each company $i, i \in [1; n]$ carries out costs of two types: production costs c_i and entry costs k. Production costs are directly related to the contract execution, while entry costs include all preparatory costs of a company that are necessary to enter the auction. For example, each company has to prepare and submit the necessary documentation, guarantee her financial and participate in the auction. Production costs of companies are equally, independently and uniformly distributed at the interval $[0; 1]$ with c.d.f. $F(c), F(0) = 0, F(1) = 1$ and density function $f(c)$. Entry costs of all companies are identical, $1 \geq k \geq 0$.

To purchase the product the procurer organizes the reverse first-price sealed-bid auction, according to the standard rules. The reserve price in the auction equals $r,\ r < 1 + k$, and is set exogenously[5]. All participating companies simultaneously and secretly make a bid $P_i(c_i), i = 1, \dots, n$. At the agreed time the procurer discloses all bids and announces the winner that is a company that made a minimum bid lower the reserve price. The winner must perform the contract at a price equal to his or her bid. According to the properties of the first-price sealed-bid auction, a bid of each company positively depends on her production costs and exceed their value: $P_i{}'(c_i) > 0, P_i(c_i) > c_i$. If none of the companies participate in the auction, the auction is void and all players receive zero payoffs. This assumption is accordance with the current procurement practice and was use in the previous literature (e.g. Auriol, 2006).

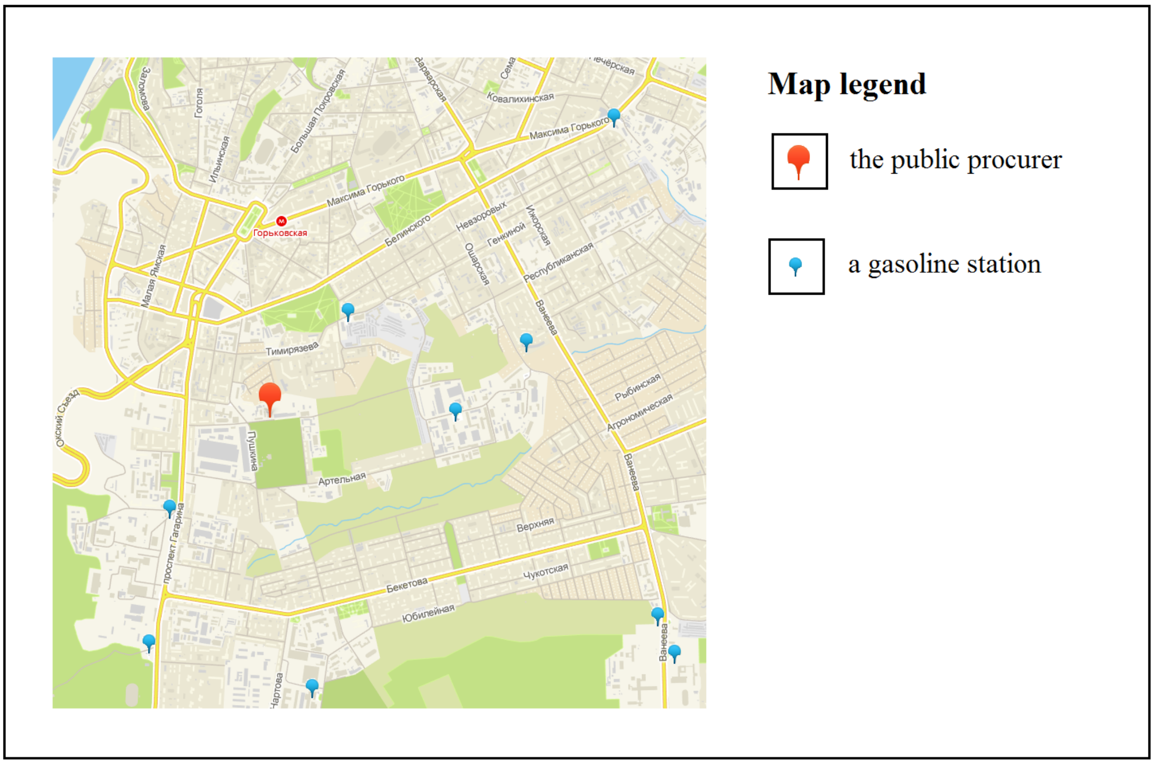
[4] Hereinafter we refer to a procurer as “he” and to a company as “she”.
[5] Further we will mitigate this assumption.

As the Samuelson's model, each company realizes the exact value of her entry costs before she decides to enter the auction. Hence, the certain threshold level of production costs c^* exists: a company enters the auction, only if her production costs are under this level. Information about the production costs of the company is her private information, while the distribution function of the production costs, entry costs and the reserve price are common knowledge.

2.2. Manipulation of contract terms

Before announcing the auction the procurer sets requirement for the companies and the public contract terms. Let us assume that the procurer knows non-price characteristics of one company that distinguish her from the others[6]. Then the procurer decides whether to make entry into the auction possible to everyone or only to the company 1. We denote the procurer's strategy “to manipulate” (contract terms) as M and the strategy “not to manipulate” as NM. Let us consider a simple example of the gasoline procurement, which shows how contract terms affect company's entry in auctions.

Figure 1
Manipulation of contract terms



Source: Nizhnii Novgorod, Russia. 2GIS. (http://2gis.ru/n_novgorod)

[6] Hereinafter we refer to this company as the company 1.

One public procurer (an university) wants to buy gasoline at local gas stations. Figure 1 shows nine gasoline stations that belong to the five companies are situated nearby the procurer. Each company has a set of certain characteristics: e.g. the number of gasoline stations and their addresses; it can be a vertically integrated company or an independent gasoline station. Let us assume that the university has complete information about all unique characteristics of the company 1, for example, that only she has two gasoline stations in this and the neighboring districts of Nizhny Novgorod. Then if the procurer adds the condition "the supplier has to have more than one gasoline stations in district X and district Y" (by choosing the strategy M), only company 1 can enter the auction. In contrast, if the university does not set such manipulative conditions (NM), each company can enter the auction.

2.3. Corruption subgame

The nature defines the type σ of the public procurer. If $\sigma = 0$ the procurer is benevolent to the society and does not demand a bribe, if $\sigma = 1$ the procurer may demand a bribe, so he is potentially corrupted[7].

A corrupt procurer may propose the company 1 to become his favorite company by making a corrupt deal $< B, r >$: the company gives a bribe B in exchange for the public contract at the reserve price[8]. For the realization of this deal the procurer manipulates contract terms, «tailoring» them to the company 1[9] that prevents the entry of all other companies into the auction. The company 1 realizes manipulation and understands that she is the only company that can enter the auction, so she makes the highest possible bid and becomes the winner. For the sake of simplicity we assume that the procurer has all the bargaining power, so he makes take-it-or-leave-it offer to the company 1 and demands the highest possible bribe that she can give.

In our model the corrupt deal happens before the company 1 realizes her production costs. This situation takes place, for instance, when the procurer invites the company that is somehow affiliated with him (e.g. a company run by his former classmates or colleagues) to

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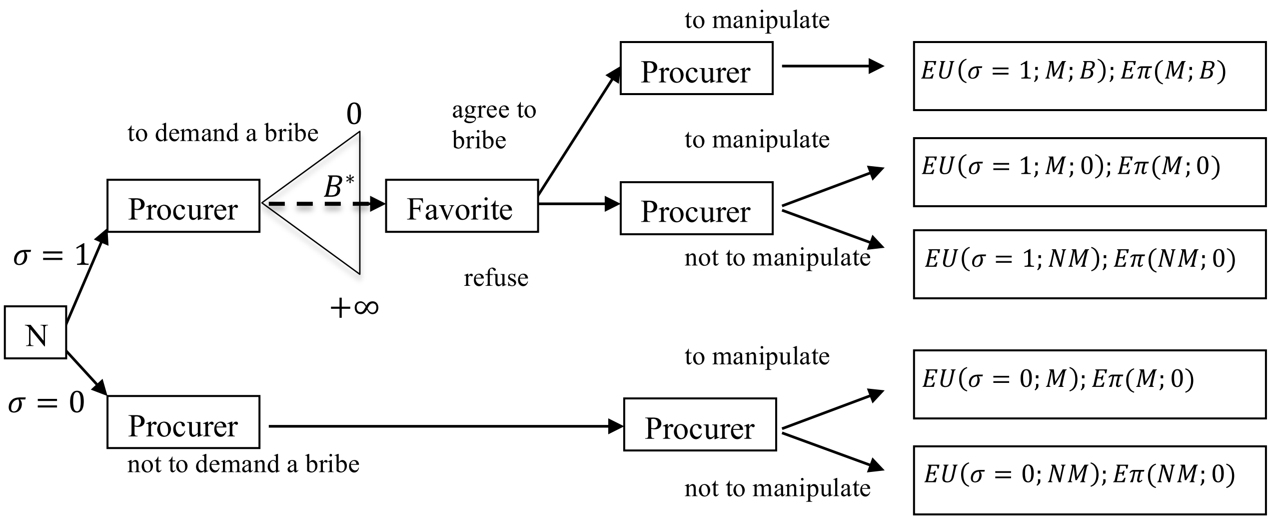
[7] In the general case the parameter σ shows which share of the total corruption costs is the bribe to the public procurer (Auriol, 2006). To make a corrupt deal the company carries out some organizational costs, for instance, guarantee the secrecy of the deal and transfer the money to the procurer's bank account. Therefore the procurer gets the certain share of these costs as the bribe. If this share is high, the bribe is big; hence, the procurer is easily bribed. If this share is low (close to zero), the bribe is very low, hence, it is impossible to bribe the procurer.

[8] Problems of corrupt contract performance are beyond this work. One may find more details, e.g., in Lambsdorff, 2002.

[9] An alternative approach to model manipulation is to assume the corrupt procurer sets such contract terms that no company can meet. For instance, he can request the delivery of large amount of gasoline in a very short period of time that no company can execute because of certain production constraints. Then the procurer tells the company 1 that he is ready to "close eyes" on her misfit if she agrees to give a bribe. This way of modeling the manipulation of contract terms in close to the idea that the procurer can distort the quality assessment proposed by Burguet and Che (2004).

enter a public auction. The favorite company becomes a newcomer in the public procurement; therefore she realizes the exact value of her production costs after the procurer's invitation, but before the auction (as we follow Samuelson and consider simple and homogeneous product).

Scheme 1
Corruption game and manipulation of contract terms



Notes. B* is the highest bribe that the company 1 can give; M is the strategy «manipulate»; NM is the strategy «not to manipulate».

