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Faculty of Social Sciences
Institute of Economic Studies

MASTER THESIS

Detection of bid rigging - theoretical and empirical analysis

Author: **Bc. Jana Marečková**

Supervisor: **PhDr. Ing. Jiří Skuhrovec**

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Declaration of Authorship

The author hereby declares that she compiled this thesis independently, using only the listed resources and literature.

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Prague, May 17, 2013

Signature

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Abstract

This thesis is a case study examining Czech public procurement in medical machinery industry. It proposes and applies several practical methods for identifying risk of bid rigging, such as: frequency analysis of participation of the same small groups of firms, analyzing ownership structure of participating firms and frequency analysis of systematically excluded bids of firms. Results include presence of cases of the same small groups of firms which bid more frequently together with no other competitors. Main contribution of the work lays in outlining some analytical possibilities for practical detection of bid rigging risk.

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Keywords	public procurement, bid rigging, Czech Republic, medical machinery

Author's e-mail	janamar@atlas.cz
Supervisor's e-mail	jskuhrovec@gmail.com

Abstrakt

Tato práce je případovou studií zkoumající veřejné zakázky z oblasti medicínského vybavení. Práce navrhuje a aplikuje následující praktické metody pro odhalení rizika bid riggingu: frekvenční analýza účasti stejné malé skupiny firem, analýzu vlastnické strukury firem a frekvenční analýzu počtu vyřazených nabídek. Analýza odhalila případy skupin malých firem, které spolu často soutěží v omezené konkurenci. Hlavním přínosem práce je nastínění vybraných analytických postupů použitelných v praxi pro odhalení rizika bid riggingu.

Klasifikace JEL	H57, H75, K42
Klíčová slova	veřejné zakázky, bid rigging, Česká republika, medicinské vybavení

E-mail autora	janamar@atlas.cz
E-mail vedoucího práce	jskuhrovec@gmail.com

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Acronyms

CPV Common procurement vocabulary

GDP Gross domestic product

PP Public procurement(s)

Master Thesis Proposal

Author	Bc. Jana Marečková
Supervisor	PhDr. Ing. Jiří Skuhrovec
Proposed topic	Detection of bid rigging - theoretical and empirical analysis

Topic characteristics In many developed countries there is an obligation to submit procurement contracts via public auctions. Competition in these auctions should lead to efficient outcome in a sense of getting the highest quality for a reasonable price. However, in practice of public procurement auctions we may encounter cases of bid rigging in which firms secretly collude to increase prices or lower the quality of products or services. This form of secret collusion represents a serious problem of wasting public resources. In the Czech Republic is spent approximately 13 – 16 % of GDP on procurement every year, i.e. hundreds of billions CZK (Source: MMR ČR).

In my thesis I want to analyze Czech procurement auction data from various sectors and test the possibility of presence of bid rigging. There are several ways introduced in methodology section below.

Data sources:

- internal data from Centrum aplikované ekonomie
- http://www.isvzus.cz (contains Czech data)
- http://www.vsechnyzakazky.cz (contains Czech data)
- http://tender.sme.sk/en/ (contains Slovak data, this source is mentioned for possible comparisons with Czech auction results)
- own search on websites of various institutions

Hypotheses

1. Hypothesis #1: Higher number of bidders will cause that the ratio of winning bid and expected price will be decreasing and/or bidders will bid more aggressively.

2. Hypothesis #2: Closed form of procurement will have a negative effect on the winning bid.

3. Hypothesis #3: Procurement auctions with qualitative criteria (i.e. the lowest price is not the only criterion) will attract less bidders.

Methodology Main variables contained in data sets are the winning firm, number of bidders, type of procurement auction, expected price and only the winning bid. The main difference between data from the Czech Republic and data from other countries is that Czech data does not contain losing bids.

One way of testing presence of bid rigging which we can find in the non-Czech literature is based on comparing a distribution of bids from competitive model with actual data (Bajari & Ye, 2003). This approach cannot be used for the Czech data because they do not contain losing bids as it is mentioned above.

Another approach in the non-Czech literature is to find the differences in bidding behavior between cartel firms (which were convicted of bid rigging by court) and non-cartel firms based on the regression analysis (Pesendorfer, 2000). I cannot use this approach either because of very low number of procurement legal cases in the Czech Republic.

In the Czech literature we can find analysis of winning/expected price ratio and analysis of number of bidders (Pavel, 2010). Author tested the same hypothesis as hypothesis #1 and #2. However, his article was aimed only on the procurement in infrastructure.

The main contribution of this thesis is to suggest independent indicators for detecting bid rigging which will be useful for the Czech data in various industries. These indicators will be applied on foreign data (which include losing bids) whether they will lead to the same results as the approaches from non-Czech literature.

The following indicators are suggested:

- looking at a change of the Herfindahl index after entrance of a new bid-

der / high and stable Herfindahl index may indicate collusion scheme / negatively correlated market shares in time,

- downward shock of actual winning bid and expected price ratio with adjustment of possible market shocks,
- cross-sectional comparison of main characteristics of similar procurement auctions.

Outline The expected structure of my thesis:

1. Introduction
2. Theoretical Analysis
   - 2.1 Literature Review
   - 2.2 Characteristics of Procurement System (including legislation)
   - 2.3 Methodology of Applied Tests
3. Empirical Analysis
   - 3.1 Data Description
   - 3.2 Results
4. Conclusion

Core bibliography

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Author Supervisor

Disclaimer

Bid rigging is an illegal practice in the Czech Republic. To avoid potential formation of wrong allegations against the analyzed firms, all the real names of firms were changed to fictitious ones with exception of the list of all firms which won at least one public procurement in medical medical machinery in Appendix A.2. The reason is that the indicators of bid rigging risk proposed by the thesis cannot prove the bid rigging deal for sure, they are used only for general conclusions. If the fictitious names tally with existing firms it is a coincidence. For purposes of checking the results or for further research analysis I am willing to provide the original dataset and the coding table on demand.

Chapter 1

Introduction

This thesis analyzes problem of detection of bid rigging in public procurement. The goal of this study is to propose and apply practical methods for detection of potential bid rigging cases. Using the proposed methods, an empirical analysis of Czech public procurement in medical machinery industry will be deduced. Based on results of this empirical analysis, thesis aims to provide recommendations how to alter legal regulation of the procedure of evaluating bids' advantageousness.

Bid rigging in public procurement is a serious issue which increases inefficiency of public spending. Bid rigging is a secret collusion of firms leading to higher prices and/or low quality of demanded goods or services (OECD (2009)). The purpose is to gain excessive profit at the expense of a purchaser. The purchaser in this case is a public institution. Bid rigging therefore causes an economic harm to public finances which are spent inefficiently. To avoid potential huge losses caused by bid rigging, a good controlling and sanction mechanism is necessary. More revealed cases of bid rigging followed by a strong punishment make bid rigging less attractive.

The basic motivation of firms to make profit combined with some aspects of the public procurement creates incentive for bid rigging. One of the advantages of public procurements in comparison to private sector is a certainty that firms get a payment for the delivered goods and provided services. This certainty in combination with aspects such as frequent participation in public procurements within the same small group of firms creates an incentive to make a collusive deal and increase prices to get higher profit which is then divided between firms.

In the Czech Republic is spent approximately 13 – 16 % of GDP on public

procurement every year, i.e. hundreds of billions CZK (MMR ČR (2012)) and public procurement market in the Czech Republic is the second biggest in Europe relative to GDP (OECD (2011)). The prevention from bid rigging is therefore important. Moreover, the recent financial crisis caused a decrease of resources in public sector and efficiency of public spending became an important issue. Studies of indicators of bid rigging help to detect potential bid rigging cases and to derive protective measurements.

The important role in public procurement plays legal framework. Everything regarding public procurement is regulated by Act no. 137/2006 Coll. on Public Contracts that implements the Directive 2004/18/EC on the coordination of procedures for the award of public contracts. It means that the legal regulation is similar in all of the Member States, which makes the results of the thesis europe-wide applicable.

The main principles of the Act are transparency, efficiency and non-discrimination. The recent novelization valid from April 1, 2012 strengthened mainly the transparency aspect. On the other hand, the Act allows to go in some exceptions against these principles.

Regarding transparency, all basic information about all Czech large tenders are published at the informational portal `www.isvzus.cz` in a standardized form. Even though it contains errors, it provides useful information about public procurement. However, supplemental information about public procurement needed for the analysis are decentralized and unstandardized. This makes gathering all the information into one place demanding.

The objective of this thesis is to analyze Czech public procurement data in medical machinery industry. At first, it is checked whether the environment supports bid rigging. Then, frequency analysis is used to find particular cases of potential bid rigging. Parallel to frequency analysis is analyzed effect of institutional change (novelization and increased public pressure) on behavior of firms. Based on this analysis are offered recommendations for improvement of situation and for better protection of public institutions from bid rigging.

The thesis is structured into the following chapters. Chapter 2 is divided into sections which cover: a theoretical introduction into bid rigging, review of the main research articles and documents, important definitions and characteristics for the Czech environment, summary of important databases and sources of information and overview of important factors which may help to detect bid rigging. Chapter 3 is devoted to the empirical analysis. It begins with an overview of basic indicators of Czech public procurements and then it

moves to description of the dataset and gathering data. Next section contains results of the analysis of public procurement in medical machinery. Chapter 4 summarizes the main findings and recommendations for improvement of the current situation.

Chapter 2

Theoretical analysis

2.1 Introduction to Bid Rigging

According to OECD (2009), bid rigging is a situation when businesses that should compete, secretly collude to increase prices and/or lower quality of goods and services for purchasers.

Bid rigging is therefore an unwanted behavior of firms in public procurement. The main idea of a competition process in public procurement is that in the end a public institution should get a desired product at reasonable price and quality. However, bid rigging causes the completely opposite effect, i.e. high prices and/or low quality. So, the overall effect is that the money from taxpayers are spent in vain and the competition is undermined.

It should be no surprise that bid rigging is illegal in the most of the developed countries. In the Czech Republic, the punishment takes a form of a fine from the antitrust authority.

2.1.1 Forms of Bid Rigging

There are several forms of bid rigging. Some of them are described in OECD (2009). All of these forms lead to the same result, that winner chosen in advance wins the contract and the price paid is much higher than a customary price on the competitive market.

The following strategies taken from OECD (2009) may be used by colluding firms:

- **Cover bidding**. In this strategy, the firms agree to submit bids which only simulate appearance of competition. One possible behavior is that

"competing firms" agree to bid higher than the designated winner. Another possibility is that firms submit bids that are higher than some known limit and would be surely excluded. Sometimes, firms can submit bids which would not satisfy some special condition and would be excluded during the evaluation process.

- **Bid suppression**. In this case, firms make a deal that one or more firms do not submit a bid or withdraw a bid in order to make some chosen firm a winner. In other words, they lessen competition.

- **Bid rotation**. The collusive firms have an agreed pattern in which they take turns of becoming a winner. The rule may be that they allocate equal monetary values from public procurements to each firm and rotate accordingly.

- **Market allocation**. For this strategy is typical that firms divide the market and do not compete against each other.

- **Subcontracting**. The other competitors do not have to submit bids (but they can submit some non-winning bid) and they get their share via subcontracts to the designated winner.

Some of these strategies can be analyzed and tested in a dataset. For example, bid rotation or subcontracting leave patterns and evidence in data which can be discovered by a frequency analysis. Cover bidding strategy can be revealed by an analysis of distribution of bids, if we have some competitive benchmark (see e.g. Porter & Zona (1993), Porter & Zona (1999) or Bajari & Ye (2003)). The other strategies are more difficult to unveil by a frequency or another analysis.

2.1.2 Factors Supporting Bid Rigging

There are market environments in which firms are more prone to agree on collusive schemes. The environment is typically such that firms can regularly "compete" together, they can control each other if everyone is keeping to their part of a deal and they can punish each other when cheating. Even though such conditions may help a cartel, they are not necessary conditions for making a cartel deal.

According to OECD (2009) the following characteristics help firms to collude:

- **Small number of companies**. The transaction costs to create and control a cartel increase with a number of participants. Therefore, it is more likely that a cartel arises in a less competitive environment where it should be less complicated to agree on a pattern or other form of rigging the bids.

- **Little or no entry**. In a situation in which firms in a market are protected from competition by some barriers of entry, it is easier to comply with a cartel agreement. Lowering a danger of a competition with a new entrant helps to increase the probability that a cartel survives.

- **Market conditions**. Another factor is a situation on the market regarding demand or economic business cycle. In a case where a contracting authority[1] has a regular demand for some goods or services, firms can more easily plan their future actions together. Another market condition that may affect cartels is a recession. In time of uncertainty, firms may have higher incentives to cooperate and replace their lower profits from private sphere by public money.

- **Repetitive bidding**. If firms have a chance to meet more regularly in public procurements, incentives to organize their actions increase. It is easier for firms to allocate the contracts among them in repetitive bidding. Moreover, chance for controlling the other firms is better. As a punishment for a cheater, the other firms can sabotage public procurements in which he was a chosen winner.

- **Few if any substitutes**. The absence of substitutes gives an advantage to firms against a public institution. If the public institution do not have a chance to buy any alternative product or service, the firms can easily control deliveries and increase prices in a cartel.

- **Little or no technological change**. Technological progress makes a cartel deal difficult to preserve over time. The reason is that technological progress changes the conditions under which the cartel was made and therefore, makes it more difficult for a cartel to survive.

The list above summarizes the main factors supporting bid rigging. The most of them are impossible to suppress or avoid, so a public institution has

[1] By a contracting authority is meant a public institution which submits a public procurement. For a definition in the Czech environment see page 14.

to count with them. A public institution can make it more difficult for firms to make an collusive agreement. For example, by giving the smallest amount of time as possible for submitting a bid or increase the amount of uncertainty as of how many bidders can submit their bid by not giving too restrictive requirements needed for the contract. Some other suggestions are mentioned in OECD (2009). Nevertheless, there will always exist an effort of firms to find ways of eluding the protective measures and gain an excess profit. Therefore, an efficient controlling and sanction mechanism is important.

This was a short introduction to bid rigging followed by an overview of literature.

2.2 Literature Review

Issue of bid rigging is often discussed in research and media. In this section are mainly analyzed research articles about bid rigging. The results of academic research and case studies led to formulation of recommendations and guidelines which should help contracting authorities to minimize risk of bid rigging. The guidelines will be discussed shortly at the end of the section.

The literature is divided into 3 parts (theoretical studies, empirical studies and practical guidelines) for better orientation.

2.2.1 Theoretical Studies

Majority of works which are directly aimed on bid rigging are theoretical. The reason is that bid rigging is an illegal practice which is made in secret and therefore its real existence is hard to prove. Lack of revealed real cases of bid rigging does not allow to conduct empirical analysis.

First relevant study is McAfee & McMillan (1992) which studies bidding rings. They describe bidding ring as a group of colluding agents which agreed how to divide items for sale in an auction. The ring which cannot make side-payments is called a weak ring. The members of a weak ring cannot do nothing else than submit the same bid and randomize who will get the item. In a strong ring, the members can make side-payments and exclude new entrants. The best strategy for a strong cartel is to make a pre-auction within the group and let only the winner to participate in auction. The others then get side-payments

for staying out. This may be one of the explanations why only one firm often participates in public procurements.

The McAfee & McMillan (1992) study was aimed on a static environment. On the other hand, the study of Aoyagi (2003) is based on dynamic optimization in repeated auctions. The optimal strategy for a strong cartel in repeated auctions is a bid rotation. On the contrary to the static environment, the dynamic environment makes the cartel better off without side-payments. They have inter-temporal payments ensured by bid rotation instead. The firms can communicate explicitly or by signals.

Last but not least will be mentioned the study from Hendricks & Porter (1989) which emphasize that bid rigging takes many forms and it is necessary to suit the theoretical and empirical analysis to particular cases. In other words, one general testing procedure is not sufficient for detection of bid rigging.

2.2.2 Empirical Studies

Moving to more empirical studies, a combination of theoretical and empirical analysis offers Feinstein *et al.* (1985). In their model they assume that purchaser makes expectations about the future price and buys a product depending on the price expected in the future. The purchaser has no information about costs and market structure, so he gains information only via procurement auctions. Firms can exploit this information asymmetry and misinform the purchaser via bids and force him to make a high expectation of future price. Feinstein *et al.* (1985) tested their model on highway construction cartels from North Carolina in period 1975-1979. The data containing collusive and non-collusive bids confirmed their model in which information asymmetry leads to bid rigging which is used by firms to misinform the government and manipulate the government's estimate of future price.

Porter & Zona (1993) wrote a case study about high construction cartel on Long Island formed in early 1980s. They compared behavior of cartel and non-cartel members of Nassau and Suffolk county contracts and found that both groups formed their bids differently. Another study from Porter & Zona (1999) analyzed school milk procurement in Ohio. They compared a group of milk suppliers in Ohio to a control group and found that behavior of firms in

Ohio is inconsistent with the control group. The main findings of the authors are that cartel bidders have higher bids than non-cartel bidders, cartel bids are more correlated than non-cartel bids and cartel bidders bid less aggressively against each other than non-cartel bidders.

Bajari & Ye (2003) provided an intriguing study of bid rigging using model with asymmetric bidders. They introduced a set of conditions which are necessary and sufficient for a distribution of competitive bids. The first condition is conditional independence, i.e. that bids should be independent. The next condition is exchangeability, i.e. that costs alone should determine how firms bid. For a further analysis, they derive a prior distribution of firm's costs based on beliefs of experts and use it in a Bayesian framework for choosing between competitive and cartel model. So at first, based on the violation of at least one of the conditions they find suspicious firms, then they derive prior distribution of costs using expert beliefs and as a final point they use their structural cost models (competitive and cartel) to get posterior distribution of costs which determine whether the contracting authority should investigate or not.

Some of the studies also mention the effect of politicians or municipalities on the result of a public procurement. Hyytinen *et al.* (2007) looks at the effect of politicians in Swedish public procurements for cleaning services. Their conclusion was that the influence of politicians in favor of some bidders is quite probable. Another study from Coviello & Gagliarducci (2009) focused on the potential relationship between mayor's time in office and results of public procurements during 2000-2005 in Italy. Their conclusion was that longer stay of a mayor in office helps creation of a local cartel.

