István János Tóth[1] - Miklós Hajdu[2]

Intensity of Competition, Corruption Risks and Price Distortion in the Hungarian Public Procurement – 2009-2016

Working Paper Series
CRCB-WP/2017:2

December 2017 - Budapest

[1] senior research fellow at IE CERS HAS and director at CRCB (istvanjanos.toth@crcb.eu)
[2] PhD student at Corvinus University of Budapest and research fellow at CRCB (miklos.hajdu@crcb.eu)

Abstract

The report examines Hungarian public procurement data in the period between 2009 and 2016. Data from 151,457 contracts were used for the analysis, which focuses on information about the intensity of competition, price distortion and corruption risks. We analysed price distortion using Benford's law. We also studied the performance of EU-funded projects from these viewpoints. The results show that 2016 was a very special year from the aspect of Hungarian public procurement, as there was a major decrease in the number of contracts and an extremely low proportion of EU-funded public procurement. The findings also provide evidence for the presence of price distortion based on different approaches during the period under examination. Finally, employing several methods, we estimated the volume of direct social loss due to corruption. According to the results, the aggregate amount of estimated direct social loss reached at least 2.1–3.3 trillion forints (6.7–10.6 billion euros) and came to 15–24% of total public procurement spending in the 2009–2016 period. Based on the results, we point out that EU funding has perverse effects on public procurement in Hungary: it has aided in reducing the intensity of competition and increasing both the level of corruption risk and the weight of price distortion, and it has generated the growth of estimated direct social loss due to weak competition and a high level of corruption risk during the period.

JEL classification: D22, D72, H57, L13

Keywords: public procurement, intensity of competition, price distortion, corruption risk, social loss, empirical analysis Hungary

The Corruption Research Center Budapest was created in November 2013 in response to the growing need for independent research on corruption and quality of government in Hungary. Hence, the Center was established as a non-partisan research institute independent of governments, political parties or special interest groups. The aims of the Center are to systematically explore the causes, characteristics, and consequences of low quality of government, corruption, and regulatory failure using an inter-disciplinary approach. The Center also aims to help citizens to hold governments accountable through the use of empirical evidence.

Intensity of Competition, Corruption Risks and Price Distortion in the Hungarian Public Procurement – 2009-2016

The report was prepared for the EU Commission. The database building and the research on corruption risks in the Hungarian public procurement was supported by the Hungarian National Scientific Fund (OTKA, K116860).

Working Paper Series: CRCB-WP/2017:2

Supporting partners:
3gteam ltd: http://www.3gteam.hu/

Staff:

Mikós Hajdu	sociologist
Balázs Molnár	sociologist
Anna Nyáry	sociologist
Klára Ungár	economist
István János Tóth	economist & sociologist

Experts:

Katalin Andor,	economist
Katalin Goldstein	language consultant
Jenő Gyenese	software engineer
Magda József	lawyer
Zoltán Kelemen	lawyer
Attila Székely	procurement specialist

Authors:
István János Tóth & Miklós Hajdu

Head of research:
István János Tóth

Corruption Research Center Budapest
e-mail: info@crcb.eu
internet: http://www.crcb.eu/

Suggested citation: Tóth, I. J., M. Hajdu. 2017. Intensity of Competition, Corruption Risks and Price Distortion in the Hungarian Public Procurement – 2009-2016. Working Paper Series: CRCB-WP/2017:2. Budapest: CRCB.

Date of publication: 20 December 2017

Contents

Executive Summary

- The report examines Hungarian public procurement data in the period between 2009 and 2016. Data on 151,457 contracts were used for the analysis. The report focuses on information about the intensity of competition, price distortion and corruption risks. We also analyse the performance of EU-funded projects from these viewpoints. The results provide evidence of price distortion based on several different approaches during the period under examination. Based on observations derived from contract data, we also estimate the magnitude of estimated direct social loss due to corruption risk and weak completion.
- In 2016, there was a major decrease in the number of contracts (it was about two-thirds of the 2015 volume), which occurred due to a sharp drop in the quantity of EU-funded contracts, although the aggregate sum of net contract values for 2016 barely changed compared to 2015.
- It was anticipated that the new Public Procurement Act (Act CXLIII of 2015 on Public Procurement) would generate an upturn in the intensity of competition (although some provisions of the Act could potentially trigger the opposite result). We expected an increase in the proportion of contracts with an estimated value and in the number of contracts per procedure and a decrease in the frequency of public tenders with unannounced negotiated procedures. These expectations were confirmed by our empirical analysis.
- Between 2015 and 2016, the share of contracts with one, two or three bidders fell in total number of contracts, and there was a rise in the proportion of contracts with four, five or more than five bidders. These changes stem mostly from tenders where the contract value did not exceed the EU threshold. The sudden growth in the share of contracts with four bidders may be a consequence of the new public procurement law, as it mandated a larger number of participants (i.e. at least four) in certain negotiated procedures.
- During the 2009–2015 period, the intensity of competition (an index based on the number of bids) decreased, while it increased slightly in 2016. Between 2009 and 2015, the intensity of competition tended to be lower for EU-financed public procurement compared to public procurement financed from national sources. However, this difference disappeared by 2016.
- The Transparency Index (TI) of public procurement provides information on the way in which tenders were issued (with or without an announcement). The level of TI in 2015–2016 remained far below the 2009–2010 level. Since 2011, EU-funded tenders were characterised by significantly lower TI values in each year than non-EU-funded ones. The detailed analysis shows that the level of TI was significantly weaker in

2016 than in 2015, when we control for EU funding, the size of contract and sector.

- Besides transparency, the occurrence of single-bidder contracts is another important indicator of corruption risks. The share of tenders with a single bid (i.e. non-competitive tenders) decreased between 2015 and 2016; however, it remained high (28% of all tenders). In 2016, the decline in the share of single-bidder contracts was less prevalent for tenders financed by EU grants compared to non-EU-funded ones. In international comparison on the basis of the TED database, the share of tenders with only a single-bidder is notably high in Hungary, varying between 25% and 33% in 2006–2015. During the same period, the share of non-competitive tenders did not exceed 12% in the old EU member states (for instance, Denmark, France, the Netherlands, Germany and Sweden). This is a clear sign that Hungarian public procurement tenders are strongly affected by corruption risks.
- Based on the composite corruption risk indicator, which combines information on transparency, single bidding and an element of price distortion, an upward trend in corruption risks can be observed between 2009 and 2015. The average value of the corruption risk indicator fell slightly in 2016 but remained at a relatively high level, and it was higher for EU-funded tenders than for non-EU-funded ones between 2010 and 2016.
- We examined the amount of money spent on public tenders marked by the highest level of corruption risk. We defined this aggregate value taking into account tenders where the value of the corruption risk indicator was 1, and then we aggregated the contract value of these tenders. The results show that in 2016 the aggregate value of tenders with the highest level of corruption risk moved up compared to those in 2014–2015 and the relative share of these tenders in total value of all tenders grew from 30% to around 44% in 2016.
- The concept of price distortion/overpricing is related to corruption. We consider the former as an outcome of a corrupt situation. In the case of a corrupt tender, the contract price includes the economic rent generated by corruption in addition to the market price. As a consequence, price setting within corrupt tenders must be fundamentally different from that of tenders involving competition. We interpret price distortion as a sign of a non-zero level of corruption risk. We use three methods to detect this phenomenon: we analyse (i) rounded data in contract prices; (ii) the observed distribution of first digits of net contract price against distribution of first digits predicted by the Benford's law; and, finally, (iii) the drop in contract prices compared to the estimated value of tenders (i.e. the price estimated by the issuer and published in the call for tenders).
- The indicators of rounded prices show a decreasing trend in price distortion in the last three years. However, the value of the rounded price indicators

remained very high: more than 60% of contract prices were rounded in Hungarian public procurement.

- There is a weak positive statistical relationship between the occurrence of rounded data in contract prices and the level of corruption risk. Winners of tenders with a high level of corruption risk use rounded data in their prices more often than winners of tenders with low corruption risk. Where the tender was implemented with high corruption risk, a higher share of the contract price was rounded by at least 10,000 (35%) than in the case of those with low corruption risk (27%).
- We analysed price distortion measured by rounding in EU-funded projects. The results show that EU funding has a contradictory effect on price distortion when we control for the contract value, sector and date of tenders. Given that corruption risks are higher and the intensity of competition is lower for EU-funded projects than for non-EU-funded ones, this new empirical evidence on price distortion points out the hypothesis that the that EU support can produce contradictory effects in Hungary. Spending of EU funds is thus associated with higher corruption risks, weaker intensity of competition and it cannot be demonstrated that the EU funding would clearly reduce the level of price distortion.
- We also analysed price distortion in terms of the distribution of the first digits in contract prices based on Benford's law. This analysis indicates that contract prices in Hungarian public procurement tenders fit the theoretical distribution well when the 2009–2016 period is examined as a whole. However, there are significant differences in price distortion across years: price distortion rose in the first seven years based on this measure. While contract prices fit the theoretical distribution well in 2009 and 2010, the magnitude of price distortion became significant thereafter. This observation indicates a rising frequency of overpricing, pointing to weakening competition and growing corruption risks. In 2016, the degree of price distortion fell compared to the peak level in 2015, but remained significantly high.
- The construction sector and industry appear to display the lowest level of price distortion vis-à-vis Benford's distribution, while the IT sector is characterised by the highest. The high level of price distortion in the IT sector is probably related to the large share of heterogeneous and specific goods and services in this sector. The results again show that EU-funded tenders are more affected by price distortion than nationally funded ones.
- Our findings highlight that the strength of price distortion falls as intensity of competition becomes stronger. The prices in public procurement contracts are remarkably distorted when there is no competition (i.e. single-bid tenders). There is also a positive correlation between the two independent indicators of price distortion: the level of price distortion measured by Benford's law is significantly higher for contracts with rounded prices than for those with non-rounded contract prices.

- There is a clear indication that the strength of price distortion as captured by Benford's law increases significantly with the growth of corruption risk. This result supports our hypothesis on the positive relationship between corruption risks and price distortion. Price distortion over the entire period under examination is closely linked to tenders marked by high corruption risks as measured by our composite risk indicators. Our analysis suggests that the significant increase in price distortion in the 2009–2015 period was driven by the effect of EU-funded projects.
- The magnitude of the price drop in the actual contract price relative to the estimated value can be regarded as a proxy measure for the intensity of competition. The core assumption behind this is that increased competition between bidders will produce more intense price competition, which should lead to lower prices in the end. Thus, the greater magnitude of the price drop points to a higher level of competition intensity in public tenders, while a low or zero price drop represents low intensity or lack of competition.
- The price drop weakened significantly over the period under examination: the median values of the price drop measure declined from 9% in 2009–2010 to 1% in 2014–2015. There was some reversal of this trend in 2015 and 2016: the magnitude of the median price drop increased from 1.3% to 1.8%.
- The extent of the price drop tended to be greater over the period under examination for non-EU-funded tenders than for EU-funded ones.
- The results for the extent of the price drop support our assumption that the price drop could be considered as a useful proxy for the level of competition, as intensity of competition is greater (i.e. it involves larger number of bids) when the magnitude of the price drop is greater. The analysis also demonstrates a positive relationship between the magnitude of the price drop and our composite indicator of corruption risks. First, in the case of tenders with only a single-bidder (non-competitive tenders), the extent of the price drop was significantly lower than for tenders with at least two bidders, and transparent tenders (tenders with announcement) showed a significantly greater price drop than non-transparent ones. The result is the same for the price distortion indicator based on rounded and non-rounded prices. All in all, our findings suggest that the lower the risk of corruption, the higher the magnitude of the price drop.
- A higher price drop is linked to a lower level of overpricing. In other words, price distortion must be less prevalent in cases where contract prices dropped more compared to the estimated price than in cases where the price drop rate was zero. The empirical results support this insight: with regard to the magnitude of squared errors from distribution of first digits of contract price predicted by the Benford's law, the data do show that prices of tenders with a large price drop conform more significantly to Benford's law than those with a small price drop. We concluded that the

magnitude of the price drop provides us with information not only on the level of intensity of competition, but also on corruption risks and the existence of price distortion.

- Looking at the pattern of the price drop indicator over time, we found that the extent of the price drop decreased significantly between 2009 and 2015, but there was some reversal of this trend in 2016. The extent of the price drop was greater for non-EU-funded tenders than for EU-funded ones, and tenders above the EU threshold value were marked by a significantly greater price drop than those below this threshold.
- The estimated direct social loss of tenders with high corruption risks and a low level of intensity of competition takes the form of rent, which occurs when payments are made above competitive market prices. The high corruption risk and/or low level of intensity of competition in public procurement are regularly and closely associated with political favouritism and rent seeking. In the report, we present one approach to estimating direct social loss in public tenders due to high corruption risk and low competition. First, we evaluate the differences in average contract prices between public tenders with and without corruption risks. Second, we assess differences between estimated and actual contract prices.
- Although our estimation results on direct social loss due to high corruption risks and a low level of intensity of competition can be considered as lower bound estimates, they demonstrate an astonishingly high direct social loss in Hungarian public procurement. Based on the measured gap between the net estimated contract value and the actual contract price, the analysis shows a very high level of estimated direct social loss: 15–24% in total contract value in the 2009–2016 period. According to our findings, the aggregate amount of estimated direct social loss reached at least 2.1–3.3 trillion forints (6.7–10.6 billion euros) during this period.
- With regard to the trends between 2009 and 2015, the rate of estimated direct social loss relative to total net contract value increased in 2012 and thereafter remained stable. In 2016, the estimated rate of social loss did not change significantly; only a slight decrease could be detected compared to the previous year.
- In the case of EU-funded tenders, the intensity of competition was significantly lower, the level of corruption risk higher, price distortion more likely, and the rate of estimated direct social loss considerably greater than for non-EU-funded ones. Consequently, the quality of EU regulation and the institutional background of EU subsidies seem weak and ineffective in Hungary during the period under examination. It appears that these factors only helped to fulfil some formal criteria, but they are not sufficient to achieve the EU's general aims in public procurement: to assist in strengthening competition, to restrain the high level of corruption risk and to hinder social loss among public tenders. In fact, based on our results, we can even say that EU funding has perverse effects in public

procurement in Hungary: it aided in reducing the intensity of competition and increasing both the level of corruption risk and the weight of price distortion, it spurred the growth of estimated direct social loss due to weak competition, and to high level of corruption risk during the period.