2.4. Payoffs

Unlike Samuelson (1985) and the other preceding papers on endogenous entry, we consider the public procurer as a separate player with his own utility function. This utility may depend on the contract price in two different ways, as far as the procurer may pay the whole contract price $P, P > 0$ or pays nothing if he is financed by the society (or the benevolent government). In what follows we will say that in the former situation that the procurer manages his own funds ($\beta = 1$), and in the latter situation that he manages public funds ($\beta = 0$). Note that we do not consider the agency problems and do not distinguish between the procurer as the public manager and as the public organization. As far as we use a common definition of corruption as "the abuse of public office for the private gain" [Mauro, 1998, p. 11], if the procurer receives a bribe from a favorite, corruption arises independently of who is funding the contract. To make the purchase always beneficial for the procurer, we impose the following restriction on the reserve price: $\beta r < 1$.

One may consider this situation in terms of monetary incentives in the public sector, namely, the introduction of a pay-for-performance (Meyer, 1975). Although the output of the public officer is often treated as unobservable and costly to be measured (Dixit, 2002), when this condition does not hold a pay-for-performance may lead to greater improvement in the productivity (Peter K. Lindenauer et al., 2007). In the analyzed situation the contract price may indicate whether the procurer is motivated to cut public expenditures or not. Hence, if $\beta = 1$, the motivation scheme includes the pay-for-performance component; if $\beta = 0$, this scheme is not implemented.

As the result, if the purchase takes place (auction is not void), the expected utility of the procurer EU equals to:

$$EU = Prob(purchase)(1 - \beta EP + \sigma B), \quad (1)$$

where $Prob(purchase)$ is the probability that the purchase takes place, 1 is the contract value for the procurer, EP is the expected contract price.

Since we do not model the punishment for corruption and monitoring costs, strategies chosen by the procurer, the company 1 and other companies do not depend on whether other companies have information on corruption agreement between the procurer and the company 1. Let us imagine that several companies know that the corrupt deal was made. As the procurer manipulates contract terms, no one, but the favorite company, can participate in the auction. And the favorite company has the same incentives to make the highest possible bid: it enters alone into the auction and makes the bid maximizing her profit. In contrast, if the procurer does not manipulate contract terms, the optimum bid for each company depends on her production costs and is not related to the type of the procurer organizing auction.

Expected profits of all companies, except for the favorite one, are equal to standard payoffs in English auction with entry costs:

$$E\pi_{i \neq 1} = \begin{cases} 0, if\ i\ does\ not\ enter \\ Prob(P_i = \min\{P_2, .., P_n\})(P_i - c_i) - k, if\ i\ enters \end{cases}, \quad (1.2)$$

where $Prob(P_i = \min\{P_2, .., P_n\})\ (P_i - c_i)$ is the probability that the company $i \neq 1$ wins the auction.

If the corrupt deal is made, the expected profit of the favorite company equals the following:

$$E\pi_1(B) = r - c_1 - k - B. \quad (1.3)$$

Otherwise the favorite company receives the same expected profit as others.

2.5. Timing

All players are rational and risk neutral. The table 1 presents the timing of the game that consists of five active steps: corruption proposal (t=1), consent or refusal to give a bribe (t=2), preparation of contract terms (t=3), entry of companies (t=4) and contract award (t=5). In case of the benevolent procurer the game starts from the Step 3.

Table 1
Timing of the game[10]

1	*Corruption proposal* The corrupt procurer demands a bribe from the company 1 in exchange for the contract at the reserve price (take-it-or-leave-it offer).
2	*Consent or refusal to give a bribe* The company 1 decides whether to give a bribe.
3	*Preparation of contract terms* The procurer sets contract terms: M or NM.
4	*Entry of companies* Each company realizes contract terms and decides to enter the auction or not.
5	*Contract award* The procurer organizes the reverse first-price sealed-bid auction. All players receive zero payoffs if no one enters the auction.
	Outcomes The procurer purchases a product and receives a bribe if the purchase and the corruption deal have taken place, respectively.

In the Section 3 we solve the basic model. At first we find the solution of the subgame with the benevolent procurer ($\sigma = 0$) and then examine when favoritism (a set of strategies «demand a bribe; give a bribe») is the equilibrium in the subgame with the corrupt procurer ($\sigma = 1$).

3. Basic model of endogenous entry in public procurement

3.1. The case of the benevolent procurer

This subgame consists of three active steps: preparation of contract terms (t=3), entry of companies (t=4) and contract award (t=5). In the beginning the benevolent procurer sets contract terms (manipulative or not) that maximize his expected utility and announces the auction. Then each company decides whether she enters the auction depending on the reserve price, entry costs

[10] Our model addresses the situation when the company 1 realizes her production costs after the corruption deal, but before the auction. Thus considered situation occurs under two following conditions. First, a product is simple, so the entry is informative. Second, for the sake of simplicity the procurer and the company 1 make a corrupt deal before realization of production costs (there is substantially more time between the corruption deal and the auction, than between the auction and the start of the contract performance).
Let us we assume the opposite: the company 1 and the procurer know the production costs of the company 1 before the corrupt deal. If these production costs are high, the favorite company cannot give a bribe (or even has no incentives to enter the auction) and the corrupt deal does not take place. If the company 1 carries out such production costs that the optimal bribe exceeds the negative difference between two expected utilities of the procurer, favoritism arise. Other things being equal the higher entry costs are, the higher the optimal bribe is. If entry costs exceed some threshold level (that depends negatively on the realized production costs of the company 1), the optimal bribe becomes lower than the negative difference between two expected utilities of the procurer, and favoritism is gone. Thereby the main result of the model is robust to the timing of the corruption deal.

and her production costs. If a company enters the auction, she makes a bid maximizing her expected profit. We will find SPNE using the reverse induction.

At the last step (t=5) the procurer organizes a reverse first-price sealed-bid auction. If the procurer has manipulated contract terms in favor of the company 1, the contract price is equal to the reserve price, as the company 1 makes the biggest possible bid to maximize her profit. If the procurer has manipulated contract terms, all companies, which production costs are below the threshold level, participate in first-price sealed-bid auction. According to Samuelson (Samuelson 1985), the expected contract price is the sum of the minimum expected production costs $c_{(1)}$, the expected total profit of n companies and the sum of expected entry costs of the companies. As a result, the expected price is equal to:

$$P = \begin{cases} Ec_{(1)} + \sum_{i=1}^{n} E\pi_i + nF(c^*)k, if\ the\ procurer\ does\ not\ manipulate \\ F(r-k)r,\ if\ the\ procurer\ manipulates\ contract\ terms \end{cases}, \quad (2)$$

where $Ec_{(1)}$ is the expectation of the minimum production costs of companies (first order statistics), $\sum_{i=1}^{n} E\pi_i$ is the total expected profit of n companies, $nF(c^*)k$ is the sum of entry costs carried out by n companies, each of which enters the auction with probability $F(c^*)$, $F(r-k)$ is the probability that the company 1 agrees to execute the contract at the reserve price.

At the pervious step (t=4) each company decides whether she will participate in the auction. This decision, first of all, depends on whether she meets the contract conditions which are the result of the procurer's choice to manipulate contract terms or not.

- The procurer does not manipulate contract terms, *NM*

Following Samuelson we assume that if the procurer does not manipulate contract terms, each company enters the auction if her production costs do not exceed a certain threshold level c^* (Samuelson 1985).

If the production costs of the company equal to the threshold, her expected profit in the auction is equal to zero. This company can win the auction only when she is the only participant, so it is beneficial for her to make the highest possible bid in the auction (the reserve price). Then the expected auction revenue for this company equals entry costs[11]:

$$[1 - F(c^*)]^{n-1}(r - c^*) = k, \quad (3)$$

[11] For more details see Samuelson (1985).

where $[1-F(c^*)]^{n-1}$ is the probability that the company with production costs c^* is the only participant in the auction.

Expected profits of the companies participating in the auction depend on the size of their production costs. The lower the production costs are, the greater the probability that she wins the auction is, and the higher her expected profit is. In general, the expected profit of the company with production costs $x < c^*$ equals the profit of the company with production costs equal to the threshold value plus the difference between her production costs x and the second minimum production costs of her competitor in case she wins the auction.

According to the equation (3), the first term is zero, so the company with production costs x gets the expected profit:

$$\pi(x) = \int_x^{c^*} [1-F(x)]^{n-1}\, dc.$$

The expected profit of the company before realizing the exact value of her production costs equals:

$$E\pi_i = \int_0^1 f(x) \left[\int_x^{c^*} [1-F(x)]^{n-1}\, dc\right] dx\,, i = 1 \dots n.$$

If the production costs are higher than c^*, the profit of the company equals zero. Hence, we replace the upper limit of integration to c^*. Further, integrating by parts and using Leibniz integral rule we get the following:

$$E\pi_i(NM) = \int_0^{c^*} F(c)[1-F(c)]^{n-1} dc, i = 1 \dots n. \tag{4.1}$$

Total expected profit of companies equals $\sum_{i=1}^{n} E\pi_i(NM) = nE\pi_i(NM)$.

- The procurer manipulates contract terms, *M*

In this case all companies, but the company 1, cannot enter the auction and receive zero profit. If the company 1 enters the auction, she makes a bid equal to the reserve price and wins the auction without competition. Expected profits of companies equal:

$$E\pi_1(M) = F(r-k)(r-k) - \int_0^{r-k} f(c)cdc, \tag{4.2}$$

$$E\pi_{j\neq 1}(M) = 0, j = 2, .., n,$$

where $F(r-k)$ is the probability that the company 1 agrees to execute the contract at the reserve price (her production costs plus entry costs are lower than the reserve price), $\frac{1}{F(r-k)} \cdot \int_0^{r-k} f(c)cdc$ is the conditional expectation of the production costs of the company 1 in this case.

At the previous step (t=3) the benevolent procurer sets contract terms, which give him maximum utility (see equation (1)):

$$EU = \max\{EU(M;0); EU(NM;0)\}.$$

He compares expected utilities when he chooses the strategy «manipulate» and the strategy «not to manipulate». If the procurer manipulates contract terms, the purchase takes place with probability $F(r-k)$ when the expected profit of the company 1 executing the contract at the reserve price is non-negative. Hence, the procurer gets the following expected utility:

$$EU(M;0) = F(r-k)(1-\beta r), \tag{5.1}$$

If the procurer does not manipulate contract terms, the purchase takes place with probability $1-[1-F(c^*)]^n$ when at least one company out of n companies enters the auction. As the equation (2) shows, the expected contract price equals the sum of the expectation of the first order statistics and the total profit of companies. As the result, the procurer gets the following expected utility:

$$EU(NM;0) = 1-[1-F(c^*)]^n - \beta\int_0^{c^*} c dG(c) - \beta n E\pi_i(NM) - \beta n F(c^*)k, \tag{5.2}$$

where $\int_0^{c^*} c dG(c)$ is the expected first order statistics of the production costs , $G(c) = 1-[1-F(c)]^n$ is its cumulative distribution function.