In the Czech environment, it is worth to mention studies from Pavel (2010) or Nikolovová *et al.* (2012). Pavel (2010) studied public procurements in infrastructure and highway construction. His conclusions were that the higher amount of bidders decreases the price of contract and that introducing other evaluation criteria than price leads to decrease of amount of bidders. His recommendation for an improvement of the situation and decrease of prices is to create an environment in which more bidders have an incentive to enter. Higher level of competition may also decrease a risk of bid rigging.

Study from Nikolovová *et al.* (2012) focused on the contracting authorities

and their behavior. One of the main findings was that contracting authorities suppress the expected price of public procurements, so that they could apply less formal procedures. Another findings were that stricter rules given in law and more competitive environment decreases winning bid. Summarizing point related to this thesis is that there might be cases in which a contracting authority helped bid rigging by its behavior.

Regarding empirical papers, there are studies which focused on analyzing the characteristics of bid rigging after a legal authority sentenced the colluding firms and then compared whether bid rigging firms behave differently from competitive firms. Into this category belong e.g. Feinstein *et al.* (1985) or Porter & Zona (1993).

On the other hand, there are studies looking for a methodology useful for a detection of collusive behavior even though it is not proved yet if the collusion occurred or not, e.g. Porter & Zona (1999) or Bajari & Ye (2003).

The last group contains studies in which the author analyzes the environment and behavior of the participants to detect characteristics which may indicate or cause a presence of cartels and bid rigging, e.g. Pavel (2010) or Nikolovová *et al.* (2012).

2.2.3 Guidelines for Contracting Authorities

Bid rigging in practice[2] incurs inefficient expenses of money, so antitrust authorities publish guidelines for contracting authorities how to minimize risk of bid rigging, e.g. OECD (2009) or Parker & Maher (n.d.). In all of them we can find advices like: look for suspicious patterns, look for suspicious information in the submitted documents, etc.

Among suspicious patterns belong for example rotating patterns of winners, when some firms repeatedly fail or send insufficient bids, sudden increase of prices even though costs are the same or sudden drop of prices after appearance of a new bidder. All these suspicious patterns should lead to a deeper investigation because in some cases, these suspicious patterns may a result of coincidence or a result of a mistake or insufficient preparation of a bid and the accusation from bid rigging may be wrong.

[2]The most famous cases in Europe are "Building and Construction Industry in the Netherlands" or "Pre-Insulated Pipe Cartel 1998", see OTVeZ (n.d.).

To sum up, in the literature review I covered important research papers and documents from practice devoted to bid-rigging and public procurement. This thesis would belong to the group of empirical studies which analyze the behavior of firms and detect characteristics which may indicate a presence of bid rigging.

2.3 Definitions and Characteristics of the Czech Public Procurement System

In this section are described main definitions of public procurements and its environment. The section starts with legal framework and main concepts of the whole procedure of public procurement defined by law. It is followed by a part devoted to a summary of the whole process within the scope of legal boundaries. The last part looks at controlling and sanction mechanisms.

2.3.1 Legal Framework

Public procurement in the Czech Republic is regulated by Act no. 137/2006 Coll., on Public Contracts (AoPC). Previously, it was regulated by Act no. 40/2004 Coll. which harmonized Czech and European law with respect to public procurement. Definitions and rules of public procurement for our analysis are taken from Act no. 137/2006 Coll. because our dataset contains data from 2006 - 2012. AoPC went through several novelizations since 2006 but really essential changes brought novelization in 2012. Until then, the changes in AoPC originated mainly from needs to harmonize AoPC with changes in other norms.

Definitions of Used Terms

The following part of this subsection contains a list of definitions from AoPC which are important for this work.

Public Procurement According to a §7 in AoPC, public procurement is any commission which is realized on a basis of a contract between a contracting authority and suppliers. Public procurements must have a written form of a contract.

Subject of Public Procurement Subject of a public procurement is any payable provision of goods, services or construction work. Public procurements of goods, services and construction work are defined in §8 - §10 in AoPC.

Expected Price The level of expected price affects formal requirements of the whole process of a public procurement. Expected price is defined in §13 - §16 of AoPC. It is a total amount of expected payable expenses. In case of contract for an indefinite term, expected price equals to expected expenses for the consecutive 4 years. Estimate of expenses should be based on previous similar procurements. If contracting authority does not have such historical information, it should make a market analysis or take an advice from experts.

In the law from 2004, a public procurement was limited from below by the expected price 2 000 000 CZK.The consequence of this limit was that antitrust authorities could not analyze the process of submitting contracts and selecting a supplier in public procurements below this limit. Change of this definition in 2006 led to a facilitation of controls of these low priced contracts by an antitrust authority, i.e.the competences of controlling mechanism improved a little.

Types of PP with respect to Expected Price According to the AoPC, there are three groups of public procurements with respect to the level of expected price:

- **Public procurement of small extent** ("Veřejná zakázka malého rozsahu") is a public procurement, whose expected price of a contract for goods and services is below 2 000 000 CZK (without a value added tax) and in case of contracts for construction work the expected price is below 6 000 000 CZK (without a value added tax).[3] This type of public procurement is completely excluded from the duty to obey the AoPC. The only thing that law says is that a contracting authority has to obey the 3 principles mentioned in §6 during the whole process.[4]

- **Above limit public procurement** ("Nadlimitní veřejná zakázka") is a public procurement, whose expected price (without value added tax) is above limit defined in special rules for implementations. Different contracting authorities (which will be described in one of the following sub-

[3]From April 1, 2012 the limits are 1 000 000 CZK for goods and services and 3 000 000 CZK for construction work. From January 1, 2014 the limit will be 1 000 000 CZK for any type of public procurement.

[4]For the completeness the 3 principles are mentioned on page 16.

sections) have different limits for different types of contracts (i.e. contracts for goods, contracts for services and contracts for construction work). For illustration how these limits evolved during time look at Table 2.1.

Table 2.1: Lower Limits for Above Limit Public Procurements from 2006 to 2012 (in thd. of CZK)

CONTRACTING AUTHORITY	YEAR	GOODS AND SERVICES	CONSTRUCTION
Czech Republic, Czech Republic - Ministry of Defense (some goods given in special rules for implementations)	2006	4 290	165 288
	2007	4 290	165 288
	2008	3 782	146 447
	2009	3 782	146 447
	2010	3 236	125 451
	2011	3 236	125 451
	2012	3 256	125 265
Municipal Authorities, State Allowance Organizations, Subsidized given in special rules for implemen- Suppliers, Czech Republic - Ministry of Defense (goods not given in special rules for implementations)	2006	6 607	165 288
	2007	6 607	165 288
	2008	5 857	146 447
	2009	5 857	146 447
	2010	4 997	125 451
	2011	4 997	125 451
	2012	5 010	125 265
Sectional supplier	2006	13 215	165 288
	2007	13 215	165 288
	2008	11 715	146 447
	2009	11 715	146 447
	2010	10 020	125 451
	2011	10 020	125 451
	2012	10 021	125 265

Source: Years from 2006 to 2010 from Nikolovová *et al.* (2012), years 2011 and 2012 added by the author from Ministerstvo pro místní rozvoj ČR (2011)

- **Below limit public procurement** ("Podlimitní veřejná zakázka") is a public procurement, whose expected price is above the limit for public procurement of small extent and below the limit for above limit public procurement.

Differences between below limit and above limit process The requirements given by law for above limit public procurements are stricter than for below limit public procurements. The main difference important for bid rigging anal-

ysis is that for below limit processes there is no obligation to publish a report about public procurement which usually contains information about all bids (but now the report must be published for all public procurements announced after April 1, 2012).

Table 2.1 shows that the lower limits for the above limit public procurements have a decreasing trend in time with some exceptions. This means that stricter rules are applied for more public procurements. These changes should bring a better control over the public money and better controls which may lead to detection of bid rigging.

To sum up, the above limit public procurements have the strictest formal procedure and on the other side of the scale, public procurements of small extent require the least strict formal procedure. Of course, it is forbidden by law to divide a public procurement into smaller contracts to achieve a less strict formal procedure.

Contracting Authority Contracting authorities, defined in §2 of AoPC, are the ones that submit public procurements.

Types of Submitting of Public Procurement Whole second part of AoPC is devoted to types of submitting a public procurement. Law defines the following 6 types of submitting for above limit and below limit public procurements in §27 - §38:

- open process ("otevřené řízení"),
- closed process ("užší řízení"),
- proceeding with publication ("jednací řízení s uveřejněním"),
- proceeding without publication ("jednací řízení bez uveřejnění"),
- competitive dialog ("soutěžní dialog"),
- simplified below limit process ("zjednodušené podlimitní řízení").

In the dataset which will be analyzed in more detail in the Section 3.3 were used only the following 3 types of submitting.

Open Process Open process is the least discriminative process. In an open process, there is no limit for a number of potential suppliers and anyone can send their offers without being directly asked by the contracting authority. Announcement of the public procurement is a beginning for accepting offers and proofs of qualification (if wanted).

Closed Process Closed process has two stages. In the first stage, a contracting authority announces their demands to an unlimited number of potential suppliers. Then, contracting authority waits for applications to enter and proofs of qualification from these potential suppliers. After analyzing proofs of qualification, contracting authority selects the well-qualified suppliers and invites them to the next stage in which they offer their bids.

Before novelization valid from April 1, 2012, contracting authorities could set upper limit for number of suppliers selected to the second stage. However, after the novelization it is allowed only for some exceptions and AoCP requires that at least 3 or 5 potential suppliers (depending on the exception) are contacted in the first stage.

The novelization of AoPC regarding cancellation of upper limit for amount of selected suppliers helped to make a closed process less discouraging for contacted firms to enter. The motivation to prepare for the bid and enter to public procurement is lower if there is a possibility that the contracting authority would not chose the firm because of some artificial limit.

Simplified Below Limit Process A contracting authority can announce simplified below limit process for all below limit public procurements with one restriction in case of construction work.

The contracting authority has to ask at least 5 potential suppliers for an offer and proof of qualification. After novelization in September 2010, the contracting authority must accept an offer from a potential supplier which was not directly asked by the contracting authority. The level of competition is after the novelization limited only by a fact whether the firm found out about the announcement of public procurement. This limitation was influenced mainly by the specific form of announcement about public procurement chosen freely by the contracting authority.

To improve this situation, the form of the announcement was novelized and harmonized in April 1, 2012, so that no firm would be discriminated in this aspect. After April 1, 2012, the contracting authorities should announce public

procurements on their profile of a contracting authority[5]. There is a list of these profiles at central informational system `www.isvzus.cz`.

Criteria for Choosing the Best Bid Criteria which determine which bid wins are the most important aspect in the whole process of evaluating bids. Authority can choose between two options given in §78 – "The lowest price option" (the only criterion is price) and "The most economically advantageous tender" (authority can add other criteria to the price criterion and assigns weights for each criterion).[6] Most typical criteria for the most economically advantageous tender are e.g. technical parameters, term of delivery and/or service conditions.

Principles for Interpretation AoPC Any law needs to have principles which are used for interpretation and application. In §6 are written three basic principles for public procurements: principle of transparency, principle of equal treatment and principle of non-discrimination.

Principle of transparency should lead to openness of the whole process, in a sense that most of potential suppliers have a chance to know about the public procurement in advance and if they want, they can send an offer. Transparency should also lead to a clear process of announcing a public procurement and choosing the best supplier. This principle results in duties such as documenting important events, announcing criteria used for choosing a supplier, etc, i.e. the principle of transparency is important for availability of data. Based on this documentation, antitrust authorities can analyze any discrepancies and inconsistencies which may have arisen during the process.

The other two principles, principle of equal treatment and of non-discrimination, should result in a situation, in which every potential supplier has the same set of information and conditions are the same for everyone (including suppliers from foreign countries). One may see a potential conflict of these principles with some types of public procurement discussed above, in which a contracting authority asks only a limited number of chosen suppliers and offers the public procurement only for them (e.g. exceptions in closed process). However, this discussion is beyond the scope of this thesis.

[5]See page 21 for more details about profile of contracting authority.

[6]Both terms are harmonized in European Union by COMMISSION IMPLEMENTING REGULATION (EU) No 842/2011.

Novelization from April 1, 2012 Quality of legislature regarding public procurement is without a doubt a very important aspect for the efficiency of public spending. Novelization from April 1, 2012 contributed to improvement in some aspects. In my opinion, among the most essential changes which helped to improve the environment of public procurement belong:

- decreasing price limits of public procurements which are excluded from the duty to obey AoPC (this should lead to better transparency),
- cancellation of the possibility of contracting authorities to limit the number of potential participant in some types of public procurements (this should lead to higher level of competition),
- making financial and economical qualification less formal (this should lead to possibility that smaller companies have better chance to participate),
- doubling sanctions for contracting authorities and suppliers in case of breaking the law (this should decrease incentives for unfair competition),
- publishing report about public procurement which contains information about other bidders, their bids and reasons why some bids were excluded for all types of public procurement (this enables better controlling and increases transparency),
- obligation to cancel public procurement if only one bid was received or only one bid remained after exclusion of incomplete bids with some exceptions (this should lead to higher competition).

All these points show an effort to improve the environment for public procurements and to create more difficult conditions for bid rigging. With higher transparency and bigger competition it is more difficult to hide or preserve a bid rigging deal or even win with an overpriced offer against competition. In the empirical part of the thesis will be analyzed whether and how firms changed their behavior in a new environment.

2.3.2 Stages of a Public Procurement Process

In this subsection is provided a simple structure of a public procurement process based on Reimarová (2011). The public procurement process consists of the following 5 stages:

- **Stage 1 - Formulating Needs**: A contracting authority formulates its needs into official documentation which potential suppliers study before working on their bids. The subject of purchase and other requirements should be clearly stated and criteria for evaluation of bids are announced too.

- **Stage 2 - Announcement of a Public Procurement**: The contracting authority announces the public procurement in a way given by law. Potential suppliers prepare their bids and deliver them to specified place before deadline. Control from public or antitrust authority may be present at this stage.

- **Stage 3 - Evaluation of Delivered Bids**: The contracting authority evaluates the bids according to chosen criteria. Bids which did not meet the requirements stated in documentation or contain errors are excluded at this stage. From the rest of the bids, the authority choses the winner.

- **Stage 4 - Announcement of the Winner**: The contracting authority has to announce that public procurement was submitted to the winner. In the announcement must be information about the winning firm and its winning bid. After novelization in 2012, the contracting authority must publish a report with information about non-winning bids. The reports and announcements from this stage serve for a potential ex-post control in case that a losing firm reports some violations to the antitrust authority.

- **Stage 5 - Signing a Contract**: The winner and the contracting authority sign a contract and the subject of the contract starts to be fulfilled.

A potential case of bid rigging forms in stage 2. If the stages 3 - 5 are well documented and available to public and antitrust authorities, it helps to control the whole process and makes it possible to look for suspicious patterns in behavior of firms.

2.3.3 Controlling and Sanction Mechanisms

Regarding controlling, there are two authorities in the Czech Republic which can analyze public procurements, the Supreme Audit Office (NKÚ) and the antitrust authority (ÚOHS). Each of them has different legal means which they can implement.

NKÚ controls contracting authorities and reports their findings to government. Then, it is up to government whether it will punish the contracting authority or not. However, ÚOHS has stronger competences and can fine the firms and contracting authorities for breaking the law. ÚOHS investigates cases based on the received complaints from any natural or legal person (e.g. resident, company, police or ministry) or based on reports from leniency program or it can start its own case ex officio, i.e. based on its own investigation (ÚOHS (2012a)).

The probability that ÚOHS would investigate the case of bid rigging based on complaints is not very high without further incentives. Firms in a working cartel would not report it, if they would not believe that the probability of revealing the cartel is high. Then, only police or some active organization can report a case and support it with found evidence. What can increase the probability that an antitrust authority would investigate cases of bid rigging is to open a lot of cases ex officio which might increase the incentives of firms to report the cases in leniency program to get a lower fine. The other discouragement of bid rigging can be a close cooperation of police and antitrust authority in looking for evidence of law violation.

According to the latest report of ÚOHS (2012b), in 2011 the amount of received complaints about public procurements increased by 25%. The reason provided in ÚOHS (2012b) for this increase is that lower amount of resources in public sector caused the change in firms' behavior and they became more competitive. This conclusion supports the findings of Pavel (2009) that controlling mechanism is not effective and it seems that in today's form it needs external shocks (like financial crisis) to become more efficient. Nevertheless, in 2010 the first case of bid rigging was revealed.

The First Revealed Case of Bid Rigging in the Czech Republic The first revealed case of bid rigging in the Czech Republic is known as "Case Litoměřice" (ÚOHS (2012a)) and is a typical example of cover bidding. In this case, the Ministry of Defense looked for a firm which would take care of a complex of lodging houses in Litoměřice in 2006. The contract was designed for an indefinite term and the value of contract was 10 million CZK per year.

The evidence for this case was collected by the police. According to the email correspondence of the 5 participants, the winning firm prepared the price bids for the other 4 companies. These price bids without any change were

delivered to the contracting authority. Furthermore, all the bids were delivered by one person from the winning company (Beck-online (2012)).

The antitrust authority started to investigate the case in 2009 and condemned the firms for bid rigging in 2010. The total fine was 4 906 million CZK. The verdict was a result of cooperation of the antitrust authority and police. None of the firms took an advantage of a leniency program.

On this revealed case can be illustrated that the antitrust authority has two functions. One is to control whether the law was violated or not and the other one is to punish the violation. Regarding the controlling part in this case, ÚOHS and police did a good job. The other question is the punishment which should be such that firms would lose the incentive to make cartel deals. In this case, the total fine was only a small fraction of the value of the contract and in my opinion it did not play the role of discouragement of future cartel deals.

The possible recommendation for harder punishments than solely a ban to participate in public procurements in the next 5 years for firms which made a cartel deal. The 5-year forgone profit from public sector even via fair competition may be a good discouragement from bid rigging.

