

INTERIM GRANT REPORT

“Development of methods to counteract supplier collusion in the process of conducting electronic auctions for public procurement in the healthcare sector in Russia”

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Introduction

Definitions of collusion

The problem of collusion between participants in public procurement is considered by researchers, as a rule, within the framework of the models of competitive behavior in an oligopolistic market. In collusion, firms coordinate their actions and mimic the behavior of a single dominant company in order to increase expected profits.

One of the first theoretical works defining the economic concept of «collusion» and its main types was the work of Stigler (1964).

Stigler (1964, p. 45) defines collusion as the cooperative behavior of supposedly independent firms in which they determine production and prices in their own interests. Therefore, Stigler identifies two main components of the economic definition of collusion. The first – is having a common strategy (when firms act as one dominant company). And the second – the presence of collusion protection mechanisms (or collusion enforcements) – those tools that allow to identify deviations in the behavior of the collusion participants from the adopted strategy and to punish the deviators.

Kuhn (2001) distinguishes between an economic and legal view of collusion. From a legal point of view, collusion is a “preliminary agreement” of a firm about joint actions, while from an economic point of view, it is the behavior of several firms in an oligopolistic market, similar to the behavior of one dominant firm and resulting in similar results. (see also Albano et al., 2006)

For practical purposes, collusion can be thought of as any conduct adopted by a group of firms that aims at reproducing or approximating the market outcome induced by single, dominant firm. To achieve such an objective, firms need to coordinate their strategies either tacitly or explicitly. They face then a non-trivial problem of choosing a profile of coordinated strategies.

Colluding firms usually form a cartel – that is, a group of firms acting as the bottom of the dominant firm in the market. Among the key peculiarities of cartels according to Graham and Marshall (1987) there are the following:

- Stability. Defined rules of conduct for cartel participants are preserved over time;
- The applied strategy is focused on eliminating competition between participants;
- The participants share their common profit, while the profit division can occur both after each interaction (auction), or by sequential receipt of profit by different participants;

- The cartel sooner or later includes all competitive participants of the interaction;
- The auctioneer, who is aware of the cartel existence, changes the strategy of behavior (for example, increases the reserve price (decrease in procurement)), therefore the participants in the cartel often imitate competitive behavior.

Types and forms of collusion

Among the first theoretical works describing models of coordinated interaction of firms in an oligopolistic market, as well as the features of such associations, is the work of Graham and Marshall (1987). Furtherly, collusion models were analyzed for the area of public procurement. The most outstanding research in this area was done by McAfee and McMillan (1992) and Aoyagi (2000). These models highlight the most common collusion mechanisms between participants in public procurement and describe the process of the collusion chains formation under bidding procedures.

Depending on the coordination mechanism and its “institutionalization” there are two types of collusion:

- **Explicit collusion** – when firms participating in an auction get agree in advance on strategies of their behavior. This form is illegal in most jurisdictions because the cartel is built among members to publicly exchange prices (Modak, Panda, & Sana, 2016). Three significant forces make running such a cartel difficult. First, they are generally illegal and are aggressively policed by competition authorities, presenting a significant obstacle to coordination. The second challenge is that cartels face a classic collective action problem: individual cartel members have short-term incentive to deviate from the collusive agreement. In the language of game theory, defection from the cartel is a dominant strategy when a single round is played. Finally, effective collusion requires unanimity, meaning that a single defector can significantly diminish the profits of the other cooperating firms (Wachs, Kertesz, 2019).
- **Tacit collusion** – when firms make decisions separately, focusing on signals from other participants, or based on the past experience of interacting with competitors.

The most common collusion strategy is the “Fixed Price” strategy – when firms choose a winner among themselves and agree on a profit sharing. As a result of such collusion, "bidding rings" are formed. Profits can be split based on various criteria - market shares, geographic segmentation, potential order execution costs, etc. Bidding rings may be all-inclusive, i.e., include every bidder participating in an auction, or incomplete, consisting only of a subset of the

set of all bidders. (Hendricks et. Al., 2013). Bid rigging is generally illegal in the U.S., the E.U., China, and many other countries.

In many theoretical studies on bid rigging, the analysis is based on models of auctions with a long-term relationship. One of the most important research questions is by how much can collusion increase the joint profit of collusion members under asymmetric information (the existence of private information). (Arai et al, 2011)

Bid rigging is the most common form of explicit collusion in auction markets (the other, less common, form being explicit collusion between one or more bidders and the auctioneer). The rings usually face some of the same challenges as cartels: detection by the antitrust agencies or by the seller, internal enforcement, entry, and private information about the gains from trade. The ability of rings to solve these problems, and the nature of the solution, depends on the type of auction the seller uses (Hendricks et. Al., 2013)

McAfee and McMillan consider two separate cases: “weak cartels,” which can coordinate bids but cannot transfer money between members; and “strong cartels,” which can.

- **Weak cartels** – in the case of weak cartels, a group of bidders can coordinate their bids but cannot reallocate the object after the auction or transfer money between them. (These constraints may be the result of antitrust regulators, or other reasons)
- **Strong cartels** – cartels, that can exclude nonserious bidders and can transfer wealth between its members. The result of strong cartels is that, when transfers are allowed, there is a mechanism the bidders can use to truthfully reveal who values the object the most; he is then assigned to be the only bidder, wins the object, and in addition makes transfers to the other bidders.

Weak cartels usually act by determining the winner of the auction and suppressing competition from other cartel members. The winning bidder is determined through "market sharing" agreements, through "rotation of bids" where firms take turns winning contracts (for example, in the case of collusion with electrical equipment in the United States), or more complex schemes. Designated bidders place bids at roughly the reserve price level, while bids from other cartel members are either suppressed entirely (the practice of “bid suppression”) or submitted at non-competitive levels (Che, 2018).

Country and industry distribution of discovered collusion cases. Collusion in healthcare procurement

Examples of collusion in public procurement and their analysis are presented in the papers of many authors.

A series of studies has been devoted to the problem of collusion when purchasing milk for school meals in various US states. The structure of this market at the time of detection of collusion and statistics of charges of collusion in various US states are given in the work of Lanzillotti (1996). The study highlights a number of factors facilitating collusion. Among them there are stable cyclical demand, geographic division, which limits the number of participants in each individual auction, firms often interact outside the auction, and a high dependence of the customer on the supplier.

Pesendorfer (2000) examines tendering for school milk contracts in Florida and Texas in the 1980s. Analysis of the data showed that cartels in the two states distribute contracts differently: one cartel divides the market between participants, and the other cartel uses additional payments to compensate members of the collusion for refusing to bid. Furtherly the market of school milk was investigated by Porter and Zona (1999). The study includes the observation of statistics of procurement auctions conducted by Ohio school districts for milk. The State of Ohio was charged thirteen dairies with bid rigging in the period 1980-1990.

Porter and Zona (1993) examine bidding for state highway construction procurement auctions in Long Island, New York from 1979-1985. They evaluate whether the characteristics of these procurement auctions would tend to facilitate collusion. The authors demonstrated that the rates of firms united by geographic location differ from the rates of all other firms, and are likely to be fictitious, which confirms the existence of collusion.

Krishna (2002) reported that in the 1980s, collusion and auctions went hand-in-hand: 75% of US cartel cases involving collusion were auction-based. To date, approximately 30% of antitrust cases filed by the Department of Justice since 1994 involved bid-rigging in industries such as construction, antique sales, military supplies, utility procurement, etc. (Agranov, Yariv, 2018).

Baldwin, Marshall, and Richard (1997) examine the winning bids and characteristics for 108 oral auctions for timber sold by the Forest Service in the Pacific Northwest from 1975 to 1981. Athey, Levin, and Seira (2011) examine Forest Service auctions that occurred in Idaho-Montana and California between 1982 and 1990. They show that sealed bid auctions attract more small bidders and tend to yield higher revenues to the Forest Service.

A large number of cases of collusion in the context of various types of auctions in areas such as metallurgy, construction, pharmaceuticals in the United States and Europe were included

in the (Handbook procurement, 2006). Moving toward the Asia, we can find an empirical analysis of collusion in public procurement of consulting work in Japan (Ishii, 2009).

The article by Balsevich et al. (2012) is devoted to a detailed examination of the Russian experience in public procurement through the prism of collusion, which analyzes in detail the reasons and consequences of the coordination of bidders in public procurement of medicines, as well as in the field of road construction and repairs in the Russian Federation. Factors contributing to collusion in the purchase of oil and gas products for municipal needs in some regions of the Russian Federation, as well as empirical evidence of collusion, are presented in the article by Eremina and Zoroastrova (2012).

The authors collected a base that consists of 121 of discovered collusion cases in the Russian healthcare procurement in 2016-2017.

Thus, we can summarize that the collusion does not know the geographic and industries borders.