Introduction

The goal of the report

The goal of this report[3] is twofold. On the one hand, we would like to present analytic tools to examine the phenomenon of corruption in public procurement; and on the other hand, the report illustrates the use of the presented tools through the empirical analysis of the Hungarian public procurement data in the period of 2009-2016. In the report we analyse the Hungarian public procurement in terms of intensity of competition, corruption risks, and price distortion.

Frist, we are using a unique dataset of the Hungarian public procurement created by the CRCB's staff[4]. The CRCB downloaded 209,408 notices and 176,886 procedures' data from the Hungarian Public Procurement Authority's web page from the period of 2009-2016 and then these data were cleansed and arranged into a complete database. Data about all the awarded contracts and about all those published in the Public Procurement Bulletin during the whole year of 2016 from January 1st to December 31st were accounted for in the report and analysed. Our primary aim was to examine what changes took place in the Hungarian Public Procurement process in 2016. The openness of the procedure, the number of tenders without competition, the level of corruption risk and the volume of price distortion were scrutinized. The analysis is mainly descriptive, but, where possible, the analysis takes a more in-depth approach.

An analysis of this kind can be significant in at least two ways, that are related to each other. On the one hand, the actors' (institutions with calls for tender and bidder companies) behavioural change is studied with respect to corruption risk, intensity of competition and price distortion with descriptive statistical tools. On the other hand, only the data from public procurement contracts can provide answers regarding the impact from changes in the public procurement legal system (e.g. the modification of the public procurement law) had on the public

[3] We would like to express our sincere thanks to Katalin Goldstein, Samuel Markson, Balázs Molnár, Attila Székely and Magda József for their valuable help during the database building and preparation of this report. We also would like to thank to Katalin Andor, Iván Csaba, the public procurement experts of the Hungarian government, and the participants of the meeting organized by ECFIN on 22 June 2017 for their invaluable comments and suggestions on this report.

[4]. In the framework of the ongoing research program of CRCB, we are restoring, cleaning the data of the Hungarian public procurement in the period of 1998-2017 to build a comprehensive, well-structured database for the future empirical research on competition, corruption of public tenders. Neither the Hungarian authorities (including the Hungarian Public Procurement Authority) nor the Hungarian taxpayers have such a database. See other research programs on this topic: the CEU Microdata (http://bit.ly/2ARyGzg) and the Digiwhist project (http://bit.ly/2ASDlkF).

procurement actors' behaviour, and furthermore the extent to which the regulatory changes increased the intensity of competition or lowered the chance of corruption in public procurement.

Our analysis focuses on providing an answer to the first question, while at the same time it wishes to contribute to the more in-depth studies that target the economic analysis of the effects of governmental regulatory decisions.

In the first part of the report the changes in the number and in the value of public procurement that happened in 2016 are to be dealt with. After that the intensity of competition, corruption risk and price distortion will be analysed. In the next part, there will be an attempt to have an estimation on the direct social losses that are linked to a low competition intensity and overpricing. Finally the assessment concerning the year of 2016 will be summed up. The description the database and indicators used for this specific study can be found in the Annex besides some supplemental information that may help in understanding the outcomes.

Brief conceptual framework

During the report we use two general concepts: corruption and competition. For simplicity we include the several forms of collusion (cartels, bid rigging) into the concept of corruption, because these activities also hurt the rules of competition. We interpret the corrupt activity of players of public tenders in the frame of principal-agent model (Rose-Ackermann, 2006; Lambsdorff, 2007). In the case of public procurement, the concept of corruption and competition can basically be described by three different phenomena: (i) a public tender is conducted in accordance with the rules of the competition, thus there is no corruption here. Or (ii) the tender is corrupt, thus there is no competition here; (iii) or at the given public tender there is competition and corruption as well. It is possible that the corrupt offers of actors competed with each other to obtain the tender.

During the analysis, we use elementary and composite indicators which are based on information derived from official publications (announcements and contract awards) of Hungarian public procurement[5]. In this report we focus on only information of six different factors[6]:

1. the date of public tender;
2. the type of procedure (especially: whether it was a call for tenders or

[5] We have extracted all our data for the webpage of the Hungarian Public Procurement Authority. See: http://bit.ly/2r1sIHM

[6] We omit to deal with other important factors of public tenders as the time elapsed between the invitation to tender and the tender's submission (in calendar days or working days); the name of issuer; the type of issuer; the address of issuer; the name of winner; the address of winner; the names of other bidders; and finally the address of other bidders.

not);

3. number of bids;

4. estimated value of public tender;

5. contract value (the bid price of the winner);

6. common procurement vocabulary (cpv) code.

For the purpose of analysis we constructed several elementary and composite indicators that indirectly serve to measure the various aspects of competition and corruption. These are the following (for the precise definitions see the Annex 1.7.):

1. Transparency index (TI) [0,1], dummy variable;

2. Single-bidder (SB); [0,1], dummy variable;

3. ICI: index of competition intensity;

4. Rounded contract price (ROUND4); its value is 1, if the net contract value is rounded by 10^4; and 0, else;

5. Rounded contract price (ROUND5); its value is 1, if the net contract value is rounded by 10^5; and 0, else;

6. Relative weight of rounding (ROUNDR2); the winner price includes what degree of rounding [0.25, 0.5, 0.75, 1], ordered variable;

7. BENFORD1: the first digit test of net contract price, categorical variable;

8. RPRD: the rate of price drop; net contract price compared to the estimated value;

9. Indicator of corruption risk (CR2) with two components (TI and SB) [0, 0.5, 1]; ordered variable;

10. Indicator of corruption risk (CR3) with three components (TI, SB, and ROUND4) [0, 0.33, 0.66, 1]; ordered variable;

The listed and above identified indicators are used to measure three operationalized concepts (i) corruption risks, (ii) price distortion, and (iii), intensity of competition.

Corruption risks relate to the existence of conditions of corruption. We assume that actors who want to behave in a corrupt way will create the conditions which meet the planned corrupt transaction. Corruption risks measure the extent to which effective conditions for corruption have been created.

Corruption risks should be measured primarily by indicators that can already be seen before or during the public procurement process (e.g. type of public tender or the number of bids submitted), but information on the assessment of

corruption risks can also be used to relate to the outcome of procedure used. For instance, these may include information on the contract prices. From these information, it can be deduced how effective the conditions were for corruption existing in the given public tender. Accordingly, these indicators cannot be used as classical "red flags". With regard to the ongoing procedures, their use cannot provide predictions of which public procurement is more likely to be threatened by corruption. But with the help of these indicators, after the completion of public tenders, it is possible to analyse which group or types of tenders, winners or issuers had the highest or lowest risk of corruption.

This analytical strategy can also be useful in tackling corruption: it raises the light of the type of public tenders that needs to be taken to cover the risk of corruption; what sort of public procurement might be more likely to be threatened by corrupt transactions. But they also help answer the question about the actual impact of modification of public procurement rules / laws on the corruption risks of public tenders.

Another important concept for which we would like to propose measurement tools is price distortion. In this report we only look at the distortion of contract prices, and we do not deal with the price distortion at estimated value. Analysing the price distortion, we rely essentially on the methods developed in fraud analysis and forensic accounting. Among the tools recommended by these researches (Nigrini, 2012; Miller, 2015; Kossovsky, 2015), only two will be used in this report: (i) the last-two digit test; (ii) and the first digit test and these two test will take only for net contract prices. The former is a powerful test for number invention (Nigrini, 2012) and the latter is a general and basic tool for the detection of distortive behaviour of price setting actors, in our case, the winners and in certain special cases, the issuers.

According to fraud detection research, rounded values point out to the presence of distortion. It is worth observing the rounded values (prices) in the context of intensity of competition and corruption risks and examine the relationships amongst them. In this analysis we use four indicators to measure the rounded values: the ROUND4, ROUND5 and ROUNDR2 indicators.

We believe that the strength of corruption risks and intensity of competition in the public procurement market are closely related to the price distortion: in a corrupt situation, the winning price is rather an invented price, which should contain economic rent related to corruption and thus the price should be higher than the market price. In the case of a corrupt public tender, the winners are likely to invent their prices without any cost based, or market based analysis and therefore they are more likely to apply invented prices accordingly.

The other indicator comes from the first digit test of Benford's distribution (BENFORD1). In a natural market environment - such as when public tenders are driven by rules of competition, winning prices are not accompanied by any external (non-competitive) effects. In that case, the prices of public tenders behave like market prices. The purchase of goods by the issuers and the responsive bid prices of the bidders (the companies participating in the public

procurement competition) are also generated as a result of the natural processes i.e. competition, that are determined by the rules of competition. Thus, the first digits of the winning prices should then be Benford's distribution: that is, if most of the public procurement is conducted on a competitive basis, we expect the first digit of the contract price to be distributed to Benford's Law. Completely other outcome could be expected in a corrupt situation: the price setting at these tenders does not follow the natural, competitive rules, because the behaviour of the corrupt actors (issuers and/or bidders), as one of possible form of rent-seeking behaviour, tends to generate corruption benefit. Accordingly, at tenders with high corruption risks and low level of intensity of competition we expect higher price distortion, i.e. the distribution of first digits of contract price has the highest difference from the predicted, Benford's distribution.

The third concept is the intensity of competition. It means at what level of competitive intensity the public tenders are conducted. If, for example, at a given tender there were 6-7 bids, it is considered to be a higher competition intensity than if there were only 2-3 bids competing. The intensity of competition is measured on the one hand by the index of competition intensity (ICI, ICIO). On the other hand, another indicator also includes the aspect of how much the contracted price of the winner has been lower than the estimated price by the issuer (estimated value). For this, we observe the difference between the contact price and the estimated value relative to the contact price (RPRD). The relationship between the above indicators and the operationalized concepts, and the related general concepts are described in Table 1.

Table 1. Relationships amongst general concepts, operationalized variables and composite and elementary indicators

General concepts	Operacionalized concepts or variables	Composite indicators	Elementary indicators
corruption	corruption risks	SB {NBID}	TI
		CR2 {TI, SB}	NBID
		CR3 {TI, SB, ROUNDD}	
	price distortion	ROUNDD {NCVALUE}	NCVALUE
		ROUND4 {NCVALUE}	
		ROUND5 {NCVALUE}	
		ROUNDR2 {NCVALUE}	
		BENFORD1 {NCVALUE}	
competition	intensity of competition	RPRD2 {NEVALUE, NCVALUE}	NEVALUE
		ICI {NBID}	NCVALUE
		ICIO {NBID}	NBID

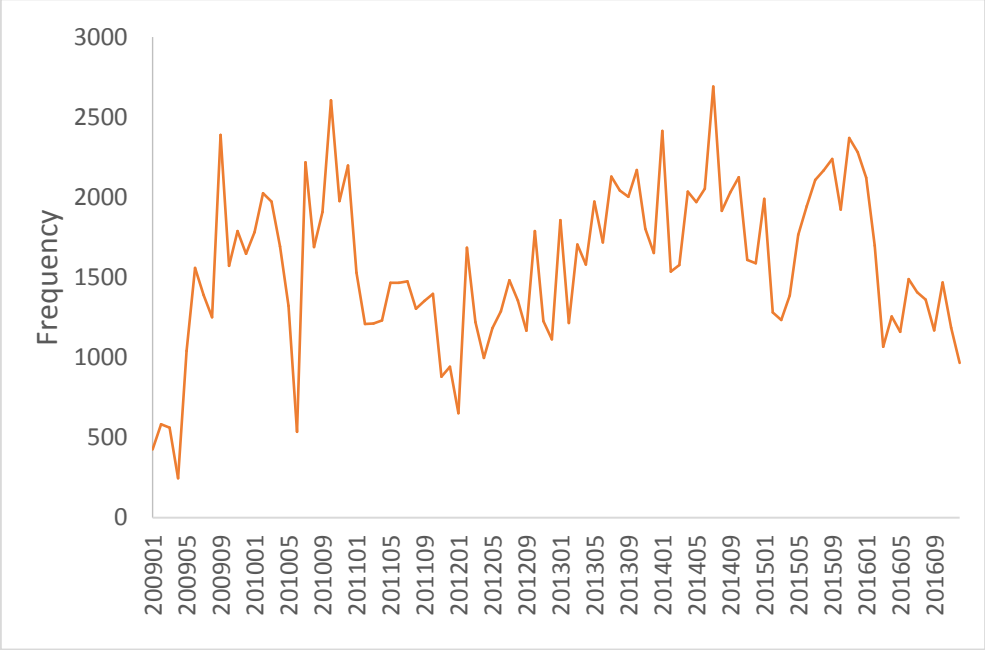
1. What happened in 2016?

It seems that 2016 was a very special year from the aspect of the Hungarian public procurement, as there was a major decrease in the number of contracts (it was about the two-third of the 2015 volume) and the ratio of public procurements with EU-fund was extremely low. The most important tendencies are the following:

- Regarding the monthly number of contracts, a major decrease occurred during the first quarter of 2016 (see Fig. 1.1.).
- The total number of contracts in 2016 was significantly less than it was between 2013 and 2015 (see Fig. 1.2.).
- The share of EU-funded contracts fell dramatically in the first month of 2016 (see Fig. 1.4.).
- During 2016, the share of EU-funded contracts was far less than it was between 2009 and 2015 (see Fig. 1.5.).
- While the number of contracts without EU-funds show only minor changes between 2013 and 2016, there was a drop in EU-funded contracts in 2016 what resulted in the major decrease in the overall number of contacts (see Fig. 1.7.).
- The aggregated sum of the net contract values[7] for 2016 barely changed in comparison to 2015 (see Fig. 1.9.); besides that the number of the contracts decreased, the average of net contract value increased to 128 million HUF from 84 million HUF between 2015 and 2016.