The controlling and sanction mechanism in the Czech Republic needs improvements but in general has a an increasing trend in efficiency. The recent novelization increased sanctions and ÚOHS investigates more cases than before. Moreover, in 2011 a new department devoted to investigating bid rigging was established. The biggest potential for further improvement I see in an increase of ex officio cases which may increase the probability of revealing a cartel and then firms may have a higher incentive to participate in the leniency program. Other possible improvement for discouragement of firms to make bid rigging deals is to add a punishment of banning the firms temporarily from participation in public procurements.

2.4 Databases and Sources of Information in the Czech Republic

This subsection contains description of 3 sources of information for the empirical analysis. The first and the third one are the most important.

ISVZUS The main informational portal which includes data about public procurements can be found at `www.isvzus.cz`. The database contains above limit and below limit public procurements since Jul 2006.[7] The contracting authority must sent information about above limit and below limit public procurements to this database. It is therefore a main source of information about large public procurements. Among the most important information for my analysis belong: date of announcement of public procurement, winner, winning bid, number of bidders, type of procurement and product specification (contained in a CPV code). Data from this source made the base for the dataset used in the empirical analysis.

Unfortunately, ISVZUS does not contain information about other bidders and their bids. Information about other bidders, their bids, number of excluded bids from a public procurement and reasons for exclusion were added to original database from `www.isvzus.cz` by myself from other sources.

Prague PP Other database used in the analysis is at `www.zakazky.praha.eu`. It contains public procurements announced by the Prague City Hall. This database contains all types of public procurements (even public procurements of small extent).

Profile of a Contracting Authority Profile of a contracting authority is nowadays an electronic tool on the Internet which is used for announcing public procurements, announcing the winner and posting all the documents related to the public procurements like e.g. report about subcontractors, report about public procurement, buying contract etc. Since April 1, 2012, it is obligatory to have and use the profile of contracting authority for all types of submitting public procurement (before April 1, 2012 it was obligatory only for a specific type of submitting public procurement).

Profile of an contracting authority was used as a source of information for the above mentioned data which are not made public at `www.isvzus.cz`. Since providing information about other bidders was not obligatory until April 1, 2012, the presence of information for older public procurements is exceptional.

[7] Definitions of above limit and below limit public procurements are on page 12, as well as public procurement of small extent.

2.5 Important Variables for Empirical Analysis

In this section will be described important criteria on whose evaluation are based the conclusions whether the symptoms of bid rigging are present.

2.5.1 Number of Bidders

The first important factor is the number of bids which were delivered to the contracting authority. The number of delivered bids reflects the level of competition. As it was already mentioned in Subsection 2.1.2 a low level of competition is one of the potential supporting factors of bid rigging.

The mechanism is simple. The smaller the amount of competitors is, the lower are the transaction costs to make a bid rigging deal and therefore, potential gains from increase of prices make bid rigging profitable for all members. They can share the profit via subcontracts or inter-temporally via bid rotation if the low level of competition is stable, i.e. the same group of firms bids. Supplemental factors for a potential bid rigging deal are also a low probability of investigation and low sanctions.

The forms of bid rigging supported by low level of competition are cover bidding and bid rotation. Cover bidding and bid rotation can arise when firms know already in advance that there is no other competitor in their field and make a bid rigging deal in advance. The other option is that in repetitive bidding they find out that they are the only competitors who send bids and then they decide to increase their profits by bid rigging. Theoretically it was derived in Aoyagi (2003) that in repetitive bidding firms can gain more profits by bid rotation and increase of prices.

The most extreme case of a low level of competition is 1-bidder public procurement. One explanation for this outcome may be that the subject of a public procurement was very specific and only one firm was able to fulfill it. Another explanation for receiving only one bid may be that a contracting authority did not specify the subject and requirements well enough and bidders were discouraged to send their bids. In this case, it is better to cancel the public procurement and specify everything better next time. Last potential reason is that it may be also a result of bid suppression schemes. Bid suppression may arise when a few competitors in the field compete often against each other. Then, it pays off to make a deal who send a bid and when and decrease the costs for preparing the bids. The extreme bid suppression leading to only one

participating bidder is supported as a theoretical outcome of strong cartels in McAfee & McMillan (1992).

In all the situations mentioned in the previous paragraph, potential knowledge that nobody will compete against a firm leads to a situation that firm has an opportunity to overprice the contract and misinform a contracting authority about prices in the industry, so that in the future a similarly high bid would not be suspicious. Outcomes of 1-bidder public procurements may be therefore very inefficient and should be investigated more deeply. Even the recent novelization of AoPC does not allow to continue in public procurement if only one bid was delivered or left after the evaluation with exceptions of some special cases.

In this section were stated reasons why observing a low level of competition[8] competition may be a reason for deeper analysis whether bid rigging is present or not. Several times were mentioned that low level of competition in a combination with repetitive bidding may lead to a bid rotation deal. The next section is therefore devoted to a frequency analysis.

2.5.2 Frequencies of Participation of Firms in Public Procurements

As it was mentioned above and in Subsection 2.1.2, high frequency of participation in public procurements is also one of the potential supporting factors of bid rigging.

In a stable environment, i.e. if firms bid repeatedly within the same small group of firms, it is profitable for firms to make cartel deals. Moreover, the purchaser cannot go to a potential competitor which did not enter in public procurement, so the power of cartel to dictate prices increases. Therefore, finding higher frequencies of participation for the same group of firms may indicate that they already have a bid rigging deal or it is very likely that they will make one. In these cases, it is probable to find cover bidding and/or bid rotation deals.

Based on this, groups of firms with higher frequencies of participation are more suspicious from making a bid rigging deal in the empirical analysis.

[8]For the purpose of the empirical analysis, it is assumed that low competition means presence of less than 5 bidders because even AoPC enforces in some types of submitting of public procurement to ask at least 5 bidders to participate in order to ensure a sufficient level of competition.

2.5.3 Valid and Excluded Bids

Another aspect of public procurements are valid and excluded bids. During the evaluation process, the authority can exclude all unsatisfactory bids. Bid is unsatisfactory if it does not satisfy technical or other qualification conditions, if it contains some error in calculation, if price bid exceeds the upper limit given by the authority, etc. The contracting authority has a certain amount of discretion whether to exclude the bid or not which leads to problems with possible cooperation of bidder and contracting authority discussed below.

Excluded bids are analyzed because from the firm's point of view, firm has no incentive to send an unsatisfactory or incomplete bid. This behavior would only increase its costs with no chance for making profit. The possible explanation for this behavior may be a membership in a cartel. Firm in a cartel would send a bid only to simulate competition and make the public procurement less suspicious from low level of competition. However, in fact it is not a real competitor because his bid does not satisfy all the conditions and in the end the competition is smaller.

The other possible explanation for a presence of excluded bids is that an authority wants to give a PP to some firm and therefore may try to exclude better bids because of some kind of error in them. However, these cases are beyond the scope of this thesis.

The empirical analysis aims on firms which systematically send unsatisfactory bids. According to the reasoning written above, sending unsatisfactory bids to contracting authorities is only a waste of resources and such a firm may be a part of a bid covering deal.

Making a short summary, low level of competition especially with combination of a stable environment may indicate potential bid rigging and high amount of excluded bids may indicate a potential bid covering deal.

To sum up, the first chapter introduced bid rigging, which forms it takes and which characteristics of environment support bid rigging behavior. Then, the literature review was presented and followed by specifics for public procurement in the Czech Republic such as legal framework, stages of public procurement process, controlling mechanisms and their relation to bid rigging. In the next section were described databases and sources of information about public procurements. The end of the chapter was devoted to factors which are used in

empirical analysis and reasoning why to use them.

Chapter 3

Empirical Analysis

3.1 What Data Say in General About Public Procurements

For an overall illustration of the situation in public procurements (PP), I will present a few general results based on data from `www.vsechnyzakazky.cz`. The dataset at this web page contains downloaded data from servers `www.isvzus.cz` and `zakazky.praha.eu` and covers period Jan 2007 - Feb 2013.[1]

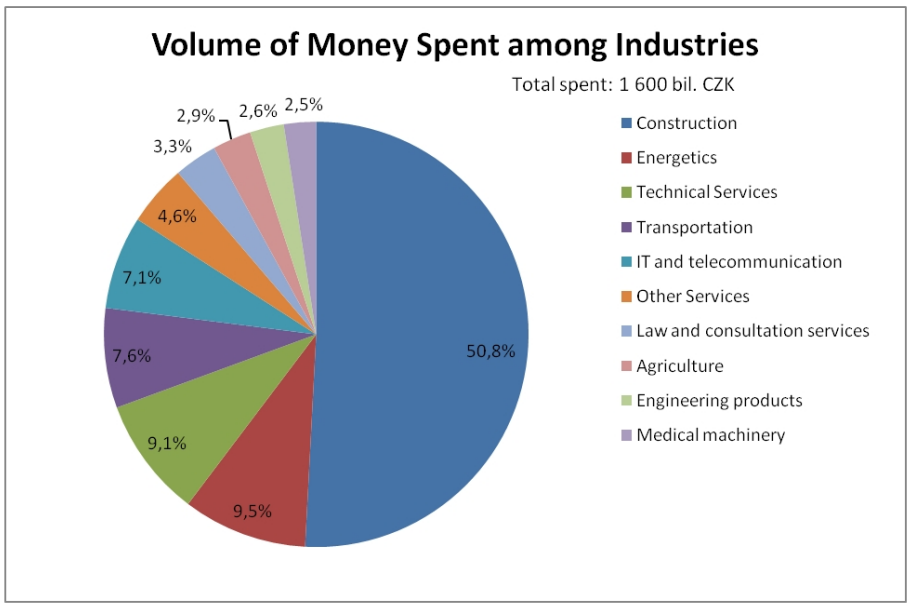
Industry Analysis The total volume of money spent during period Jan 2007 - Feb 2013 was 1 600 billion CZK without VAT and Figure 3.1 represents shares of this total volume of money spent across industries. The biggest share belongs to the construction industry. It has consumed more than a half of the total money spent in PP since 2007. Medical machinery with 2.5% belongs to less money consuming industries.

Let us have a look at number of PP across industries. The total number of PP during the period Jan 2007 - Feb 2013 was 78 420. Figure 3.2 shows relative shares of announced PP since 2007 across industries. The biggest share (little more than one third) of all PP is in construction, lower shares are in technical services.

In the detailed empirical analysis about bid rigging I will aim on medical machinery industry. Based on the previous graphs, medical machinery has the 10^{th} biggest share of cumulated expenses since 2007 and is the 6^{th} biggest with respect to cumulated number of PP since 2007. This industry is likely to satisfy the following conditions supporting bid rigging from Subsection 2.1.2:

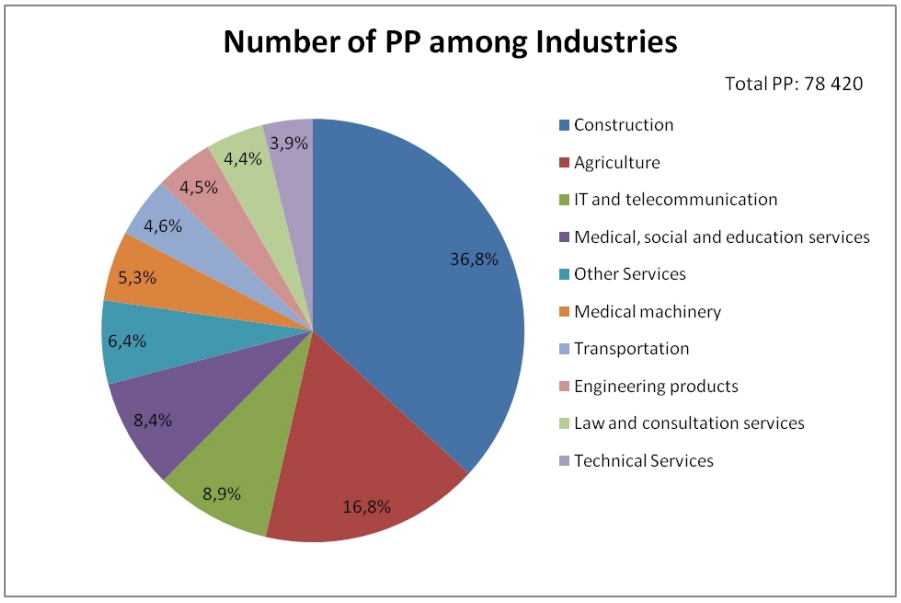
[1] The description of databases is in Section 2.4.

Figure 3.1: Industrial Structure - Volume of Money (Jan 2007 - Feb 2013)



Source: www.vsechnyzakazky.cz

Figure 3.2: Industrial Structure - Number of PP (Jan 2007 - Feb 2013)

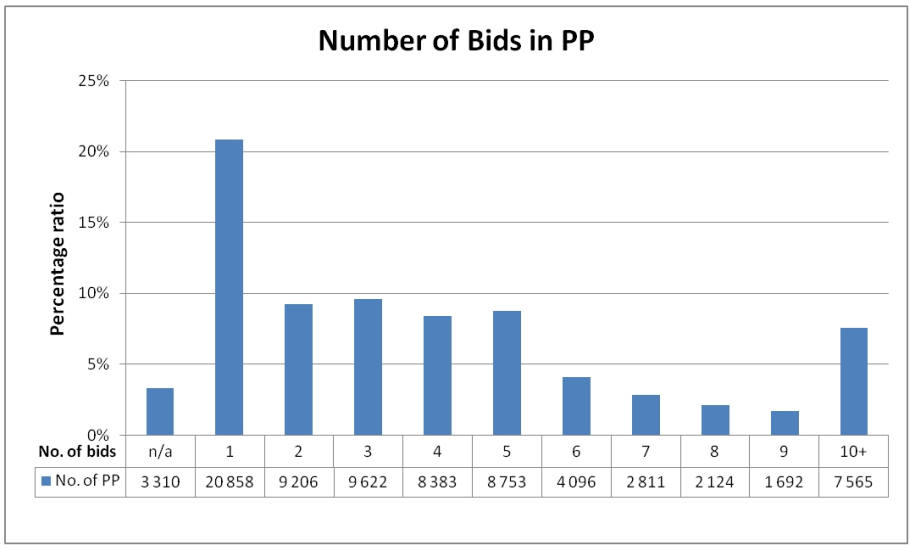


Source: www.vsechnyzakazky.cz

presence of small number of firms, repetitive bidding and absence of substitutes. In the Czech Republic are about 180 hospitals[2] which have very similar needs, firms therefore have a lot of opportunities to bid often together in PP and in combination with low level of competition, there is a potential to make a bid rigging deal. In some cases, medical machines are so specialized that only a few firms can deliver them and no substitutes may exist.

Number of Bidders Another interesting analysis from the data is visible from the number of bidders in PP (i.e. all bids before an evaluation stage).

Figure 3.3: Number of bidders (Jan 2007 - Feb 2013)



Source: www.vsechnyzakazky.cz

Figure 3.3 shows that about 20% of all PP had only 1 bidder who sent a bid. As it was mentioned in Subsection 2.5.1, 1-bidder PP can lead to inefficient outcomes (overpricing and misinformation). High ratio of 1-bidder PP indicate that some of the resources may have been spent in vain. It was already mentioned that even novelized AoPC restricts the possibility of 1-bidder PP only to special cases with a vision that it should help to achieve more competitive environment with lower prices. After this novelization, the antitrust authority should look at 2-bidder PP and check whether the outcome is efficient or whether the firms make deals just to fulfill the legal condition but prices are still higher than customary prices.

[2] `http://www.uzis.cz/rychle-informace/nemocnice-ceske-republice-roce-2012`

To sum up, overall analysis of PP showed how big part of PP creates medical machinery industry in which I am interested in the further analysis and that most often 1 - 5 bidders send their bids.

3.2 Dataset for Further Analysis

The first step for empirical analysis is to have a dataset with all important variables. The fundamental database for PP in medical machinery was downloaded from `www.isvzus.cz` and was provided to me by my supervisor. During the data processing I encountered the following problems:

- **The database was incomplete.** Some PP did not have results about winner, even though PP were not canceled. The reason was that contracting authorities did not enter the information properly to `www.isvzus.cz` and downloading script was not able to reveal this information. Similar problem had some PP with announcement about cancellation.
- **Important data for the analysis were at different public websites.** Information about other bidders are not available at `www.isvzus.cz` and they were downloaded manually from profiles of contracting authorities.
- **Database contained PP which had no relation to medical machinery.** The most frequent cases, caused by a mistake while entering information into the ISVZUS system, were PP with a subject of purchasing LCD computer monitors.

To avoid a situation of making right conclusions, however based on incomplete data, I tried to complete the database, so that it would contain data as close to reality as possible.

The solution for the above mentioned problems were:

- Completing information about winners from `www.isvzus.cz` was done manually. I was able to find information about winner through searching names of PP at `www.isvzus.cz`. In case of not unique names I looked at name of contracting authority or date of announcement of PP.
- The most demanding part was downloading information about other bidders. Each contracting authority is free to decide about its profile. Some contracting authorities post everything on their own websites, the other

authorities chose one of the online electronic tools provided by private companies. Some authorities have even several profiles of contracting authority used in different time spans or for different types of PP. I visited profiles of contracting authority for all PP with known winner and searched for a report about PP containing the important data.

- While I was looking for reports about PP, I deleted several PP with no relation to medical machinery.

Based on this experience, I would strongly recommend a creation of a standardized central database of PP with all the relevant information important for a controlling mechanism. The contracting authorities and antitrust authority (in case of some information) would have a duty to fill in all the information. The database could contain everything what is already at `www.isvzus.cz` and additionally:

- information about non-winning bidders and their bids,
- number of excluded bids,
- information about excluded bidders, their bids and reason of exclusion,
- information about subcontractors and their shares on the PP,
- unit price for homogeneous goods,
- whether the PP was investigated by an antitrust authority, why (investigating a contracting authority and/or firms) and what was the result, etc.

in more reasonable form than it is available today. This would make a controlling mechanism much faster and more efficient. Information about solved cases may then serve as competitive benchmarks for analysis of bid rigging.