Organization of collusion counteraction: institutional aspects

The countries' public procurement policy and regulation are usually based on the Model Law on Procurement of Goods, Construction and Services (hereafter: Model Law), developed by the United Nations Commission on International Trade Law (UNCITRAL), and recommendations of such international authoritative organizations as OECD and World Bank.

Below, to discuss the institutional aspects of collusion counteraction, we will use the Guide to Enactment of the UNCITRAL Model Law on Public Procurement (Guide, 2014) that widely discusses the collusion issues, OECD Guidelines for fighting bid rigging in public procurement (OECD, 2009), and OECD recommendations on competition policy (OECD, 2010).

According the latter, the following ways to counter collusion in the procurement process are observed (ibid., 29-30):

- 1) Creating sustainable national and international relationships between procurement authorities, antitrust and law enforcement agencies;
- 2) Raising awareness of public contracting authority about the risks of collusion in public procurement;
- 3) Develop clear methods, rules and regulations for collusion detection combined with a strong punishment mechanism.

(1) Creating sustainable national and international relationships

On the macroeconomic level, the actions of the government as a buyer could lead to the consolidation of the market and consequential reduction of the number of participating suppliers

or contractors, particularly where the Government purchases constitute a significant percentage of the market by volume or value. At the extreme, oligopolies or monopolies could be created or maintained. For this reason, ensuring reporting and cooperation between agencies responsible for monitoring the public procurement function and that responsible for competition policy should be ensured (Guide, p. 19). Below, some examples of such coordination are listed.

Great Britain. As part of the development and improvement of the anti-collusion strategy, the UK Office of Fair Trade actively cooperates with private businesses to determine the main factors for filing or not filing complaints with the antitrust authorities and develop further actions to encourage bidders to signal possible cases of collusion (OECD, 2010, 389-400).

Singapore. Recognizing that collusion and corruption often occur together, the Competition Commission of Singapore (CCS) maintains a close working relationship with the Corruption Investigation Bureau (CPIB). In particular, CCS has developed a Protocol with CPIB that deals with the distribution of cases and administration between the two institutions and provides clarity and efficiency in case management (*ibid.*, 335-336).

In the **Russian Federation** (hereafter: RF) the Federal Antitrust Service (hereafter: FAS) is responsible for competition policy and the public procurement monitoring at the same time. On the other hand, FAS as a Monitor tightly coordinates its activity with the Ministry of Economics, the Coordinator of Russian public procurement.

(2) Raising awareness

Raising awareness of the collusion risks in public procurement implies that procurement authorities should be competent to apply appropriate rules and mechanisms to prevent and detect unfair behavior of the procurement participants. In 2009, the OECD Competition Committee developed a special Guide to help procurement authorities improve the procurement process by fighting bid manipulation (OECD, 2009). The Guidelines on anti-collusion suggest that the risk of supplier collusion in bidding could be reduced by carefully designed procurement process. Moreover, many OECD countries are actively implementing national programs to raise procurement authority's awareness of issues related to countering supplier collusion in auctions.

For instance, the Australian Competition and Consumer Commission has developed an extensive education program for government employees involved in public procurement. The main purpose of this program is to train government customers on how to detect cartel activity in the procurement process (OECD, 2010, 61).

Besides informing of the collusion risks, the Model Law leaves the wide discretion to public entities in their control of collusion, for example,

- the procuring entity should have the discretion to decide on a case-by-case basis on whether the Information on possible forthcoming procurement should be published (Guide, 2014, 69),
- where the procurement takes place in a concentrated market, or on a repeated basis, an assessment should be made and recorded as to the likelihood of collusion before a decision to engage in direct solicitation is made (ibid., 139),
- a procuring entity may cancel the procurement for reasons of public interest, such as where there appears to have been a lack of competition or to have been collusion in the procurement proceedings (ibid., 105), etc.

Against it, the modern Russian public procurement policy has been directly aimed at counteracting the corrupt behavior, before all, at the restricting of public entity's discretion power (Ivanov, 2016, 119). Among several ways to do that, the most relevant one is the choice of the electronic price auction (hereafter: ERA) as the main procurement procedure. Being concentrated on the restriction of public entity's discretion power, the Russian Principal¹ does not pay necessary attention to combating different forms of suppliers' mala fide behavior such as collusion and dumping and, actually, obstruct the contracting authorities of doing it.

According to the Guide (p. 41), the Principal should be aware of practical difficulties and lack of specialized capacity in procuring entities to identify and prevent collusive practices, in particular because there is no automatic link between the extent of competition and the presence or absence of collusion. Correspondingly, it gives some recommendations on control collusion when different procurement methods are applied. Let us consider some of them refers to the electronic auctions using.

ERAs are more vulnerable to price manipulation, price-signaling or other anti-competitive behavior in markets with only a limited number of potentially qualified and independent suppliers or contractors known to each other, or in markets dominated by one or two major players, and in the repeated use of ERAs with the same participants, because anonymity is in practice more difficult to maintain (Guide, 228). The Model Law's procedures have also been designed to mitigate this risk, for example by encouraging the combination of ERAs and open framework agreements (Model Law, art. 2, e-v) in the case of repeated purchase.

The procurement regulations or rules or guidance from the public procurement agency or other body should therefore guide the procuring entity in considering the market concerned before a procurement procedure commences, to identify the relative risks and benefits of an ERA (Guide, 231).

¹ The principal is a complex of public institutions which are responsible for public policy and regulation development and enforcement.

The lack of measures to counter collusion leaves researchers with the ability to recommend generally accepted international provisions for improving national policy and regulation that will be done at the next sections.

(3) Developing of methods and rules for detecting collusion in combination with a strong punishment mechanism

Practical experience in countering suppliers' collusion at auctions clearly shows that the most effective means of combating collusion in public procurement are high penalties, both civil, criminal, and administrative. However, a number of countries uses alternative counteraction tools, such as self-confirmation of compliance with the law, disqualification orders or blacklisting.

Confirmation of compliance with the law by bidders and customers is a significant mechanism for countering collusion in international practice. For example, in some countries, bidders must submit a Certificate of Independent Bid Determination (CIBD) as a requirement when bidding (OECD, 2010, 30). This mechanism has been introduced in such countries as Australia, Brazil, the United Kingdom, Canada, New Zealand, and the United States.

The prohibition on participation in procurement procedures for a long period of time has been successfully applied in a number of OECD member countries: Brazil, Colombia, Latvia, Peru and many others. In Latvia, the prohibition is set for 12 months from the date of the final trial decision on the case (*ibid.*, 242). In Peru, there are two types of disqualification: a temporary prohibition on participation from 3 months to 6 years and a permanent disqualification on participation in public procurement (*ibid.*, 308-315).

The transition of collusion at auctions to a digital format is a new world-wide trend, so in many countries modern information technologies are successfully used to detect and stop collusion.

Brazil. The Economic Law Secretariat of the Ministry of Justice (SDE), Brazil's antitrust authority, has access to the ComprasNet data repository, which is a comprehensive database of public procurement data from the Federal government. It includes business intelligence tools and allows SDE to extract and analyze public procurement data. In addition, SDE uses an electronic data matching system, Observatório da Despesa Pública, designed to detect signs of collusion (*ibid.*, 72-77).

In Korea, antitrust authorities use the Bid Rigging Indicator Analysis System, which uses data obtained online from government agencies to calculate the probability of bid manipulation, weighing various indicators such as the probability of winning bids, the number of bidders,

contract prices, supplier selection methods, the number of unsuccessful bids and reserve price increases, switching to private contracts, and others (ibid., 238).

Thus, in addition to ensuring compliance with countries competition laws, their administrative and criminal legislation, and rules related to public procurement, there are a number of methods by which the integrity of the public procurement process can be protected or improved:

- International cooperation and cooperation between various national law enforcement agencies,
- Opening national markets to international competition to attract more bidders,
- Reorganizing the procurement process to ensure maximum transparency,
- Proof of independent bid determination,
- Training of civil servants, businesspeople, and civil society,
- Data analysis tools for determining indicators of anti-competitive or corrupt activities.

Research tasks

The current study is aimed at developing of methods of identification of collusion among the suppliers in public procurement in the Russian Federation in the sphere of healthcare (procurement of medicines, consumables, and medical equipment).

The choice of this specific sphere is motivated by the following.

- According to the monitoring of the Russian Ministry of Finance, procurement of medicines is at the 3rd position on the TOP-10 list (totaling 355.91 billion rubles).
- The procurement of medicines and medical consumables in the Russian healthcare are organized exclusively via the price auction (with only a small part of the medical products being purchased through requests for quotations). This allows to focus the study of suppliers' collusion on the English price auction only.
- The Decree of the Government of the Russian Federation of November 30, 2015, No. 1289 "On restrictions and conditions for the admission of medical products originating from foreign countries included in the list of vital and essential medical products for the purpose of procurement to meet state and municipal needs" restricts participation of foreign companies in government procurement, which makes the pool of suppliers more homogeneous and increases the chances of suppliers' collusion.