We calculate the contract price in the equation (5.2) completely in accordance with Samuelson's model. Since our model treats the procurer as a separate player benefiting from the contract, his utility also contains the expected contract value.

The procurer manipulates contract terms if this strategy simply gives him higher expected utility than the strategy "not to manipulate": $EU(\sigma=0;M) > EU(\sigma=0;NM)$. Previously, we assumed that the production costs of companies are i.i.d., $c \sim U[0;1]$. Then substituting the values of the expected utilities of the procurer from equations (5.1) and (5.2) into the inequality (6) and simplifying the expression, we get the general condition under which the benevolent procurer manipulates contract terms:

$$(r-k)(1-\beta r) > (1-[1-c^*]^n)(1-\beta\frac{Ec_{(1)}+nE\pi_i(NM)+\beta nF(c^*)k}{1-[1-c^*]^n}), \tag{6}$$

if this condition holds: $(r-k) < 1$.

Let us now examine the choice of the procurer depending on whether he manages public money or private money.

- The procurer manages the public money, $\beta = 0$

In this case the expected utility of the procurer equals the probability that the purchase takes place. Therefore, if the probability that the company 1 agrees to execute the contract at the reserve price is higher than the probability that the auction is not void, the procurer manipulates contract terms. If this condition does not hold, otherwise is true. When the reserve price increases, the company 1 benefits more from the reserve rice contract and enters with higher probability.

Proposition 1

The benevolent procurer managing the public money does not manipulate contract terms if the reserve price is lower than the maximum production costs, and manipulates contract terms if the reserve price exceeds their value.

Proof

By substituting the value of the entry cost from the equation (3) into the expression (6) and simplifying it, we find under what conditions the benevolent procurer chooses the strategy «manipulate»:

$EU(M;0) > EU(NM;0)$,

$r - k > 1 - [1 - c^*]^n$,

$r - [1 - c^*]^{n-1}(r - c^*) > 1 - [1 - c^*]^n$,

$r(1 - [1 - c^*]^{n-1}) > 1 - [1 - c^*]^{n-1}$,

Since $k > 0$, $[1 - c^*]^{n-1} < 1$, we divide both sides of the inequality by $1 - [1 - c^*]^{n-1}$ and get:

$$r > 1 \quad (7)$$

Proposition 1 is proved.

We find out that the decision of the benevolent procurer upon manipulating contract terms depends only on the level of the reserve price. This decision is not connected to entry costs and the number of companies in the market. Figures 2a – 2d demonstrate this result. One can observe that for different number of companies in the market ($n = 2, n = 5$) and different entry costs ($k = 0.1, k = 0.4$) the found relation between expected utilities of the benevolent procurer when he chooses «to manipulate» and «not to manipulate» holds. If the reserve price is lower than 1 the benevolent procurer does not manipulate contract terms; if the reserve price is higher than 1 he manipulates them.

Figures 2a-2d

Impact of number of companies and entry costs on expected utilities of procurer

Figure 2a

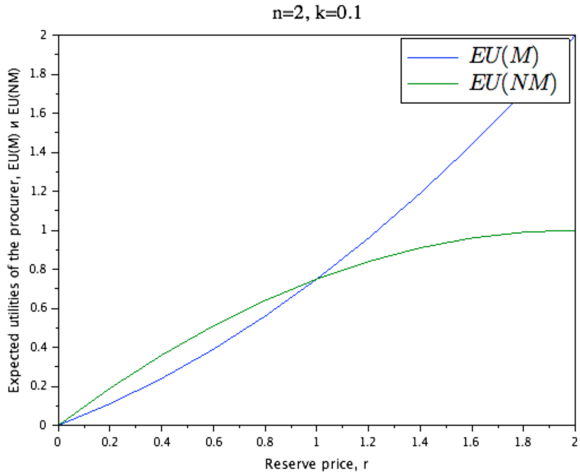


Figure 2b

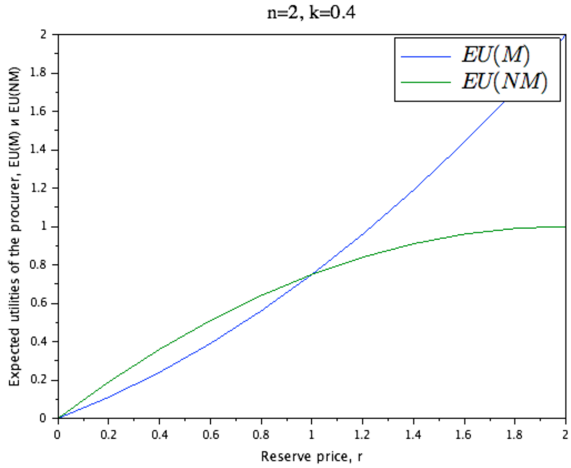


Figure 2c

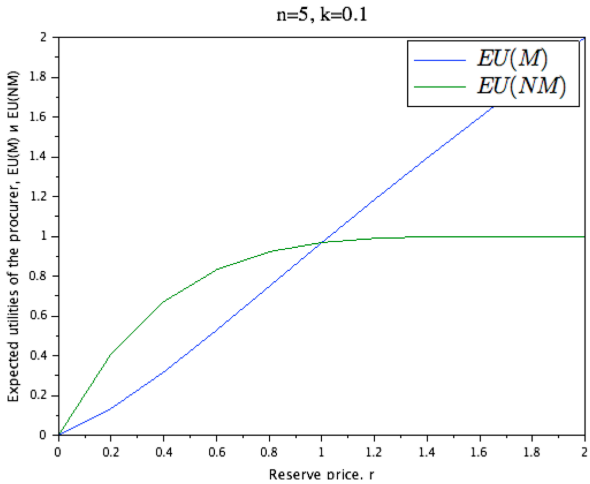
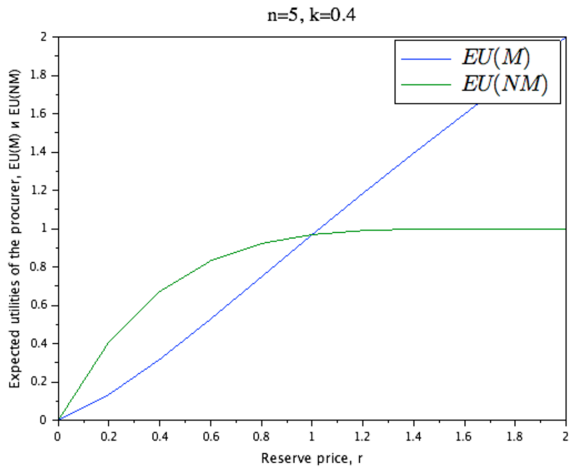


Figure 2d



- The procurer manages the private money, $\beta = 1$

Proposition 2

The benevolent procurer managing the public money does not manipulate contract terms if the reserve price is lower than the maximum production costs. Otherwise this decision the procurer depends on the trade-off between the effects of the purchase probability and the contract price on the procurer's utility.

Proof

At first we examine the case when the reserve price is lower than the maximum production costs: $r < 1$. In this case the first multiplier on the left side of the inequality (6) is always lower than the first multiplier on the right side of this inequality:

$$(r - k) < (1 - [1 - c^*]^n).$$

According to the rules of the auction with a reserve price, the winner bid (the contract price) cannot exceed the reserve price:

$r > Ec_{(1)} + nE\pi_i(NM) + \beta nF(c^*)k.$

Hence, the second multiplier on the left side of the inequality (6) is always lower than the second multiplier on the right side of this inequality. Thus if the procurer manages the private money he does not manipulate contract terms if the reserve price is lower than 1. We have proved the first part of Proposition 2.

Then we examine the case when the reserve price is higher the maximum production costs: $r > 1$. In this case he first multiplier on the left side of the inequality (6) is always higher than the first multiplier on the right side of this inequality. However the second multiplier on the left side of the inequality (6) is always lower than the second multiplier on the right side of this inequality. If the procurer switches from the strategy «not to manipulate» on the strategy «to manipulate», he raise the probability of the purchase that results in higher expected utility, but also increases the expected contract price that lowers his expected utility.

One may re-write the inequality (6) in the following way:

$EU(\sigma = 0; M) > EU(\sigma = 0; NM),$

$$\frac{r-k}{1-[1-c^*]^n} > \frac{(1-\beta r)}{1-\beta EP)} \quad (8)$$

Thus, the choice of the procurer depends on the relationship of two opposite effects:

1. the effect of the purchase probability: $(r-k)/(1-[1-c^*]^n)$,
2. the effect of the price increase: $(1-\beta r)/(1-\beta EP)$.

If the effect of the purchase probability exceeds the effect of the price increase, the procurer gets higher expected utility manipulating contract terms: $EU(\sigma = 0; M) > EU(\sigma = 0; NM)$. Otherwise the procurer does not manipulate contract terms.

Proposition 2 is proved.

3.2. The case of the corrupt procurer

The subgame with the corrupt procurer consists of five active steps: corruption proposal (t=1), consent or refusal to give a bribe (t=2), preparation of contract terms (t=3), entry of companies (t=4) and contract award (t=5). Using the reverse induction we research when the set of strategies «demand a bribe, give a bribe» is SPNE. In other words, we find which factors lead to favoritism. Steps 4 and 5 in this subgame corresponds to the respective steps in the subgame with the benevolent procurer, since bids and entry of the companies depend not on the type of the procurer (corrupt or honest), but on the manipulation of contract terms. Therefore we skip these steps and focus on steps 1, 2 and 3 (see Table 1).

At the step 3 the procurer sets contract terms. If the company refuses to give a bribe, agents receive the same prizes as in the subgame with the benevolent procurer. From Propositions 1 and 2, the reserve price and the financial source (public or private money) affect the procurer's choice to manipulate or not. If the company 1 agrees to give a bribe, the corrupt procurer manipulates contract terms. Then the expected utility of the procurer and the expected profit of the favorite equal, respectively:

$$EU(M;B) = 1 - \beta r + B, \qquad (9.1)$$

$$E\pi_1(M;B) = r - \int_0^1 f(c)cdc - k - B. \qquad (9.2)$$

The expected profit of other companies is zero.

At the step 2 the company 1 decides to agree on the corruption deal or not. If it is more beneficial to the procurer to manipulate contract terms in the absence of the bribe ($EU(M;0) \geq EU(NM;0)$), the company 1 has no incentives to bribe him. This case is very simple and less interesting than the case when the corruption deal is possible. In order to concentrate on the latter case it is enough to make an assumption that the reserve price is lower than the maximum production costs: $r < 1$ (Propositions 1 and 2). Then if the company 1 refuses to give a bribe, the procurer does not manipulate contract terms. This may encourage the company 1 to on a corruption deal, and there favoritism will arise.