3.3 Analysis of Public Procurements in Medical Machinery

The detailed empirical analysis of the thesis is aimed on the market of medical machinery and equipment. In the final dataset, we have in total 2009 procurements with a known winner. The basic dataset was enriched by data

about other bidders where they were available. The period covered by the dataset is Jul 2006 - Dec 2012.

In case of interest, whether a particular authority or a particular firm is involved in this dataset, the list of all authorities (157 in total) and the list of all suppliers which won at least one procurement (283 in total) can be found in the Appendix A.

In the following subsections are stated the hypotheses and results of the detailed analysis. The detailed analysis of the PP in medical machinery is a combination of frequency analysis and analysis of the institutional environment and its effect on behavior of firms. Institutional environment for the purpose of this analysis denotes legislature, public pressure and pressure from an antitrust authority. Frequency analysis is aimed on the variables discussed in Section 2.5, i.e. number of bidders and excluded bids, and looks for patterns indicating a potential bid rigging deal.

3.3.1 Hypotheses

In this subsection, I will introduce hypotheses which will be examined in the thesis. All the hypotheses are related to an institutional framework, i.e. pressure on PP and novelization of AoPC.

The first hypothesis aims at one aspect of institutional framework. By this hypothesis will be tested whether this aspect was present around year 2010. The institutional framework affects forms of bid rigging which are used, e.g. imposing cancellation of PP with only one valid (=not excluded) bid give an incentive to make bid rigging deals between at least 2 firms to avoid the cancellation of PP. Another example is that in an environment which is more controlled by public and/or the antitrust authority, it is expected that potential bid rigging firms will simulate higher level of competition. These changes of behavior may leave patterns in the data. Based on this reasoning, the next 2 hypothesis were formulated.

Hypothesis 1: *"Pressure on PP from public and from controlling authorities increased around year 2010."* In July 2010 a new government came to power in the Czech Republic. This government established itself as a government of budget responsibility, justice and fight against corruption (Vláda ČR (2010)). Similar proclamations were contained in the election campaigns. Since political parties try to reflect the public opinion to win the elections, I want

to test whether there was an increased pressure from public on PP around year 2010. I will also look for events supporting an increased pressure from controlling authorities.

Hypothesis 2: *"If public pressure on PP increases and controlling mechanism is stronger, firms will behave more competitively (or at least will simulate competition)."* The increased public pressure brings higher probability that a control mechanism will work more effectively and investigate more cases. This may be an incentive to become competitive or to hide bid rigging behind simulated competition. This change of behavior will be tested on number of bidders before and after the increase of public pressure, if the first hypothesis confirms.

Hypothesis 3: *"Novelization does not affect distribution of 2 and more valid bids."* Cancellation of PP with one valid bid allows us to test whether firms from PP with 1 valid bid disappear from PP as it was suggested by the novelization or whether they adjust their behavior and shift to PP with 2 or more valid bids and potentially create a bid rigging deal.

3.3.2 Pressure on Public Procurement

In this subsection it is checked based on several indicators whether pressure on PP increased around 2010 as it was stated in the first hypothesis.

Antitrust Authority As it was already mentioned, ÚOHS revealed the first case of bid rigging in 2010. After this, one of the improvements of controlling mechanism of ÚOHS was establishment of a new department devoted to a monitoring of public procurements and bid rigging in 2011. This shows determination to punish firms for this behavior and increases pressure on PP and firms from the side of the antitrust authority.

Public Pressure - Corruption Perception Index (CPI) CPI measures perception of corruption in public sector and is published annually by Transparency International. The index takes values between 0 and 10, where 10 denotes environment with no corruption and 0 denotes high level of corruption. PP is a part of public sector and therefore, CPI is involved in analysis of public pressure on PP. The values of CPI for the Czech republic are in Table 3.1.

The decreasing trend in index from 2008 to 2011 means that perception of

Table 3.1: Corruption Perception Index for the Czech Republic

Year	Index
2006	4.8
2007	5.2
2008	5.2
2009	4.9
2010	4.6
2011	4.4
2012	4.9

Source: Transparency International

corruption was high. I would interpret this decrease as a reflection of stronger public interest and pressure. Stronger perception of corruption in a developed country motivates public to deal with the problem and create pressure on politicians. Small positive result of this pressure may be confirmed by higher index in 2012.

Public Pressure - Google Trends For more specific analysis of public pressure on PP than CPI was used Google Trends[3]. The Google Trends shows statistics of how often a particular phrase was looked up in a specified period of time and in a specified location. Google Trends computes a special index ranging from 0 to 100. At first the data are normalized to reflect how many times a particular term was searched on Google relative to the total number of searches done on Google over a selected period. Then, the data are scaled in such a way that the value 100 represents an absolute peak of searching a particular term in a selected period and location.

Since Google is one of the most used searching engines, it may be helpful in detecting of what people are interested in and when. The interest about PP can be evoked by e.g.:

- change in AoPC,
- interest of new entering firms looking for PP (since 2009 may be trying to enter into PP to compensate lower profits caused by financial crisis; they can also call for transparent environment, etc.) or
- interest of public about PP.

[3] `http://www.google.com/trends/`

Big changes regarding AoPC came in 2006 and 2012. Around these periods high searching index will be interpreted as a result of looking for the upcoming and recent changes in AoPC. In the rest of the examined period (2007-2010) the trend of searching index will be interpreted as an increase or decrease of interest of public and potential new entrants.

As it was mentioned above, Google Trends allows to specify time and location parameter for the analysis. So, our selected period is Jan 2006 - Jan 2013 and geographically the analysis was restricted to the Czech republic region.

In Figure 3.4 we can see a time series of Google Trends index for the phrase "veřejné zakázky" (PP) with the parameters specified above. The first peak in 2006 can be explained by an introduction of a new AoPC. Similar explanation can be used for a high level in 2011 - 2012 because of novelization in 2012. For the period 2007 - 2011, Google Trends index is taken as a proxy for an increased interest of public and new entering firms. The trend is increasing from 2008 and it attains its maximum in 2010. The index reached the absolute maximum in June 2010. The conclusion is that public and firms using Google for search were interested in PP and their interest was the highest in 2010.

Figure 3.4: Google Trend analysis for "veřejné zakázky" (Jan 2006 - Jan 2013, Czech Republic)

Source: Google Trends.

Public Pressure - Media Media has a big influence on what is known in public. I look at statistics of number of articles about PP and other sources of information for illustration of increased public pressure.

For analysis of frequency of articles about PP was chosen an on-line bulletin `http://denik.obce.cz` because it contains an archive of articles since 1998. It brings information from public administration and local administration of municipalities and regions to employees of public sector. For a period

2005 - 2012 were found frequencies of published articles under section Public Procurement (see Table 3.2). The articles are mainly about cases of punished PP by an antitrust authority, changes in AoPC and reports of Transparency International. Table 3.2 shows that the number of articles increased more than 4 times in year 2010.

Table 3.2: Number of Articles Published at `http://denik.obce.cz`

Year	Articles
2006	2
2007	3
2008	9
2009	4
2010	17
2011	21
2012	24

Source: http://denik.obce.cz

Another source which can influence public opinion are blogs. As an illustration, I will present two articles showing that PP attracted attention in 2010. The first article was published on October 4, 2010 at `http://tomashudecek.blog.idnes.cz`. He writes about overpriced Prague PP and recommends better public availability of information about PP.[4] The other article was published at `http://jirikubicek.blog.idnes.cz` on August 21, 2010 and shows an unfairness in one particular PP announced by Municipality of Prague 7.[5]

Public Pressure - Elections Before elections in 2010 all political parties with exception of the Communist Party covered in their election programs problem of PP. As it was mentioned at aktuálně.cz (2010), political parties were claiming to enforce more transparent allocation of public resources via PP as a reaction to the revealed cases of corruption and non-transparent PP.

The political sphere stated its intention to increase pressure on PP and make them more transparent for controlling mechanism. Evidence that it was meant seriously by political parties was a novelization of AoPC in 2012 which in certain aspects helped to higher transparency (see page 16). Since political

[4]For details you can see `http://tomashudecek.blog.idnes.cz/c/158207/Vsechny-verejne-zakazky-na-web-jinak-se-zlepseni-nedostavi.html`.

[5]For details you can see `http://jirikubicek.blog.idnes.cz/c/151892/Jak-nezadavat-verejnou-zakazku.html`.

parties try to do what public wants to get their votes, it is also a potential indicator that public wanted some change for better environment in PP.

Several factors regarding the pressure on PP were analyzed above and all of them indicated that time around year 2010 was a breaking point for the situation in PP and confirmed the first hypothesis.

The summary of the results follows. New department of ÚOHS, established in 2011, created a pressure on firms from side of the controlling mechanism. Decreasing CPI index in 2008 - 2011 and increasing Google Trend index indicate that public and potential new firms wanting to enter PP were interested more in PP and problems of public sector and especially firms may have called for more transparent environment in PP. Regarding media, the number of articles and examples of blog entries from 2010 showed increased public pressure on PP. Because election programs of political parties often reflect what public wants to get votes, it was taken as an indicator of public pressure. Before elections in 2010 almost all of the programs covered problem of PP.

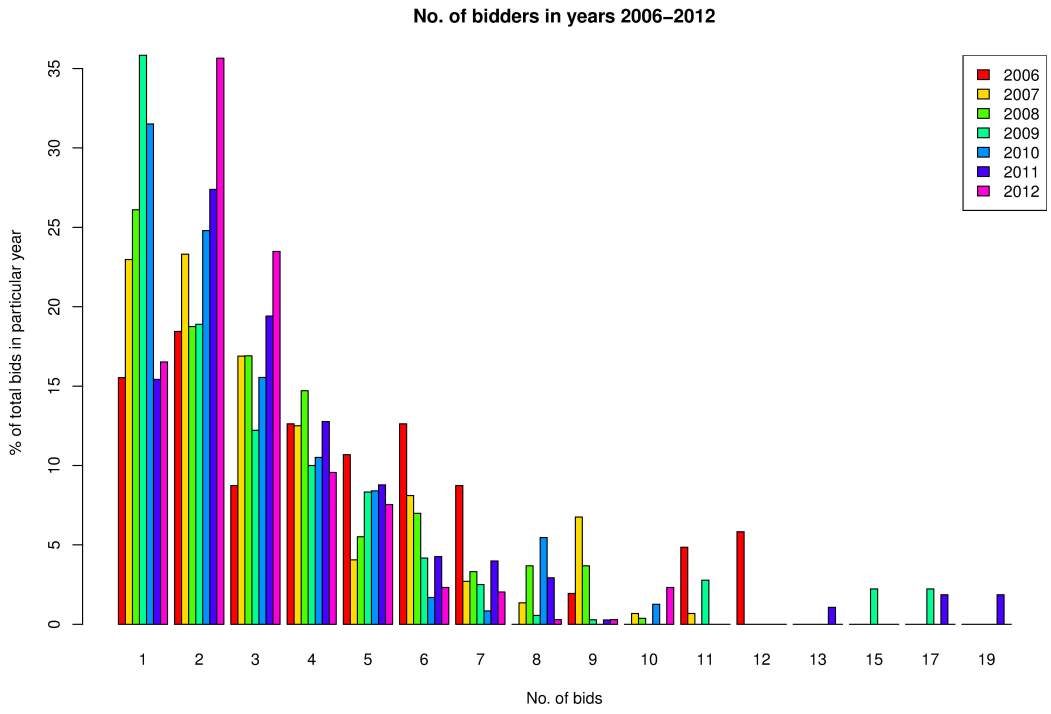
Knowing that pressure on PP increased around 2010, the next part of the analysis is conducted. The outline of the analysis is to look whether there is a low or high level of competition in medical machinery industry. If low level of competition will be confirmed, frequency analysis will be used to find cases of bid rigging supported by low level of competition within a stable group of firms.The last part about excluded and valid bids might reveal potential cases of bid covering and the third hypothesis will be tested in this part. During the whole analysis, I will look for the evidence that year 2010 influenced the behavior of firms and based on that I will confirm the second hypothesis or not.

3.3.3 Number of Bidders in Years

In this subsection the analysis of number of bidders across years is conducted to confirm or reject the second hypothesis of increased competitive behavior of firms after increased pressure on PP around 2010. The PP were divided into years according to the date when the announcement about the PP was sent to ISVZUS system. The law which is applied on the procedure of a PP unwinds from the sending date of the announcement, this will affect the number of 1-

bidder PP in 2012, since such PP are forced to be canceled since April 1, 2012. Figure 3.5 captures the results.

Figure 3.5: "Time series" of number of bidders (Jul 2006 - Dec 2012)



Source: Author's computation.

In procurements with one bidder we can see a steep increase until year 2010. Decrease in relative shares of procurements with one bidder after 2010 is replaced by an increase in two and three bidder procurements after 2010. Procurements with more than 4 bidders are not that often (less than 15% of the cases from each year). This leads to the first main conclusion that level of competition is low in medical machinery.

For the sake of completeness, it must be mentioned that one bidder procurements in 2012 are lower also because of the novelization from April 1, 2012, which forbids to announce a winner when only one bid was received or left after evaluation and the PP must be canceled. Therefore, all the one bid procurements in 2012 in this graph were announced before April 1, 2012.

Years 2010 and 2011 confirm our second hypothesis about change of firms' behavior to become more competitive by shifting the shares from one bidder PP towards two and three bidder PP. The huge decrease in 2011 may be mainly

caused by the introduction of a new department mentioned in previous subsection.

Overall, the shift from 1-bidder to 2- and 3-bidder PP confirms the second hypothesis of more (simulated) competitive behavior. The structure of bids across years shows that procurements with medical machinery and equipment have a very concentrated[6] market. In the majority of cases there are less than 4 bidders in a PP. This finding leads to a conclusion that there may be a risk of bid rigging behavior supported by low level of competition. The other supporting findings for bid rigging are sought by frequency analysis in Subsection 3.3.5. The next subsection looks for subsectors of medical machinery with low level of competition.

3.3.4 Number of Bidders in Subsectors

In this subsection is analyzed a level of competition across subsectors to see which of them may be prone to support bid rigging behavior. For classification of PP into subsectors will be used so called CPV codes.

Common procurement vocabulary (CPV) is a classification system containing unique codes for all types of goods, services and construction work and is harmonized in the whole EU. CPV codes allow to find in a database all PP for the chosen product(s), service(s) or construction work.[7]

Subsectors for medical machinery are defined according to CPV codes into following 10 categories:

0 ... Authority did not chose any of the following subcategories,

1 ... Imaging systems for medical, dental and veterinary purposes (Zobrazovací přístroje pro lékařské, stomatologické nebo veterinární účely),

2 ... Recording systems and diagnostic systems (Záznamové systémy a vyšetřovací přístroje),

3 ... Dental tools and tools and devices of subspecializations (Zubolékařské nástroje a přístroje a nástroje a přístroje podspecializací),

4 ... Medical expendable supplies (Zdravotnický spotřební materiál),

[6] "concentrated" = there are not many companies that compete against each other

[7] All CPV codes can be found at `http://www.portal-vz.cz/Dokumenty/Ke-stazeni.aspx?id=cbbc5b7a-6c66-4a2c-94e6-a944c268f530`

5 ... Systems for radiotherapy, mechanotherapy, electrotherapy and physiotherapy (Přístroje pro radioterapii, mechanoterapii, elektroterapii a fyzioterapii),

6 ... Surgery technique (Operační technika),

7 ... Anesthetics and resuscitation (Anestézie a resuscitace),

8 ... Support of body functions (Podpora funkcí),

9 ... Other medical systems and products (Různé zdravotnické přístroje a výrobky).

One specific of medical machinery PP is that most of the firms are only reselling machines from producers. Reselling firms can therefore participate in more subsectors. If the reselling firm is not participating in some of the subsectors in which machines are resold, it may indicate a potential deal about allocation of the market. The analysis of the subsectors follows.

The whole analysis in this subsection is based on frequency analysis. Reader interested in institutional analysis may skip this subsection.

In Table 3.3 are results of comparing the number of bids across the subsectors. There is a high concentration of firms in each subsector except from subsector 4 (Medical expendable supplies) and subsector 8 (Support of body functions). In subsector 4 belong plasters, bandages, syringes, gauzes, etc. In subsector 8 belong renal support devices, cardiac support devices, orthopedic support devices, extra-corporeal circulatory units, hearing aids, etc. This result is expectable, since procurements in medical expendable supplies and support of body functions can benefit from more competitive market.

In other sectors, procurements with 1 or 2 bidders are dominating. This may indicate that there are only few firms at the market which can fulfill the demands of the authorities. In the following analysis will be analyzed in which subsector firms compete more often to see in which subsectors firms bid repetitively and if they can find partners for collusion within a subsector.

Table 3.3: Relative shares of bidders for each sector (in %)

Bids / Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	15	17	19	NA
0	34.78	39.13	14.49	5.43	3.99	0.72	0.00	0.00	0.00	1.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	33.61	35.28	13.89	10.00	3.06	1.39	0.83	0.00	0.00	0.00	0.28	0.00	0.00	0.00	1.39	0.00	0.28
2	27.21	36.03	21.32	8.82	3.68	2.21	0.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	41.18	23.53	35.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	16.36	14.13	14.68	12.64	8.74	9.48	7.06	3.72	4.28	0.93	2.42	0.93	0.74	1.30	1.30	1.12	0.19
5	36.00	28.80	15.20	4.80	8.00	4.00	0.00	0.80	0.80	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	37.23	40.15	15.33	2.92	0.73	2.92	0.00	0.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	15.79	31.58	21.05	23.68	5.26	2.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	13.98	15.88	19.43	19.67	10.43	4.98	2.13	3.08	2.84	1.66	0.71	0.24	0.00	0.24	0.71	0.24	3.79
9	25.75	25.47	20.87	9.49	7.32	5.15	2.71	2.71	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27

Source: Author's computation.

In Table 3.4 is gathered how many times firm won with respect to all opportunities to win which the firm had (according to the available information, i.e. as a winner and as a non-winning bidder). Just note that we do not have information about non-winning bidders for all procurements (only for 295). Variable "Info" captures how many of the opportunities had available info about other bidders. Another important note is that in some cases more subsectors (i.e. more CPV codes) were assigned to one PP, therefore the "Sum" column in Table 3.4 (which sums all the won/total opportunities) do not reflect the number of PP in which firm entered. Because of space and parsimony only 23 most active firms are shown in Table 3.4.