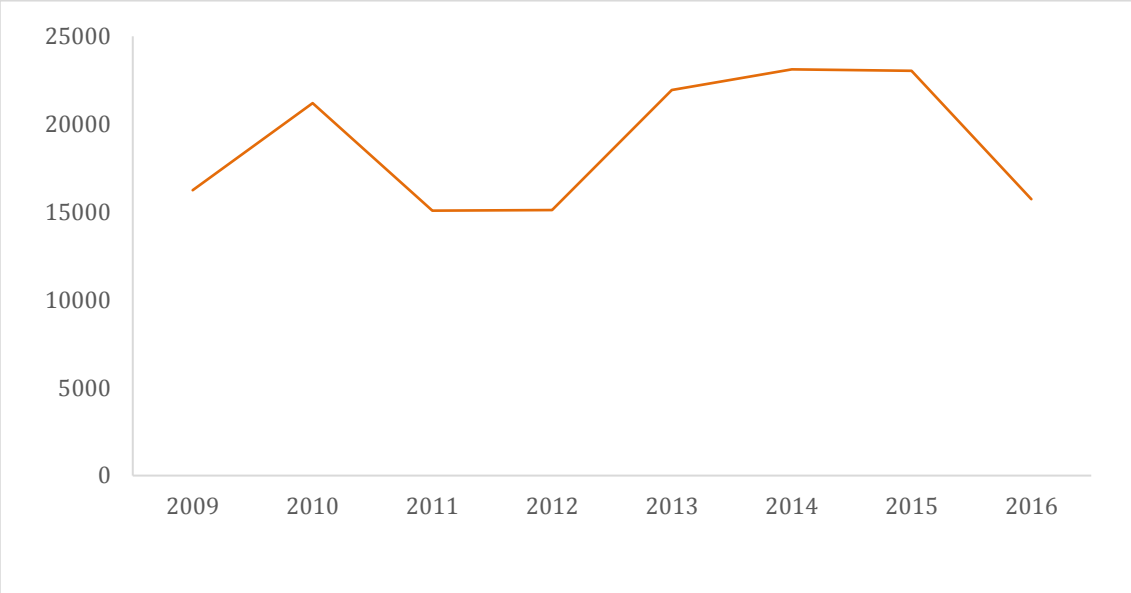
[7] The framework agreements are excluded from this analysis – for details, see A1.

Figure 1.1.: Monthly number of contracts, 2009-2016, N = 151,457



Note: with framework agreements; data are filtered by variable goodx (for details, see Table A1.7.)[8]
Source: CRCB

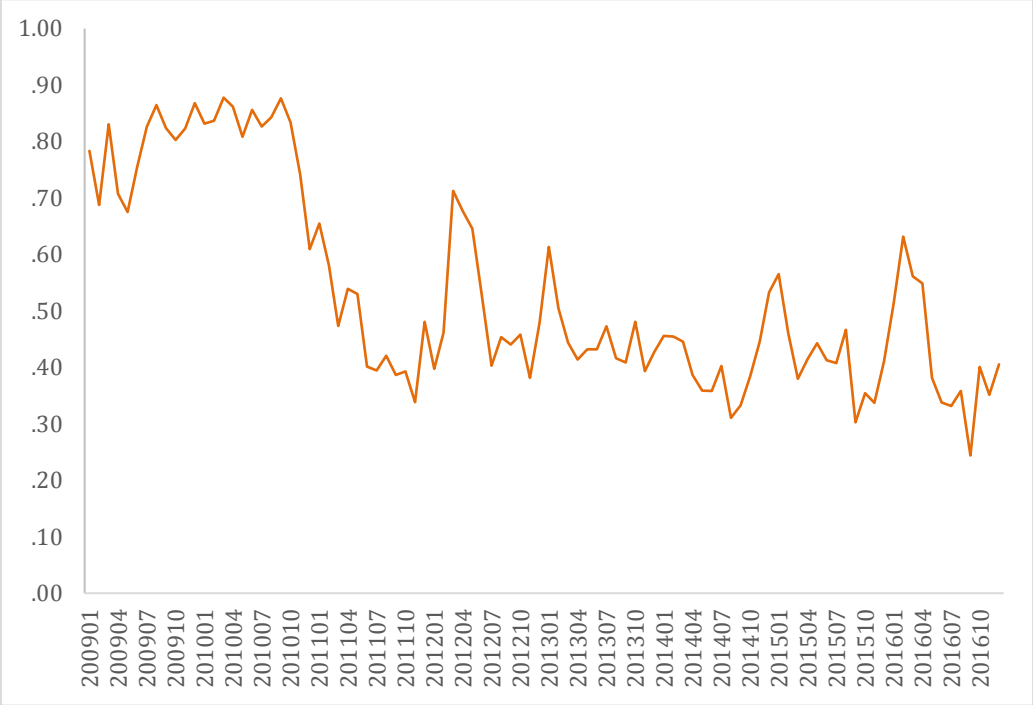
Figure 1.2.: Yearly number of contracts between 2009 and 2016, N = 151,457



Note: with framework agreements; data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

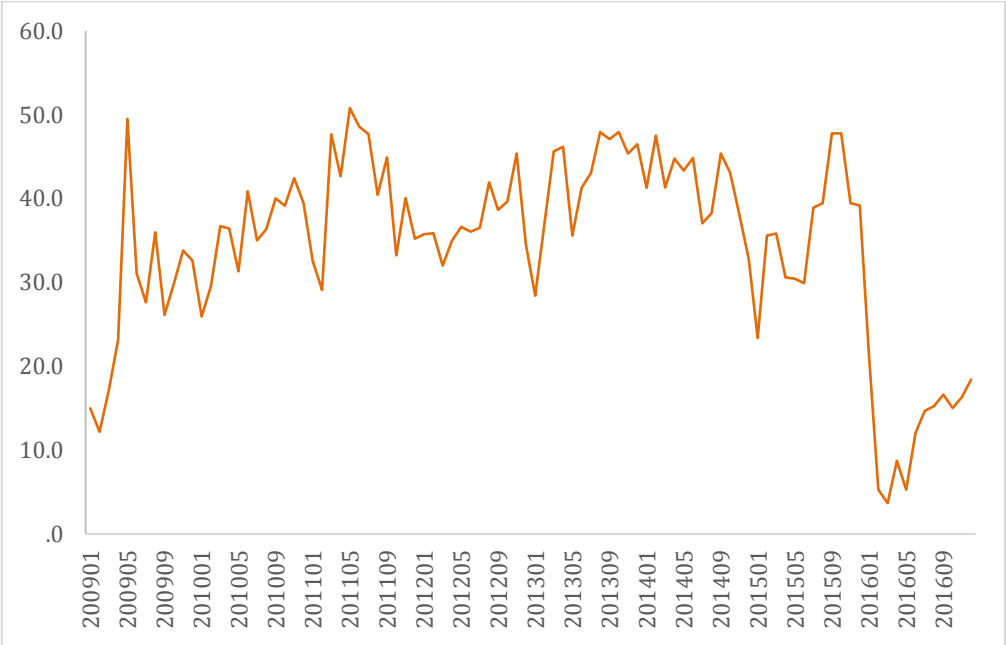
[8] We had to filter out some contracts from our analyses that were published incorrectly – for more details, see the referred table in the Annex.

Figure 1.3. Share of contracts deriving from transparent procedures in the Hungarian public procurement per month between 2009 and 2016, N= 151,457



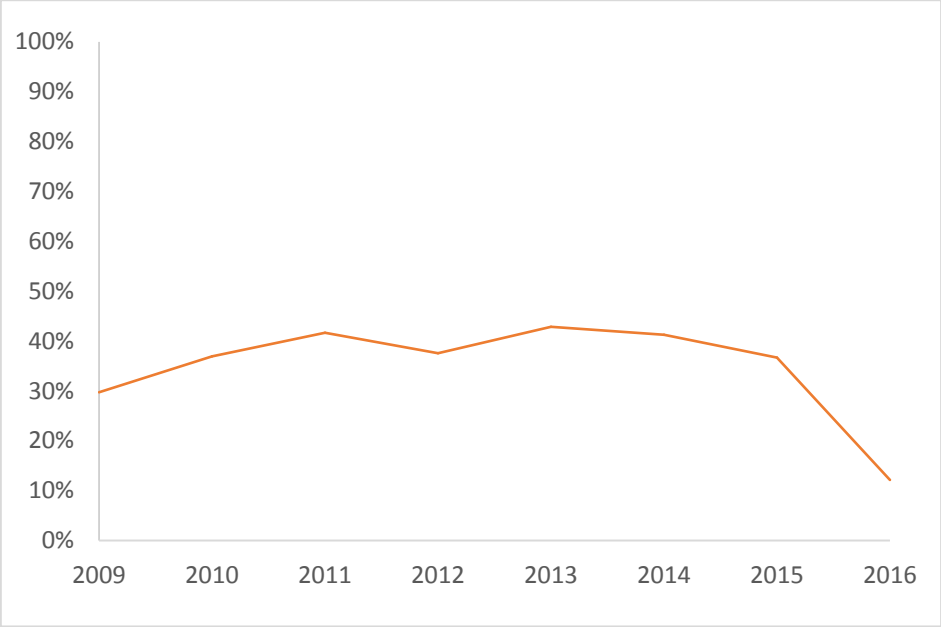
Note: with framework agreements; data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Figure 1.4. Share of EU-funded contracts in the Hungarian public procurement per month between 2009 and 2016, N = 150,942



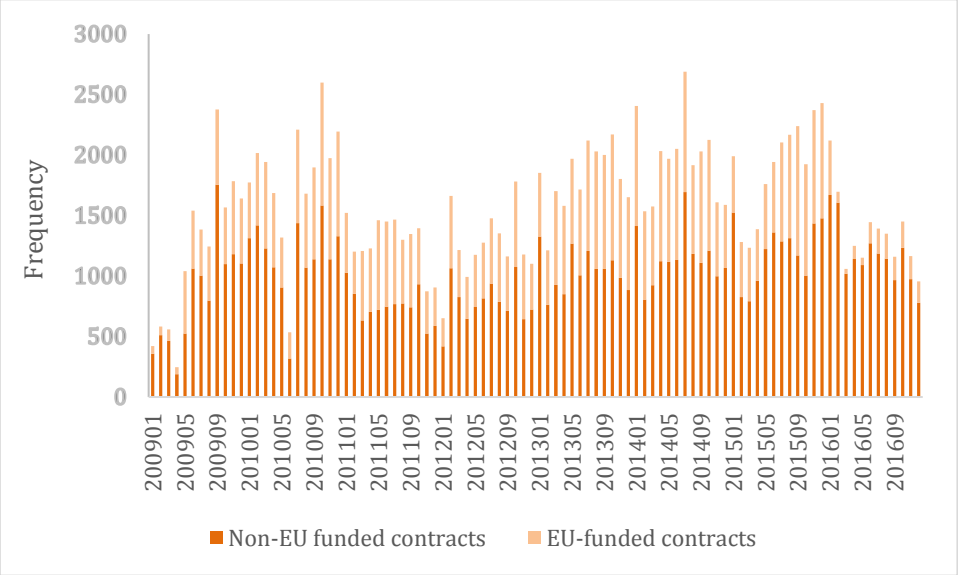
Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Figure 1.5. Share of EU-funded procedures contracts in the Hungarian public procurement per year between 2009 and 2016, N = 150,942



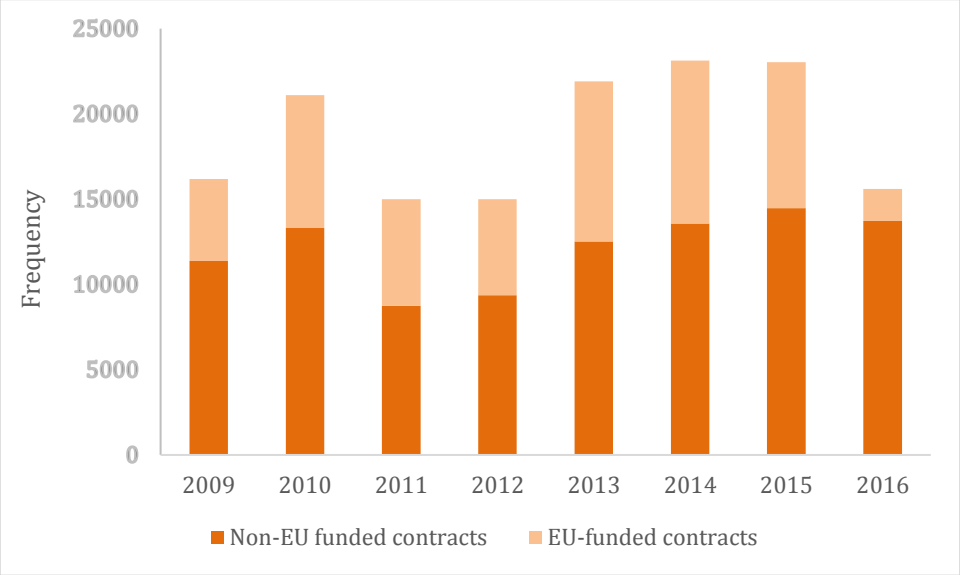
Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Figure 1.6. Number of EU-funded and non-EU-funded contracts in the Hungarian public procurement per month between 2009 and 2016, N = 150.942



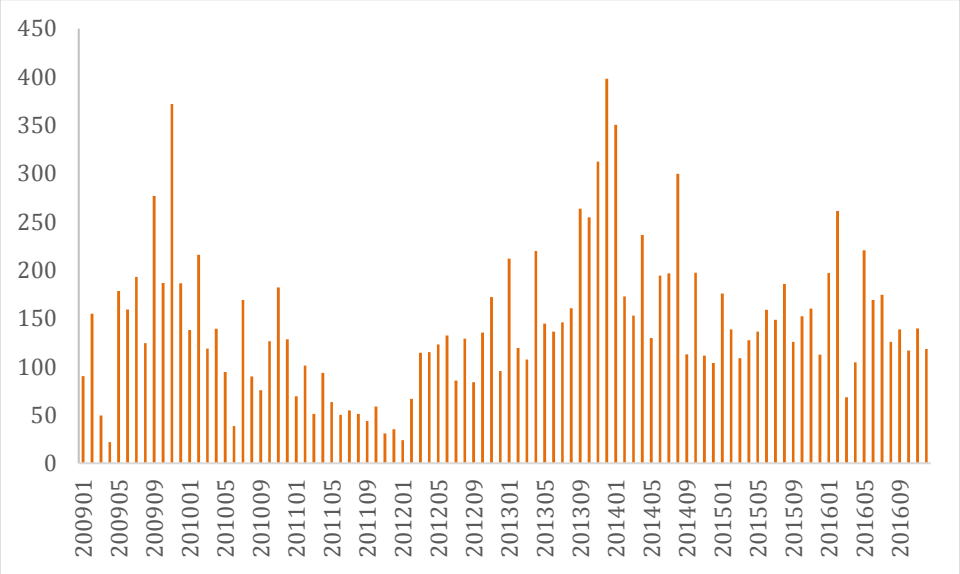
Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Figure 1.7. Number of EU-funded and non-EU-funded contracts in the Hungarian public procurement per year between 2009 and 2016, N = 150.942



Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

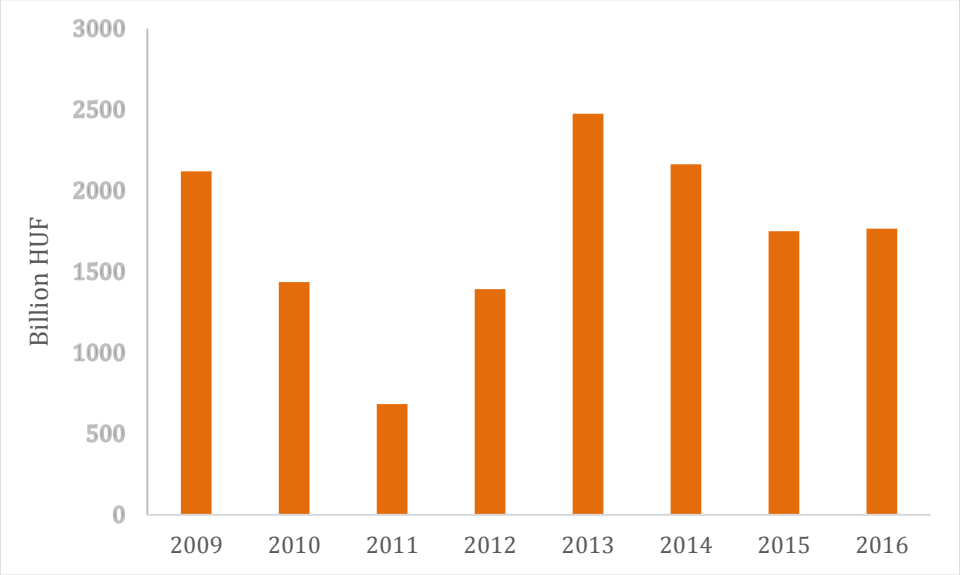
Figure 1.8. Aggregated net contract values in the Hungarian public procurement per month between 2009 and 2016, N = 138.743



Note: without framework agreements;
data are filtered by variable goodfwc (for details, see Table A1.7.)[9]
Source: CRCB

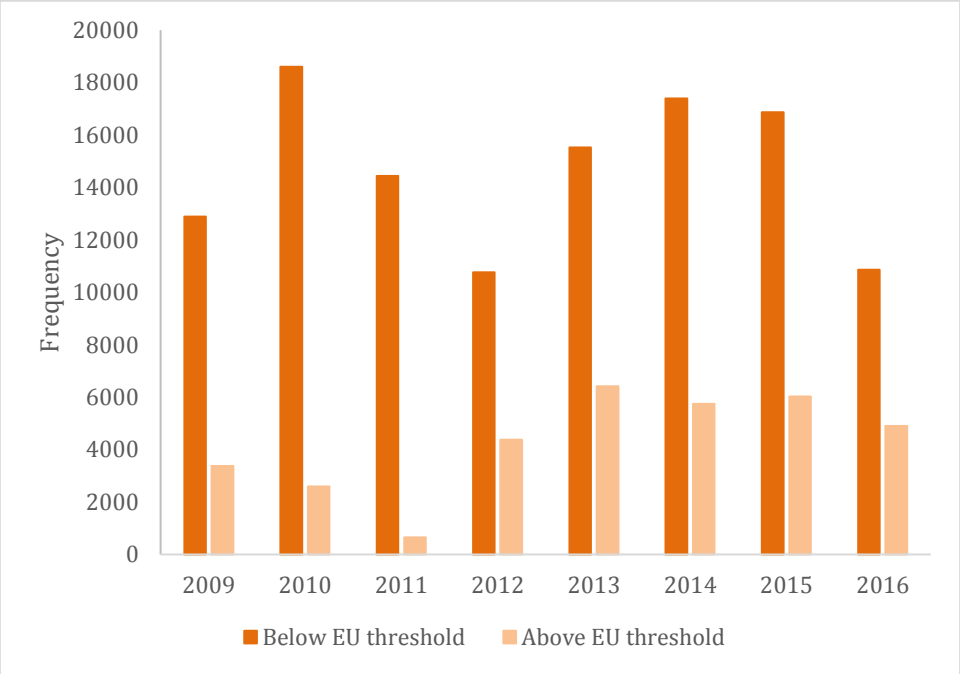
[9] In the cases of analyses taking into account contract values, the contracts of framework agreements are filtered out – for more details, see the referred table in the Annex.

Figure 1.9. Aggregated net contract values in the Hungarian public procurement per year between 2009 and 2016, N = 138,743



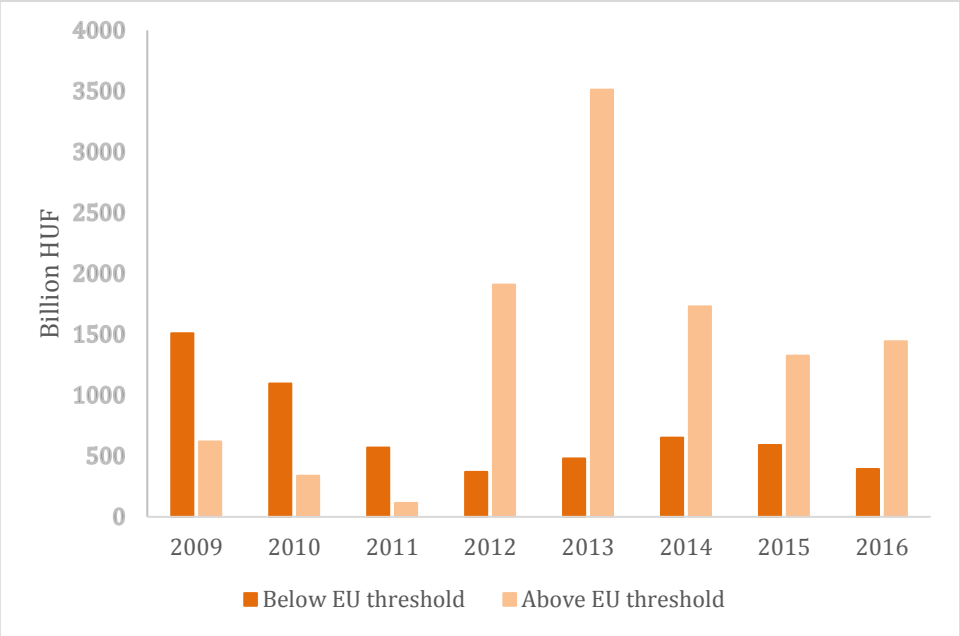
Note: without framework agreements;
data are filtered by variable goodfwc (for details, see Table A1.7.)
Source: CRCB

Figure 1.10. Yearly number of contracts with value above and below the EU threshold between 2009 and 2016, N = 150,914



Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Figure 1.11. Aggregated net contract values in the Hungarian public procurement per year above and below the EU threshold between 2009 and 2016, N = 142,558



Note: without framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

2. Intensity of competition

In this section, first we analyse the evolution of number of bidders by years then we construct an indicator which summarize the information on intensity of competition using the number of bidders at public tenders. The number of bidders can be regarded as an indicator of competition.

Between 2015 and 2016, the share of contracts with one, two or three bidders fell in total number of contracts, and there was a rise in the proportion of contracts with four, five or more than five bidders (see Table 2.1.). The sudden increase in the share of contracts with four bidders may be the result of the new public procurement law, as it mandated an increased number of participants (i.e. at least four) in certain negotiated procedures. The effects of the new regulations are discussed more deeply in section 5.2.

Table 2.1. Average share of contracts by the number of bidders by year, 2009-2016, N = 149,786

year	number of bidders						
	1	2	3	4	5	6 or more	Total
2009	31.10	18.62	16.15	10.88	6.75	16.51	100
2010	34.50	20.92	18.29	9.35	5.13	11.81	100
2011	26.36	22.23	26.98	8.22	4.61	11.60	100
2012	25.82	21.04	29.12	8.19	4.18	11.65	100
2013	25.90	22.71	33.05	6.76	3.54	8.05	100
2014	31.41	21.01	30.86	6.85	3.79	6.08	100
2015	32.18	19.89	29.95	6.95	3.56	7.46	100
2016	27.83	19.09	21.30	17.97	4.55	9.25	100
Total	29.68	20.74	26.2	9.06	4.41	9.90	100

Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

As the contracts below the EU threshold is subject to national rules with a greater discretion of the domestic authorities, it is worth analysing whether there are some dissimilarities between the groups of the contracts with values below and above the EU threshold. We can conclude that the aforementioned changes stem mostly from the tenders where the contract value did not exceed that limit. In case of the contracts where the contact value was below the EU threshold the share of 4 or more bidders has risen from 12.4% to 33% between 2015 and 2016 (see Table 2.2.). However, such changes cannot be observed in the group of contracts with higher values (in fact, there was a 4 percentage points decrease – see Table 2.2.).

Table 2.2. Share and number of contracts with value below the EU threshold by the number of bidders, yearly data, 2009-2016, N = 115,924

year	1	2	3	4	5	6	Total
2009	31.73	19.19	16.33	10.42	6.63	15.70	100
2010	34.66	21.47	18.26	8.99	5.03	11.59	100
2011	26.20	22.35	27.46	8.17	4.42	11.40	100
2012	24.66	21.61	34.70	7.68	3.24	8.10	100
2013	23.40	22.52	40.03	5.88	2.85	5.32	100
2014	31.26	20.92	35.53	5.25	2.70	4.35	100
2015	31.74	19.85	36.02	5.53	2.34	4.51	100
2016	24.77	18.63	23.74	21.54	3.73	7.58	100
Total	29.03	20.90	29.27	8.62	3.81	8.37	100

Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Table 2.3. Share and number of contracts with value above the EU threshold by the number of bidders, yearly data, 2009-2016, N = 33,862

year	1	2	3	4	5	6	Total
2009	28.62	16.43	15.45	12.62	7.22	19.66	100
2010	33.35	16.86	18.53	11.97	5.82	13.48	100
2011	29.91	19.46	16.3	9.34	8.86	16.14	100
2012	28.64	19.65	15.49	9.42	6.48	20.32	100
2013	31.96	23.15	16.16	8.88	5.20	14.64	100
2014	31.87	21.28	16.66	11.71	7.12	11.34	100
2015	33.38	19.99	13.32	10.85	6.90	15.56	100
2016	34.61	20.11	15.9	10.08	6.36	12.94	100
Total	31.9	20.20	15.71	10.55	6.47	15.16	100

Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Deriving information from the number of bids (NB) we constructed an indicator which measures the intensity of competition (Index of Competition Intensity)[10]. This indicator has missing value if NB = 1, because we assume that if there is only one bid, then there was no competition that could be measured – such cases will be analysed by the single-bidder indicator presented in the next chapter. We calculate the ICI with the following formula:

$$ICI = \lg \mathrm{NB} \qquad \textit{if } 1 < \mathrm{NB} \leq 10 \textit{ and,} \qquad (1)$$
$$ICI = 1 \qquad \textit{if } 10 < \mathrm{NB}.$$

During the 2009-2015 period, the intensity of competition decreased (from 0.59 to 0.50), while it increased slightly in 2006, as the index moved from 0.50 to 0.53.

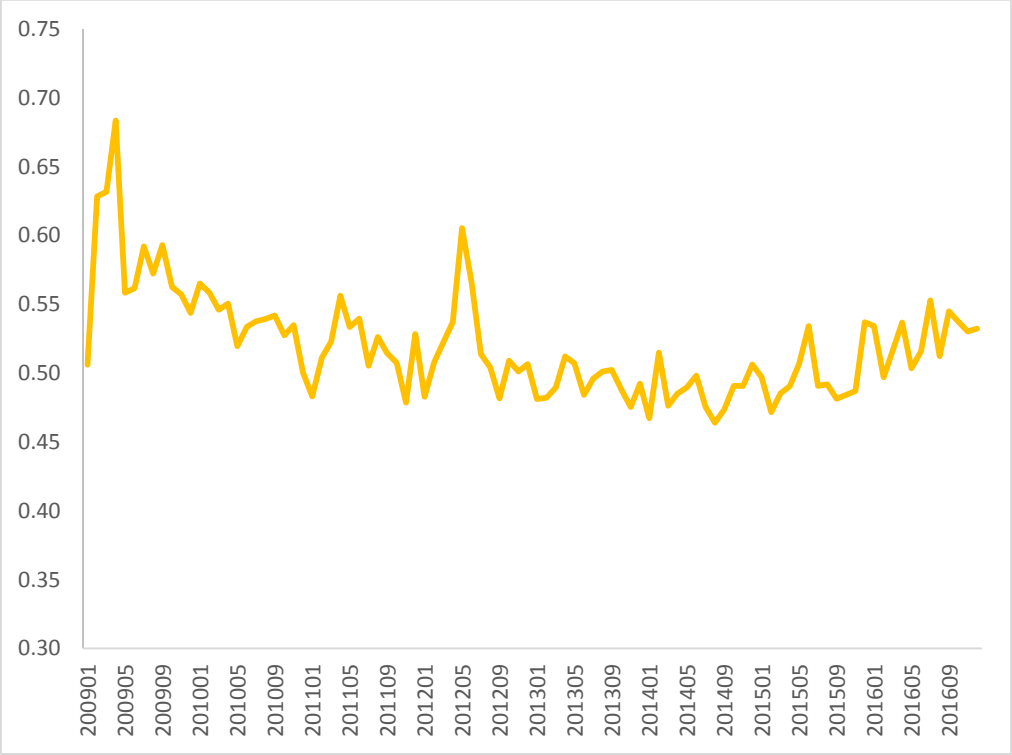
- The increase was typical in all sectors. The most dynamic development happened in construction sector between 2015 and 2016. Some cross-sector differences can be highlighted that are present for several years. For example, the IT sector can be characterised by the lowest and the engineering, RD and financial services sector had the highest ICI scores in the last three years.

[10] See: CRCB, 2016 and Tóth & Hajdu 2016a.

- Between 2009 and 2015, the intensity of competition tended to be lower for the EU-financed public procurement compared to public procurement financed from national sources by about 0.03-0.04 units of the ICI. This difference disappeared by 2016, as the value of ICI was 0.53 in both of the groups.