The company 1 gives a bribe if she gets at least the same expected profit compared to the case when she refuses (incentive compatibility constraint, IC_1) and its expected profit is not lower than zero (individual rationality constraint, IR_1):

$$\begin{cases} E\pi_1(M;B) \geq E\pi_1(NM;0), & (IC_1) \\ E\pi_1(M;B) \geq 0 & (IR_1) \end{cases} \qquad (10)$$

If the incentive compatibility constraint holds, the individual rationality constraint is always true, since we get from the equation (4.1) that $E\pi_1(NM;0) > 0$. Therefore in what follows we may ignore this condition. Since the procurer has all the bargaining power and extracts the highest possible bribe that the favorite can give, incentive compatibility constraint holds as the equality. Let us examine it in more details.

If the company 1 refuses to bribe, the procurer does not manipulate contract terms (this results from Propositions 1, 2 and assumption that $r < 1$). Comparing the expected profits of the favorite in situations when the procurer demands a bribe, manipulates contract terms and does not manipulate them, we get the following:

$E\pi_1(M; B^*) = E\pi_1(NM; 0)$ =>

$r - \int_0^1 f(c)cdc - k - B = \int_0^{c^*} F(c)[1 - F(c)]^{n-1}dc$

The bribe is by definition higher than zero, therefore taking into account that $c \sim U[0; 1]$ we simplify the expression given above and find the other constraint for the reserve price:

$B^* > 0,$

$$r > \int_0^{c^*} c[1 - c]^{n-1}dc + k + \frac{1}{2} \quad (11)$$

Inequality (11) shows that favoritism arises only if the reserve price is higher than the sum of the expected profit of the company in the auction without manipulation, entry costs and the expected production costs of the company 1 in the beginning of the game (in case of the uniform distribution they equal $\frac{1}{2}$).

Substituting the expression for the entry cost from the equation (3) we get the highest bribe that the favorite agrees to give:

$$B^* = maxB = r(1 - [1 - c^*]^{n-1}) + c^*[1 - c^*]^{n-1} - \int_0^{c^*} c[1 - c]^{n-1}dc - \frac{1}{2} \quad (12)$$

What factors affect the size of the optimal bribe B^*? We hypothesize that the more companies are in the market, the lower the expected profit of any company in the auction is. So the favorite is ready to pay higher bribe in order to make a contract at the reserve price. In addition to it, the higher entry costs are or the lower the reserve price is (all things being equal), the greater the expected profit of the company 1 in the auction without manipulation differs from the expected profit when the company executes the contract at the reserve price.

Proposition 3

The optimal bribe increases in the reserve price and the number of companies in the market and decreases in entry costs.

Proof of the Proposition 3 is in Appendix 1.

The Table 2 demonstrates the main results.

Table 2
Determinants of the optimal bribe

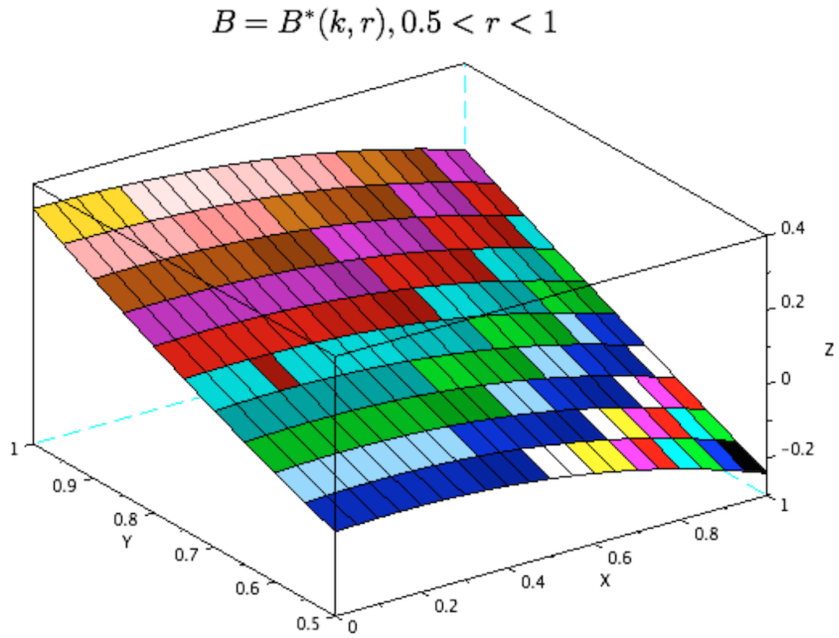
Factor	Entry costs, k	The reserve price, r	The number of companies, n
Sign of the derivative	Negative	Positive	Positive

Previously we have found out that if the reserve price is low (see inequality (11)) or very high (see Propositions 1, 2), favoritism does not arise. Further we examine how entry costs and the reserve price together influence the optimal bribe. We consider the simple case with two companies: the company 1 (the potential favorite) and the company 2. By substituting $n = 2$ in the expression of the optimal bribe (13) we get the following:

$$B^*(n = 2) = \frac{1}{3}(c^*)^3 - \frac{3}{2}(c^*)^2 + (r + 1)c^* - \frac{1}{2} \quad (13)$$

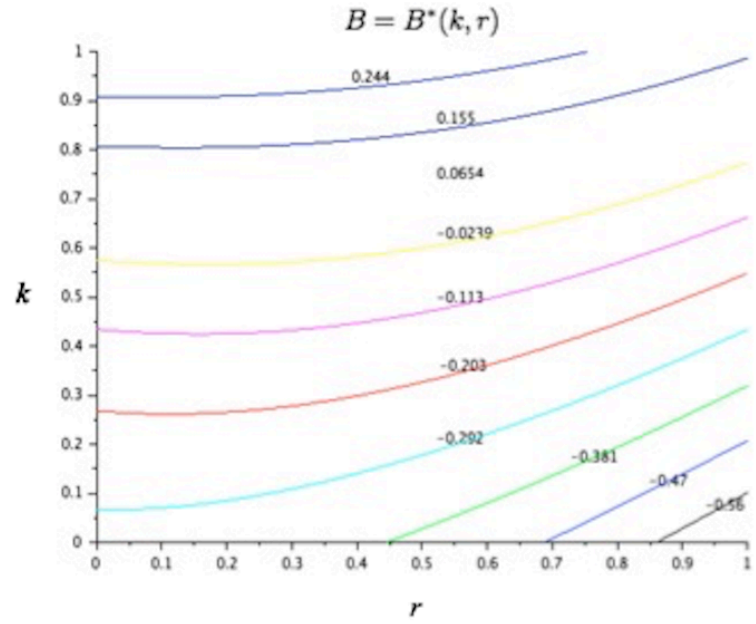
Figure 3 illustrates this relationship. The x-axis corresponds to entry costs k, y-axis corresponds to the reserve price r and z-axis corresponds to the optimal bribe B^*.

Figure 3
Optimal bribe as function of entry costs and reserve price



For simplicity of perception we transfer Figure 3 into two-dimensional coordinate system by drawing the contours of the surface B^* (Figure 4).

Figure 4
Optimal bribe as function of entry costs and reserve price (contours)



We find different effect of entry costs on the optimal bribe for different values of the reserve price. If the reserve price is high (higher than approximately 0.8, but lower than 1), the favorite can give a positive bribe under any possible size of entry costs (0;1). If the reserve price is low (lower than approximately 0.6), the optimal bribe is always lower than zero, therefore the favorite cannot give a positive bribe and the corrupt deal does not takes place. The inequality (11) reflects the last case. We call all reserve prices that belong to this interval (lower than approximately 0.8, but higher than approximately 0.6) as intermediate reserve prices. The Figure 3 and the Figure 4 shows than the size of entry costs is crucial for the optimal bribe and possibility of favoritism on this interval, so we formulate the following Proposition:

Proposition 4

For each intermediate value of the reserve price there is a unique size of entry costs $\tilde{k}$ where the optimal bribe equals zero:

$$B^*(\tilde{k}) = \frac{1}{3}\left(c^*(\tilde{k})\right)^3 - \frac{3}{2}\left(c^*(\tilde{k})\right)^2 + (r+1)c^*(\tilde{k}) - \frac{1}{2} = 0. \quad (14)$$

If entry costs are below this level, the company 1 is ready to give a positive bribe and the corruption deal may take place. If entry costs exceed this level, the company 1 is not ready to give a positive bribe and the corruption deal never takes place.

Proof of the Proposition 4 is in the Appendix 2.

One may interpret the Proposition 4 in the following way. When the reserve price is intermediate, lowering entry costs does not lead to favoritism if the magnitude of their decrease is small. It stimulates favoritism if the magnitude of this decrease is large enough. So the governmental attempts to substantially decrease entry costs may provoke favoritism and prevent entry of honest companies.

Now we turn back to the general case with $n \geq 2$ companies in the market.

At the Step 1 the procurer decides whether to demand a bribe B^*. He demands a bribe if it leads to higher expected utility (incentive compatibility constraint, IC_P), and his expected utility is not lower than zero (individual rationality constraint, IR_P):

$$\begin{cases} EU(M;B) > \max\{EU(NM;0); EU(M;0)\} & (IC_P) \\ EU(M;B) \geq 0 & (IR_P) \end{cases} \quad (15)$$

If the incentive compatibility constraint holds, the individual rationality constraint is always true, since equations (5.1-5.2) result in $EU(M;0), EU(NM;0) > 0$. Therefore in what follows we may ignore this condition. Let us examine the incentive compatibility constraint in more details. Since we consider the case when favoritism is possible, $r < 1$, hence, the benevolent procurer does not manipulate contract terms (from this assumption mentioned above and the inequality (6)). Then we may re-write IC_P in the following way: $EU(M;B) > EU(NM;0)$.

Proposition 5

The expected utilities $EU(M;B), EU(NM;0)$ decrease in entry costs. The higher entry costs are, the higher the contract price the procurer pays in the auction without manipulation and the lower the optimal bribe is in case of manipulation.

Proof of the Proposition 5 is in the Appendix 3.

Lower entry cost decrease the expected utility of the corrupt procurer independently of what set of strategies ("demand a bribe, manipulate" or "not to demand a bribe, not to manipulate") he chooses. We wonder how entry costs affect the relationship between two these expected utilities. The first possibility is that the expected utility of one set of strategies is always higher than the expected utility of the other set. Then the procurer always makes the former alternative. The second possibility is that under different levels of entry costs the gap between the expected utilities of the procurer is different. Then after the change in the entry cost around some threshold level the procurer switches from one strategy to the other one.