Based on Table 3.4 the firms with the highest absolute participation in each subsector were detected:

- Subsector 1 (Imaging systems): Magnolia, s.r.o., Liriodendron, s.r.o., Mahonia, s.r.o. and Clematis, s.r.o.,
- Subsector 2 (Recording systems and diagnostic systems): Celtis, s.r.o., Morus, s.r.o., Deutzia, s.r.o.,
- Subsector 3 (Dental tools and tools and devices of subspecializations): too few observations,
- Subsector 4 (Medical expendable supplies): Prunus, s.r.o. and Rosa, s.r.o.,
- Subsector 5 (Systems for radiotherapy, mechanotherapy, electrotherapy and physiotherapy): Celtis, s.r.o., Trollius, s.r.o.,
- Subsector 6 (Surgery technique): Corylus, s.r.o., Celtis, s.r.o.,
- Subsector 7 (Anesthetics and resuscitation): Morus, s.r.o.,
- Subsector 8 (Support of body functions): Adonis, s.r.o., Silene, s.r.o., Dianthus, s.r.o.,
- Subsector 9 (Surgery technique), Celtis, s.r.o. and Deutzia, s.r.o..

The frequency analysis will help to confirm whether some of the above mentioned firms competed together often within the subsectors. However even

Table 3.4: Won/Total Opportunities across Subsectors (Jul 2006 - Dec 2012, absolute values)

Firm \ Sector	0	1	2	3	4	5	6	7	8	9	Sum (Info)
Trollius, s.r.o.	9/12	2/5	0/3	0/0	1/1	14/18	0/0	2/7	1/2	5/9	34/57 (33)
Magnolia, s.r.o.	4/5	21/30	6/10	0/0	0/0	0/0	0/0	0/0	0/0	1/1	32/46 (19)
Prunus, s.r.o.	13/20	6/9	1/3	1/1	65/83	2/2	6/10	1/1	32/36	42/44	169/209 (61)
Dianthus, s.r.o.	0/0	0/0	0/0	0/0	1/1	0/0	0/0	0/0	29/37	0/3	30/41 (16)
Viola, s.r.o.	0/0	2/2	0/0	0/0	21/21	0/0	0/0	0/0	18/21	0/0	41/44 (3)
Adonis, s.r.o.	3/4	2/2	4/4	0/0	1/2	3/3	2/2	0/0	41/50	3/6	59/73 (19)
Liriodendron, s.r.o.	5/8	29/36	6/9	0/0	1/1	1/1	0/0	0/0	0/0	2/2	44/57 (23)
Rosa, s.r.o.	0/0	0/0	0/0	0/0	39/52	0/0	0/0	0/0	0/0	0/0	39/52 (14)
Celtis, s.r.o.	54/64	21/30	14/18	0/0	5/7	25/27	17/23	3/5	6/8	63/73	208/255 (85)
Papaver, s.r.o.	4/5	20/20	4/4	0/0	0/0	0/0	6/6	1/1	0/0	4/6	39/42 (3)
Polygonum, s.r.o.	5/8	0/0	1/1	0/0	5/5	4/7	0/1	3/5	4/5	10/10	32/42 (18)
Silene, s.r.o.	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	20/28	3/3	23/31 (16)
Polygonum, s.r.o.	3/3	1/1	1/1	0/0	34/36	0/0	17/17	0/0	12/14	7/7	75/79 (11)
Elodea, s.r.o.	5/5	2/2	0/0	2/2	2/2	0/0	0/0	0/0	0/0	22/29	33/40 (18)
Morus, s.r.o.	8/13	0/1	13/13	0/0	0/0	1/4	0/0	12/16	1/2	3/6	38/55 (27)
Anemone, s.r.o.	1/1	0/0	0/0	0/0	9/10	1/1	2/2	0/0	17/22	1/1	31/37 (7)
Corylus, s.r.o.	4/12	1/3	0/0	0/0	0/3	2/2	18/23	0/0	0/0	1/1	26/44 (31)
Mahonia, s.r.o.	3/3	32/34	3/3	0/0	0/0	0/0	0/0	0/0	1/1	0/0	39/41 (7)
Ficaria, s.r.o.	7/10	20/23	1/1	0/1	15/24	2/2	1/2	1/1	0/1	10/12	57/77 (20)
Deutzia, s.r.o.	25/43	8/15	12/14	0/0	2/3	1/2	13/14	2/3	7/11	33/50	103/155 (60)
Melica, s.r.o.	10/10	12/13	7/7	0/0	0/0	1/1	0/0	0/0	1/1	8/8	39/40 (5)
Clematis, s.r.o.	5/6	37/46	10/10	1/1	0/1	4/4	1/1	0/0	0/0	2/2	59/71 (18)
Aconitum, s.r.o.	6/9	4/6	1/4	0/0	1/1	5/5	0/0	0/0	0/0	2/16	19/41 (16)

Source: Author's computation.

in sector 8 which has higher level of competition than the others, it seems according to the list above that there might be a potential bid rigging deal. Regarding the market allocation, sector 7 seems to be monopolized.

As a next step, it was analyzed at which frequencies the same firms met in PP and at which subsectors. 2-bidder PP were picked and analyzed. The total amount of 2-bidder PP with information about non-winning bidders is 129. In Table 3.5 are shown the results about firms which competed together more than once (column "Freq" shows the number of entered PP by both firms together) and in which subsectors (column "Subsectors"). To explain why in Table 3.5 are in some cases more subsectors than number of entered PP, I remind the reader that it happens that more subsectors are sometimes assigned to one PP.

Table 3.5 partially confirms the results from Table 3.4 since 3 firms from cases 2 and 13 with the highest frequencies were in the list on page 41. Cases 2 and 13 are candidates for a potential bid rigging scheme.

Table 3.5: Firms which compete together in 2-bidder PP

	Firm 1	Firm 2	Freq	Subsectors
1	Deutzia, s.r.o.	Elodea, s.r.o.	2	0 9 9
2	Deutzia, s.r.o.	Celtis, s.r.o.	5	0 0 5 9 9 9 4 9 0
3	Deutzia, s.r.o.	Trollius, s.r.o.	3	1 0 8 0
4	Celtis, s.r.o.	Morus, s.r.o.	3	0 2 2
5	Kernera, s.r.o.	Primula, s.r.o.	2	4 4
6	Thesium, s.r.o.	Oxyria, s.r.o.	2	0 0
7	Cortusa, s.r.o.	Liriodendron, s.r.o.	2	1 1
8	Myosotis, s.r.o.	Swertia, s.r.o.	2	0 0
9	Corylus, s.r.o.	Medinet s.r.o.	2	6 5 6
10	Corylus, s.r.o.	Prunus, s.r.o.	2	6 0 4
11	Campanula, s.r.o.	Medinet s.r.o.	2	5 6 6
12	Carduus, s.r.o.	Adonis, s.r.o.	2	2 1
13	Doronicum, s.r.o.	Liriodendron, s.r.o.	4	0 0 1 1

Source: Author's computation.

Case Celtis, s.r.o. and Deutzia, s.r.o. in subsector 9 This case has the highest frequency and shows slight potential for bid rigging. As it was discussed in Subsection 2.5.2, environment in which firms bid often together within a small group may lead them to profitable cooperation. They could have had a priori knowledge about low level of competition and made a deal or they could

have learned that they are the only ones who bid and made a deal later or they may potentially make a deal in the future in similar PP.

Case Doronicum, s.r.o. and Liriodendron, s.r.o. in subsector 1 This case has the second highest frequency. The reasoning for cooperation is the same as in previous case. In an environment with low level of competition and high frequency of entering same PP within the same small group of firms, it is profitable to make bid rigging deal.

In this subsection, I aimed on bid covering. In the summary of the main findings is that with exception of 2 subsectors (subsector 4 and 8), the level of competition is low. Frequency analysis revealed 2 potential cases in which making a cartel deal within a subsector is probable. The other types of bid rigging would be analyzed by different method.

3.3.5 Conditions in which Firms Won their Contracts

Now, I leave subsector restriction and continue in the frequency analysis over time. The reason for separating the previous 2 cases is that in these cases plays an additional role the same subsector in deciding about potential bid rigging.

The first part is again based on frequency analysis to find patterns in behavior of firms. At first is analyzed how many contracts were won by firms and at which level of competition. Then is analyzed whether the same firms compete often together across years in PP with low level of competition (2-bidder and 3-bidder). Then begins analysis of the effect of a change in institutional environment on behavior of firms linked via ownership structure. Reader who is not interested in frequency analysis may skip to that part. The frequency analysis is provided to show how firms linked via ownership structure were revealed by a systematic analysis.

At first, I analyze the 25 most active firms and tabulate the amounts (Table 3.7) and shares (Table 3.8) of contracts they won against given number of bidders. These tables will be useful for checking the firm 's ability to win at a certain level of competition.

In total, the most successful suppliers are Prunus, s.r.o. (138 won procurements) and Celtis, s.r.o. (143 won procurements). Especially Celtis, s.r.o. has

a significant bias to winning in smaller competition. The more detailed analysis is conducted further.

In a similar way as in the previous section, it is analyzed how often the firms met in 2- and 3-bidder procurements with respect to years. The goal of these analyses is to look at time dependencies in potential cooperation and other potential relations. One of the hypotheses for this section is that after year 2010, we may see some indicators for increased cooperation because the increased pressure on PP caused a decrease in 1-bidder PP and firms may try to back up their wins.

As a first overview, Table 3.6 represents the availability of additional information about other bidders in the dataset across years[8]. The method of collecting data is described in Section 3.2. Out of 2009 procurements with a known winner, there are 295 PP for which there is an additional information about other bidders. The problem is that it was not obligatory to inform about the other bidders until April 1, 2012. Therefore, there is a bias towards year 2012 with respect to known additional information. The other factor that plays for the bias towards 2012 is that from April 1, 2012 it is forbidden to announce a winner if only one bid was sent or remained for evaluation. This caused a shift to 2- and 3-bidder PP according to Subsection 3.3.3. Together, they cause an increase in available information for PP with 2 and more bidders from year 2012 on.

Table 3.6: Number of PP with Additional Information across Period Jan 2006 - Dec 2012

Bidders\Year	2007	2008	2009	2010	2011	2012	Sum
2	2	2	1	2	28	94	129
3	0	0	0	0	33	49	82
4	0	0	0	0	12	29	41
5	0	0	0	0	9	17	26
6	0	1	0	0	4	3	8
7	0	0	0	0	3	5	8
8	0	0	0	0	0	1	1
Sum	2	3	1	2	89	198	295

Source: Author's computation.

[8]Year is taken from the date when the announcement of the public bid was sent to ISVZUS.

Table 3.7: Contracts won (Jan 2006 - Dec 2012, absolute values)

Firm\No. of bids	1	2	3	4	5	6	7	8	9	10	11	12	13	15	17	19	Won/ In
Trollius, s.r.o.	3	5	8	3	7	3	0	0	1	0	0	0	0	0	0	0	30/48
Magnolia, s.r.o.	7	7	13	2	0	1	0	0	0	0	0	0	0	0	0	0	30/42
Prunus, s.r.o.	18	30	23	19	14	11	4	7	3	2	3	1	1	1	1	0	138/172
Nardus, s.r.o.	2	0	4	8	7	0	0	0	0	0	1	1	1	0	0	0	24/28
Dianthus, s.r.o.	2	3	9	8	4	0	0	0	0	0	0	1	0	0	0	0	27/38
Viola, s.r.o.	3	1	8	8	3	4	1	0	2	0	1	1	0	1	2	1	36/39
Adonis, s.r.o.	20	8	14	3	4	0	0	0	0	0	0	0	0	1	0	0	50/64
Crocus, s.r.o.	11	4	1	1	0	1	0	0	1	0	1	0	0	0	0	0	20/22
Liriodendron, s.r.o.	11	20	4	3	3	1	0	0	0	0	0	0	0	0	0	0	42/52
Rosa, s.r.o.	2	2	2	1	4	5	5	2	7	0	0	0	0	0	0	0	30/43
Celtis, s.r.o.	57	58	16	6	4	0	1	1	0	0	0	0	0	0	0	0	143/180
Papaver, s.r.o.	13	8	1	0	1	0	0	0	0	0	0	0	0	0	0	0	23/26
Polygonum, s.r.o.	5	2	4	4	1	2	2	1	1	0	0	0	1	0	0	0	23/31
Silene, s.r.o.	2	2	13	1	3	0	0	0	0	0	0	0	0	0	0	0	21/29
Polygonum, s.r.o.	24	16	9	4	5	4	4	1	2	0	1	1	0	1	2	0	74/78
Elodea, s.r.o.	5	7	7	1	0	0	0	0	0	0	0	0	0	0	0	0	20/25
Stipa, s.r.o.	0	9	6	7	0	1	0	0	0	0	0	0	0	0	0	0	23/23
Morus, s.r.o.	4	13	4	2	1	0	0	0	0	0	0	0	0	0	0	0	24/39
Anemone, s.r.o.	6	7	5	2	1	3	3	0	0	0	0	0	0	1	1	0	29/35
Corylus, s.r.o.	5	8	5	1	1	0	0	0	0	0	0	0	0	0	0	0	20/30
Mahonia, s.r.o.	14	9	8	6	0	0	0	0	0	0	0	0	0	0	0	0	37/39
Ficaria, s.r.o.	13	7	0	6	3	4	1	3	1	0	1	0	0	0	0	0	39/58
Deutzia, s.r.o.	28	21	13	4	3	1	0	0	0	0	0	0	0	0	0	0	70/106
Melica, s.r.o.	8	12	7	4	2	3	1	0	0	0	0	0	0	0	0	0	37/38
Clematis, s.r.o.	9	19	14	5	0	0	1	0	0	0	0	0	0	0	0	0	48/59

Source: Author's computation.

Table 3.8: Shares of Won Contracts (Jan 2006 - Dec 2012, in %)

Firm\No. of bids	1	2	3	4	5	6	7	8	9	10	11	12	13	15	17	19
Trollius, s.r.o.	10	17	27	10	23	10	0	0	3	0	0	0	0	0	0	0
Magnolia, s.r.o.	23	23	43	7	0	3	0	0	0	0	0	0	0	0	0	0
Prunus, s.r.o.	13	22	17	14	10	8	3	5	2	1	2	1	1	1	1	0
Nardus, s.r.o.	8	0	17	33	29	0	0	0	0	0	4	4	4	0	0	0
Dianthus, s.r.o.	7	11	33	30	15	0	0	0	0	0	0	4	0	0	0	0
Viola, s.r.o.	8	3	22	22	8	11	3	0	6	0	3	3	0	3	6	3
Adonis, s.r.o.	40	16	28	6	8	0	0	0	0	0	0	0	0	2	0	0
Crocus, s.r.o.	55	20	5	5	0	5	0	0	5	0	5	0	0	0	0	0
Liriodendron, s.r.o.	26	48	10	7	7	2	0	0	0	0	0	0	0	0	0	0
Rosa, s.r.o.	7	7	7	3	13	17	17	7	23	0	0	0	0	0	0	0
Celtis, s.r.o.	40	41	11	4	3	0	1	1	0	0	0	0	0	0	0	0
Papaver, s.r.o.	57	35	4	0	4	0	0	0	0	0	0	0	0	0	0	0
Polygonum, s.r.o.	22	9	17	17	4	9	9	4	4	0	0	0	4	0	0	0
Silene, s.r.o.	10	10	62	5	14	0	0	0	0	0	0	0	0	0	0	0
Polygonum, s.r.o.	32	22	12	5	7	5	5	1	3	0	1	1	0	1	3	0
Elodea, s.r.o.	25	35	35	5	0	0	0	0	0	0	0	0	0	0	0	0
Stipa, s.r.o.	0	39	26	30	0	4	0	0	0	0	0	0	0	0	0	0
Morus, s.r.o.	17	54	17	8	4	0	0	0	0	0	0	0	0	0	0	0
Anemone, s.r.o.	21	24	17	7	3	10	10	0	0	0	0	0	0	3	3	0
Corylus, s.r.o.	25	40	25	5	5	0	0	0	0	0	0	0	0	0	0	0
Mahonia, s.r.o.	38	24	22	16	0	0	0	0	0	0	0	0	0	0	0	0
Ficaria, s.r.o.	33	18	0	15	8	10	3	8	3	0	3	0	0	0	0	0
Deutzia, s.r.o.	40	30	19	6	4	1	0	0	0	0	0	0	0	0	0	0
Melica, s.r.o.	22	32	19	11	5	8	3	0	0	0	0	0	0	0	0	0
Clematis, s.r.o.	19	40	29	10	0	0	2	0	0	0	0	0	0	0	0	0

Source: Author's computation.

Before going to the results, it is important to know that out of the 295 cases with information about non-winning bidders only 1 was submitted in a simplified below limit procedure and the other ones were submitted in an open process. It means that in 294 of them a contracting authority had lower influence on the number of delivered bids.

2 bidders The number of all 2-bidder PP which were analyzed is 129. In 33 cases (25% of all cases) some firms met more than once. In Table 3.9 are shown the frequencies at which they met. As a potential cases of bid rigging in Table 3.9, I would pick numbers 2, 4 and 13. In all these cases the firms met across years. Since we are in environment with low level of competition and where the same firms bid repetitively together across years, firms have an incentive for making a bid rigging deal.