Thus, in this study we set up the following research tasks.

1. Identification of the type of collusion in the procurement procedure via deductive mathematical modeling (modeling of the "ideal" public preferences, modeling of the preferences

of the principal by analyzing the proposed regulation; modeling of the preferences of the public buyer based on the enforcement practice).

2. Setting up and stability of collusion in the English auction (price auction with minimal limitations on the quality of the procured goods) under the institutional conditions of the Russian Federation (with a high level of corruption and a poor quality of regulatory impact assessment) and the peculiarities of procurement regulation (easy access to public procurement, low price thresholds, dominance of the price auction over alternative procurement methods) via game-theoretic modeling.

3. Construction of an econometric logistic model as a tool for estimation of the probability of collusion based on the collected dataset of public purchases in the Russian healthcare system.

Chapter 1. Key areas of collusion research in public procurement

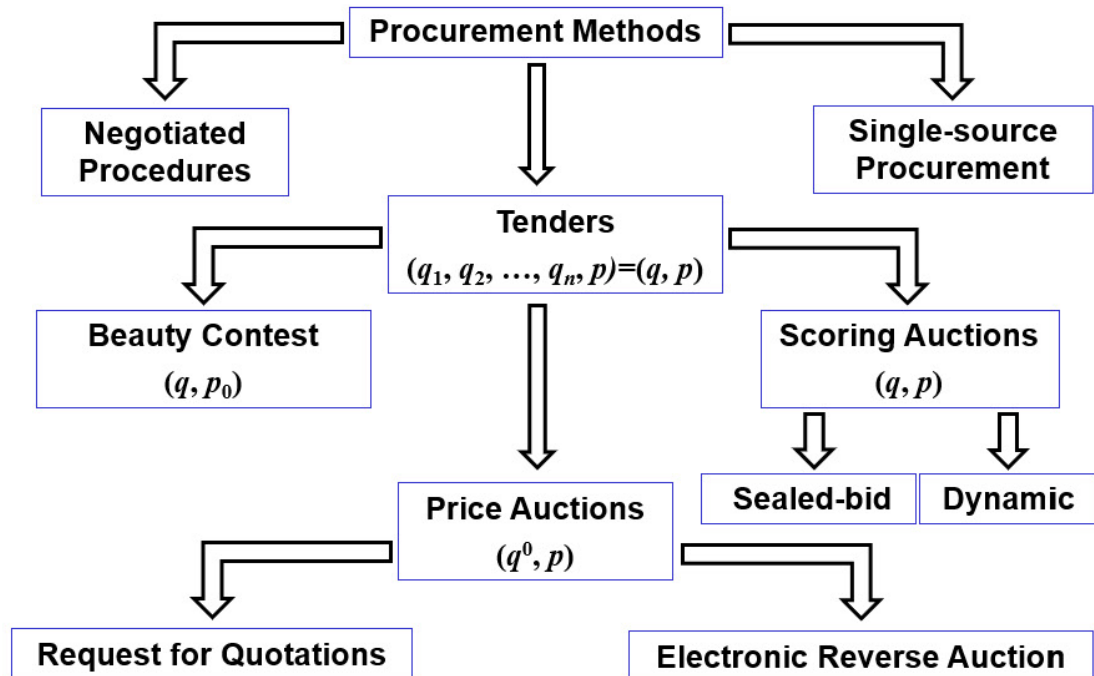
1.1. Collusion in the context of different procurement methods application

The coordination and punishment mechanisms inside the group of colluding firms as well as the methods of collusive behavior discovering are heavily depend on the applied procurement method.

The article 27 of the Model Law suggests 11 procurement methods, which can be conditionally divided into negotiated procedures, single-source procurement, and open tenders (for simplicity reasons, we do not consider restricted and multi-staged methods). The latter supposes the comparing of bids according quality and price criteria and can be divided into three types of procedures:

- scoring auction applying all criteria (sealed-bid and dynamic),
- beauty contest, which uses quality criteria only²,
- electronic reverse auction (hereafter: ERA), which uses only price in comparing the bids satisfying established quality conditions³.

Given comments, the Fig. 1.1 represents the Hierarchy of Model Law Procurement Methods⁴.



² According to the Model Law (Art. 11-2), the price *may* be included into the list of criteria in contrast to Russia where it is a mandatory criterion.

³ In the international practice, ERA can assume price auction and dynamic scoring auctions as well.

⁴ p_0, q^0 – values of selecting criteria, p, q – values of selecting and/or awarding ones.

Fig. 1.1. A Simplified Hierarchy of Model Law Procurement Methods

Four basic auction types are used when a unique item is to be sold (bought – in procurement): the English auction; the Dutch auction; the first-price sealed-bid auction; and the second-price sealed-bid (or Vickrey) auction (McAfee, McMillan, 1987, 702).

In the English auction, the price is successively gone up (down – in procurement) until only one bidder remains. The essential feature of the English auction is that, at any point in time, each bidder knows the level of the current best bid.

The Dutch action is the converse of the English auction. The auctioneer calls an initial extremely high (zero) price and then lowers (uppers) the price until one bidder accepts the current price.

With the first-price sealed-bid auction, potential buyers (suppliers) submit sealed bids and the highest (lowest) bidder is awarded the item for the price he bid. The basic difference between the first-price sealed-bid auction and the English auction is that, with the English auction, bidders are able to observe their rival's bids and accordingly, if they choose, revise their own bids; with the sealed-bid auction, each bidder can submit only one bid.

The only difference between first- and second price sealed-bid auction is that in the latter the highest (lowest) bidder wins the item but pays (receive) a price equal not to his own bid but to the second-highest bid.

From four basic auction types, the Model Law recommends using of an English auction (second-price auction) and the first-price sealed-bid auction (respectively, ERA and request for quotation in Fig. 1.1).

There are a lot of academic papers that examine collusion issues when different procurement methods are applied. The impact of procedural factors on the likelihood of collusion between procurement participants is discussed in the research of Cramton, Schwartz (2000); Robinson (1985); Waehrer (1999), Marshall and Marx (2007), etc.

Marshall and Marx (2007) demonstrate that the auction format (first price versus second price) leads to different results in terms of the viability and profitability of collusion.

In the conditions of the second-price auction, the collusion ring suppresses the bids of all participants except the bidder with the highest value (lowest value in the procurement). The member of the ring with the highest value bids in the same way as in the absence of collusion. Any member of the group who wishes to withdraw from the bidding ring and enter the auction goes through the highest bid which observed by the ring members and can be outbid by the preselected winner. As a result, deviant behavior in this case does not benefit the participants. Therefore, second-price auctions are rarely used in practice (in contrast to RF), they create

additional incentives for collusion. This type of auctions has been discussed by Mailath, Zemsky (1991).

Another case is the first price auction, which is considered in McAfee and McMillan (1992). Under this type collusion can be won if the ring member with the highest value lowers his bid below what he would have offered without cooperation and the other ring participants must suppress their bids. But when the highest-valuing ring member lowers his bid, it is possible for the member of the cartel who does not have the highest rating to apply for the auction on his own or through a shill and get the item.

Thus, the incentives for collusion in auctions are generally weaker in a sealed-bid auction than in a dynamic auction.

Regardless of the format of the auction, cartels are able to suppress any ring competition by sending only the most valuable member of the ring to the auction, where he wins the object at a price equal to the auctioneer's reserve. Thus, this single contrast suggests little difference between the viability or profitability of collusion in first and second price auctions, despite the aforementioned difference.

Furthermore, economically open auctions encourage collusion, as under these conditions, participants have the opportunity to identify deviations from the general strategy and apply sanctions to the deviating participants. The impact of open and closed auctions on the sustainability of collusion is discussed by Robinson (1985).

Hendricks et al (2013) note that different types of auctions create different incentives for non-ring members to join the collusion. In the case of English auctions, non-ring members have no incentive to remain outside of the ring, since the ring captures all the collusive gains. But in case of first price sealed-bid auctions, non-ring members may find it more profitable on average to remain outside the ring since the collusive gains leak out to non-ring members.

1.2. Basic methods for counteracting collusion

As it was stressed in the Subsection 0.3, the problem of collusion is the great challenge for corresponding government structures anywhere. The regulators measures to combat collusion among suppliers can be divided into an ex-ante and ex-post counteraction.

The ex-ante measures, we will call them *proactive methods*, are aimed at creating incentives for the bona fide behavior of the sellers and developing the design of procurement procedures that impede the implementation of the collusion. The ex-post measures (*reactive methods*) apply information about the suppliers' behavior in the procurement process and its results to identify the bona fides of the participants and their possible punishment.