We define the difference between two expected utilities of the procurer as dU: $\mathrm{dU} = EU(M;B) - EU(NM;0)$. From expressions (5.2) and (9.2) we get that this difference equals:

$$\mathrm{dU} = (1-\beta)r + (1 - r + \beta n c^*(r - c^*))[1 - c^*]^{n-1} + (2\beta n - 1)\int_0^{c^*} c[1-c]^{n-1}dc - \frac{1}{2} \quad (16)$$

Under $dU > 0$ the procurer chooses a set of strategies «to demand a bribe, to manipulate» if the favorite is ready to give a possible bribe (see Figure 3 and Figure 4). Under $dU < 0$ the procurer chooses a set of strategies «not to demand a bribe, not to manipulate» independently of the favorite's readiness to give a bribe. In the latter case even the highest possible bribe does not compensate the procurer's losses when he manipulates contract terms instead of organizing the auction without manipulation.

Further we research the choice of the procurer depending on whether he manages public money or private money. As previously, we focus on the simple case with two companies in the market, $n = 2$.

- <u>The procurer manages the public money, $\beta = 0$</u>

Proposition 6

If the procurer manages the public money, the difference between procurer's utilities is positive, $dU > 0$. The procurer always benefits from favoritism, and favoritism always arises when the company is ready to give a positive bribe.

Proof

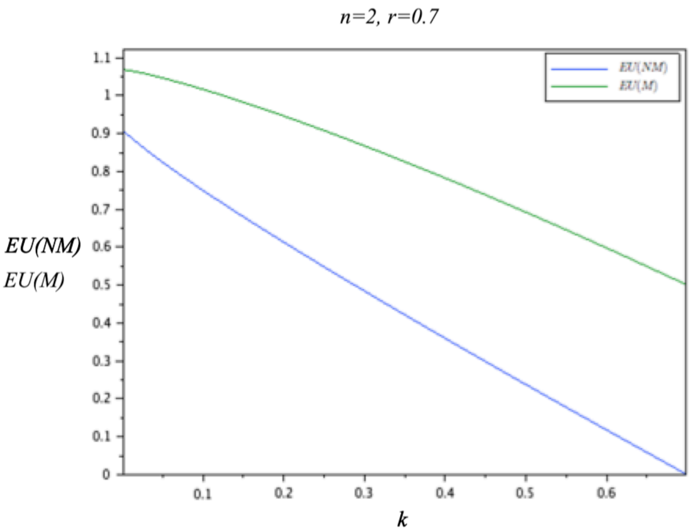
Substituting $n = 2$ and $\beta = 0$ into the equation (16) we get:

$$\mathrm{dU} = \frac{1}{3}(\mathrm{c}^*)^3 - \frac{1}{2}(\mathrm{c}^*)^2 - (1-r)\mathrm{c}^* + \frac{1}{2} \quad (17)$$

We equate the difference between procurer's utilities to zero. Under previously imposed assumptions, $\mathrm{c}^* < r$, $\mathrm{c}^* < 1$, $r \in (0.5 + k; 1)$, the equation does not have real roots. The procurer's expected utility of a set of strategies "to demand a bribe, to manipulate" exceeds the procurer's expected utility of a set of strategies "not to demand a bribe, not to manipulate" for any reasonable level of the entry cost. Hence, when the favorite is ready to give a positive bribe, the corrupt procurer always demands it if he manages the public money.

Proposition 6 is proved. The Figure 5 illustrates expected utilities of the procurer when the reserve price equals 0.7.

Figure 5
Expected utilities when procurer manipulates and does not manipulate contract terms



- The procurer manages the private money, $\beta = 1$

Proposition 7

If the procurer manages the private money, the difference between procurer's utilities is zero or negative, $dU \leq 0$. The procurer never benefits from favoritism, and favoritism does not arise.

Proof of the Proposition 7 is in the Appendix 4.

4. Impact of entry costs on contract prices

In this section we analyze how entry costs influence the contract price in more details. As we have shown before (see Propositions 1-3, 5-6 and equation (15)), the contract prices paid by the corrupt procurer ($\sigma = 0$) and the benevolent one ($\sigma = 1$) depend on the reserve price, entry costs and the number of companies in the market:

I. $r > 1$ (very high) =>

$EP(\sigma = 0) = EP(\sigma = 1) = r$,

II. $1 > r > c_2^*$ (high and intermediate)=>

$$EP(\sigma = 0) = 2n\frac{\int_0^{c^*} c[1-c]^{n-1}dc}{1-[1-c^*]^n} + \frac{nc^*k}{1-[1-c^*]^n}$$

$$EP(\sigma = 1) = \begin{cases} r, \ in\ case\ of favoritism \\ EP(\sigma = 0), \text{otherwise} \end{cases}.$$

III. $c_2^* > r$ (low) =>

$$EP(\sigma = 0) = EP(\sigma = 1) = 2n\frac{\int_0^{c^*} c[1-c]^{n-1}dc}{1-[1-c^*]^n} + \frac{nc^*k}{1-[1-c^*]^n}$$

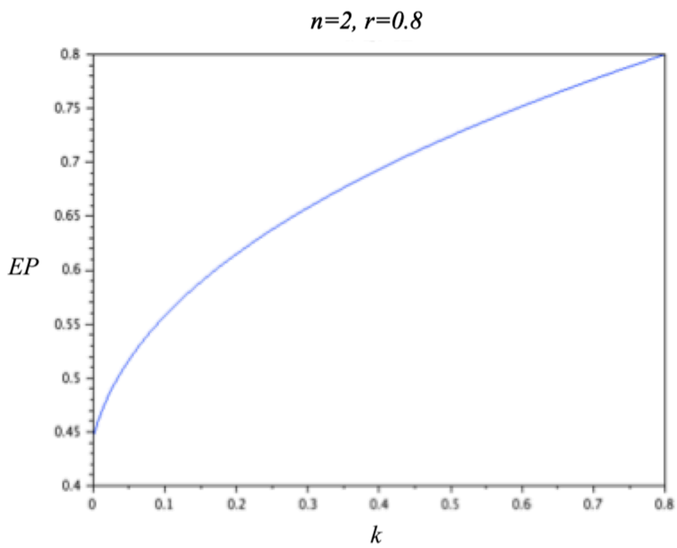
where c_1^* and c_2^* are the real roots of the equality (13).

Cases I and IV demonstrate that if reserve prices are high or low, contract prices paid by the corrupt and the benevolent procurers are the same, while cases II and III show that if the reserve price is intermediate, contract prices may be different. We are mostly interested in the case II, because it is more appropriate to the procurement practice when favoritism and manipulation is a possible equilibrium, but not the only one. So further we analyze the influence of entry costs on the contract price paid by each type of the procurer when the reserve price is intermediate. Again we examine the case with two companies in the market.

4.1. The case of the benevolent procurer

Under the accepted assumptions the benevolent procurer does not manipulate contract terms independently on the financial source (public money or private money). The derivative of the expression (8.2) with respect to entry costs when *n=2* is strictly higher than zero. Hence, exogenous decrease in entry costs leads to lower expected contract price paid by the benevolent procurer. Figure 6 shows this relationship if the reserve price equals 0.80.

Figure 6
Expected contract price paid by the benevolent procurer, $\boldsymbol{\beta = 0}$

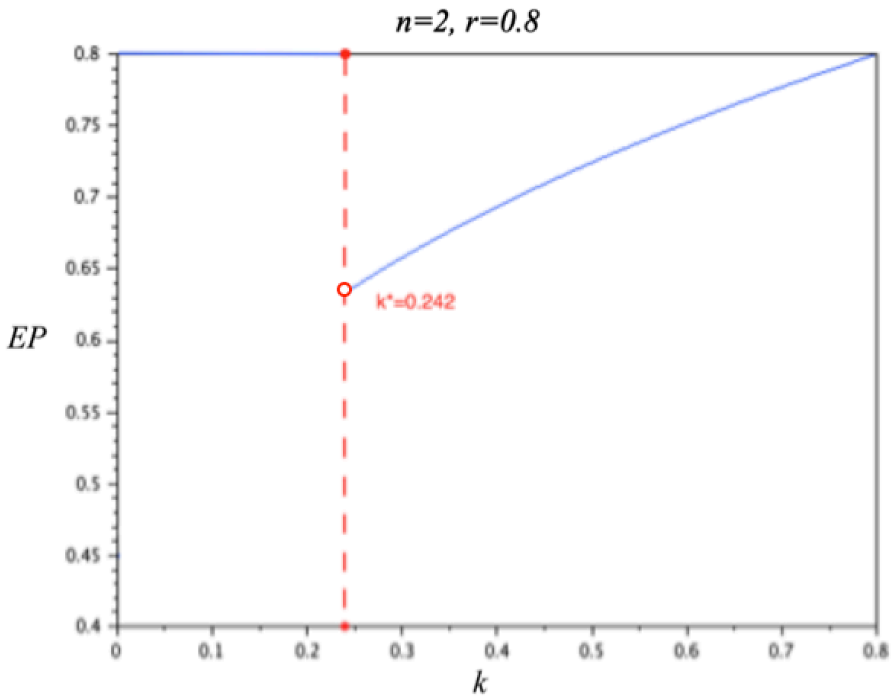


4.2. The case of the corrupt procurer

Unlike the case of the benevolent procurer, the financial source influence on the corrupt procurer's decision to manipulate contract terms or not.

If the procurer manages the public money, favoritism may arise and the procurer manipulates contract terms. When entry costs are high enough (exceed the certain threshold level, see Proposition 6), the company 1 cannot give a bribe. Hence, the corrupt procurer does not manipulate contract terms and gets the same contract price, as the benevolent one. When entry costs are decreasing, the optimal bribe increase (Proposition 3), and when entry costs are lower than the certain threshold level the company 1 becomes ready to bribe the procurer. Since the procurer manages the public money, he always benefits from favoritism (Proposition 6). Then the procurer makes a corrupt deal with the company1 and receives a bribe in exchange for the contract at the reserve price. Therefore the contract price dramatically increases. This situation corresponds, for instance, to the decrease in entry costs from 0.3 to 0.2 on the Figure 7.

Figure 7
Expected contract price paid by the corrupt procurer, $\beta = 1$



If the procurer manages the private money, we get the different result. According to the Proposition 7, in this case the strategy “not to manipulate” is always a weakly dominant strategy for the procurer, and no favoritism arises. Hence, the contract price paid by the corrupt procurer the contract price paid by the benevolent procurer and always decreases in entry costs (see Figure 6).

5. Extensions of the basic model

Bargaining powers of procurer and company 1

Following the convention adopted in the literature (e.g., see. Laffont, 2000) we have assumed that the procurer has all the bargaining power that allows him to demands the highest possible bribe. Now we relax this assumption and examine how it affects the result.