Table 3.9: Firms which sent Bids together in 2-bidder PP

	Firm 1	Firm 2	Freq	Years
1	Deutzia, s.r.o.	Elodea, s.r.o.	2	2012 2012
2	Deutzia, s.r.o.	Celtis, s.r.o.	5	2011 2011 2011 2008 2011
3	Deutzia, s.r.o.	Trollius, s.r.o.	3	2012 2012 2012
4	Celtis, s.r.o.	Morus, s.r.o.	3	2011 2012 2012
5	Kernera, s.r.o.	Primula, s.r.o.	2	2011 2011
6	Thesium, s.r.o.	Oxyria, s.r.o.	2	2012 2012
7	Cortusa, s.r.o.	Liriodendron, s.r.o.	2	2012 2012
8	Myosotis, s.r.o.	Swertia, s.r.o.	2	2012 2012
9	Corylus, s.r.o.	Medinet s.r.o.	2	2012 2012
10	Corylus, s.r.o.	Prunus, s.r.o.	2	2012 2012
11	Campanula, s.r.o.	Medinet s.r.o.	2	2012 2012
12	Carduus, s.r.o.	Adonis, s.r.o.	2	2012 2012
13	Doronicum, s.r.o.	Liriodendron, s.r.o.	4	2012 2011 2012 2012

Source: Author's computation.

Case Deutzia, s.r.o. and Celtis, s.r.o. Particularly, in case 2 Deutzia, s.r.o. and Celtis, s.r.o. met once in 2008 and four times in 2011. As it was mentioned above, until April 2012 it was not obligatory to inform public about other bidders. Therefore, there may be some positive probability that they gave bids

together even in years 2009 and 2010 because of their high rate of participation in PP shown in Table 3.7. Unfortunately, as it is shown in Table 3.6, not enough information for these years is available.

There is no case from year 2012. There might be several reasons. If there was some cooperation, it may have ended in 2011. Another explanation may be that results from all PP from 2012 were not announced yet. Of course, there is a chance that the cooperation never existed and they met as competitors just because they specialize in the same field as showed previous analysis of subsectors. However, since both aspects, low level of competition and higher frequency, are fulfilled, it is more profitable for them to make a bid rigging deal than to compete. Based on common history or complex subject of PP they may coordinate its actions in particular PP.

Case Celtis, s.r.o. and Morus, s.r.o. In the next case number 4 firms Celtis, s.r.o. and Morus, s.r.o. gave their bids together 3 times in 2-bidder PP since 2011. If we look deeper, we can find out that Celtis, s.r.o. is a 100% owner of Morus, s.r.o.. This leads to the conclusion that if they are together in a PP, the most probable reason is that they just try to simulate competition. This supports the hypothesis of increased cooperation after year 2010.

Further analysis of this case and motivation of firms will be at the end of the subsection devoted to firms linked via ownership structure.

Case Carduus, s.r.o. and Adonis, s.r.o. Analysis of ownership structure revealed one additional case of firms Carduus, s.r.o. and Adonis, s.r.o. (case 12 from Table 3.9). More detailed analysis of firms linked via ownership structure is at the end of the subsection.

Case Doronicum, s.r.o. and Liriodendron, s.r.o. Last case from Table 3.9 with high frequency is case 13. Doronicum, s.r.o. and Liriodendron, s.r.o. have met 4 times since 2011.

Analysis of 295 cases with information about non-winning bidders reveals that in total they gave 5 bids together. In 4 cases they were the only bidders and in one case a new firm entered. The details of these 5 cases are presented in Table 3.10. The columns show information about winner of PP ("Winner"), how many bids were delivered to contracting authority ("Bids") and how many of them were excluded by contracting authority ("Out").

Table 3.10: Details for Case 13: Doronicum, s.r.o. and Liriodendron, s.r.o.

	Winner	Bids	Out
1	Doronicum, s.r.o.	2	0
2	Doronicum, s.r.o.	2	0
3	Clematis, s.r.o.	3	0
4	Liriodendron, s.r.o.	2	0
5	Liriodendron, s.r.o.	2	0

Source: Author's computation.

In case 3 from Table 3.10, the presence of another competitor caused that none of these two firms won the PP. Even Table 3.7 shows that Liriodendron, s.r.o. is much stronger at 1 and 2-bidder PP than in 3 or higher bidder PP. This may indicate the presence of bid rigging supported by low level of competition and repetitive competition within the same group of firms.

3 bidders The number of all 3-bidder PP which were analyzed is 82. In 34 cases (41% of all cases) some firms met more than once. In Table 3.11 is shown how often they met. The case with the highest frequency in Table 3.11 is number 8. In this case the firms met across years.

Case Dianthus, s.r.o., Silene, s.r.o. and Adonis, s.r.o. Case number 8 has the highest frequency from all the cases. The same three firms have met 10 times in 3-bidder PP since 2011 according to the available data. This is quite a high frequency which may indicate presence of cooperation. In Table 3.7 we can see that all from the triplet Dianthus, s.r.o., Silene, s.r.o. and Adonis, s.r.o. are relatively successful in 3-bidder PP. This may support the conclusion of potential cooperation. Another possible explanation for the high frequency is that they are just specialized in the same area, therefore the probability that they meet in PP in this area is higher.

However, competing with only 2 other firms across years represent a stable environment which supports bid rigging. The firms have to make a deal all together, if they enter the same PP. If only 2 firms would make a bid rigging deal, the 3rd one would always give lower competitive bid. By bid rigging, all the members can be better off.

At this place I would like to remind the reader the list from Subsection 3.3.4 with typical firms for selected subsectors. All these 3 firms are most active

Table 3.11: Firms which sent Bids together in 3-bidder PP

	Firm 1 Firm 3	Firm 2	Freq	Years
1	Deutzia, s.r.o. Prunus, s.r.o.	Celtis, s.r.o.	2	2011 2012
2	Deutzia, s.r.o. AURA Medical s.r.o.	Celtis, s.r.o.	2	2011 2011
3	Deutzia, s.r.o. Arabis, s.r.o.	Fragaria, s.r.o.	2	2011 2011
4	Elodea, s.r.o. Alyssum, s.r.o.	Celtis, s.r.o.	2	2012 2011
5	Elodea, s.r.o. Alyssum, s.r.o.	Aconitum, s.r.o.	4	2012 2011 2011 2011
6	Celtis, s.r.o. Prunus, s.r.o.	Corylus, s.r.o.	2	2012 2012
7	Kernera, s.r.o. Primula, s.r.o.	Falcaria, s.r.o.	3	2011 2011 2011
8	Dianthus, s.r.o. Adonis, s.r.o.	Silene, s.r.o.	10	2011 2011 2012 2012 2012 2012 2011 2011 2011 2011
9	Ficaria, s.r.o. Prunus, s.r.o.	Coronilla, s.r.o.	2	2012 2012
10	Trifolium, s.r.o. Lavatera, s.r.o.	Seseli, s.r.o.	3	2012 2012 2012
11	Linum, s.r.o. Trollius, s.r.o.	Morus, s.r.o.	2	2012 2012

Source: Author's computation.

in subsector 8 (Support of body functions). This subsector was denoted as competitive in previous analysis. On this example is nicely shown that potential bid rigging case may happen also in a competitive environment and that each case of potential bid rigging is unique.

The main findings of the inter-temporal frequency analysis are that in 2-bidder PP were additionally revealed firms bidding together while being in a clear ownership structure. This finding will be discussed in the next part. For

firms detected already in the subsector analysis was found out that they met across years, so another supporting aspect (entering same PP across years) was added for their potential risk of bid rigging. The 3-bidder PP revealed 1 case of high frequency in a low competitive setting of 3 firms which may indicate presence for bid rigging, even though that .

Ownership structure The most interesting finding of the frequency analysis is a reaction of firms on increased pressure by bidding with a firm from the same ownership structure. The Table 3.12 contains such cases. Columns "F1 - all PP" and "F2 - all PP" show how many PP Firm 1 and Firm 2 entered, respectively. Column "Together" reveals how many of them they entered together and last column shows how many of those from previous column either of them won.

Before analyzing particular cases from Table 3.12, I will provide in the following list of potential reasons which may lead firms linked via ownership structure to giving bids together in PP:

- **Fulfillment of AoPC after novelization in April 1, 2012**: For firms which won 1-bidder PP before April 1, 2012 brought novelization an incentive to look for co-bidder which would save the PP from cancellation. This explanation fits for at least one firm from each pair from Table 3.12 (i.e. Adonis, s.r.o., Celtis, s.r.o. and Thesium, s.r.o.). In Table 3.7 is clearly visible that Adonis, s.r.o. and Celtis, s.r.o. won a lot of times in 1-bidder PP. Analysis of Thesium, s.r.o. reveals that the firm wins more often in lower level of competition, however this result is based on 7 observations only.

- **Simulating competition to decrease probability of investigation since 2011**: Another incentive is to look less suspicious in environment with better controlling mechanism and increased pressure from public. Imitating competition may decrease the probability of investigation.

- **Advantage of none side-payments to other firms**: For firms linked via an ownership structure, the profit ends at the same place. Therefore, they do not have to come up with a system of side payments or bid rotation, i.e. transactions costs for making a bid rigging deal are almost zero. This reason may influence a firm's decision of choosing to make a bid rigging deal with a firm which is linked via ownership or with a firm which not linked via ownership.

Table 3.12: Firms with Special Ownership Structure

	Firm 1	Firm 2	F1 owns F2	F1 - all PP	F2 - all PP	Together	F1 or F2 won
1	Celtis, s.r.o.	Morus, s.r.o.	100%	180	39	5	4
2	Thesium, s.r.o.	Oxyria, s.r.o.	100%	7	3	2	2
3	Carduus, s.r.o.	Adonis, s.r.o.	majority in both of them owned by 2 persons	2	64	2	2

Source: Author's computation.

- **Minimizing risk for concern of being excluded from PP**: Firms as team players may together minimize the risk of being excluded totally from PP by a contracting authority and losing profit for the whole structure.

In the list is not stated as a possibility a competition of firms within a concern. The competition within a concern is not an expected behavior. The reason is that firms would decrease their profits by such a behavior. Firms in a concern compete rather with firms outside the concern. This lack of credibility for simulation of competition in this case leads me to the conclusion that firms would use this behavior only for a short term period until they will find a better solution for bid rigging because these clear ownership structures are very easily identifiable by an antitrust authority.

Case Celtis, s.r.o. and Morus, s.r.o. Celtis, s.r.o. and Morus, s.r.o. gave their bids together 5 times in total. Table 3.13 shows more details about these 5 cases. Columns "Bids" and "Out" in Table 3.13 represent total amount of bids and number of bids which were excluded during the PP, respectively. All of the PP were submitted in open process. New firm which won in case 4 may indicate that these two firms did not give competitive bids but only profited from low competition.

Table 3.13: Details for Case 4: Celtis, s.r.o. and Morus, s.r.o.

	Winner	Bids	Out	Firm 2	Firm 3	Firm 4
1	Celtis, s.r.o.	2	0	Morus, s.r.o.		
2	Morus, s.r.o.	3	2	Celtis, s.r.o.	Verbascum, s.r.o.	
3	Morus, s.r.o.	2	0	Celtis, s.r.o.		
4	Melica, s.r.o.	4	0	Doronicum, s.r.o.	Celtis, s.r.o.	Morus, s.r.o.
5	Morus, s.r.o.	2	0	Celtis, s.r.o.		

Source: Author's computation.

In 3 cases out of 5 in Table 3.13, there was no other competitor. 2 cases out of these 3 were announced after April 1, 2012, therefore the potential reason for this may be a fulfillment of AoPC in case of PP which was too complex for some other firm to fulfill. The possible future strategy for these two firms is to bid together to fulfill the conditions given by AoPC until time that another

firm will join them in these special PP and then try to make a deal with this new firm and cover bid rigging in a more sophisticated way.

Case Thesium, s.r.o. and Oxyria, s.r.o. These firms went together to two PP and in both one of them won. Both PP were announced after novelization in April 1, 2012 and the firms were the only bidders. The most probable reason for these bids was a formal fulfillment of AoPC because maybe no other firm could fulfill the subjects of PP so they chose the certainty of cooperation of a firm linked via ownership structure.

Case Carduus, s.r.o. and Adonis, s.r.o. This case is similar to the previous one. Both firms went together to two PP and both times won one of the firms. In both cases they were the only bidders. Therefore, explanation may be again a formal fulfillment of AoPC, since both of the PP were announced after the novelization in April 1, 2012.

Main finding based on these cases is that firms linked via ownership structure appeared in PP after novelization valid from April 1, 2012. This leads to a conclusion that they bid together mainly to avoid cancellation of PP.

As an additional analysis were computed the price differences as a ratio of the lowest bid for all the cases in which these three pairs of firms bid together and one of them won. All PP were submitted in an open process and evaluation criterion was the lowest price. The results are in Table 3.14.

Table 3.14: Percentage Differences of Bids between Firms in the Same Ownership Structure

Firm 1	Firm 2	% Difference
Celtis, s.r.o.	Morus, s.r.o.	0.10
Morus, s.r.o.	Celtis, s.r.o.	0.09
Morus, s.r.o.	Celtis, s.r.o.	0.38
Morus, s.r.o.	Celtis, s.r.o.	0.02
Thesium, s.r.o.	Oxyria, s.r.o.	7.31
Thesium, s.r.o.	Oxyria, s.r.o.	11.17
Adonis, s.r.o.	Carduus, s.r.o.	1.56
Adonis, s.r.o.	Carduus, s.r.o.	2.90

Source: Author's computation.

Big numbers at Thesium, s.r.o. cases are given by a small price of both

contracts, therefore it seems that firms chosen a strategy to add to the lowest bid some nice round figure than only a small percentage. The other 6 contracts had much higher prices therefore adding a small percentage is already quite an amount.

This leads to a conclusion that each case of potential bid rigging must be investigated separately, since even for a quite homogeneous group a different interval of price bid can cause huge differences in one analyzed variable. The potential way how to find out that firms were colluding is to compare the bid with a customary price on private market if it is possible. Then, it will be possible to conclude whether the prices were manipulated or not. As a recommendation for improving the indication of overpriced PP would be an establishment of a new evaluation criterion of customary price on the relevant private market. If the difference between the bid and customary price would not be sufficiently explained, bid will be excluded.

Summary of the part about firms linked via ownership structure: Table 3.12 contains 3 different pairs of firms which entered to PP in total 9 times and won in 8 cases. The amount of revealed cases is not high which may support the conclusion that it is only a quick, temporary solution for firms after change of institutional environment in 2011 and 2012. However to confirm such a hypothesis, the presence of this pattern should be tested again in the future. Analysis of percentage difference between the bids revealed that one variable applied on all the PP is not always the best way how to prove some behavior.

To conclude the whole subsection, there are suspicious cases of bid rigging in 2-bidder and 3-bidder PP. Some of them were confirmed across years and within subsector. The main supporting factors for bid rigging in these cases are low level of competition and high frequency of competition within the same group of firms across years and in 3 cases within subsector. Another unveiled phenomenon was bids of firms which were linked in an ownership structure. Therefore whoever wins, the profit goes to the "same place", so in the end they just simulate competition for some of the reasons mentioned above. The analysis of behavior of firms linked via ownership structure also confirms second hypothesis about simulation of competition after 2010. In my opinion, this bidding of firms in an ownership structure will be only temporary until firms would find more sophisticated behavior in the new environment because the clear owner structure may be easily identified by an antitrust authority.

Based on these results, one of the recommendation for contracting authority may be to check the ownership situation of firms and ask firms for an explanation of such a behavior. If the explanation would not be credible, the firms' bids would be excluded for suspicion from bid rigging. The other recommendation is to clearly analyze the conditions before applying one procedure on the whole sample of data.

3.3.6 Analysis of Excluded and Valid Bids

This subsection is also separated into part based on frequency analysis aimed on excluded bids and the following part which analyzes the effect of institutional change on valid bids, i.e. testing the third hypothesis. The frequency analysis aims on detecting cases of bid covering, especially sending an unsatisfactory bid on purpose.

The analyzed aspect of PP by frequency analysis is an amount of excluded and valid bids. During the evaluation process, the authority can exclude all unsatisfactory bids. Bid is unsatisfactory if it does not satisfy technical or other qualification conditions, if it contains some error in calculation, if price bid exceeds the upper limit given by the authority, etc. All these are examples of bids which cannot be taken into the consideration. The authority has a certain level of discretion when it decides about exclusion of a bid. This may lead to a problem of cooperation between firm and contracting authority. However, this is beyond the scope of this theses.

From the firm's point of view, firm has no incentive to send an unsatisfactory or incomplete bid. This behavior would only increase its costs with no chance for making profit. The possible explanation for this may be a membership in a cartel. Firm in a cartel would send a bid only to simulate competition at first glance. However, in fact it is not a real competitor because his bid does not satisfy all the conditions and in the end the competition is smaller. The excess profit may be distributed via side payments (e.g. subcontracts).

What do the data say about this aspect of PP? Table 3.15 is a contingency table revealing the total amount of bids which were sent (row dimension) and amount of bids which remained after the evaluation (column dimension). Therefore, for example the figure at the second row and the first column says that in 15 cases authority obtained 2 bids but 1 was excluded. The figure at the second row and the second column says that in 114 cases authority obtained 2 bids and none was excluded.

Table 3.15: Exclusion of Bids

After		1	2	3	4	5	6	7
Before	1	63	0	0	0	0	0	0
	2	15	114	0	0	0	0	0
	3	8	36	44	0	0	0	0
	4	0	5	18	17	0	0	0
	5	0	3	3	7	13	0	0
	6	0	0	1	1	2	3	0
	7	0	0	0	0	0	1	4
	8	0	0	0	0	1	0	0

Source: Author's computation.

In the dataset, 359 PP are available with known information about the amount of excluded bids. Table 3.15 reveals 101 cases with excluded bids out of these 359.

Based on this 101 cases, particular firms were analyzed whether they sent unsatisfactory bids and how often. If the firm systematically have unsatisfactory bids it only increases its costs and this behavior is not profitable without any compensations. Table 3.16 contains all the firms which sent a bid which was excluded and it happened more than once.

Among potential cooperators belong e.g. Falcaria, s.r.o. with almost 50% of excluded bids. Using the previous frequency analysis, according to Table 3.11, Falcaria, s.r.o. and Kernera, s.r.o. gave bids together three times with Primula, s.r.o. and in these three cases Falcaria, s.r.o. was excluded in all of them and Kernera, s.r.o. in two of them, leaving Primula, s.r.o. won twice. This looks like a potential bidding ring.

From firms which have 100% of excluded bids has the highest amount Verbascum, s.r.o. and is followed by Jasione, s.r.o. and Nonea, s.r.o.. All these firms were excluded mostly in high level of competition with 5 and more bidders but no patterns were found.