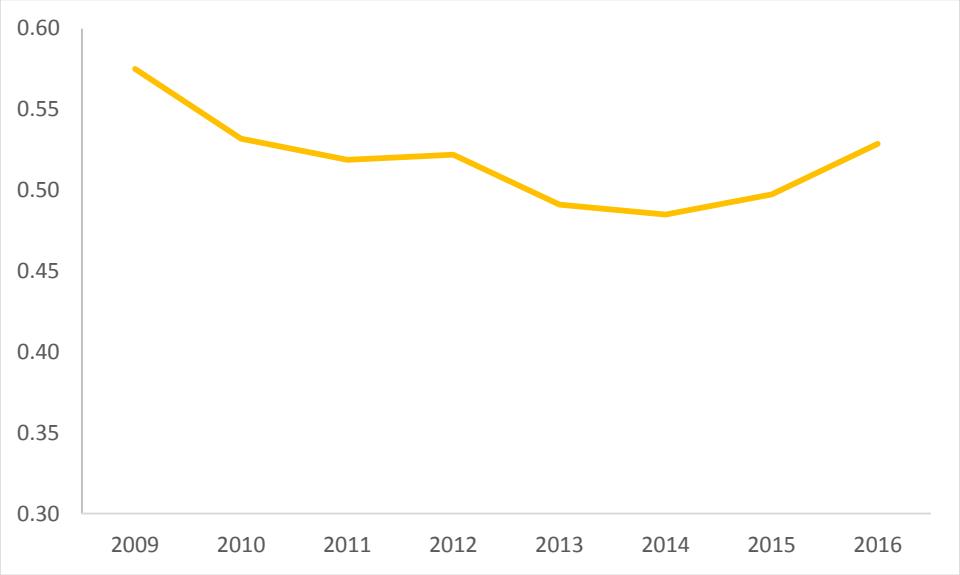
- We can find the same feature when we classify the tenders according to the EU threshold. While between 2009 and 2015 the intensity of competition of public tenders below the EU threshold tended to be lower than the tenders above the threshold (in 2015, there was 0.1 unit difference between the two groups), this difference almost had vanished in 2016. In 2016, the intensity of corruption of tenders below the EU threshold increased from 0.47 to 0.52, while the ones above the threshold decreased from 0.57 to 0.55; therefore, the two groups reached almost the same level of intensity of competition by 2016.

Figure 2.1.: The Index of Competition Intensity in Hungarian public procurement, monthly data, 2009-2016, N = 105,325



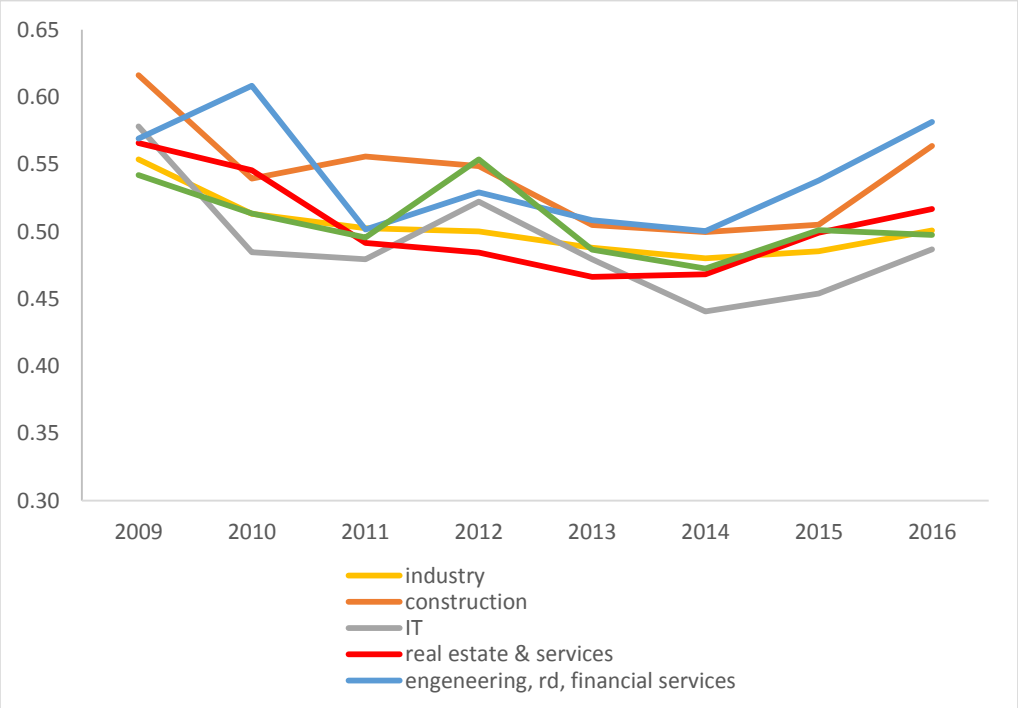
Note: with framework agreements
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Figure 2.2.: The Index of Competition Intensity in Hungarian public procurement, yearly data, 2010-2016, N = 105,325



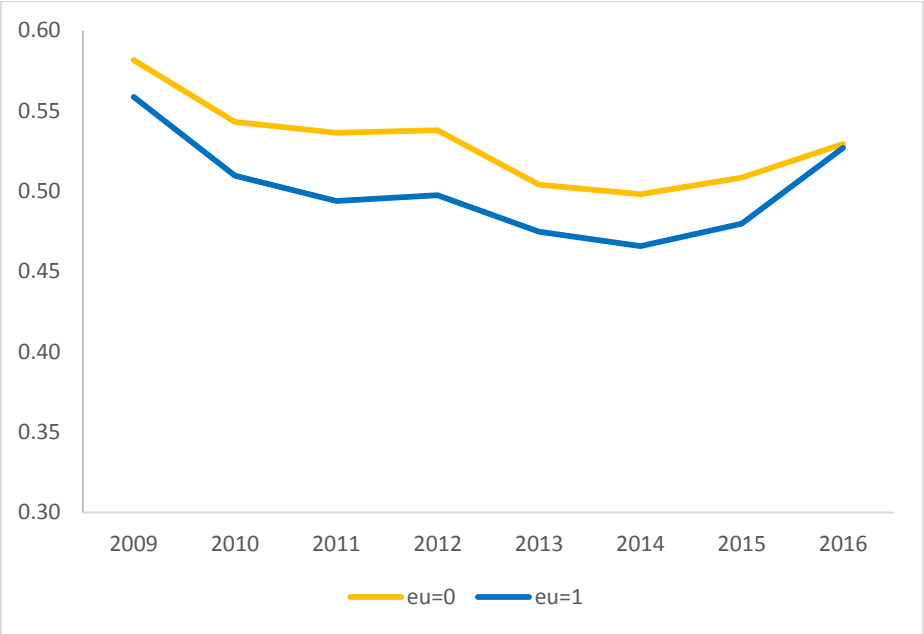
Note: with framework agreements
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Figure 2.3. The Index of Competition Intensity (ICI) in Hungarian public procurement by industry, 2010-2016, yearly data, N = 102,462



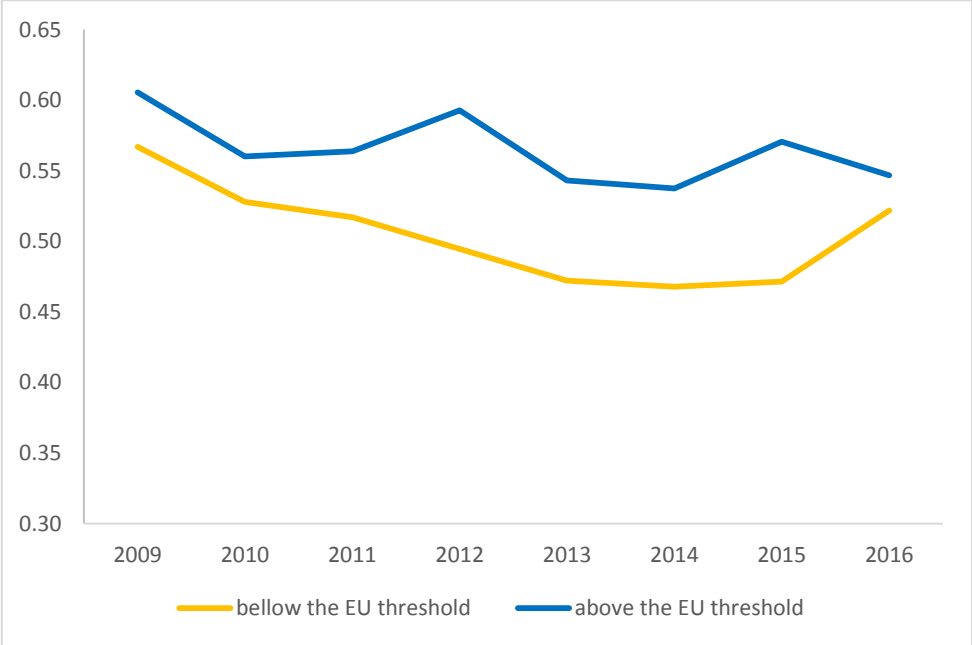
Note: with framework agreements
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Figure 2.4.: The Index of Competition Intensity (ICI) in Hungarian public procurement in EU-funded and non-EU-funded tenders, 2010-2016, yearly data, N = 104,9715



Note: with framework agreements
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Figure 2.5.: The Index of Competition Intensity (ICI) in Hungarian public procurement by EU threshold, 2010-2016, yearly data, N = 105,325



Note: with framework agreements
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

3. Corruption risks

As there are no robust objective indices of corruption, the CRCB proposes a new approach in measuring institutionalised grand corruption by calculating corruption risk indicators (Fazekas et al. 2013a; Fazekas et al. 2016; Tóth-Hajdu, 2016a). This approach is based on micro-level data allowing for directly modelling the economic rent extraction of corrupt actors by tracing the on the two core requirements of institutionalised grand corruption on public procurement:

1) The generation of economic rents by corruption;
2) The regular extraction of such rents.

In order to achieve both of these, proper conditions have to be created during the procedures of public tenders, that limits the competition on the tenders (and may result in a considerable amount of procedures with only one bidder). For example, this can be done by non-transparent procurement procedures, as the potential bidders who were not invited to participate may be excluded from them. In addition, several signs of conditions facilitating corruption can be incorporated into composite corruption risk indicators. To conclude, the corruption risk indicators tackle the conditions of public procurements making corruption to be more likely.

Considering our composite corruption risk indicator (CR3), we can say that there was an increasing trend between 2009 and 2015 in corruption risks. However, the average value of the indicator slightly decreased in 2016, but remained at a relatively high level. The tendencies behind this finding will be discussed in this chapter.

Firstly, we overview the tendencies concerning open procedures over the period; the detailed definition of open procedures can be found in the Annex (A7.)[11]. Then, we deal with all types of procedures with announcement[12], that we call transparent procedures, as all the potential bidders may have known about them. The risks of corruption should be lower in the case of open and transparent procedures than in the rest of the procurements. In the final part of this chapter we focus on the measurement and analysis of corruption risks of public procurement tenders.

The ratio of open procedures increased less than 1 percentage point, from 34.6% to 35.3% between 2015 and 2016 (see Table 3.1. and Figure 3.1.).

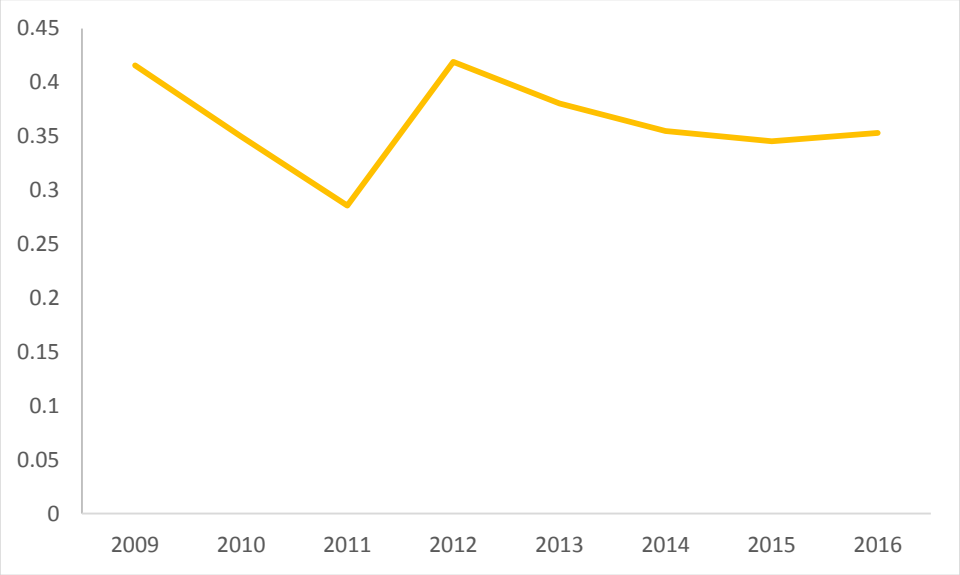
[11] Open procedures introduced by the Act CXLIII of 2015 on Public Procurement and discussed later in this section are not considered to be open in the case of this calculation.
[12] Call for tenders is available for every potential bidder, thereby not only the favoured companies can apply.

Table 3.1. Share and number of contracts by the openness of the procurement procedure, yearly data, 2009-2016, N = 139,618

year	Not open	Open	Total
2009	9,043	6,440	15,483
%	58.41	41.59	100
2010	12,644	6,806	19,450
%	65.01	34.99	100
2011	5,406	2,163	7,569
%	71.42	28.58	100
2012	7,894	5,697	13,591
%	58.08	41.92	100
2013	13,531	8,315	21,846
%	61.94	38.06	100
2014	14,897	8,205	23,102
%	64.48	35.52	100
2015	15,045	7,946	22,991
%	65.44	34.56	100
2016	10,079	5,507	15,586
%	64.67	35.33	100
Total	88,539	51,079	139,618
	63.42	36.58	100

Note: with framework agreements
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Figure 3.1.: Share of contracts where issuers used open procedures, 2009-2016, yearly data, %, N = 139,618

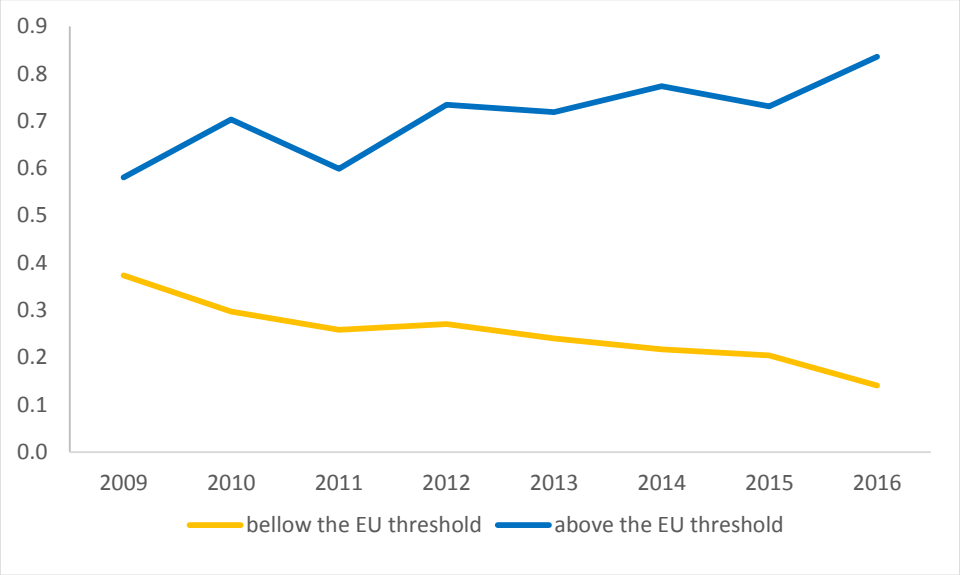


Note: with framework agreements
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

This increase can be observed only in the subgroup of contracts with value above the EU threshold, as for the ones with below that limit considerable decrease can be pointed out regarding this aspect (Figure 3.2.). Regarding the EU-funded and non-EU-funded tenders, in both of the groups a decline happened between 2015 and 2016 in the share of open procedures (see Figure 3.3.)[13].