Let us consider the simplest case when the procurer and the company 1 have equal bargaining powers and the procurer disagree to manipulate contract terms without a bribe ($r < 1$). Then the new optimal bribe B' is the Nash bargaining equilibrium:

$$F = EU(M;B') \cdot E\pi_1(M;B') \rightarrow \max_{B'} \quad ,$$

s.e.

$$\begin{cases} EU(M;B') > EU(NM;0) \\ E\pi_1(M;B') > E\pi_1(NM;0), \\ B' > 0 \end{cases}$$

where $EU(M;B') = 1 - \beta r + B'$;

$E\pi_1(M;B') = r - k - B' - \frac{1}{2}$;

$EU(NM;0) = 1 - [1 - F(c^*)]^n - \beta \int_0^{c^*} c dG(c) - \beta n E\pi_i(NM) - \beta n F(c^*) k$;

$E\pi_i(NM;0) = \int_0^{c^*} F(c)[1 - F(c)]^{n-1} dc, i = 1 \dots n$ (resulted from the equalities (9.1), (9.2), (5.2) and (4.1), respectively).

A new optimal bribe reduces the difference between the expected utilities of the procurer and increases the difference between the expected profits of the company 1 from different strategies. Therefore the company 1 agrees to give a bribe more often, while the procurer demands it less often compared to the basic model.

F.O.C.

$$\frac{dF}{dB'} = 0, B' = -\frac{(\beta+1)}{2} r + \frac{1}{2} k + \frac{3}{4}.$$

F.O.C. shows that unlike the basic model, the new optimal bribe increase in entry costs. The relationship between entry costs and the sustainability of favoritism depends on whether the procurer manages the public money or the private money.

If the procurer manages the public money, $\beta = 0$, then

$EU(M;B') > EU(NM;0)$ and $B' = -\frac{1}{2} r + \frac{1}{2} k + \frac{3}{4} > 0$,

hence, favoritism is the equilibrium (as in the basic model).

If the procurer manages the private money, $\beta = 1$, a new optimal bribe is positive if $k > 2r - \frac{3}{2}$. Since $1 > k > 0$, favoritism may become more or less stable in comparison to the basic model depending on other factors.

Endogenous reserve price

We relax the assumption that the reserve price is given exogenously and research what reserve prices the corrupt and the benevolent procurers choose. Let us consider the case when the procurer manages the public money. The maximum expected utility of the benevolent procurer equals:

$$maxEU(\beta = 0\,; r) = \max\{EU(NM; 0; r); EU(M; 0; r)\},$$

According to equations (5.1) and (5.2), the maximum of this function is reached when the procurer chooses the strategy "to manipulate" and sets the reserve price equals to the sum of the maximum production costs and entry costs:

$$maxEU(0; r) = EU(M; r = 1 + k) = 1.$$

The maximum expected utility of the corrupt procurer equals:

$$maxEU(\beta = 1; r) = \max\{EU(NM; 0; r); EU(M; 0; r); EU(M; B'; r)\}.$$

According to the equality (9.1) if the procurer manages the public money, his expected utility in case of favoritism positively depends on the optimal bribe: $\frac{dEU(M;B')}{dB'}$. Hence, he has incentives to set the highest possible reserve price that exceeds the optimal reserve price set by the benevolent procurer.

6. Case-study of Russian gasoline procurement

Public procurement constitutes a substantial share of GDP in Russia and relates to a variety of rent-seeking problems from bid rigging to poor contract performance. Some anecdotal evidence and speeches of senior officials demonstrate that high public waste is one of the biggest issues in Russian public procurement[12]. The recent e-procurement reform conducted in 2010-2011 was aimed at reducing prices in public procurement:

"[In the first year after the reform] we expect to save twice as much public spending in e-auctions, approximately 400-500 mln rubles" – stated the initiator of the reform, the head of the Federal antimonopoly agency Igor Artemiev[13].

In the case study we examine how the introduction of e-auction influenced entry of companies and prices in public auctions. In terms of our model, this shift for traditional auctions to e-auctions[14] means the decrease in entry costs. We consider two indicators of the entry (the total number of companies and the number of companies that submitted bids in an auction) and

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[12] E.g. see this publication in the media that states public waste equals one eight of the consolidated Russian budget: http://www.vedomosti.ru/newspaper/article/248724/ukrast_trillion

[13] http://pravo.ru/news/view/25397/

[14] In what follows we refer to the former type of auction as an open-bid auction and to the latter type of auction as an e-auction.

two indicators of the price decrease (the price discount made by the winner and the relative contract price[15]). It is impossible to without insider information about side payments or revealed corruption cases. However we can illustrate the theoretical model by analyzing different actions of procurers and their outcomes, and make propositions about procurers' incentives on the basis of it. According to the model,

- if the procurer did not manipulate contract terms in e-auctions, more companies entered and prices decreased in e-auctions compared to open-bid auctions;
- if the procurer manipulated contract terms in e-auctions, entry did not change and prices remained the same or increased in e-auctions compared to open-bid auctions.

As e-procurement reform might somehow affect the behavior of procurers (manipulation of contract terms and setting reserve prices) and bidders (tacit collusion), further we take these possible changes into account.

Background

We analyze Russian procurement during the period 2008-2013 when the Federal Law 94-FL "On public procurement" strictly regulated the procurement process. The majority of simple homogeneous goods were purchased through two procurement procedures: open-bid auctions and sealed-bid auctions. Both of them were ordinal first-price auctions started from the maximum reserve price set by the procurer. Sealed-bid auctions were always treated as an extra procedure. The procurer might use sealed-bid auction only for small contracts (the reserve price below a certain threshold) once in a quarter. A sealed-bid auction gave procurers wider opportunities for corruption, because bidders submitted their bids in closed envelopes to the procurer or the public commission. Therefore dishonest procurer could open envelopes illegally and used the right of first refusal in exchange for a bribe[16].

In 2008-2010 traditional open-bid auctions were treated as a priority procurement procedure, later open-bid auctions in electronic form replaced them. In 2010 Russian government started e-procurement reform aimed at reducing contract prices by converting traditional open-bid auctions in electronic format. Lower entry cost of companies and anonymity of bidders were expected to be the key instruments of this reform. First, e-auctions reduced paperwork very much. Unlike open-bid auctions, which were organized in traditional way in the public procurer's office, e-auctions were organized online on e-platforms chosen by the

[15] Following Balsevich and Podkolzina (2014) we calculate the relative contract price as the relation between the final bid made by the winner and the total price of the same contract in average prices measured by the Russian statistical agency (www.gks.ru).

[16] E.g. see Burguet and Perry (2007); Compte, Lambert-Mogiliansky, and Verdier (2005)

government. Second, e-auctions concealed identities of bidders, so that each bidder observed bids of his/ her competitors, but did not know who they are. Such anonymous bidding raised monitoring costs of cartels, thus making them more vulnerable.

After 2011 the procurement law obliged public procurers to set reserve prices on the basis of certain informational sources, e.g. official statistics, letters of the Ministry of Economic Development, market analysis or offers of companies. The list of these informational sources was open and the procurer was absolutely free to choose any other informational source. We address this change in our case analysis and use our theoretical model to demonstrate that the potentially corrupt procurer and the benevolent procurer used different informational sources to set reserve prices that resulted in different contract prices.

Public procurement of gasoline

We choose public procurement of gasoline through gasoline stations organized by two big procurers in Nizhnii Novgorod for the following reasons. First, gasoline[17] is a simple homogenous product that perfectly satisfies main assumptions of our model. The gasoline delivered via gasoline stations has the same level of quality in the public procurement and the private market. Moreover, differences in contract prices organized by different procurers reflect public waste (potentially corruption or collusion) rather than the quality difference.

Second, we need to collect data on open-bid auctions before e-procurement reform (published on the regional web-sites) and e-auctions after e-procurement reform (published on the federal web-site, http://zakupki.gov.ru). Therefore we choose Nizhnii Novgorod as one of regions with a sufficient number of open-bid auctions and e-auctions and transparent regional web-site (http://www.goszakaz.nnov.ru).

A typical public contract contains the following parts:

- the subject of the contract: types of the gasoline and their volume (in liters);
- the duration of the delivery: the relevant period when gasoline stations should provide gasoline to the procurer's cars (in days);
- the geographical area: the area where gasoline stations should be located, e.g. local areas, districts, cities, regions;
- extra requirements to bidders, e.g. round the clock delivery.

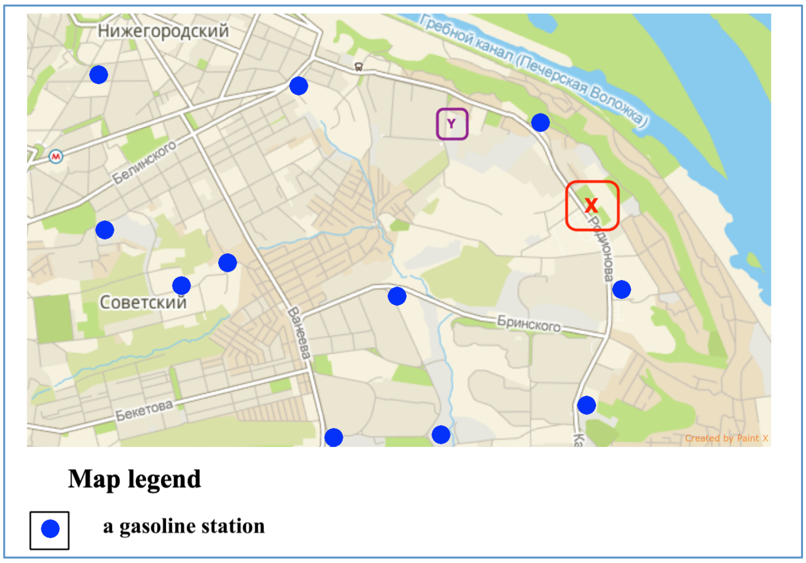
Low number of companies and wide spread horizontal collusion are two specific features of the gasoline market which we should take into account in our analysis.

[17] Balsevich and Podkolzina (2014), Yakovlev et al. (2015) use these advantages of gasoline to study such topics, as corruption and repeated interactions between public procurers and suppliers.

Gasoline auctions: procurer X and procurer Y

We focus on open-bid auctions organized by two public procurers. Procurer X was a big public hospital, while procurer Y was the regional agency of the Ministry of Emergency Situations. Both procurers were situated in the same district of Nizhniy Novgorod close to each other (<3 km between them, see Figure 8) and asked for the gasoline through gasoline stations located in Nizhnii Novgorod and Nizhegorodskaya oblast (hereinafter – the region).