Reactive methods, in turn, can be associated with the development and applying methods of collusion discovering, as well as, for example, the response of regulating authorities to receiving external information, such as complaints from a supplier who is not involved in a conspiracy (Anti-cartel enforcement manual, 2015, 8)⁵.

1.2.1. Pro-active methods of countering collusion

Albano et al (2006) consider different types of auction designs (tendering formats) and their effects on collusive behavior. Several most important conclusions include:

- second price competitive tendering are highly exposed to the risk of collusion,
- sequential competitive procurements facilitate collusion,
- if collusion is a major concern, the agent should procure simultaneously all supply contracts on which the same bidders are active.

Besides this, if a collusion is the major concern in designing a dynamic auction, the following precautions might be adopted:

- Publish anonymous bids;
- Limit the number of bids published
- Limit bids in their last digits
- Make withdrawals costly
- Limit the amount of bid increments / decrements (i.e., the value of a tick)
- Adopt object-by-object closing rule.

The design of the auction and incentives to form collusion are discussed in detail in the chapter “Bidding rings and the design of anti-collusive measures for auctions and procurements” of William E. Kovacic et al. (Handbook of procurement, 2006). In general, the main conclusion is: collusion is more difficult with sealed-bid auctions than ascending-bid auctions, it requires ex-ante communication that is not needed with collusion at an oral ascending-bid auction, and there is the possibility of profitable deviant behavior that cannot be traced to the deviator.

The literature provides several ways for auctioneers to implement auction rules that discourage bidders to collude. It is well known that the auctioneer may impose a reserve price to do so (Graham and Marshall, 1987). Recent papers show that collusion-proof mechanisms exist under fairly general circumstances. These mechanisms raise as much revenue as a revenue-maximizing mechanism in the absence of collusion (Laffont and Martimort, 1997, 2000; Jeon and Menicucci, 2005; Che and Kim, 2009).

⁵ In the cited manual, terms “reactive” and “proactive” methods have been used differently to the paper. The manual’s authors apply them correspondingly to two directions of ex-post counteraction.

Among the existing auctions, the literature suggests using the first-price sealed-bid auction (FP) instead of the English auction (EN) (Robinson, 1985; Marshall and Marx, 2007). The reason is that a cartel agreement is stable in EN, where no bidder has an incentive to deviate from the cartel agreement because the cartel will continue bidding up to the highest value of its members. In contrast, a cartel in FP has to shade its bid below the highest value in the group to make a profit, which gives individual cartel-members an incentive to cheat on the agreement and submit a higher bid than the cartel.

With repetitive procurement procedures, public information can be used by companies for better communication. When organizing similar purchases, increasing the term of contracts can reduce the incentives for collusion. (Pivovarova, 2009)

Also, dividing contracts into homogeneous or heterogeneous lots can increase the number of potential bidders and reduce the incentives to collusion.

Other recommendations for organizing purchases include publishing information about the course of tenders after their completion, and simultaneous procurement when purchasing related goods.

Collusive disclosure is often facilitated by companies that evade the overall cartel strategy. Therefore, many countries are trying to expand incentives to disclose collusion. For example, the US and the EU have introduced "soft" penalties for firms that cooperate with government authorities on collusion disclosure (see, Spagnolo, 2006). Many authors emphasize that punishment mitigation works better if concessions are introduced for everyone who surrenders (Chen, Harrington, 2005; Aubert et. al., 2005). In general, positive measures, such as monetary rewards, work better than negative ones, such as lowering the penalty for disclosing collusion.

And, finally, it would be worth to know and apply Model Law recommendations mentioned in the subsection 0.4 (Guide, 2014, 69 and 139).

1.2.2. Re-active methods of countering collusion

The range of applied empirical methods to detect corruption and collusion is very wide – from the use of simple statistical screens to application of modern time-series analysis techniques (such as ARCH and GARCH models) and machine learning algorithms.

Lengwiler Y., Wolfstetter E. (2010), using modern numerical methods, analyze a model in which the auctioneer orchestrates bid-rigging by inviting one bidder to either lower or raise his bid, whichever is more profitable.

Tkachenko et al. (2017) run price analysis of stable relations between customer and supplier in the public procurement of homogeneous goods to differentiate opportunistic from honest behavior among economic agents. Using linear regression analysis, they find that for

private suppliers, prices of repeated contracts were lower compared to onetime deals when procured through more transparent procedures and higher when procured through non-transparent procedures.

Bid leakage is a corrupt scheme in a first-price sealed-bid auction in which the procurer leaks the opponents' bids to a favored participant. The rational behavior of such participant is to bid close to the deadline in order to receive all bids, which allows such participant to ensure his/her win at the best price possible. Ivanov, Nesterov (2020) use semi-supervised machine learning techniques to detect corruption in the form of bid leakage.

The range of methods of detection of bid-rigging/price fixing cartels varies substantially: from simple statistical screening to quite advanced approaches of the modern time-series econometrics. For example, Esposito and Ferrero (2006) analyze the Italian gasoline and baby food markets using the simple mean and the standard deviation for prices. They find that under collusion prices are higher and that variance of prices is lower. Imhof (2017) applies simple statistical screens to a bid-rigging cartel in Switzerland and shows how well the screens detect it by capturing the impact of collusion on the discrete distribution of the bids.

Bolotova et al. (2008) demonstrate the impact of the lysine cartel and the citric acid cartel by analyzing the price evolution with ARCH and GARCH models. Tas (2017) designs a method to identify and test for bid rigging in procurement auctions with limited information. Huber, Imhof (2018) combine machine learning techniques with statistical screens computed from the distribution of bids in tenders within the Swiss construction sector to predict collusion through bid-rigging cartels.

1.2.3. Collusion determinants

Despite the comprehensive study of the problem of coordination of actions between participants in the procurement process, collusion detection remains one of the unresolved problems. All models, both theoretical and practical, either give an idea of the mechanisms for implementing collusion in the government procurement system or allow to confirm the hypothesis of its existence on the basis of empirical data – the history of prices in the purchases that took place.

The empirical research devoted to the problem of identifying collusion in public procurement include papers of Porter (1983) and Lanzilloti (1996) in which based on the history of auctions in the United States the attempts to discover the fact of collusion ex-post are made. Moreover, the researchers determined the nature of collusion, as well as the mechanisms of its formation.

In general, we can conclude, that there is a separate section of the literature which is devoted to identification of the main characteristics of the market or the features of procedures that contribute to the emergence and successful maintenance of collusion.

Researchers define several groups of factors influencing the incentives for collusion and its sustainability: structural variables, demand characteristics and supply side features (Stigler (1964), Ivaldi et al. (2003), Pivovarova (2009), Albano, et al. (2006).

- **The level of competition in the market.** Collusion is more difficult when there are more competitors. The more firms participate in the competition, the more difficult it is for the cartel to develop a coordinated strategy for overall behavior. In addition, the more member firms, the lower the potential profit of each member.

- **Entry barriers.** The higher the barriers to entry, the greater the incentives to form cartels, since the prospects of further competition growth is lower. Thus, in the work of Stenbacka (1990), in the frame of a dynamic model, the dependence of the probability of collusion on the number and height of barriers to market entry for new firms was formulated.

- **Asymmetry in market shares, costs and production capabilities of companies.** More symmetric market shares facilitate collusion, whereas larger market share asymmetry hinder collusion, at least to the reason that it complicates collusion sustainability due to asymmetric cost-benefit ratio from collusion for different market participants. The same logic underlines the way the cost and production capabilities asymmetries influence the collusive behavior (See for ex. Compte et al., 2002) Questions of the influence of the degree of symmetry in market shares and production capabilities of cartel participants are discussed in the research of Bain (1948), Lambson (1987, 1994, 1996).

- **Frequent interactions and frequent price adjustments** make it easier to collude. When the bidding procedures for the procurement of one-type items are repeated frequently, it is possible for bidders to observe each other's behavior. Thus, the possibility of collusion is facilitated.

- **Market transparency**, which is understood as the availability of information about its functioning (for example, price history, profit information, history of rates or the content of bids). Green, Porter (1984) revealed that the impact of market transparency on incentives to collusion is mixed. Market transparency reduces barriers to entry and makes collusion less profitable. On the other hand, the higher the transparency, the easier it is to "punish" those firms that deviate from the collusive strategy or to enforce the collusion. The availability of information about price fluctuations can reduce the incentive to collusion by signaling firms to price wars. At the same time, even partial disclosure of information facilitates cooperation.

(Abreu et al. 1985, Kuhl, 2001) Thus, the availability of information can both limit the incentives to collusion and enhance them.