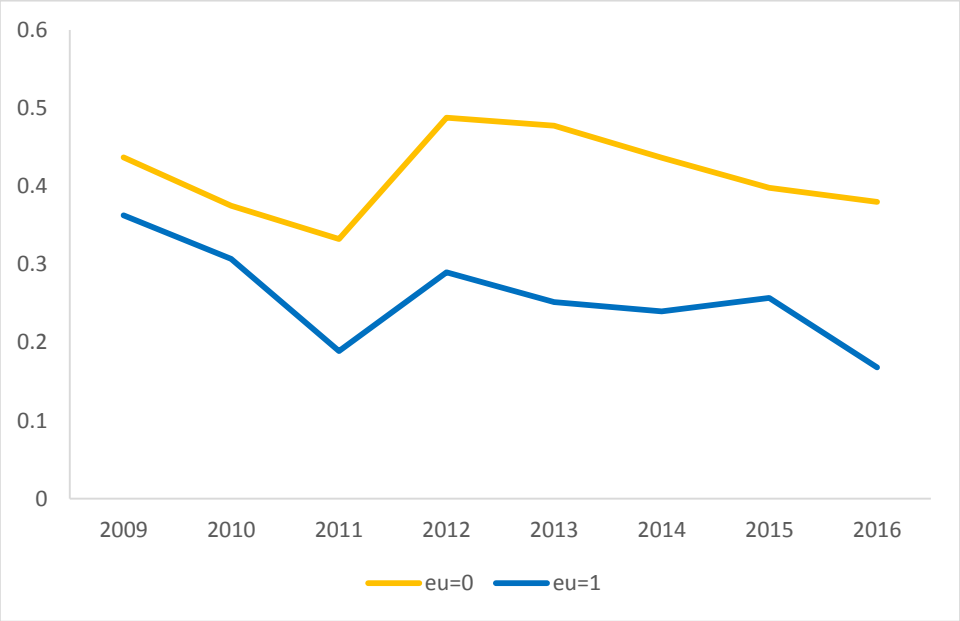
[13] The Simpson paradox can be a possible explanation of this phenomenon. For more details, see: https://plato.stanford.edu/entries/paradox-simpson/

Figure 3.2.: Share of contracts where issuers used open procedures by EU threshold, 2009-2016, yearly data, %, N = 139,632



Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Figure 3.3.: Share of contracts where issuers used open procedures by EU funding, 2009-2016, yearly data, %, N = 139,618



Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

We constructed an indicator which gives us information on transparency of procedures (Transparency Index). We define the Transparency Index (TI) in the following way:

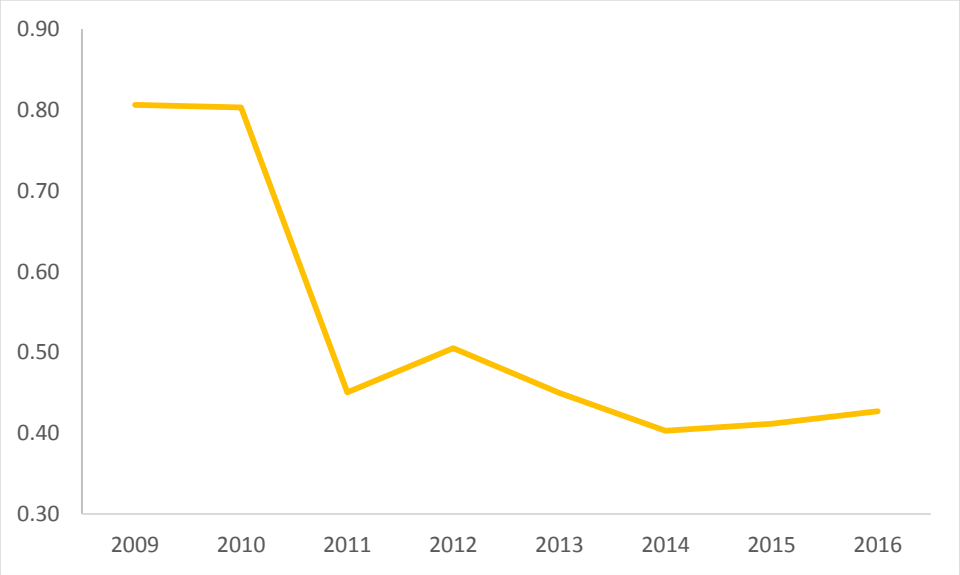
TI = 0, if the tender was issued, without announcement; and

TI = 1 if the tender was issued transparently, i.e. with announcement.

Firstly, we analyse the evolution of TI over the period in several subgroups of tenders, then we focus on the evolution of single-bidders and then the composite indicators of corruption risk.

Regarding the Transparency Index (TI) we see slight positive change in 2016 as compared to 2015 data (the value of the index changed to 0.43 from 0.41 – see Figure 3.4.), but the level of TI in 2015-2016 remained far below the 2009-2010 level, when its value was 0.8.

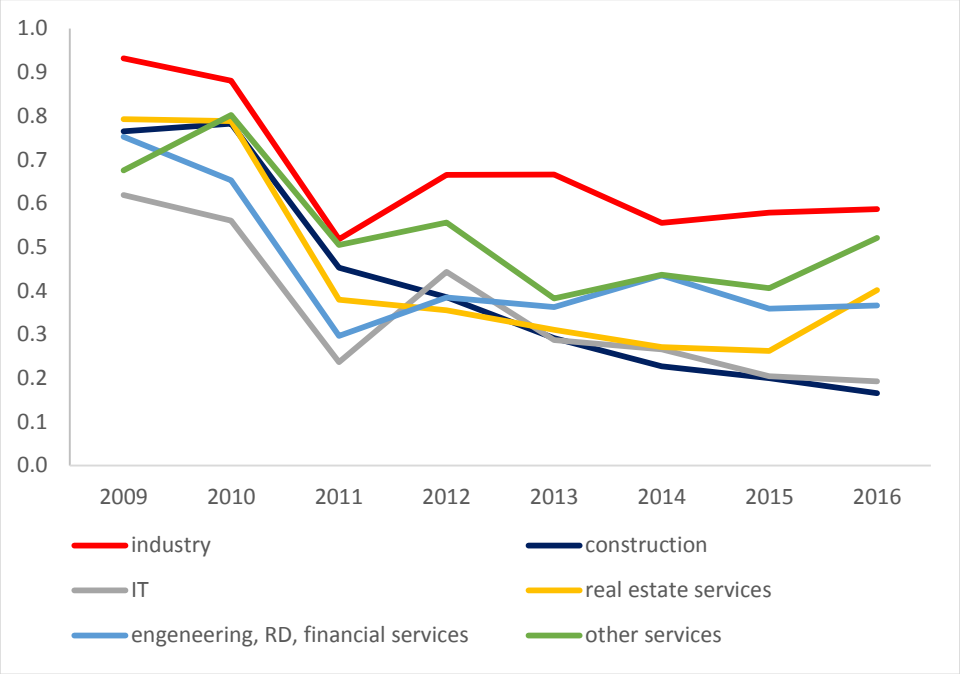
Figure 3.4.: The Transparency Index of Hungarian Public Procurement, 2009-2016, yearly data, N = 151,457



Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

The comparison of TI values between industries shows that the positive tendency was driven by the real estate and other services in contrast in the IT and construction (see Figure 3.5.) where the value of TI dropped.

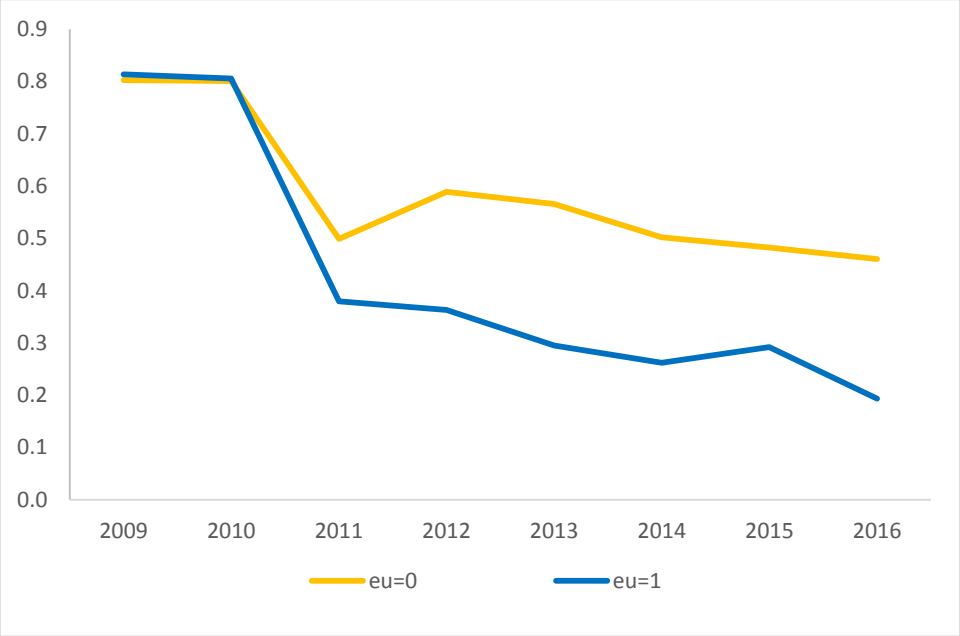
Figure 3.5.: The Transparency Index of Hungarian Public Procurement by industrial sectors, 2009-2016, yearly data, N = 147,801



Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

The analysis of the impact of EU-funded tenders gives us interesting results (see Figure 3.6.). In the case of EU-funded tenders and also in the case of non-EU-funded ones the Transparency Index dropped significantly from 2015 to 2016, while, we pointed out earlier, in the whole universe of tenders the TI rose slightly during 2016 compared to 2015. This is not a calculation error, on the contrary this situation is a good example of a special paradox, known as the Simpson's paradox (what we have mentioned earlier), when a tendency seems to exist in the complete population, but if different subgroups are analysed, it disappears or reverses. For showing the detailed results we put the data in the Annex 5.1 Table.

Figure 3.6.: The Transparency Index of Hungarian Public Procurement in EU-funded and non-EU-funded tenders, 2009-2016, yearly data, N = 150,942



Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

The explanation of these paradoxical results is based on two factors. First, since 2001, the EU-funded tenders have significantly lower TI value in each year than the non-EU-funded ones, second, the share of the EU-funded tenders dropped significantly from 2015 to 2016 (from 37% to 12%). Accordingly, the later, because their negligible weight in the total number of contracts much less reduced the Transparency Index in the overall population than before.

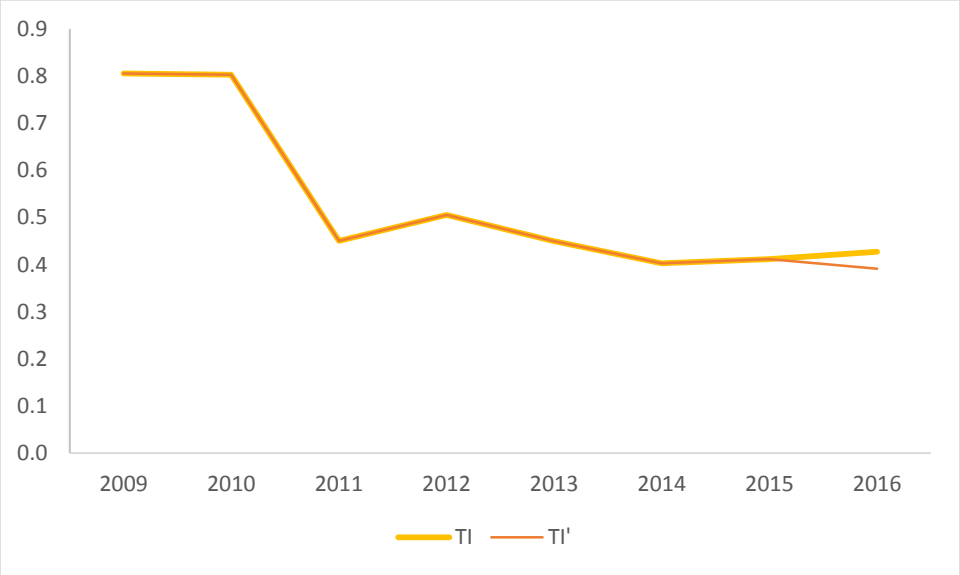
This fall can be corrected if for the purpose of estimation, we assign the same weight to EU-funded tenders in 2016 as the weight was in the previous year. In this case, we can eliminate the effect of considerable drop of EU-funded project to the level of Transparency Index.

To create a hypothetical dataset and achieve the purpose of the estimation, we used the following method: we put 6,380 EU-funded contracts from the year of 2015 to the year of 2016 data. Thus, we got a hypothetical dataset with the same weight of EU-funded project in 2016 as we had in 2015 (see A5.3. Table).