Figure 8
Procurers X and Y and local gasoline stations



Case I: the potentially benevolent procurer

Procurer X organized 8 open-bid auctions in 2008-2010 and 13 e-auctions in 2011-2013. One can observe the following changes in contract characteristics between open-bid auctions and e-auctions. First, the procurer organized e-auctions more often than open-bid auctions, so public contracts became smaller. The reserve contract price decreased a bit if we take inflation into account (at least 6% a year); there were fewer types and volumes of gasoline in e-auctions contracts at average (see Table 3). Second, the procurer set lower reserve prices in e-auctions than in open-bid auctions. We think that this change may signal that the procurer is honest, because since 2011 he used the most objective sources of information: regional statistics and official recommendations by the Ministry of Economic Development. However these lower prices might decrease the entry of companies (see Samuelson, 1985).

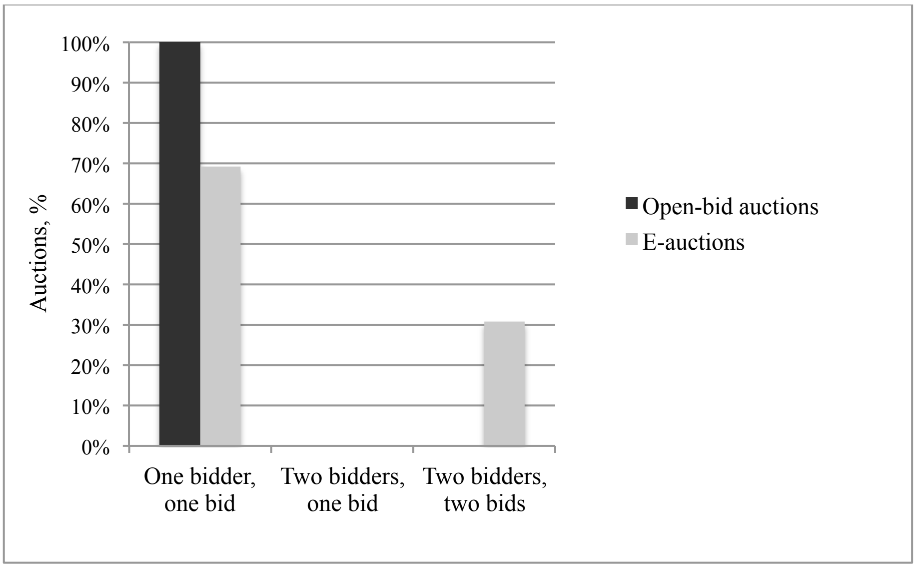
Table 3
Some contract characteristics: Procurer X

	Open-bid auctions		E-auctions	
Variables	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Reserve price, rub.	819583.10	509630.3	954937.3	569926.5
Total volume of gasoline	37650	21057.27	33730.77	19482.49
Types of gasoline	3.13	1.36	1.85	.80
24 hours delivery	0	0	0	0
Reserve price/ market price	1.065	.022	1.018	.006
Obs.	8		13	

In our opinion, the procurer did not manipulate contract terms in order to prevent some companies from bidding. The duration of the delivery remained reasonable (one, three or six months). Procurer X never asked for round the clock delivery of gasoline. He demanded that gasoline stations should be situated in Nizhnii Novgorod and the region, which seems to be reasonable as ambulance cars were sent to different parts of the region. The requested geographical area remained the same in open-bid auctions and e-auctions.

Hence, two potential factors might affect the entry in different directions: lower reserve price and lower entry costs. The data shows that the entry increased in e-auctions compared to open-bid auctions, so the decrease in entry costs had stronger effect on the entry. An extra bidder started to enter e-auctions and always made bids (see Table 4). We checked for possible affiliation between competitors and did not find anything.

Table 4
Bidding in auctions: Procurer X



Bidders competed more aggressively and prices dropped down (see Table 5). We observe both higher discounts made by the winner and lower relative contract prices. The average contract price was 5.8% higher than the market price in open-bid auctions and was equal to the market price in e-auctions.

Table 5
Entry and prices: Procurer X

	Open-bid auctions		E-auctions	
Variables	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Total bidders	1	0	1.31	.48
Bidders that made bids	1	0	1.31	.48
Passive bidding	0	0	0	0
Discount	.006	.006	.018	.008
Relative price	1.058	.024	1.000	.008
Obs.	8		13	

Thereby this case confirms results of our theoretical model. Since 2011, when more informational sources on gasoline prices became available, procurer X was setting lower reserve prices on the basis of official recommendations. That is why we consider procurer X as "honest" in terms of our theoretical model. The introduction of e-auctions led to lower contract prices when the procurer was honest, more specifically, did not manipulate contract terms and set low reserve price. Although lower entry costs provided higher incentives for favoritism, procurer X did not collude with the preferred bidder. Lower entry costs stimulated more companies to enter, and the preferred bidder faced higher competition in e-auctions than in open-bid auctions. We observe the significant positive impact of lower entry costs on entry and contract prices, because it covered the negative impact of lower reserve price.

Case II: the potentially corrupt procurer

Procurer Y organized 13 open-bid auctions in 2008-2010 and 12 e-auctions in 2011-2013. Public contracts in open-bid auctions and e-auctions differed in the following way. First, reserve prices and the number of gasoline types in the contract decreased, while the total volume of gasoline in the contract increased in e-auctions. Such a high difference (see Table 6) results mostly from one huge atypical public contract concluded in 2008 for the whole next year. It was the only public contract with more than one gasoline type in 2008-2010; its reserve price the total volume was approximately 2.5 as big as the average reserve price and total volume of the rest of public contracts made in this period. If we drop this public contract (Table 6, second part), the only crucial change in contract characteristics is the decrease in types of gasoline in e-auctions.

Second, procurer Y set higher reserve prices in e-auctions than in open-bid auctions. We consider this as a signal that procurer Y is potentially corrupt, because since 2011 he frequently asked bidders about the desired reserve price, which is the most corrupt and biased source of information. He presented results of two requests as public information and results of three requests as secret. In the former case the company that procurer Y chose as an informational source later won e-auctions at higher prices in the absence of active competitors. In the latter case it is impossible to identify the companies that he chose. In the rest of e-auctions procurer Y used regional statistics.

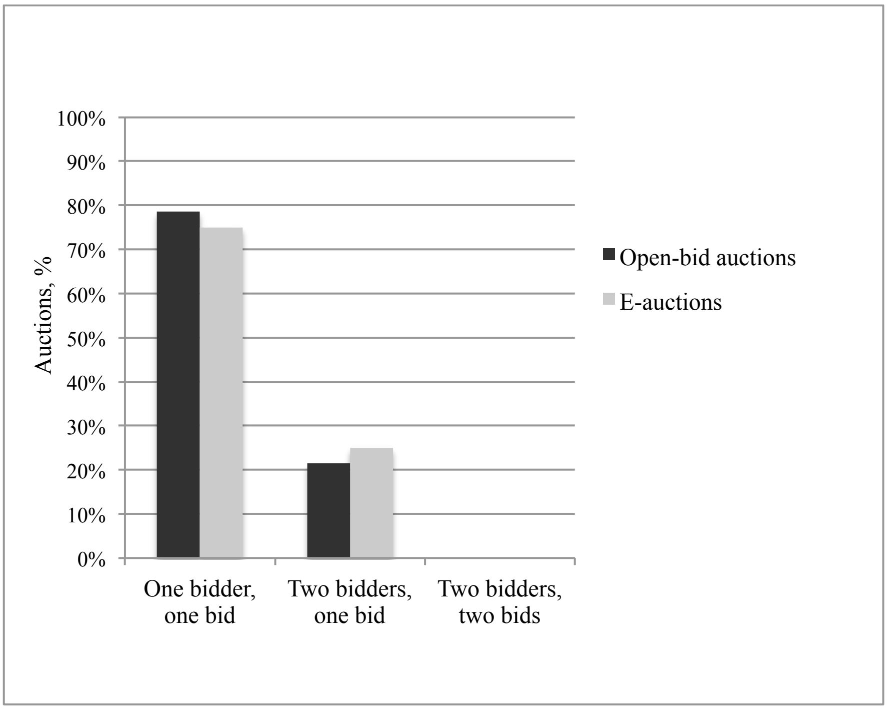
Third, procurer Y reduced the duration of the delivery in several times in e-auctions compared to open-bid auctions, if one considers comparable volumes of gasoline. He asked to deliver huge volume of gasoline for five-seven days that was very hard to make. For instance, in the December 2010 procurer Y organized an open-bid auction for the delivery of 12’700 liters for approximately one month, while in the September 2012 he organized an e-auction for the delivery of 13’205 liters for seven working days. We consider these requirements as manipulation of delivery terms: they are practically impossible to be met because of production constraints of companies.

Table 6
Some contract characteristics: Procurer Y

	Open-bid auctions		**Open-bid auctions**		**E-auctions**	
Variables	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Reserve price, rub.	3523969	7184544	777964.2	206412.2	770629	435786.3
Total volume of gasoline	212625.2	495160.4	37141.67	10354.6	28114.56	17183.14
Types of gasoline	1.43	1.09	1	0	1.58	.67
24 hours delivery	0	0	0	0	0	0
Reserve price/ market price	.986	.023	0.997	.008	1.037	.017
Obs.	13		12		12	

Procurer Y did not use other ways of manipulation: never asked for round the clock delivery of gasoline and did not change the reasonable geographical area where gasoline stations should have been located. Surprisingly, the total number of companies insignificantly increased (see Table 7): an extra bidder started to enter e-auctions more frequently than open-bid auctions. After checking the data more thoroughly, we see that extra bidders did not make bids in any of e-auctions. Therefore entry of companies increased only because of more frequent passive bidding, which might be a coordinated behavior of companies.

Table 7
Bidding in auctions: Procurer Y



The form of passive bidding changed: in open-bid auctions extra companies registered for participation, but did not come to auctions, while in e-auctions extra companies came to auctions, but did not make bids. These extra bidders simulated competition with the preferred bidder, which started to make higher discount in e-auctions compared to open-bid auctions. However one may notice that this discount is very small (approximately 0.13% on the average and 0.5%-1.1% in each e-auction with passive bidding) and did not cover the increase in reserve prices. As the result, relative prices increased in e-auctions.

Table 8
Entry and prices: Procurer Y

	Open-bid auctions		E-auctions	
Variables	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Total bidders	1.21	.43	1.5	.45
Bidders that made bids	1	0	1	0
Passive bidding	.21	.43	.25	.45
Discount	0	0	.0013	.0007
Relative price	.986	.023	1.035	.016
Obs.	13		12	

The case of procurer Y also confirms results of our theoretical model. According to the model, when the procurer is potentially corrupt, lower entry costs give him wider opportunities to demand a bribe in e-auctions. Hence, he had stronger incentives to manipulate contract conditions. This is exactly what happened in procurement auctions organized by with procurer

Y. We think that he is potentially corrupt because he set high reserve prices, including the use of price offers made by his favorite company as the relevant informational source.