- **Demand growth.** As a factor of collusion was discussed in research of Rotenberg, Saloner (1986), Haltiwanger, Harrington (1991), Bagwell, Staiger (1997). For a fixed number of market participants, collusion is easier to maintain in growing markets where firms have larger expectations about future profits, when today's profits are low compared to tomorrow's. Nevertheless demand growth can also be an indicator of the growing market in general, attracting new participants, therefore the perspective of collusion becomes less attractive.
- **Business cycles and demand fluctuations** impede collusive behavior. Rotenberg and Saloner (1986) and then Haltiwanger and Harrington (1991) found that business cycles (especially when seasonal) and associated fluctuations in demand discourage collusion. This is explained by the unprofitable ratio of the benefits of collusion and potential losses associated with deviations from the general strategy for companies in the context of fluctuations.
- **Work on related markets.** Berheim and Winston (1990) described theoretically the behavior of the firms working on related markets. The conclusion they made was that interaction of firms working on related markets favored collusion.
- **Products differentiation.** Generally horizontal differentiation facilitates collusion whereas vertical differentiation hinders the collusion. Notably, vertical differentiation is the more effective in discouraging collusion, the higher it is, and the less opportunity companies have to organize information exchange (Ross, 1992, Reith, 1996)
- **Innovative markets.** Innovation provides company with significant competitive advantage over rivals, and therefore reduces the potential benefits of collusion.

Among the other factors favorable for the collusive behavior and facilitating collusion attractiveness there are: low demand elasticity, low buying power, structural links between companies, cooperative agreements, markets with club or network effects.

Chapter 2. A typology of mala fide behavior in the context of collusion-corruption control

2.1. The basics of agent typology of corrupt behavior

From a great many definitions of corruption, we select the typical one: “The corruption is acts in which public power is used for personal gains in a manner that contravenes the rules of the game” (Jain, 2001, 73).

The above cited author suggests that there are two forms of corruption, each occupying extreme positions on a scale of corrupt activities: ‘Grand corruption’ generally refers to the acts of the political elite by which they exploit their power to make economic policy, and ‘Bureaucratic corruption’ refers to corrupt acts of the appointed bureaucrats in their dealings with either their superiors (political elite) or with the public (Jain, 2001, 73-75; Jain, 2011, 3).

It is the principal-agent model that is most often used as a methodological framework for modelling corrupt behavior: “Pathologies in the agency/principal relation are at the heart of the corrupt transaction” (Rose-Ackerman, 2008, 330).

This model has been developed for describing processes in the private sector and understands the agency relationships as “a contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision-making authority to the agent” (Jensen and Meckling, 1976, 308). Accordingly, the principal faces the task of shaping a system of incentives for the agent, in which agent's preference relation, defined on a corresponding set of alternatives, coincides with (or, in extreme case, equal to) preferences of the principal.

In turn, the starting point for modeling public sector processes is the assumption that to meet public needs the political elite (principal) delegates some decision-making authority to government agencies or other public entities or, other words, to appointed bureaucrats (agents). However, in contrast to the private sector, the applying of the principal-agent model in the public sector has its own specifics related to the fact that in a democracy the political elite, in turn, is an agent, who elected by the populace for the achievement of social objectives. Thus, the ideal preferences in this case are not the preferences of political elite but society’s preferences, and we have some reasons to denote the society as a basic principal. Hence, there are three *dramatis personae* in the model, and the principal can be mala fide like the agent.

In the paper the correspondence of the preferences of the principal and the agent to the basic principal’s preferences lays in the base of suggested typology of Corruption Models. Let us consider some set of alternatives Ω , fix alternatives x and y from this set, and assume that for

basic principal (principal, agent) alternatives x is strictly better than y or indifferent to it: $x \succeq_{BP} y$ ($x \succeq_P y, x \succeq_A y$). The set of pair x and y ($x, y \in \Omega$), for which basic principal consider $x \succeq_{BP} y$ we will call the preference relation (or preferences) of basic principal, defined on the set Ω , and denote it as \succeq_{BP} . The preferences of the principal and the agent (\succeq_P and \succeq_A) are introduced the same way.

Assume that on the same set of alternatives the preferences of the basic principal, the principal, and the agent are defined.

Definition 1. We call that the principal (agent) is *mala fide* if its preference order is different from the basic principal's preference order: $\succeq_P \neq \succeq_{BP}$ ($\succeq_A \neq \succeq_{BP}$), and *bona fide* if otherwise.

If we construct the Typology of Models of Corrupt behavior or Corruption Models on the base of the *Def. 1*, we will find that theoretically four models can be created depending on the combination of the *bona/mala fides* of principal and agent.

Table 2.1. The Typology of Agency Models of Corruption

Models (#)	1	2	3	4
Actors				
Principal	Bona Fide $\succeq_P = \succeq_{BP}$	Bona Fide $\succeq_P = \succeq_{BP}$	Mala Fide $\succeq_P \neq \succeq_{BP}$	Mala Fide $\succeq_P \neq \succeq_{BP}$
Agent	Bona Fide $\succeq_A = \succeq_{BP}$	Mala Fide $\succeq_A \neq \succeq_{BP}$	Bona Fide $\succeq_A = \succeq_{BP}$	Mala Fide $\succeq_A \neq \succeq_{BP}$

Let us confine the consideration to the public procurement issues. We will designate policy-makers, legislators and other people and bodies, who are responsible for the public procurement regulation development and enforcement, as a principal, and contracting authorities (or public buyers), who are acting in the framework of given regulation rules, as an agent.

If the accumulated legal practice does not give us reasons to consider agents as *mala fide*, we obtain the model #1 that is trivial in terms of the agency relationships ($\succeq_P \equiv \succeq_A \equiv \succeq_{BP}$). Let us call this model the conflict-free one: agent has the opportunity to choose and is prone to selection of the optimal alternative for the society.

In the pioneering research, based on the assumptions of principal's *bona fides* and agent's *mala fides*, Rose-Ackerman examined the situation in which a private person attempts to corrupt

a bureaucrat in order to obtain a government contract (Rose-Ackerman, 1975, 187). In this model and the the models that adopt the same assumptions ($\gamma_P = \gamma_{BP}$, $\gamma_A \neq \gamma_{BP}$) we can identify Bureaucratic corruption ones (Jain, 2011, 3).

Let us consider the third model from the Table 2.1, which is based on the assumptions of principal's *mala fides* and agent's *bona fides* ($\gamma_P \neq \gamma_{BP}$, $\gamma_A \equiv \gamma_{BP}$).

Definition 2. *Bona fide* agent's actions violating the rules of regulation created by the *mala fide* principal will be called quasi-corrupt behavior. The model, which examines *bona fide* agent's behavior in institutional conditions created by *mala fide* principal, will be called quasi-corruption model.

The question is how it is possible to identify fact of quasi-corrupt behavior. Actually, the quasi-corruption model was constructed on the survey of Russian public procurement in 2011 (Ivanov, 2016).

In the Russian Federation in 2011 the open out-cry auctions were replaced completely with ERA for all types of public procurement bodies. The government was convinced that applying e-auctions would help suppliers to become involved in the procurement process, to ensure reducing corruption, and to hinder the possibility of collusion by suppliers, which would subsequently lead to improved competition in auctions and increase the size of price reductions.

However, the reaction of the system was unpredictable: the competition in auctions had significantly decreased and, moreover, according to the data of the Federal Antimonopoly Service at least 60% of e-auctions in that period did not take place due to the receiving of one bid only.

Thus, the sharp decline in competition in auctions and the significant number of failed auctions cannot be explained by anything other than unscrupulous actions by public buyers restricting competition in favor of a pre-selected "favorite."

At the same time, the different surveys, including the BEEPS survey showed that the level of corruption in Russian Federation, in total, and in public procurement, in particular, was significantly lower (Ivanov, 2016, 115). One possible hypothesis for explaining identified inconsistencies involves assuming the existence of "quasi-corrupt" behavior of the contracting authority. In this hypothesis, competition may be restricted by both, the *mala fide* and *bona fide* public buyer, to avoid of attributive auction risks (ibid., 128). The first seeks to obtain bribes (model #4 in Table 2.1); the second tries to obtain effectiveness in public procurement (quasi-corruption).

If we reject the assumption of principal's *bona fides*, assume him *mala fide* ($\gamma_P \neq \gamma_{BP}$) and consider agent's *mala fides* ($\gamma_A \neq \gamma_{BP}$), then, depending on whether the agent is prone to break the existing regulation ($\gamma_A \neq \gamma_P$) or not ($\gamma_A \equiv \gamma_P$), we must distinguish between two types of models.

In the 'queue model' and the 'auction model' (Aidt, 2003, F634) corrupt bureaucrats try to correct pre-existing government failures. In these models agent's actions violate accepted rules of regulation that allows us to identify differences in preferences of the principal and agent ($\gamma_A \neq \gamma_P$) and, correspondingly, the agency problem existence.