In the original dataset, we can also observe that the value of TI dropped significantly in the EU-funded projects (from 0.29 to 0.19) between 2015 and 2016. But processing the estimation for the imputed data of 2016 we calculated 0.29 TI value instead of 0.19, so in the hypothetical data of 2016 we used higher level of TI than we observed for 2016 in the reality. Nonetheless in the supplemented hypothetical dataset we get slightly lower level of TI (0.39) in 2016 compared to 2015 (see Figure 3.7.). This means, if the share of EU-funded

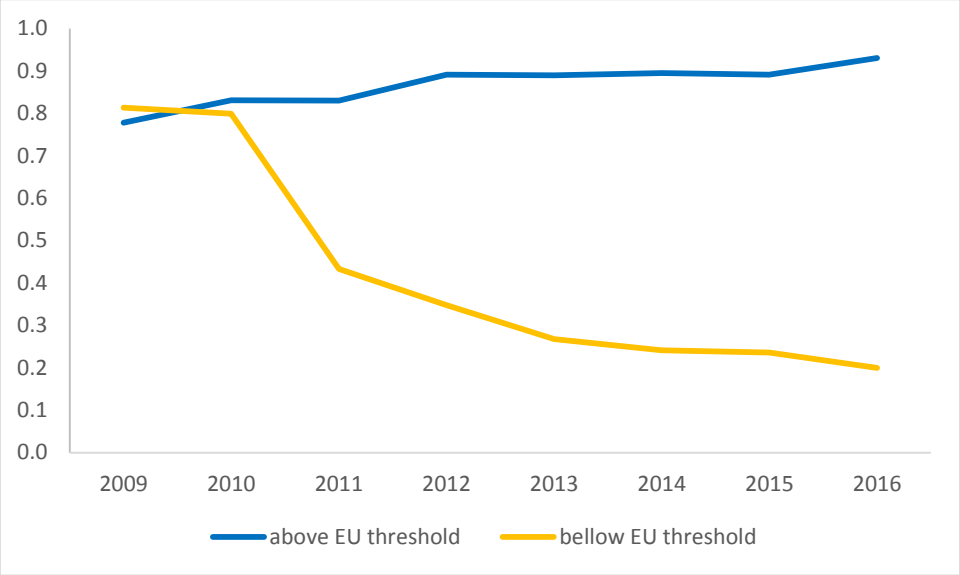
tenders had not decreased from 2015 to 2016, the level of TI would have decreased in 2016. One of factors of the observed slight rise of transparency in 2016 in the Hungarian public procurement is the significant drop of EU-funded tenders.

Figure 3.7.: The observed (TI) and hypothetical (TI') Transparency Index in Hungarian Public Procurement, 2009-2016, yearly data, N (hypothetical) = 157,837, N (original) = 151,457



Note: with framework agreements;
original data are filtered by variable goodx (for details, see Table A1.7.) and goodsx (hypothetical data)
Source: CRCB

Figure 3.8.: The Transparency Index of Hungarian Public Procurement in tenders below and above of EU threshold, 2009-2016, yearly data, N = 151,457



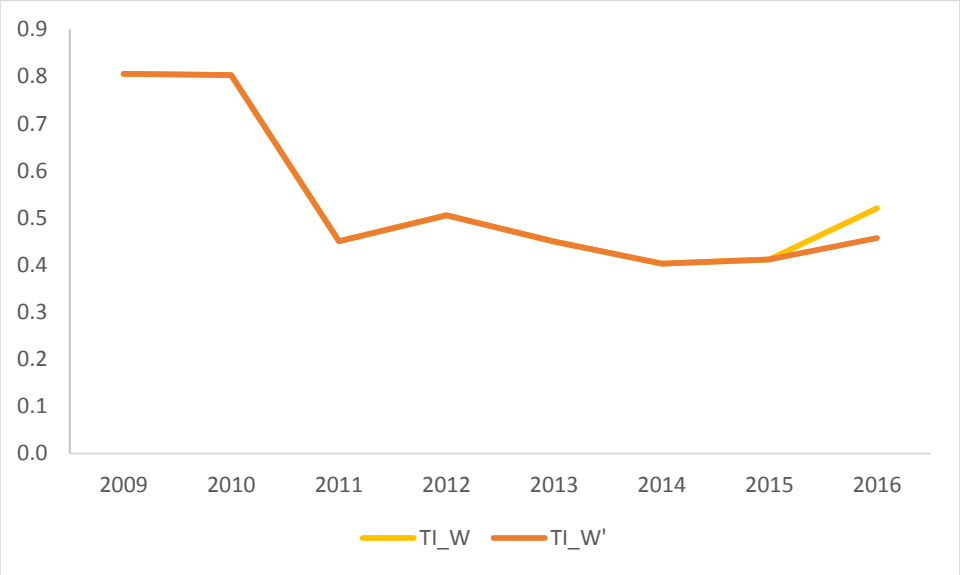
Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

In addition, we use a weaker variance of transparency index (TI_W') where put the new procedures by the Article 113 open procedure as transparent. In reality the type of 'Article 113 open procedure' gives to the potential bidders very restricted information about the future tender and it allows only five calendar days for them to report to the next step of the procedure and to require the detailed announcement[14]. In addition, the call for tender is not published as a notice above certain procurement value thresholds.

Regarding the TI_W' we have more positive picture: the level of transparency rose in 2016 even we taking consideration of significant drop of the share of EU-funded tenders (see Figure 3.9.). However in terms of the standard TI, these procedures cannot be regarded as transparent ones.

[14] Article 115 open procedures are not treated as "transparent" procedures because such type of procedures are genuinely not open procedures as there is not prior publication of the tender call involved.

Figure 3.9.: The observed (TI_W) and hypothetical (TI_W') weak Transparency Index in Hungarian Public Procurement, 2009-2016, yearly data, N (hypothetical) = 157,837, N (original) = 151,457



Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Besides transparency, the occurrence of single-bidder contracts is another important indicator of corruption risks[15]. Several studies consider it as an objective indicator of corruption risk (e.g. Coviello & Gagliarducci, 2010; Fazekas et al. 2013b; Fazekas et al. 2016; Tóth – Hajdu, 2016a).

Measuring the prevalence of single-bidder contract we constructed an indicator Single-bidder (SB) using the following rule:

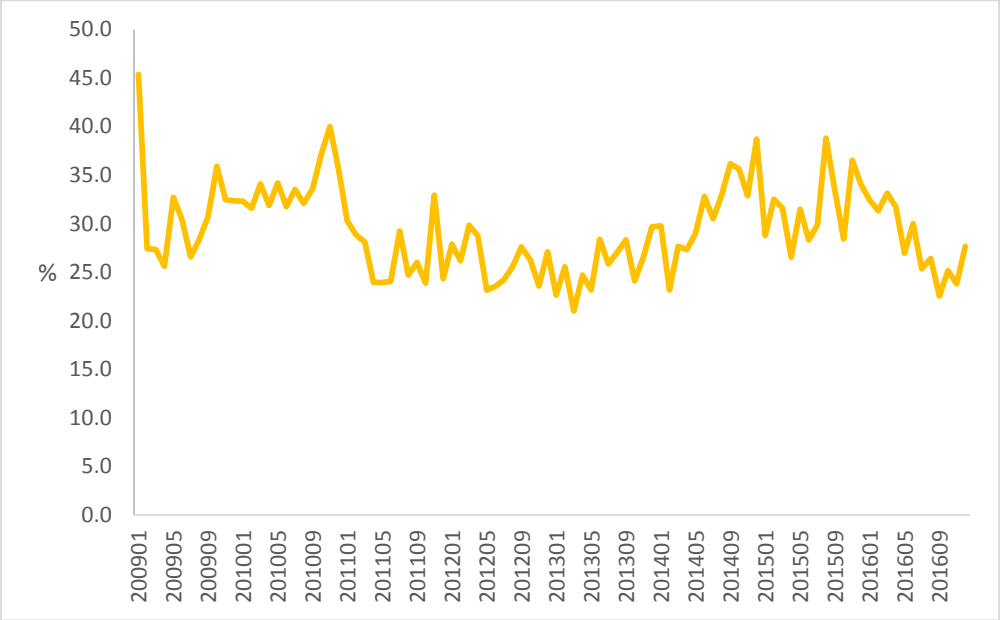
SB = 1 if the tender was conducted with only one bid

SB = 0 if there were more than one bid.

The share of tenders with single bid, i.e. non-competitive tenders, decreased 4 percentage points between 2015 and 2016 (from 32.4% to 27.8%; see Figure 3.10. and 3.11.), however, it remained high.

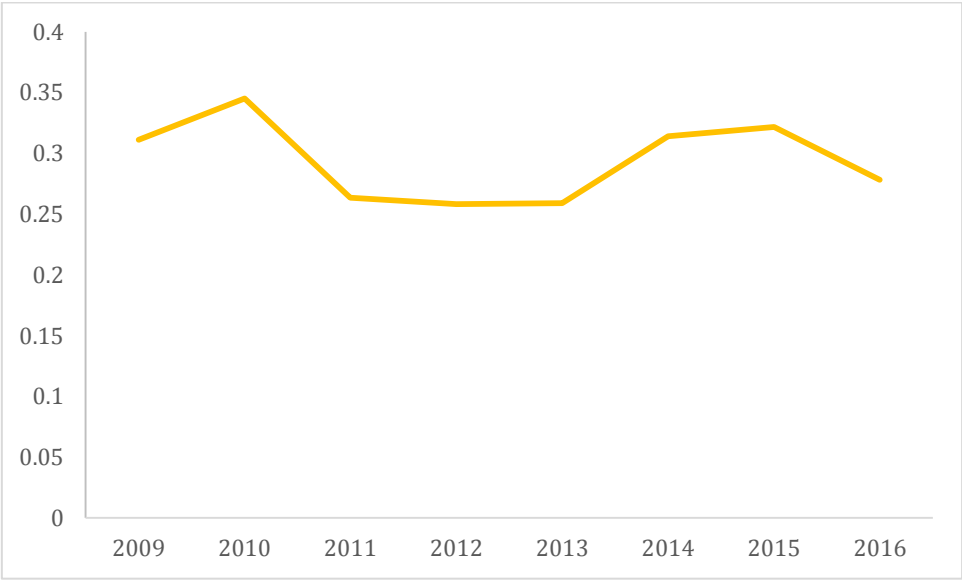
[15] Our previous study we gave an explanation of the concept of corruption risk: „The study of corruption risks is the study of the conditions of corruption. If somebody wants to cheat (to be corrupt), then he/she sets up conditions to generate cheating. Corruption risk means that these conditions for cheating exist in the examined public procurement." (See CRCB, 2016.) But it is also true that conditions favourable for corruption and the existence of these do not necessarily indicate that the corruption transaction happened. In case of public procurement, the corruption risk at any tender means that the tender was conducted with conditions which are favourable for corrupt transactions.

Figure 3.10.: Share of public procurement tenders with Single-bidder (SB) in total number of tenders, 2009-2016, monthly data, N = 149,786



Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Figure 3.11.: Share of public procurement tenders with Single-bidder (SB) in total number of tenders, 2009-2016, yearly data, %, N = 149,786



Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

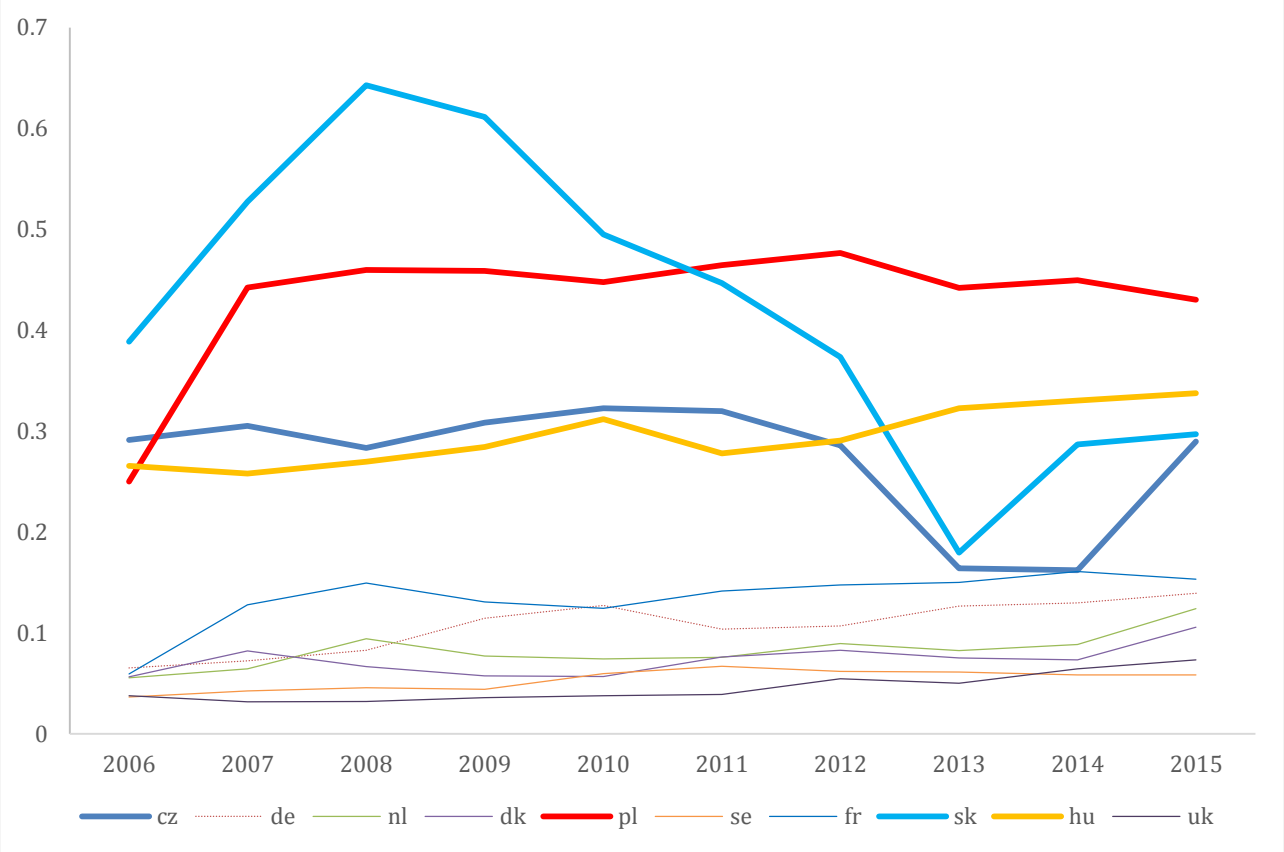
Regarding the monthly average, during the I-III. quarters of 2016 was characterised by falling tendency, by in the IV. quarters the corruption risks measured by the share of single-bidder started to increase (see Figure 3.10.).