Procurer Y started to manipulate duration terms by setting the duration of the delivery so short that is was very hard to meet. As the result, honest companies could not enter e-auctions, but lower entry costs made passive bidding less costly. So procurer Y or his favorite company might use passive bidders to provide the regulating authority with fake evidence of price decrease. These unknown passive bidders simulated competition, so that the favorite company made a small discount in e-auctions. This discount was still higher than in open-bid auctions and might convince the regulating authority that procurer Y and companies obey the procurement rules. As procurer Y set substantially higher reserve prices in e-auctions than in open-bid auctions, relative contract prices increased at 4.9% on the average.

7. Conclusion and discussion

In this paper we present the model of favoritism in procurement auctions by adapting the model of endogenous entry (Samuelson, 1985) to potentially corrupt environment. Unlike Samuelson (1985) and his other followers, we treat a public procurer as a separate player, which can manipulate contract terms in favor of one company and restrict the entry of others. If the procurer is corrupt, he may propose this company to make a contract at the reserve price in exchange for a bribe, so to become his favorite. If the procurer is benevolent, he could manipulate contract terms to increase the probability of the purchase.

Our main contribution to the economic literature is that entry costs have different effect on contract prices depending on whether the procurer is benevolent or corrupt[18]. When the procurer is benevolent, lower entry costs decrease the contract price, which corresponds to the result of Samuelson (1985). However when the procurer is potentially corrupt, lower entry costs may provoke favoritism or keep the same incentives for it. In the former case the contract price increases to the level of the reserve price, while in the latter case it stays equal to the reserve price. The reason for this unexpected change is that the bribe that the favorite company can give to the procurer decreases in entry costs. So if entry costs become lower than the certain threshold, the favorite company can bribe the corrupt procurer. Then he restricts entry of all other companies by manipulating contract terms and, finally, makes a contract with the favorite company at the reserve price. Hence, a small decrease in entry costs may provoke favoritism and a huge difference between contract prices paid by the benevolent procurer and the potentially corrupt one.

[18] Under reasonable conditions: when the reserve price is high enough to make favoritism profitable, the procurer has low or practically no monetary incentives to save governmental money and the reserve price is fixed.

The case study of two public procurers, which organized gasoline auctions in Nizhniy Novgorod, Russia, illustrates this result. In 2011 all Russian procurers were obliged to organize e-auctions instead of traditional (outcry) auctions. This reform decreased entry costs of companies, so we exploit the difference in entry costs to examine the shift in entry and contract prices in auctions organized by two different procurers. We find that two procurers started to act in a different way after the reform. One of them manipulated delivery terms, so lower entry costs did not stimulate entry of newcomers, but made passive bidding less costly and more frequent in e-auctions. Another one did not manipulate contract terms and benefited from both higher entry and lower prices in e-auctions.

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APPENDIX

Appendix 1

Proposition 3

The optimal bribe increases in the reserve price and the number of companies in the market and decreases in entry costs.

Proof

We take derivatives of the right part of the equation (13) with respect to entry costs $k$the reserve price (r) and the number of bidders (n).

The derivative of the optimal bribe with respect to entry costs is equal to:

$$\frac{dB^*}{dk} = \frac{dB^*}{dc^*} \cdot \frac{dc^*}{dk}.$$

From to the equation (3) we get that $\frac{dc^*}{dk} = \frac{-1}{[1-c^*]^{n-2} \cdot ((n-1)r - nc^* + 1)}$ and $c^* < r$. Then taking into account that production costs are lower than 1, $(n-1)r + 1 > nc^*$, hence, $\frac{dc^*}{dk} < 0$, threshold production costs decrease in entry costs.

From the equation (13) we get the following:

$\frac{dB^*}{dc^*} = (r - c^*)(n-1)[1-c^*]^{n-2} + [1-c^*]^{n-1}(1-c^*)$. Each of the terms is higher than zero, hence, $\frac{dB^*}{dc^*} > 0$, the optimal bribe increases in threshold production costs.

Multiplying two derivatives we get that $\frac{dB^*}{dk} < 0$, the optimal bribe decreases in entry costs. We have proved the first part of the Proposition 3.

The derivative of production costs with respect to the reserve price equals:

$$\frac{dB^*}{dr} = \frac{dB^*}{dc^*} \cdot \frac{dc^*}{dr}.$$

We have shown above that the derivative of the optimal bribe with respect to threshold production costs ($\frac{dB^*}{dc^*}$) is strictly positive. Then we-write the equation (3) in this way:

$$r = c^* + \frac{k}{[1-c^*]^{n-1}}.$$

and get the the derivative of threshold production costs with respect to the reserve price:

$$\frac{dc^*}{dr} = \frac{[1-c^*]^{n-1}}{[1-c^*]^{n-1} + k(n-1)}.$$

As both the numerator and the denominator are positive, $\frac{dc^*}{dr} > 0$, threshold production costs depend positively on the reserve price. Multiplying two derivatives we get that $\frac{dB^*}{dr} > 0$, the optimal bribe increase in the reserve price. We have proved the second part of the Proposition 3.

The derivative of production costs with respect to the number of bidders equals:

$$\frac{dB^*}{dn} = \frac{dB^*}{dc^*} \cdot \frac{dc^*}{dn}.$$

We have shown above that the derivative of the optimal bribe with respect to threshold production costs ($\frac{dB^*}{dc^*}$) is strictly positive. Then we-write equation (3) in this way:

$$\frac{k}{(r-c^*)} = [1-c^*]^{n-1},$$

$$\log_{1-c^*} \frac{k}{(r-c^*)} = n - 1,$$

and taking the opposite derivative get the equation for the derivative of threshold production costs with respect to the number of bidders:

$$\frac{dc^*}{dn} = -\ln(1-c^*)\cdot(r-c^*).$$

Threshold production costs c^* are lower than 1, $\ln(1-c^*) < 0$, hence, $\frac{dc^*}{dn} > 0$. Multiplying two derivatives we get that $\frac{dB^*}{dn} > 0$, the optimal bribe increase in the number of bidders. ■

Appendix 2

Proposition 4

For each intermediate value of the reserve price r there is a unique value of entry costs $\tilde{k}$ when the optimal bribe equals zero:

$$B^*(\tilde{k}) = \frac{1}{3}\left(c^*(\tilde{k})\right)^3 - \frac{3}{2}\left(c^*(\tilde{k})\right)^2 + (r+1)c^*(\tilde{k}) - \frac{1}{2} = 0. \quad (14)$$

If entry costs are below this level, the company 1 is ready to give a positive bribe and the corruption deal may take place. If entry costs exceed this level, the company 1 is not ready to give a positive bribe and the corruption deal never takes place.

Proof

We should prove that the equation (14) has one real root $c^*(\tilde{k})$, when r satisfies the inequality (11). We solve the cubic equation using trigonometric Vieta's formula and find that the real root is unique. This root satisfies all previously made assumptions and corresponds to the adequate level of entry costs $\tilde{k}$. ■

Appendix 3

Proposition 5

The expected utilities $EU(M;B), EU(NM;0)$ decrease in entry costs. The higher entry costs are, the higher the contract price the procurer pays in the auction without manipulation and the lower the optimal bribe is in case of manipulation.

Proof

The expected utilities $EU(M;B)$ and $EU(NM;0)$ equal, respectively:

$$EU(M;B) = 1 + B^* - \beta r \quad (15.1)$$

$$EU(NM;0) = 1 - [1-c^*]^n - 2n\beta\int_0^{c^*} c[1-c^*]^{n-1}dc - \beta n c^* k \quad (15.2)$$

First we consider the expected utility $EU(M;B)$. The reserve price and the financial source β are exogenous; hence, the expected utility of the corrupt procurer in case of favoritism depends on entry costs in the same way, as the optimal bribe:

$$\frac{dB^*}{dk} = \frac{dEU(M;B^*)}{dk}.$$

From the Proposition 3, $\frac{dB^*}{dk} < 0$. Hence, the expected utility of the corrupt procurer in case of favoritism decreases in entry costs:

$$\frac{dEU(M;B^*)}{dk} < 0.$$

We have proved the first part of the Proposition 4.

Second we consider the expected utility $EU(NM;0)$ and re-write it as follows:

$$\frac{dEU(NM;0)}{dk} = \frac{dEU(NM;0)}{dc^*}\cdot\frac{dc^*}{dk}.$$

The Proof to the Proposition 3 shows that $\frac{dc^*}{dk} < 0$, threshold production costs decrease in entry costs. Then we substitute the size of entry costs from the equation (3) to the equation (15) and take derivative of this with respect to threshold production costs:

$$EU(NM;0) = 1 - [1-c^*]^{n-1}(1 - c^* + \beta nrc^* - \beta n(c^*)^2) - 2\beta n \int_0^{c^*} c[1-c]^{n-1} dc,$$

$$\frac{dEU(NM;0)}{dc^*} = (n-1)[1-c^*]^{n-2}(1 - c^* + \beta nrc^* - \beta n(c^*)^2) -$$

$$-[1-c^*]^{n-1}(-1 + \beta nr - 2\beta nc^*) - 2\beta nc^*[1-c^*]^{n-1}.$$

Simplifying this expression, we obtain:

$$\frac{dEU(NM;0)}{dc^*} = n[1-c^*]^{n-2}[(1-c^*)(1-\beta r) + \beta(n-1)c^*(r-c^*)]$$

According to the set-up, $n > 1$, $1 > c^*$, $r > c^*$, $\beta r < 1$, hence, the expected utility $EU(NM;0)$ decreases in threshold production costs:

$$\frac{dEU(NM;0)}{dk} < 0.$$

As the result, the expected utility of the honest procurer in the absence of manipulation decreases in entry costs. ■

Appendix 4

Proposition 7

If the procurer manages the public money, the difference between procurer's utilities is zero or negative, $dU \leq 0$. The procurer never benefits from favoritism, and favoritism does not arise.

Proof

We can prove it by addressing two statements. First, the equation (16) has one real root $c(\hat{k})$, when $n = 2$ and $\beta = 1$. This root satisfies all previously made assumptions and corresponds to the adequate level of threshold entry costs $\hat{k}$. As in the Appendix 2, we solve the cubic equation using trigonometric Vieta's formula:

$$c(\hat{k}) = -2\sqrt{\left|r^2 - \frac{9}{4}r + \frac{11}{36}\right|}\, sh(\phi) + \frac{2}{3}r + \frac{1}{6},$$

where $\phi = \frac{1}{3} Arch\left(\frac{\left|-\frac{8}{27}r^3 + \frac{7}{9}r^2 - \frac{23}{36}r + \frac{125}{206}\right|}{\sqrt{\left|r^2 - \frac{9}{4}r + \frac{11}{36}\right|^3}}\right).$

Second, $dU < 0$. When entry costs does not equal the threshold, $k \neq \hat{k}$, $dU(c(k)) < 0$, the difference between procurer's utilities is negative .■