The models of this type, based on assumptions of *mala fides* of both: a principal and an agent, form the class of 'efficient corruption' models ($\gamma_P \neq \gamma_{BP}$, $\gamma_A \neq \gamma_{BP}$, $\gamma_A \neq \gamma_P$) (Ibid, F633).

Nevertheless, the principal can create a system of incentives for the agent, which prevents him from any actions in opposition to existing regulation. This model ($\gamma_P \neq \gamma_{BP}$, $\gamma_A \equiv \gamma_P$) we suggest calling a model of totalitarian corruption.

In the case of a totalitarian corruption, the modeling is aimed at the identifying of what underlies the ineffective regulation: grand corruption (Jain, 2001, 73-74) or bounded rationality (Simon, 1947, xxiv), which can stem from some specific features of country's institutional environment.

Thus, the Typology of Agency Models of Corruption looks like follow.

Table 2.2. The Typology of Agency Models of Corruption

Models	Corruption-free	Bureaucratic corruption	Quasi-Corruption	Efficient Corruption	Totalitarian Corruption
Actors					
Принципал	BF $\gamma_P = \gamma_{BP}$	BF $\gamma_P = \gamma_{BP}$	MF $\gamma_P \neq \gamma_{BP}$	MF $\gamma_P \neq \gamma_{BP}$	MF $\gamma_P \neq \gamma_{BP}$
Агент	BF $\gamma_A = \gamma_{BP}$	MF $\gamma_A \neq \gamma_{BP}$	BF $\gamma_A = \gamma_{BP}$	MF $\gamma_A \neq \gamma_{BP}$ ($\gamma_A \neq \gamma_P$)	MF $\gamma_A \neq \gamma_{BP}$ ($\gamma_A = \gamma_P$)

Source: on the base of (Ivanov, 2016, 118).

2.2. The typology of mala fide buyer-suppliers interaction and respective research questions

There is an extensive literature that examines corruption and collusion issues in the public procurement. Some of the papers start off with the fact that “collusion and corruption often go hand-in-hand in public procurement” (Lambert-Mogiliansky, Sonin, 2006, 884). Therefore, there is a need for structuring of different approaches to corruption and collusion modelling, as well as their interaction.

In the previous subsection have been presented five different agency models of corruption. The corresponding typology was constructed on the different assumptions of bona/mala fides of the principal and agent (public entity). Against it, the collusion issues are connected with the interactions of buyer (public entity) and suppliers.

Thus, the first research question arises: *How to describe all the forms of buyer-suppliers interaction based on their bona/mala fides?*

The definition of buyer’s mala fides was given at previous subsection. Now, we move on definition of suppliers’ mala fides.

According to (Albano et al., 2006, 348), there are two main forms of collusion:

- 1) price-fixing or “bid-rigging”, whereby colluding firms select the winning bidder and the winning bid. All other cartel members are instructed to bid higher prices or less favorable conditions (“phoney bids”);
- 2) market-sharing agreements, whereby contracting authorities are divided according to some relevant characteristics (e.g., location) and assigned to a predetermined winning bidder.

Thus, we can identify six different forms of buyer-suppliers interaction depending on combination the assumptions of their mala fides.

Table 2.3. Different forms of mala fide buyer-suppliers interactions

Suppliers		Buyer	Mala fide	Bona fide
			A	B
Mala fide	Bid-rigging	1	A1	B1
	Market-sharing agreements	2	A2	B2
Bona fide	No collusion	3	A3	B3

A1. The buyer-suppliers interaction in the cell A1 implies two possible scenarios. According to the first one, both sides of procurement coordinate their activity in the form of so-called ‘bid orchestration’ – public buyer serves as a ‘ring manager’ of a collusive cartel among the bidders who coordinates bids *before* they are submitted (Lengwiler, Wolfstetter, 2006, 417). This type of coordination is typical for scoring and first price sealed-bid⁶ auctions (requests for quotation) (Berezinets, Ivanov, 2019, 724).

The second scenario (the absence of a buyer’s bidding ring coordination) is hardly possible in the Russian institutional environment, since in the post-contracting period the public buyer, as a rule, has different ways to increase of the supplier’s transaction costs. At the same time, any cartel must solve a series of problems including agreeing on how to share the spoils, securing enforcement, and deterring entry (McAfee, McMillan, 1992, 579), and a corrupt buyer can contribute to solving some of them.

Thus, if the assumptions defining the A1 model are fulfilled, the purpose of the study can be formulated as the development of measures to impede the interaction of the buyer and suppliers at the pre-contract stage.

B1. The buyer-suppliers interaction in the cell B1 implies that a bona fide public buyer stands against bidding ring. The measures that are available to the buyer to control collusion are usually divided into the proactive and the reactive ones. Respectively, the following two research questions can be formulated:

- How to develop an auction design to decrease incentives for its participants to collude?
- How to use the information on the results of procurement to empirically estimate the probability of bid-rigging in the auction?

Regarding first question, in subsection 4.1 a game-theoretic model which takes account of the specifics of the Russian auction regulation is constructed and applied.

As to the second one, two approaches have been considered. First, we used game-theoretic modeling to identify the necessary conditions of collusion in the case of small decrease of the price in the auction (not more than 1%). Second, the modeling results and the data of the Russian Federal Antimonopoly Service (FAS) are used to develop a logit-model to empirically estimate the probability of bid-rigging in the auction.

A2. The model A2 assumptions are examined in the (Lambert-Mogiliansky, Sonin, 2006). As to the approach, presented in Table 2.1, in this case a corrupt buyer interacts with a single

⁶ In our time ‘sealed-bid’ means submitting the only unchangeable bid, may be, in the electronic form.

supplier. Like model A1, the latter has a demand on buyer's assistance in the deterring entry, before all.

As a pro-active tool to prevent mala fide behavior in the considered model, we can use the Model Law propositions connected with the secure of efficient competition in the tender (for example, the justification of procurement method selection) or European Public Procurement Directives recommendation to have definite minimal number suppliers in the tender.

In turn, the Monitor and other enforcement authorities can analyze the results of repeated tenders or buyer's procurement from definite supplier to discover their mala fide interaction.

B2. The buyer-suppliers interaction in cell B2 implies that a bona fide public buyer stands against a bidding ring representative. The latter is going to increase the contact price and, likely, decrease the costs of contract performing. In this situation, the buyer must use opportunities to raise competition in the tender. It can be done by means of attracting affiliated bidders (quasi-corruption) or opening procurement to foreign suppliers.

On the other hand, the Model Law leaves a wide discretion to the bona fide public entities in their control of collusion, for example, a procuring entity may cancel the procurement for reasons of public interest, such as where there appears to have been a lack of competition or to have been collusion in the procurement proceedings (Guide, 2014, 105).

C1. The buyer-suppliers interaction in the cell C1 is a pure corruption case. Depends on what type of corruption takes place, bureaucratic, efficient or totalitarian (Table 2.2), there are different recommendations to the Principal, how the corruption risks can be neutralized (Ivanov, 2016), (Berezinets, Ivanov, 2019).

C2. Model C2 is included into Table 2.3 due to classification approach only. The model is not connected with the examining of corrupt and collusion issues.

Chapter 3. Counteracting collusion and corruption in public procurement of the Russian Federation

3.1. Policy and regulation in the field of public procurement of the Russian Federation. The peculiarities of procurement in the healthcare sector

Since 1991, the Russian market reforms had created such political and economic conditions, in which the tools of New Public Management (hereafter: NPM), aimed at improving efficiency and quality of services provided in the public sector (Gruening, 2001, p. 2), had become in demand. In particular, great efforts have been directed at the restoration of institutions, which were not used in the Soviet time: public procurement and public-private partnership.

The introduction of NPM tools occurred in the context of intense economic reforms and was objectively accompanied by growth of corruption (Huntington, 1968, 59). Since the Regulator had consistently sought to increase the transparency of public procurement system, many corruption cases were reflected in the media, creating a constant pressure on the Government. Given these conditions, in the Russian Federation (hereafter: RF) a modern public procurement policy has been formed. The Policy is mainly aimed at the restriction of contracting authorities' discretionary power, preventing them from rent-seeking behavior, and the strengthening of institutions or, other words, is aimed at preventing three necessary conditions for corrupt behavior (Aidt, 2003, F633).

According the policy, the Federal Law No. 94-FZ "On State and Municipal Procurement of Goods, Works and Services" had been developed and came into force from 2006. The Law as well as the next Russian public procurement Law – the Federal Law No. 44-FZ “On the contract system in the procurement of goods, works and services for state and municipal needs” (hereafter: Federal Law #44-FL or PPL), which came into force from 2014, was aimed at counteracting to all above named opportunities for corruption.