By frequency analysis was found one potential case of bid covering by sending unsatisfactory bids. Other cases in Table 3.16 either did not show any patterns or have a too low ratio to be interesting.

As a next step, I will continue on testing how the institutional environment affects behavior of firms. It will be analyzed whether a novelization of the AoPC in April 2012 had some affect on the exclusion of bids. The third hypothesis

Table 3.16: Firms with excluded Bids

Firm	Excluded/Total
Trollius, s.r.o.	5/48
Prunus, s.r.o.	8/172
Nonea, s.r.o.	2/2
Nardus, s.r.o.	2/28
Dianthus, s.r.o.	6/28
Linum, s.r.o.	2/38
Verbascum, s.r.o.	4/4
Orlaya, s.r.o.	2/18
Jasione, s.r.o.	3/3
Celtis, s.r.o.	4/180
Polygonum, s.r.o.	2/31
Coronilla, s.r.o.	2/9
Centaurea, s.r.o.	2/7
Trifolium, s.r.o.	4/9
Aster, s.r.o.	3/10
Anemone, s.r.o.	2/35
Carex, s.r.o.	2/5
Alyssum, s.r.o.	2/20
Deutzia, s.r.o.	3/106
Fragaria, s.r.o.	6/16
Falcaria, s.r.o.	6/13
Kernera, s.r.o.	6/17
Clematis, s.r.o.	3/59
Aconitum, s.r.o.	7/30

Source: Author's computation.

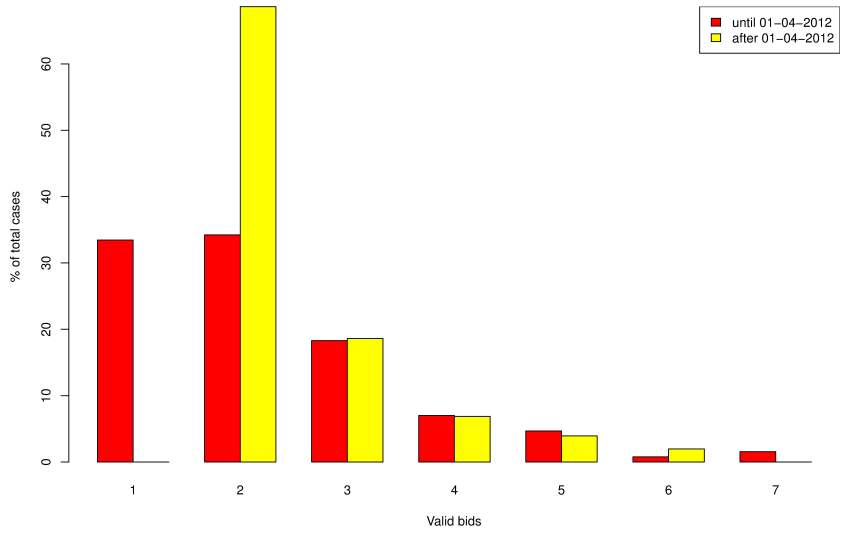
"Novelization does not affect distribution of 2 and more valid bids." can be rewritten as: *"Applying the rules from novelization on data before April 1,2012 will not change the distribution of valid bids, i.e. the behavior of firms is the same during the whole period."*

For testing this hypothesis was created a population of valid bids if novelization would have been valid before April 1, 2012[9]. This new population was compared to population of valid bids from period after April 1, 2012. The results of Kolmogorov Smirnov test are: p-value = 0.00049. We reject the null hypothesis that both of the populations are from the same distribution at 5% significance level, i.e. firms changed their behavior after novelization.

The result of KS test is illustrated on Figure 3.6 with valid bids before and after the novelization. The novelization forbids to announce a winner when

[9]As a decisive day is taken the sending day of announcement of PP in ISVZUS.

Figure 3.6: Valid Bids Comparison before and after Novelization in April 2012



Source: Author's computation.

there is only one valid bid for consideration. Therefore, the column for 1 valid bid is zero after the novelization. Columns for 3 and more valid bids remained more or less the same. The most significant change is at 2 valid bids. It seems that the firms who won alone before the novelization, found some other firms to compete with them. The question is whether it is a real competition or if it is a simulation of competition which serves only as a fulfillment of the AoPC.

To see whether firms try to simulate competition, frequency analysis is used for a detailed analysis of firms which won often in 1-bidder PP. The question is whether they appear often in 2-bidder PP after the novelization. The amount of 2-bidder procurement after the novelization with at least known winner is 62. Table 3.17 shows results for firms which were often in 1-bidder PP. The rows represent total PP entered, total PP won, 1-bidder PP won, total PP that firm entered after novelization and how many 2-bidder PP firm entered after novelization.

The most active in 2-bidder PP is Liriodendron, s.r.o. which entered in such a PP 6 times, i.e. in half of total PP after novelization. If we look back to Subsection 3.3.5 to Table 3.9, we can see that 2 times Liriodendron, s.r.o. entered with Doronicum, s.r.o., his former co-bidder. As it is mentioned in the thesis above, repetitive bidding in low level of competition may mean risk of potential bid rigging schemes.

Table 3.17: Frequent winners of 1-bider PP

	Adonis, s.r.o.	Celtis, s r.o.	Deutzia, s.r.o.	Liriodendron, s.r.o.
In	64	180	106	52
Won	50	143	70	42
Won alone	20	57	28	11
In after novel.	14	11	9	10
In 2-bidder PP after novel. (out of 62)	3	3	5	6

Source: Author's computation.

By checking frequencies in Table 3.9 for Deutzia, s.r.o. which also in half of the PP after novelization were in 2-bidder PP, it seems that its potential co-bidder may be Trollius, s.r.o. for fulfilling the law conditions. 3 times out of 5, Deutzia, s.r.o. gave a bid with Trollius, s.r.o.. For stronger conclusion, we would need future data.

Celtis, s.r.o. was already discussed above in case of the direct ownership of Morus, s.r.o.. One of the potential reasons for this behavior was a fulfillment of AoPC. Similar situation was in case Adonis, s.r.o. and Carduus, s.r.o..

To sum up, analysis of excluded bids was used to reveal suspicious patterns in firm's behavior and effect of novelization. Via frequency analysis was found one potential case of bid suppression. Next part of the analysis revealed, that suddenly after the novelization in 2012, share of 2 valid bids increased dramatically. Kolmogorov Smirnov test rejected the hypothesis that behavior of firms did not change after the novelization. Further frequency analysis indicated that there might be cases of cooperation in order to fulfill conditions from AoPC and in a low level of competition may make a bid rigging deal.

The empirical analysis ends here. The main findings are summarized in the conclusion.

Chapter 4

Conclusion

The goal of the thesis was a case study of indirect indicators of bid rigging applied on Czech PP in medical machinery industry. The main contribution of this work lays in outlining some analytical possibilities for practical detection of bid rigging risk.

The empirical analysis of the thesis had two goals. One was to find whether Czech PP in medical machinery has any of the characteristics supporting bid rigging. Then, by using frequency analysis I tried to find potential cases of bid rigging. The other goal was to test whether public pressure and changes of legislature have an effect on behavior of firms.

The first analysis of the dataset revealed that medical industry has a very low level of competition with exception of subsectors with less specialized goods. Frequency analysis revealed typical cases of potential bid rigging, small groups of firms competing often in one subsector. Frequency analysis applied on the excluded bids revealed potential bid covering deal based on sending unsatisfactory bids.

Concurrently, was conducted an analysis of effects of public pressure and novelization. After confirming that around year 2010 public pressure increased, the first finding was a change in distribution of bids in the whole industry in the period of increased public pressure, i.e. 1-bidder PP decreased and 2-bidder and 3-bidder PP increased. Null hypothesis of no change of behavior of firms after the novelization was rejected based on the distribution of valid bids before and after the change. The results indicates that firms are avoiding of cancellation of 1-bidder PP by an increased participation in 2-bidder PP. This behavior was confirmed for some cases by frequency analysis. Moreover, the frequency analysis revealed that firms within one ownership structure appear more often

together in PP after novelization. The most probable explanation is exactly that they just want to fulfill the condition in AoPC to avoid a cancellation of PP and benefit from no side payments to other firms. However, this kind of behavior can be easily detected by ÚOHS if it would investigate the case, therefore I would say that this solution would be only temporary or used only in critical situations.

Based on the results of empirical part, I would like to conclude with recommendations which may help to increase the transparency and help protecting a contracting authority from bid rigging. In the aspect of time, some indicators of bid rigging can be detected already in the early stages of the PP process, whilst the other can be traced only by ex-post control. The recommendation for protecting contracting authorities from bid rigging is to come up with a set of conditions which can be and should be checked as early in the evaluation process of bids as possible. Breaking such a condition would mean an exclusion of bid.

One such a condition is checking the owner structure and ask subjects for explanation of common presence in cases like: one of the participating subjects owns at least 50% in the other participating subject(s) and in PP is no other subject to compete with them or majority in participating subjects are owned by the same non-participating subject and in PP is no other subject to compete with them. Incredible or no explanation will lead to exclusion of the bids and cancellation of the PP.

The other recommendation would be an introduction of obligatory customary price criterion. The idea is based on checking the difference between bid and prices which were concluded between independent subjects under normal commercial terms in similar conditions (so called customary market prices). Customary price is an objective criterion which reflects a utility of the good or service. In a case that difference between bid and customary price would not be credibly explained by a bidder, bid will be excluded. For introducing into practice, guidelines for its calculation from private sphere, where meets supply and demand, should be provided.

The thesis provided a theoretical background for bid-rigging and conducted an empirical analysis on PP in medical machinery industry showing frequent cases and behavior of firms and its reaction to institutional changes such as public pressure and change of legislature. Some cases fulfilled the assumptions for potential bid rigging deal. The last concluding remark related to analysis of bid rigging is that since bid rigging takes so many forms, it is difficult to come

up with a standard procedure applicable to all cases. It is therefore important to find an approach which is suitable for a particular case.

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Appendix A

Appendix - Supplemental Material for Empirical Analysis

A.1 List of all Authorities

	Name of Authority
1	Bílovecká nemocnice, a.s.
2	CEJIZA, s.r.o.
3	Centrální nákup, příspěvková organizace
4	Centrální zdravotnická zadavatelská s.r.o.
5	Centrum dětských odborných zdravotnických služeb Brno, příspěvková organizace
6	CENTRUM KARDIOVASKULÁRNÍ A TRANSPLANTAČNÍ CHIRURGIE
7	Centrum výzkumu globální změny AV ČR, v. v. i.
8	Česká rozvojová agentura
9	Domažlická nemocnice, a.s.
10	ENDOKRINOLOGICKÝ ÚSTAV
11	Fakultní nemocnice Brno
12	Fakultní nemocnice Hradec Králové
13	Fakultní nemocnice Královské Vinohrady
14	Fakultní nemocnice Olomouc
15	Fakultní nemocnice Ostrava
16	Fakultní nemocnice Plzeň
17	Fakultní nemocnice u sv. Anny v Brně
18	Fakultní nemocnice v Motole

19 Fyzikální ústav AV ČR, v.v.i.
20 Hamzova odborná léčebna pro děti a dospělé
21 Chrudimská nemocnice, a.s.
22 INSTITUT KLINICKÉ A EXPERIMENTÁLNÍ MEDICINY
23 Karlovarská krajská nemocnice a.s.
24 Karlovarský kraj
25 Klatovská nemocnice, a.s.
26 Kraj Vysočina
27 Krajská nemocnice Liberec, a.s.
28 Krajská nemocnice Liberec, příspěvková organizace
29 Krajská nemocnice T. Bati, a. s.
30 Krajská zdravotní, a.s.
31 Krajské nemocnice, příspěvková organizace
32 Krajské ředitelství policie Ústeckého kraje
33 Královéhradecký kraj
34 Kroměřížská nemocnice a.s.
35 Léčebna respiračních nemocí Cvikov, příspěvková organizace
36 Litomyšlská nemocnice, a.s.
37 Lužická nemocnice a poliklinika, a.s.
38 Masarykova městská nemocnice v Jilemnici
39 Masarykova univerzita
40 MASARYKŮV ONKOLOGICKÝ ÚSTAV
41 Město Litoměřice
42 Město Nýrsko
43 Město Pelhřimov
44 Město Slaný
45 Město Vysoké Mýto
46 Město Žatec
47 MĚSTSKÁ ČÁST PRAHA 1
48 MĚSTSKÁ ČÁST PRAHA 10
49 Městská nemocnice Čáslav
50 Městská nemocnice Městec Králové a.s.
51 Městská nemocnice Ostrava, příspěvková organizace
52 Městská nemocnice, a.s.
53 MIKROBIOLOGICKÝ ÚSTAV AV ČR, v.v.i.
54 MINISTERSTVO FINANCÍ
55 MINISTERSTVO OBRANY

56 MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY
57 MINISTERSTVO VNITRA
58 Moravskoslezský kraj
59 Nejvyšší kontrolní úřad
60 Nemocnice Blansko
61 Nemocnice Boskovice s.r.o
62 Nemocnice Břeclav, příspěvková organizace
63 Nemocnice České Budějovice, a.s.
64 Nemocnice Havlíčkův Brod, příspěvková organizace
65 Nemocnice Ivančice, příspěvková organizace
66 Nemocnice Jablonec nad Nisou, p.o.
67 Nemocnice Jihlava, příspěvková organizace
68 Nemocnice Jindřichův Hradec, a.s.
69 Nemocnice Kadaň s.r.o.
70 Nemocnice Kyjov, příspěvková organizace
71 Nemocnice Milosrdných bratří, příspěvková organizace
72 Nemocnice Na Bulovce
73 Nemocnice Na Homolce
74 Nemocnice Nové Město na Moravě, příspěvková organizace
75 Nemocnice Písek, a.s.
76 Nemocnice Podlesí a.s.
77 Nemocnice Prachatice, a.s.
78 Nemocnice Rudolfa a Stefanie Benešov, a.s., nemocnice Středočeského kraje
79 Nemocnice s poliklinikou Česká Lípa, a.s.
80 Nemocnice s poliklinikou Karviná-Ráj, příspěvková organizace
81 Nemocnice s poliklinikou v Novém Jičíně, příspěvková organizace
82 Nemocnice Strakonice, a.s.
83 Nemocnice Sušice o.p.s.
84 Nemocnice Tábor, a.s.
85 Nemocnice TGM Hodonín, příspěvková organizace
86 Nemocnice Třinec, příspěvková organizace
87 Nemocnice ve Frýdku-Místku, příspěvková organizace
88 Nemocnice Vyškov, příspěvková organizace
89 Nemocnice Znojmo, příspěvková organizace
90 Oblastní nemocnice Kladno, a.s., nemocnice Středočeského kraje
91 Oblastní nemocnice Kolín, a.s., nemocnice Středočeského kraje

92 Oblastní nemocnice Mladá Boleslav, a.s., nemocnice Středočeského kraje
93 Oblastní nemocnice Příbram, a.s.
94 Oblastní nemocnice Trutnov a.s.
95 Olomoucký kraj
96 Orlickoústecká nemocnice, a.s.
97 Ostravská univerzita v Ostravě
98 OSTROV ZDRAVÍ o.p.s.
99 PARDUBICKÝ KRAJ
100 Plzeňský kraj
101 Poliklinika Žďár nad Sázavou
102 Psychiatrická léčebna v Dobřanech
103 REHABILITAČNÍ ÚSTAV HRABYNĚ
104 Rehabilitační ústav Kladruby
105 REZIDENCE Nové Hrady, a.s.
106 Rokycanská nemocnice, a.s.
107 RTG - CT, s.r.o.
108 Sdružené zdravotnické zařízení Krnov, příspěvková organizace
109 Sjednocená organizace nevidomých a slabozrakých České republiky
110 Slezská nemocnice v Opavě, příspěvková organizace
111 Správa státních hmotných rezerv
112 STÁTNÍ ÚSTAV RADIAČNÍ OCHRANY
113 Státní veterinární ústav Jihlava
114 Státní veterinární ústav Olomouc
115 STÁTNÍ VETERINÁRNÍ ÚSTAV PRAHA
116 Statutární město Brno
117 Statutární město Frýdek-Místek
118 Statutární město Havířov
119 STATUTÁRNÍ MĚSTO CHOMUTOV
120 Stodská nemocnice, a.s.
121 Středočeský kraj
122 Svaz neslyšících a nedoslýchavých v ČR
123 Svaz tělesně postižených v České republice, o.s.
124 Technická univerzita v Liberci
125 Thomayerova nemocnice
126 Uherskohradišťská nemocnice a.s.
127 Univerzita Karlova v Praze
128 Univerzita Palackého v Olomouci

129 Univerzita Pardubice
130 Univerzita Tomáše Bati ve Zlíně
131 Ústav geoniky AV ČR, v.v.i.
132 ÚSTAV HEMATOLOGIE A KREVNÍ TRANSFUZE
133 Ústav jaderného výzkumu Řež a.s.
134 ÚSTAV LETECKÉHO ZDRAVOTNICTVÍ PRAHA
135 Ústav molekulární genetiky AV ČR, v.v.i.
136 ÚSTAV ORGANICKÉ CHEMIE A BIOCHEMIE AV ČR, v.v.i.
137 ÚSTAV PRO PÉČI O MATKU A DÍTĚ
138 Ústav teoretické a aplikované mechaniky AV ČR, v.v.i.
139 ÚSTŘEDNÍ VOJENSKÁ NEMOCNICE PRAHA
140 Územní středisko záchranné služby Moravskoslezského kraje, příspěvková organizace
141 Veterinární a farmaceutická univerzita Brno
142 Vězeňská služba České republiky
143 Vojenská lázeňská a rekreační zařízení
144 Vojenská nemocnice Brno
145 Vojenská nemocnice Olomouc
146 Vsetínská nemocnice a.s.
147 VŠEOBECNÁ FAKULTNÍ NEMOCNICE V PRAZE
148 VYSOKÁ ŠKOLA BÁŇSKÁ-TECHNICKÁ UNIVERZITA OSTRAVA
149 Vysoké učení technické v Brně
150 Výzkumný ústav anorganické chemie, a.s.
151 Výzkumný ústav veterinárního lékařství, v.v.i.
152 Západočeská univerzita v Plzni
153 Zdravotnická záchranná služba hlavního města Prahy - územní středisko záchranné služby
154 Zdravotnická záchranná služba Jihomoravského kraje, příspěvková organizace
155 Zdravotnická záchranná služba kraje Vysočina, příspěvková organizace
156 Zdravotnická záchranná služba Plzeňského kraje, příspěvková organizace
157 Zdravotnický holding Královéhradeckého kraje a.s.