Below, we consider the content and consequences of such policy regarding the selection mechanism of procurement method in the RF. The Principal has introduced following regulation tools:

- excluding of negotiation procedures,
- selecting the price ERA as the main procurement method,
- establishing extremely low price thresholds what demands to apply open tenders (ERA or sealed-bid scoring auction) for awarding relatively small contracts,
- forming closed (but continuously growing) list of reasons for single-source procurement,
- applying of request for quotations for small contracts only.

The ERA applying is based on the broad Auction List consisting of homogeneous (paper, cleaning, ...) and differentiated (cars, engines, ...) goods, services and works, for purchasing of which it is impossible to award contract by the criterion of the most economically advantageous offer, and in these cases, buyers must apply ERA.

In contrast to an international experience (Model Law, 2-d; Directive 2014/24/EU, 35-1), the Russian auctions have a single criterion, the price.

The legislative tools have been complemented by the enforcement policy according that Enforcement authorities (Public Procurement Monitor – Antitrust Service, Office of Prosecutor, Industry Public authorities, etc.) control, before all, single-source procurement, requests for quotations and sealed-bid scoring auctions.

Thus, the set of formally affordable procurement methods is divided into, so to speak, “honest” method (ERA) and “suspicious” methods (the others). This approach is symbolically reflected at the Fig. 2, where methods not used in the RF are crossed out, and suspicious ones are in italics. Besides this, Fig. 2, contents the information on the fraction of corresponding method in the total number of procedures and total money value of Russian public procurement in 2018 according the data of Ministry of Finance⁷ (pp. 20-21).

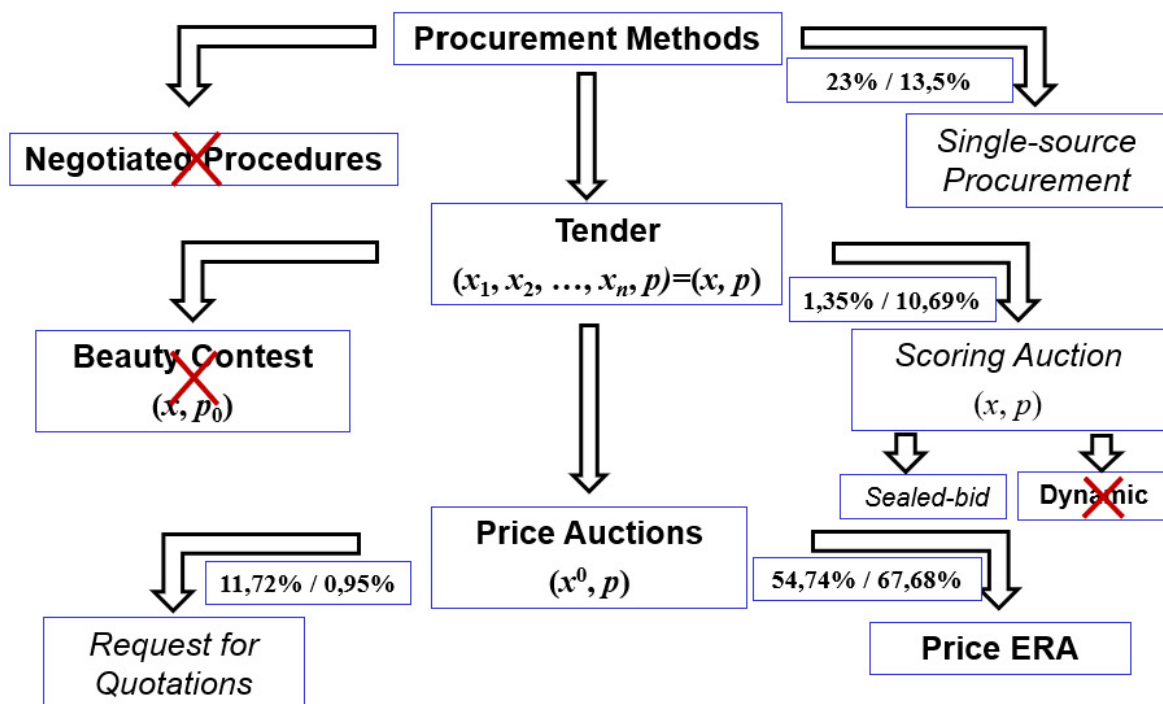


Fig. 2. Procurement Methods in RF: honest and suspicious

In the healthcare procurement the auction weight is much higher than in the other industries (Fig. 2), since medicines, consumables and the most part of medical equipment are

⁷ <https://www.minfin.ru/ru/performance/contracts/purchases/>.

included in the Auction List. There have been cases where all hospital procurement had been performed by means the auctions⁸.

3.2. FAS activities to counteract restrictions on competition in public procurement

In the Russian Federation, the Federal Antitrust Service is an authorized federal executive body that performs control and supervisory functions in the sphere of the procurement for state and municipal needs.⁹

Within the Federal Law #44-FL, FAS has broad powers to ensure fair competition at tenders and reduce the risk of collusion between participants in the procurement process. Control in the sphere of public procurement is carried out in two main directions: 1) controlling the procedure for placing a state (municipal) order, 2) controlling the compliance with the antimonopoly legislation in the procurement process.

Control of the procedure for placing an order involves control under the activities of procurement authorities in the organization of the procurement process. As a part of its functions, FAS considers complaints from procurement participants about the illegal actions that restrict competition at auctions.

According to the PPL, such illegal actions may include violation of the terms and procedure for conducting purchases, incorrect description of the purchased object, establishment of requirements that restrict the participation, subjective evaluation of applications, and other unfair actions. As results of complaints' consideration FAS issues the instruction to the procurement authorities on amendments in the tender documents, extends timing of the procurement and timing of the contract execution and also applies to the court to cancel the results of the procurement due to criminally punishable violations in the procurement process (PPL, art. 99). In that way, by performing the control function in the public order placement, FAS directly counter vertical collusion at auctions between the customer and the supplier, when the procurement authorities deliberately adjust the purchase to a specific participant.

Controlling the compliance with antitrust requirements in the sphere of procurement includes measures to counter horizontal collusion between procurement participants – to counter the actions of cartels. The antitrust requirements are disclosed in the Federal Law "On protection of competition" dated 26.07.2006 N135 (hereafter: competition law). The grounds for antitrust control actions are signs of unfair suppliers' behavior that restricts competition at tenders. In order to detect collusions and counter them, the combination of various traditional and modern

⁸ For example, the procurement of Omsk Clinical Emergency Hospital No. 1 in 2019.

⁹ Resolution of the Government of the Russian Federation "Questions of the Federal Antimonopoly service" dated 07.04.2004 N 189 (ed. of 28.01.2011).

digital methods to obtain information about possible agreements is used by FAS. The general algorithm for investigation of the coordinated actions might be presented in the following way.

Step 1. Consideration of complaints about violations of the law

Materials received from law enforcement agencies, other state bodies, public associations, as well as appealed from individuals and media reports indicating signs of violation of the antitrust legislation may serve as grounds for launching an investigation. After receiving a complaint, it is reviewed by FAS employees for content compliance with FAS competences, completeness of the information provided in the application, and the presence of the law-breaking signs in the submitted materials¹⁰.

Step 2. Confirmation of the grounds for initiating an antitrust violation case

At this stage, the signs of the anti-competitive agreements are identified by FAS, which actions include searching for possible relationships between the companies both in their current activities and their actions at auctions. In order to confirm the existence of the supplier collusion, FAS forms requests for information to law enforcement agencies and other public authorities and analyzes open data on possible colluding companies such as website, email, actual and legal addresses, phone numbers, etc.

Scheduled and unscheduled inspections of organizations are significant steps to investigate antimonopoly violations. Scheduled inspections are carried out once every 3 years according to an open schedule, but if the case relates to cartel offenses, the company being checked is not notified, and the inspection is organized in the sudden way (PPL, art. 99).

Step 3. Initiation and consideration of the case

The Case Review Commission evaluates all the collected materials, evidences and explanations of experts, and then makes a decision for the respondent companies (including the amount of fines to be paid)¹¹. If violations with signs of criminally punishable anti-competitive agreements are detected, the FAS sends the case materials to the Investigative Committee of Russia.

Accordingly, based on the results of the offense investigation, FAS is competent to:

- Review the case and take measures to prevent the offense;
- Issue a mandatory instruction to eliminate the violation, cancel the procedure;

¹⁰ Order of the Russian Federal Antimonopoly Service "About approval of administrative regulations of Federal Antimonopoly service on execution of state function on initiation and consideration of cases on violations of Antimonopoly legislation of the Russian Federation" dated 25.05.2012 N 339.

¹¹ Order of the Russian Federal Antimonopoly Service "About approval of administrative regulations of Federal Antimonopoly service on execution of state function on initiation and consideration of cases on violations of Antimonopoly legislation of the Russian Federation" dated 25.05.2012 N 339.

- Apply to the arbitration court with the claim about criminally punishable anti-competitive agreements.

Chapter 4. Model B1 examining: a bona fide public buyer against bid rigging

4.1. Collusion participation conditions in the Russian variant of English auction. Identification of a set of tools to reduce the attractiveness of collusion.

The electronic reverse auction is applied in the RF as the main procurement method. From the theoretical point of view, ERA is an English auction, and, like the Vickrey auction, let to identify price reservation of the next to winner supplier. Such auctions are called second-price auctions in contrast to Dutch auction and first-price sealed bid auction (request for quotation) that are called first-price ones.

When public entity procures something from the special Auction List it must do it by means ERA. Since in Health Care the medicines, durables and most of medical techniques are included into the Auction List, ERA is about the single procurement method.

The algorithm of the ERA is following.

- The suppliers submit their bids at one of Electronic Trade Platforms (ETP), which are authorized to perform the tenders. Each bid is divided into two parts. First one contains information about supplied goods, second one – about supplier itself.
- The ETP sends the first part of bit to the public buyer, and the latter admits supplier to take part in the auction or does not admit.
- The ETP run auction among selected suppliers during which they consistently reduce price within the step beginning from the initial contract price (ICP) P_0 , which is announce by the public entity in the solicitation to the auction. The auction step is not less than 0.5% of P_0 but not more than 5% of it.
- When during 10 minutes after the price drop last time there no new bids the auction is stopped the price is fixed, and ETP send second part of the last bidder (and some others) to the public buyer, and the latter awards the contract to him or rejects bid and move of considering the second part of next but one bidder.

Let us consider the bona fide public entity that procures a single item by means the ERA (model B1).

Assume that there are n bidders B_1, B_2, \dots, B_n with economic costs of delivering item:

$$c_1 < c_2 < \dots < c_n \leq P_0;$$

all of them have joined in the bidding ring, $c(n)$ – coordination costs¹²,

B_1 – appointed winner, P^* ($P^* \leq P_0$) – winner's price;

α_i – BR members' surpluses ($\alpha_1 > \alpha_i, i > 1$):

$$\alpha_1 = P^* - c(n) - \sum_{i=2}^n \alpha_i - c_1;$$

p – probability of bid-rigging disclosure, g_i – fines of BR members;

B_i are the risk-neutral bidders;

there is no private market for supplied goods.

Let us assume that collusive plan has been successful, and contract goes to the appointed winner at price P^* . There are two scenarios: the collusion will be disclosed or not. Let F_i stands for payoff of i^{th} supplier ($i=1, 2, \dots, n$).

Then the winner's payoff distribution is

$$\frac{F_1}{P} \left| \begin{array}{c|c} \alpha_1 & -g_1 - c(n) \\ \hline 1-p & p \end{array} \right. \quad (4.1)$$

Thus, the winner expected payoff is

$$\alpha_1(1-p) - [g_1 + c(n)]p,$$

and participation condition looks as follow:

$$\alpha_1 \geq [g_1 + c(n)] \times \frac{p}{1-p}. \quad (4.2)$$

The participation conditions for the other bidding ring members can be obtain the same way:

$$\alpha_i \geq [g_i + c(n)] \times \frac{p}{1-p}. \quad (4.3)$$

Thus, we have identified the variables that to be influenced by Principal and/or public buyer to decrease incentives to collude:

p – probability of bidding ring disclosure,

g_i – fines of bidding ring members,

$c(n)$ – coordination costs,

P^* – contract price.

¹² Appointed winner expenses to organize and support bidding ring.

Measures to decrease incentives to collude

1. How to increase the probability of disclosure

The probability of disclosure is essentially depended on the quality of re-active methods of collusion disclosure. There is lot of methods to do it (subsection 1.2.2). In addition, in the next subsection we will consider some methods to prove the fact of collusion in the English auction with a slight price reduction.

On the other hand, following the Model Law propositions (Guide, 2014, 105), it is reasonable to give a procuring entity the right to cancel the procurement for reasons of public interest, such as where there appears to have been a lack of competition or to have been collusion in the procurement proceedings. If we will denote as p_b the probability of procurement cancellation by the buyer, and assume p as probability of collusion disclosure by FAS or other enforcement authorities, then the payoff distribution of appointed winner will change following way:

$$\frac{F_i}{P} \left| \begin{array}{c|c|c|c} a_i & -g_i - c(n) & -c(n) & \\ \hline 1 - p - p_b & p & p_b & \end{array} \right. \quad 4.4$$

Thus, the winner's expected payoff will be decreased.

2. How to increase coordination costs

According to the many papers [Robinson, 1985; Albano et al.; Kovacic et al., 2006; Marshall and Marx, 2007; etc.], from the point of view of collusion counteraction the first-price auctions (Dutch auction or request for quotations) are more preferable than second-price ones due to higher incentives to quit bidding ring (the consideration will be added).

In Russian public procurement legislation, the applying of request for quotation is restricted to the small contracts (price threshold is equal to 500 000 rubs.) and total quantity (quantity threshold is established as 10% of public entity's annual procurement). From our point of view, the price threshold can be enlarged whilst the quantity threshold can be removed on condition of providing procurement method selection justification (Model Law, art. 28).

3. How to decrease the contract price

On the other hand, following the Model Law propositions (Guide, 2014, 69), the procuring entity should have the discretion to decide on a case-by-case basis on whether the Information on possible forthcoming procurement should be published. The public entity can escape

transparency of the initial contract price P_0 that is inevitable decrease the agreed winner's price P^* and, at the same time, increase the coordination costs $c(n)$.

4.2. The necessary conditions for collusion in the English auction with a slight price reduction

From the FAS practice in 2016-2017, we selected 121 Proven Collusion Cases that are characterized by following distribution of price decrease (Table 4.1).

Table 4.1. The distribution of the price decrease in the Proven Collusion Cases (2016-2017)

Price Decrease (in % of ICP)	Number of Proven Collusion Cases
0.50%	16
1%	83
1.50%	8
1.5 - 5%	10
5 - 10%	2
10 - 20%	2
Grand Total	121

Thus, in the most of collusive cases (about 90%) the price reduction was very slight (not more than 1.5% of ICP). In the next subsections we successively examining the problem of collusion disclose when price decrease is equal to 0.5, 1, and 1.5 per cent of ICP.

4.2.1. The case of contract price that is equal to 99.5% of initial contract price.

Theorem. If the auction final price is $0.995P_0$, and winner did not submit a bid at the beginning of auction, there is a bidding ring.

If the auction final price is $0.995P_0$, then the price in the auction was decreased only one time at 0.5% of ICP.

Let's assume that:

there are two bidders (Winner and Looser),

there is no bidding ring (bona fide bidders),

bidders price reservations (PR_w, PR_L) are discrete (here and below, we omit the percent sign):

$$0.5k \text{ (} k=1, 2, \dots, n \text{), } n \leq 50^{13}.$$

¹³ There is no dumping in the model.

Thus, the Loser has not submitted the bid, therefore, $PR_L = 0.5$.

Let's T is binary and stands for the time of bid submitting: 1, if 10 c or more after the auction started, otherwise – 0.

Thus, bidders' strategies: $X_L = (0.5, T_L)$, $X_w = (PR_w, T_w)$,

vector of strategies: $X = (0.5, T_L; PR_w, T_w)$.

The Loser assumes that PR_w and T_w are distributed the following ways with unknown to him parameters:

$$\frac{PR_w}{p} \begin{array}{c|c|c|c|c} 0.5 & 1 & \dots & 25 & \\ \hline p_1 & p_2 & \dots & p_{50} & \end{array}; \quad \frac{T_w}{p} \begin{array}{c|c|c} 0 & 1 & \\ \hline \alpha & \beta & \end{array}$$

Let's c is the Loser's net income from performing contract. Below, we will calculate Loser's pay-off functions for his different strategies.

If $T_L=0$, then

$$\pi_L(0.5, 0; PR_w, T_w) = 0 \times P(PR_w > 0.5) + c \times P(PR_w = 0.5) = c \times P(PR_w = 0.5) = cp_1$$

If $T_L=1$, then

$$\pi_L(0.5, 1; PR_w, T_w) = 0 \times P(T_w = 0) + c \times P(PR_w = 0.5) \times P(T_w = 1 / PR_w = 0.5) < cp_1\beta$$

Thus, for any Winner's strategy:

$$\pi_L(0.5, 1; PR_w, T_w) < \pi_L(0.5, 0; PR_w, T_w)$$

If $T_w = 1$ (winner did not submit a bid at the beginning of auction) then $T_L \neq 0$, and the assumption of Loser's bona fides is not correct. **QED**.

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