A.2 List of Suppliers which won at least 1 Procurement

	Supplier	Supplier's id
1	"APR" spol. s r.o.	CZ44792883
2	2T engineering s.r.o.	CZ28259068
3	3 M Česko, spol. s r.o.	CZ41195698
4	A care a.s.	CZ25085484
5	A.M.I. - Analytical Medical Instruments, s.r.o.	CZ63983524
6	AB Sciex s.r.o.	CZ28236661
7	Abbott Laboratories, s.r.o.	CZ25095145
8	ACESO PRAHA, s.r.o.	CZ48025551
9	Advantis Medical s.r.o.	CZ24774880
10	ADYTON s.r.o., (angl. Ltd, něm. GmbH, franc. S.R.L.A.)	CZ45807051
11	AGAVE a.s.	CZ29037786
12	AGMECO LT,s.r.o.	CZ27100022
13	AKC konstrukce, s.r.o.	CZ63322731
14	Alcon Pharmaceuticals (Czech Republic) s.r.o.	CZ26427389
15	Alien technik s.r.o.	CZ25284584
16	ALINEX - Kácovská, s.r.o.	CZ14892359
17	Alliance Healthcare s.r.o.	CZ14707420
18	ALTECH, spol s r.o.	CZ46344861
19	ALWIL Trade, spol. s r.o.	CZ16188641
20	AMEDIS, spol. s r.o.	CZ48586366
21	APTUM, a.s.	CZ28909267
22	ARID obchodní společnost, s.r.o.	CZ47916052
23	ArjoHuntleigh s.r.o.	CZ46962549
24	ARROW International CR, a.s.	CZ60112387
25	Ars Audio spol. s r.o.	CZ25100971
26	ARTIK-INTERIER s.r.o.	CZ26029081
27	Askin & Co. s. r. o.	CZ48399965
28	AUDIOSCAN, spol. s r.o.	CZ40615421
29	AURA Medical s.r.o.	CZ65412559
30	B A T Ě K	CZ16088344
31	B A T I S T s. r. o.	CZ46507850

32	B. Braun Medical s.r.o.	CZ48586285
33	BANK.SYS s.r.o.	CZ25609076
34	BARD Czech Republic s.r.o.	CZ28204158
35	BATIST Medical a.s.	CZ28813936
36	BAXTER CZECH spol. s r.o.	CZ49689011
37	Beckman Coulter Česká republika s.r.o.	CZ28233492
38	BEZNOSKA, s.r.o.	CZ43774946
39	Bio-Consult Laboratories spol. s r.o.	CZ49617281
40	BIO-RAD spol.s r.o.	CZ49243764
41	BIOMEDICA ČS, s.r.o.	CZ46342907
42	BIOMET CZ, s.r.o.	CZ25724487
43	BioTech a.s.	CZ25664018
44	BIOTRONIK Praha, spol. s r. o.	CZ16191242
45	BioVendor - Laboratorní medicína a.s.	CZ63471507
46	BMT Medical Technology s.r.o.	CZ46346996
47	BOHEMIA MEDICAL spol. s r.o.	CZ62580698
48	Boston Scientific Česká republika s.r.o.	CZ25635972
49	BS PRAGUE MEDICAL CS, spol. s r.o.	CZ25112015
50	BTL zdravotnická technika, a.s.	CZ26884143
51	BULL s.r.o.	CZ49242954
52	CANBERRA-PACKARD, s.r.o.	CZ44850867
53	CARDION s.r.o.	CZ60719877
54	CaridianBCT Europe, N.V.	BECARIDIAN_1
55	Carl Zeiss spol. s r.o.	CZ49356691
56	CASTOR CZ, s.r.o.	CZ63495619
57	CMI s.r.o.	CZ47117320
58	ComArr, spol. s r.o.	CZ15050084
59	COMESA, spol. s r.o.	CZ18630529
60	COMFES, spol. s r.o.	CZ60724846
61	COROLINE a.s.	CZ26698218
62	Covidien ECE s.r.o., organizační složka	CZ27445241
63	CYMEDICA, spol. s r.o.	CZ61682535
64	Česká letecká servisní a.s.	CZ25101137
65	České vysoké učení technické v Praze	CZ68407700
66	DANIŠEVSKÝ spol. s r.o.	CZ60109734
67	Dantec Dynamics GmbH	DEDANTEC_1
68	DARTIN spol.s r.o.	CZ40763781

69	DENT UNIT, s. r. o.	CZ45538263
70	Dentalex spol. s r.o.	CZ49286269
71	Diagnostic Pharmaceuticals a.s.	CZ26443929
72	Dialab spol. s r.o.	CZ14889200
73	DINA - HITEX, spol. s r.o.	CZ46965661
74	Distrimed s.r.o.	CZ27370046
75	DN FORMED Brno s.r.o.	CZ46982604
76	DONAU LAB, s.r.o.	CZ45244651
77	Dräger Medical s.r.o.	CZ26700760
78	DYNEX TECHNOLOGIES, spol.s r.o.	CZ48108731
79	E-Tronics s.r.o.	CZ25584413
80	E&K Automation s.r.o.	CZ45789436
81	e/mti s.r.o.	CZ49433890
82	East Port Praha, s.r.o.	CZ26185423
83	ECP a.s.	CZ25681869
84	EDOMED a.s.	CZ63673169
85	EGO Zlín, spol. s r.o.	CZ46902473
86	Electric Medical Service, s.r.o.	CZ49970267
87	ELLA-CS, s.r.o.	CZ27507785
88	ELMES PRAHA,s.r.o.	CZ65411587
89	EMBITRON s.r.o.	CZ26361175
90	ENDOIMPLANT CZ spol. s r.o.	CZ26115506
91	ENVINET a.s.	CZ25506331
92	Enviroinvest s.r.o.	CZ29052980
93	Eppendorf Czech & Slovakia s.r.o.	CZ27939031
94	ERA-PACK s.r.o.	CZ46507256
95	ERILENS s.r.o.	CZ45306371
96	EspoMed spol. s r.o.	CZ25284461
97	EUROMEDICAL spol. s r.o., EUROMEDICAL GmbH /německy/	CZ41192923
98	EXBYDO s.r.o.	CZ62497791
99	Fakultní nemocnice Ostrava	CZ00843989
100	Fénix Brno, spol. s r.o.	CZ44961863
101	Fenwal Czech s.r.o.	CZ28244168
102	FOMEI a.s.	CZ46504869
103	Forenzní DNA servis, s.r.o.	CZ27227529
104	Fresenius Kabi s.r.o.	CZ25135228

105	Fresenius Medical Care - ČR, s.r.o.	CZ45790884
106	FROS ZPS s.r.o.	CZ26803291
107	FUJIFILM CZ, s.r.o. v likvidaci	CZ14888807
108	FUJIFILM Europe GmbH, organizační složka	CZ24660736
109	Fujinon (Europe) GmbH,organizační složka	CZ27216845
110	Fujitsu Siemens Computers IT Product Services s.r.o.	CZ27414213
111	G P S PRAHA, SPOL.S R.O.	CZ60491256
112	GE Medical Systems Česká republika,s.r.o.	CZ63991306
113	GEHE Pharma Praha, spol. s.r.o.	CZ14888742
114	GeneTiCA s.r.o.	CZ25609378
115	Getinge Czech Republic, s.r.o.	CZ27614883
116	Glomex MS, s.r.o.	CZ28426525
117	GLYNN BROTHERS CHEMICALS Prague, spol. s r.o.	CZ41196074
118	GRANE s.r.o.	CZ47907193
119	Grifols s.r.o.	CZ48041351
120	GUIDANT ČR s.r.o.	CZ27065651
121	H Q H SYSTEM spol. s r.o.	CZ48112488
122	Haemonetics CZ, spol. s r.o.	CZ25555952
123	HARTMANN - RICO a.s.	CZ44947429
124	HEBIOS, s.r.o.	CZ25827596
125	HENRY SCHEIN DENTAL s.r.o.	CZ46977830
126	HEWLETT-PACKARD s.r.o.	CZ17048851
127	HighRes Biosolutions Inc.	USHIGHRES _1
128	HOCHTIEF CZ a. s.	CZ46678468
129	HOLTE MEDICAL, a.s.	CZ25634160
130	HOSPIMED, spol. s r.o.	CZ00676853
131	Hoyer Praha s.r.o.	CZ60491582
132	HPST, s.r.o.	CZ25791079
133	Hypokramed s.r.o.	CZ49616528
134	CHEIRÓN a.s.	CZ27094987
135	Chemelek spol. s r.o.	CZ48361241
136	CHIRANA T. Injecta CZ, spol. s r.o.	CZ26216469
137	CHIRMAX, s.r.o.	CZ61457434
138	CHIRONAX - DIZ s.r.o.	CZ48114421
139	CHIRONAX ESTRAL spol. s r. o.	CZ44848315

140	Chironax Frýdek - Místek s.r.o.	CZ47666391
141	Chromservis s.r.o.	CZ25086227
142	I B P medica s.r.o.	CZ47121661
143	I.T.A.-Intertact s.r.o.	CZ65408781
144	ICZ a.s.	CZ25145444
145	IMMOMEDICAL CZ s.r.o.	CZ28480830
146	IMOS Brno, a.s.	CZ25322257
147	INLAB Medical, s.r.o.	CZ25775502
148	Innova Medical s.r.o.	CZ28360931
149	INTERGOS-CZ, s.r.o.	CZ26831091
150	JK - Trading spol. s r.o.	CZ46883690
151	Johnson & Johnson, s.r.o.	CZ41193075
152	JPM Medical s.r.o.	CZ28533704
153	Kardio - Line spol. s r.o.	CZ46994769
154	KARDIO PORT, a.s.	CZ28203585
155	KRD-obchodní společnost s.r.o.	CZ26424991
156	L I N E T spol. s r.o.	CZ00507814
157	LAO - průmyslové systémy, s.r.o.	CZ25705512
158	LaparoTech Instruments s.r.o.	CZ25622846
159	LEMMA a.s.	CZ25169238
160	Lesní stavby, s.r.o.	CZ64834042
161	LHL s.r.o.	CZ27301800
162	Life Technologies Czech Republic s.r.o.	CZ25761307
163	Lima CZ s.r.o.	CZ27199592
164	LINEQ s.r.o.	CZ26131455
165	LINON CZ s.r.o.	CZ25930087
166	Lohmann & Rauscher, s.r.o.	CZ18825869
167	M e d i m spol. s r.o.	CZ47903279
168	MADISSON, s.r.o.	CZ26124637
169	MAQUET Medizintechnik Vertrieb und Service GmbH, organizační složka	CZ27611400
170	MARTEK MEDICAL a.s.	CZ47675934
171	MCAE Systems, s.r.o.	CZ60755431
172	Measurement Technic Moravia Ltd. - organizační složka.	CZ28331311
173	MEDATA, spol. s r.o.	CZ18626220
174	MEDESA s.r.o.	CZ64254577

175	MEDIAL spol. s r.o.	CZ14892901
176	MEDIAP, spol. s r.o.	CZ64509648
177	MEDICA FILTER spol. s r.o.	CZ00669555
178	MEDICA, spol. s r.o.	CZ18825249
179	MEDICAL M spol. s r.o.	CZ47287128
180	MedicCor a.s.	CZ28442636
181	MEDIFINE a.s.	CZ27718948
182	Mediform, spol. s r.o.	CZ49976770
183	MEDIN, a.s.	CZ43378030
184	Medinet s.r.o.	CZ47538198
185	MEDIPRAX CB s.r.o.	CZ63886731
186	medisap,s.r.o.	CZ48029360
187	MEDISERVIS s.r.o.	CZ27201864
188	MEDISTA spol.s r.o.	CZ60199865
189	MEDITES PHARMA, spol. s r.o.	CZ45194815
190	MEDKONSULT, s. r. o.	CZ47679522
191	MEDLOGIX s.r.l.	ITMEDLOGIX_1
192	MEDPROGRESS spol.s r.o.	CZ48027511
193	MEDTEC - VOP, spol. s r.o.	CZ64791319
194	Medtronic Czechia s.r.o.	CZ64583562
195	MERCI, s.r.o.	CZ46966447
196	Metrostav a.s.	CZ00014915
197	MIELE,spol. s r.o.	CZ18829503
198	MIKRO, spol. s r.o.	CZ41604326
199	Mölnlycke Health Care, s.r.o.	CZ25671839
200	MSA medical s.r.o.	CZ27753760
201	MSM, spol. s r.o.	CZ47546999
202	NIKON spol. s r.o.	CZ61509426
203	NIMOTECH, s.r.o.	CZ18825605
204	NORTH MED spol. s r.o.	CZ25457811
205	Nutricia a.s.	CZ63079640
206	O.K.SERVIS BioPro, s.r.o.	CZ62914511
207	OFTIS-OPTA s.r.o.	CZ64650502
208	OHL ŽS, a.s.	CZ46342796
209	OLYMPUS C & S spol. s r.o., člen koncernu Obchodní zkratka OCS	CZ14891972
210	Olympus Czech Group, s.r.o., člen koncernu	CZ27068641

211	Omnimedics CZ s.r.o.	CZ27953548
212	OMS - ZOLL s.r.o.	CZ46580379
213	OR-CZ spol. s r.o.	CZ48168921
214	OZM Research s.r.o.	CZ25278118
215	PANEP CZ s.r.o.	CZ26909243
216	PANEP s.r.o.	CZ25550250
217	PAPco, s.r.o.	CZ48038512
218	PE Systems s.r.o.	CZ48034096
219	Pharma Real, a.s.	CZ26215110
220	PHARMOS, a.s.	CZ19010290
221	Philips Česká republika s.r.o.	CZ63985306
222	PHOENIX lékárenský velkoobchod, a.s.	CZ45359326
223	Plzeňská lékárnická s.r.o.	CZ25238213
224	POLYMED medical CZ, a.s.	CZ27529053
225	Pragolab s.r.o.	CZ48029289
226	PROMA REHA, s.r.o.	CZ63219107
227	PROMEDICA PRAHA GROUP, a.s.	CZ25099019
228	ProSpon, spol. s r.o.	CZ45145466
229	PSI (Photon Systems Instruments), spol. s r.o.	CZ60646594
230	PURO-KLIMA, a.s.	CZ00149331
231	RADIX CZ s.r.o.	CZ26774321
232	Radix, spol. s.r.o.	SKRADIX, S_1
233	RAUDO - výrobní družstvo invalidů	CZ26842998
234	Rent-Pharm,a.s.	CZ25531603
235	RESI Třeboň spol. s r.o.	CZ25178989
236	Rigaku Innovative Technologies Europe s.r.o.	CZ28400020
237	ROCHE s.r.o.	CZ49617052
238	S & T Plus s.r.o.	CZ25701576
239	S. A. B. Impex, s.r.o.	CZ64511588
240	SANICARE s.r.o.	CZ26892626
241	SCIENTIFIC INSTRUMENTS BRNO, spol. s.r.o.	CZ49444875
242	SERAG s. r. o.	CZ00870382
243	SHIMADZU Handels GmbH-organizační složka	CZ15887103
244	SHK CZ s.r.o.	CZ27155544

245	SCHOELLER INSTRUMENTS, s.r.o.	CZ25065939
246	Schubert CZ spol. s r.o.	CZ41694783
247	SIAD Czech spol. s r.o.	CZ48117153
248	SICAR, spol. s r.o.	CZ47541547
249	Siemens Healthcare Diagnostics s.r.o.	CZ25056247
250	Siemens, s.r.o.	CZ00268577
251	SINOMED s.r.o.	CZ27587657
252	SPEKTRA, výrobní družstvo nevidomých	CZ00144860
253	SPIRIT MEDICAL spol. s r.o.	CZ60468581
254	STAPRO s. r. o.	CZ13583531
255	STARKON Nová Říše, spol. s r.o.	CZ63472724
256	STERIPAK s.r.o.	CZ26225484
257	Stimcare s.r.o.	CZ25749897
258	Struers GmbH, organizační složka	CZ26771209
259	SUBITO CZ spol. s r.o.	CZ27128814
260	Surgipa Medical, spol. s r.o.	CZ27275230
261	SYNLAB HOSPITAL s.r.o.	CZ25163191
262	Synthes, s.r.o.	CZ25071190
263	Technicare CZ, spol. s r.o.	CZ26817802
264	TESTIMA, spol. s r. o.	CZ40613186
265	Timed s.r.o.	SKTIMED S._2
266	TRANSKONTAKT-MEDICAL s.r.o.	CZ45797803
267	TRIGON PLUS spol. s r.o.	CZ46350110
268	TRIOS, spol. s r.o.	CZ44269471
269	UJP PRAHA a.s.	CZ60193247
270	UNIBAL s.r.o.	CZ48202941
271	unimedis,s.r.o.	CZ27073262
272	VAMEX, spol. s r.o.	CZ18626513
273	VarioMedical, s.r.o.	CZ28336551
274	VDI Meta - výrobní družstvo invalidů	CZ25861808
275	Videris s.r.o.	CZ27189112
276	VIDRA A SPOL. s.r.o.	SKVIDRA A _2
277	VisualSonics Incorporated	CAVISUALSO_1
278	VITRUM Praha, spol. s r.o.	CZ63073242
279	VITRUM Sterilizace, spol. s r.o.	CZ25381873
280	VULKAN - Medical, a.s.	CZ27226158
281	WIDEX LINE spol. s r.o.	CZ45786381

282	Zimmer Czech, s.r.o.	CZ25107976
283	ZMF Medical, s.r.o.	CZ27786374