In international comparison on the basis of the TED database, the share of tenders with only a single-bidder is notably high in Hungary, varying between 25% and 33% in 2006–2015 (see Figure 3.12.). During the same period, the share of non-competitive tenders did not exceed 12% in the old EU member states (for instance, Denmark, France, the Netherlands, Germany and Sweden) [16]. This is a clear sign that Hungarian public procurement tenders are strongly affected by corruption risks.

However, it has to be kept in mind, that the dissimilarities in the level of development of market economies and therefore in the share and number of large firms may influence the SB indicator. Taking consideration the intensity of competition we have similar results: the Hungarian public tenders have in average one of the lowest intensity of competition compared to the other European countries (see 3.13.)

[16] A possible interpretation for the relatively high ratio of contracts with single-bidder in Hungary in EU comparison can be related to the differences in the national socio-economic environments. More specifically, the limited number of potent companies operating in certain sectors can affect this indicator. However, the investigations of the CRCB prove that this concern has only a marginal effect on the index; for example it is significantly correlated to the corruption perceptions (see: http://bitly.com/1Yc7zQL). In addition, the TED data reveals that even smaller countries than Hungary from the post-socialist region can perform better from this point of view, like Latvia and Slovenia (see: http://bit.ly/2ywlZXJ).

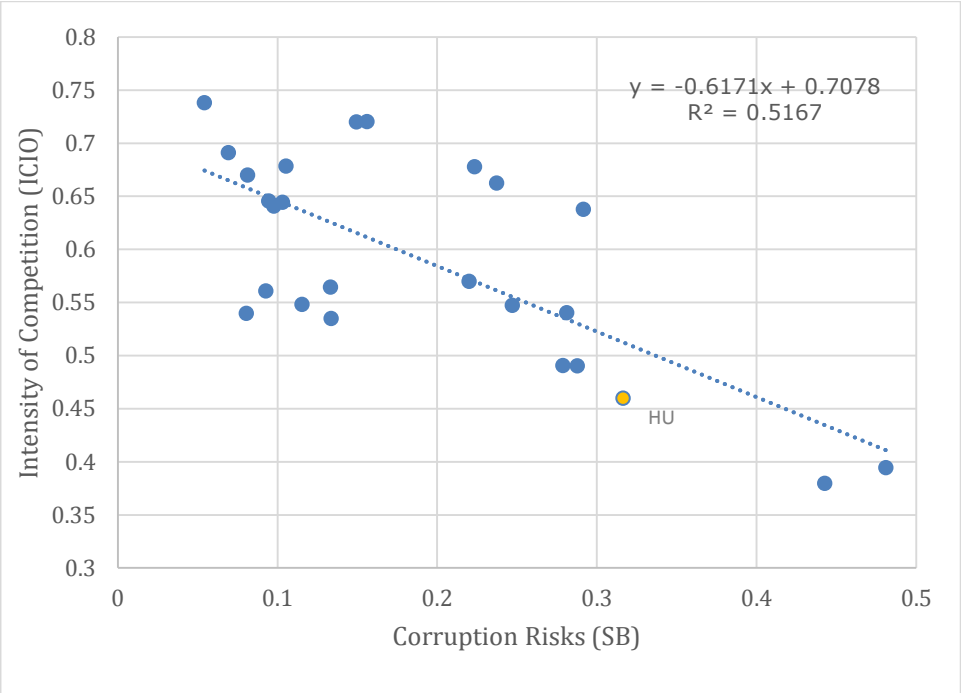
Figure 3.12.: Share of public procurement tenders with Single-bidder (SB) in total number of tenders in some EU countries, 2006-2015, yearly average data, %, N = 3,127,324



Note: calculation of CRCB base on TED data

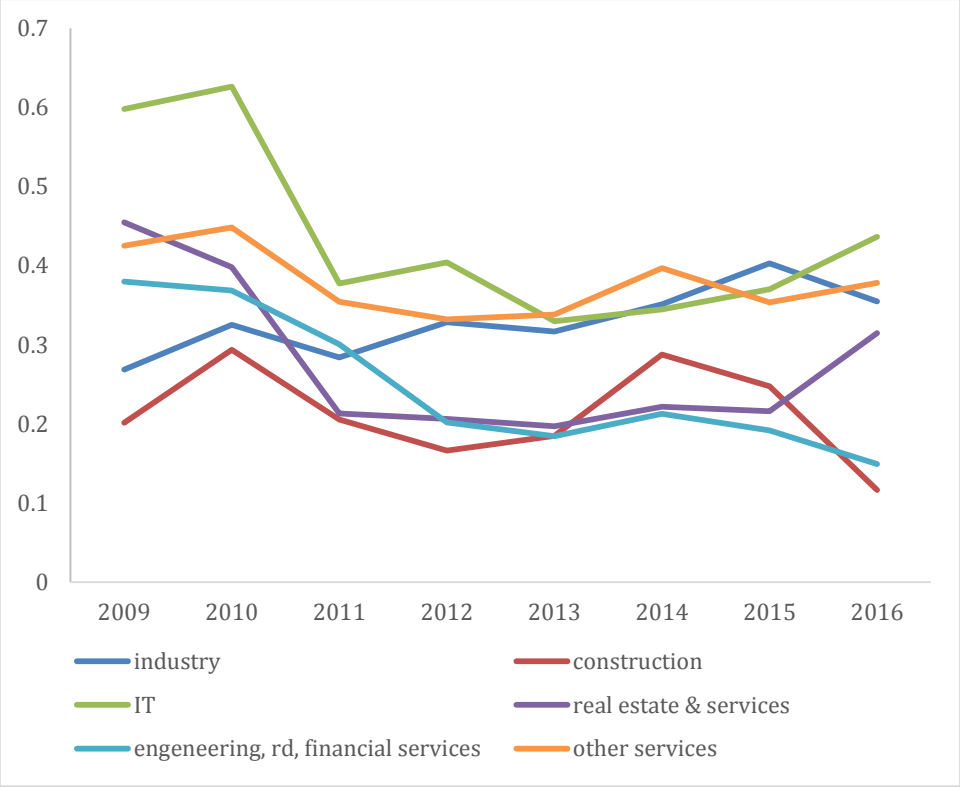
In 2016, the decline in the share of single-bidder contracts was less prevalent for tenders financed by EU grants compared to the non-EU-funded ones (see Figure 3.15.).We have to draw the attention that the share of public procurement tenders with single-bidder decreased only by 2 percentage points (from 33% to 31%) between 2015 and 2016 in case of contracts with a value above the EU threshold according to the TED data (see Figure 3.16.), whereas the decline under the national regime amounted to 7 percentage points (from 30% to 23%).

Figure 3.13.: Average share of public procurement tenders with Single-bidder (SB) and average level of intensity of competition (ICIO) in selected EU countries and Norway, 2006-2015, N = 1,983,799



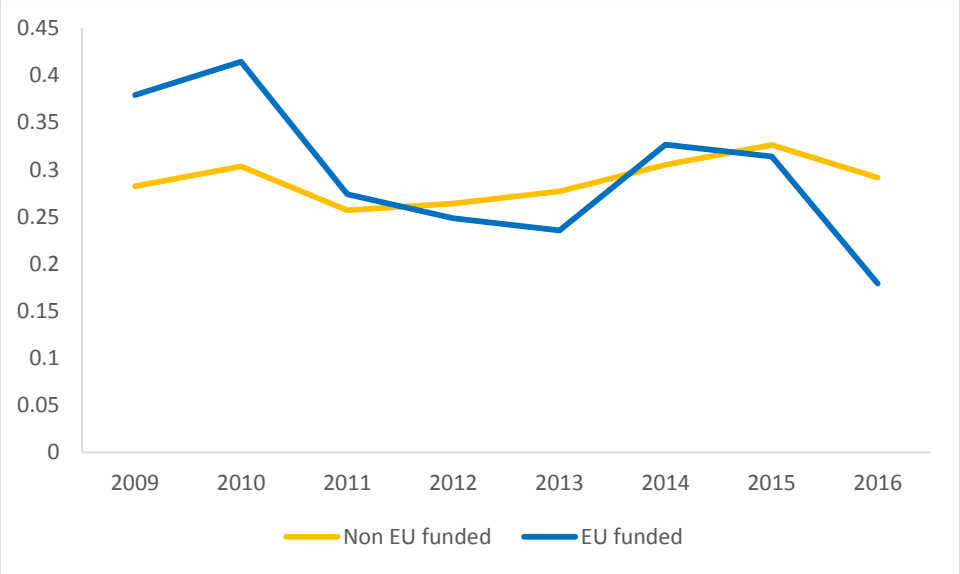
Note: calculation of CRCB base on TED data
ICIO = 0.0 if nbid=2
ICIO = 0.5 if 3 ≤ nbid ≤ 5
ICIO = 1 if nbid ≤ 6

Figure 3.14.: Share of public procurement tenders with Single-bidder (SB) in total number of tenders by Industry, 2009-2016, yearly data, N =146,150



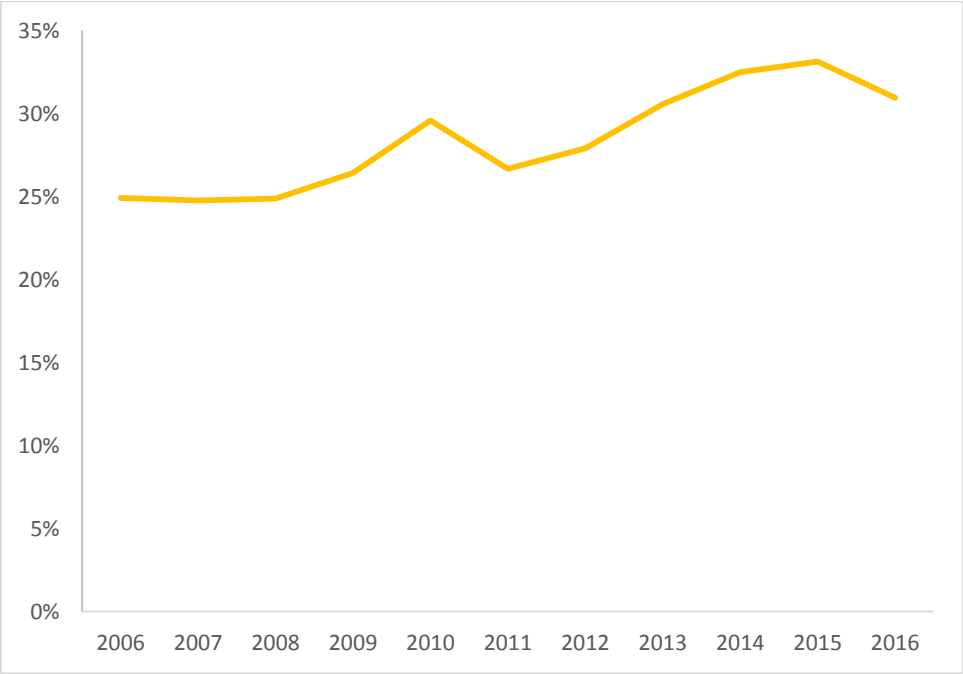
Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Figure 3.15.: Share of public procurement tenders with Single-bidder (SB) in EU-funded and non-EU-funded tenders, 2009-2016, yearly data, N = 149,288



Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Figure 3.16.: Share of contracts without competition (single-bidder) in Hungarian public procurement, 2006-2016, %, N =225,973



Source: CRCB own calculation based on TED data

The SB has lower value in the case of the contracts deriving from the newly introduced procedures of Article 113 and 115 than in the group of contracts linked to other forms of procedures (See Table 3.2.). The reason behind this finding is that these tender types involve an increased number of mandatorily invited bidders (notably Article 115) or in principle allow bidders who were initially not invited to take part if express interest.

Table 3.2. Share and number of contracts with single-bidder by the type of procurement, 2016, N = 15,593

Type of procurement	Number of bidders		Total
	Several bidders	Single-bidder	
Other procedure	5783	2921	8702
	66%	34%	100%
Article 113 open	1287	512	1799
	72%	29%	100%
Article 113 not open (negotiation)	59	39	98
	60%	40%	100%
Article 113 not open (restricted)	27	9	36
	75%	(25%)	100%
Article 115 open	3656	648	4304
	85%	15%	100%
Article 115 not open (negotiation)	488	150	638
	77%	24%	100%
Missing	47	96	143
	33%	67%	100%
Total	11347	4375	15722
	72%	28%	100%

Note: with framework agreements; data are filtered by goodx
Source: CRCB

For the analysis of conditions which are conducive to corrupt transactions we constructed a corruption risk indicator (CR2) which combines the information from transparency and from single-bidder. The CR2 has three values [0, 0.5, 1]; where the value of 0 means low corruption risk (more than one bidder and tender with announcement), the value of 1 means high corruption risk (only one bidder and tender without announcement).

The formula of CR2 is the following:

$$CR2 = \frac{(1-TI)+SB}{2} \quad (2)$$

We have also used an augmented corruption risk indicator. The pricing behaviour of winner companies differs significantly in corrupt and non-corrupt cases. According to the fraud analytics the actors (in our case the winner companies) tend to use rounded data in cases when fraud happened, and they use rounded prices less frequently in normal cases. One of the methods to detect the fraud is to analyse the occurrence of rounded data (Nigrini, 2012; Spann, 2013; Miller, 2015). In terms of corruption, rounded prices could be regarded as a further sign of low competition and higher level of corruption risks. Taking into account this consideration, we augmented the CR2 indicator with information on rounding by at least 10,000 and constructed a new corruption risk indicator (CR3) which contains information on transparency, single-bidder and on rounded contract prices[17] as well. The CR3 has four values: 0, 0.33, 0.66, 1. The value of 0 means low corruption risk (more than one bidder, tender with announcement, and not rounded price), the value of 1 means high corruption risk (only one bidder, tender without announcement and rounded price).

We constructed the CR3 using the following formula:

if CR2=0 & ROUND4 =0 then CR3 =0
if CR2=0 & ROUND4 =1 then CR3=0.33
if CR2=0.5 & ROUND4 =0 then CR3=0.33
if CR2=0.5 & ROUND4 =1 then CR3=0.66
if CR2=1 & ROUND4 =0 then CR3=0.66
if CR2=1 & ROUND4 =1 then CR3=1

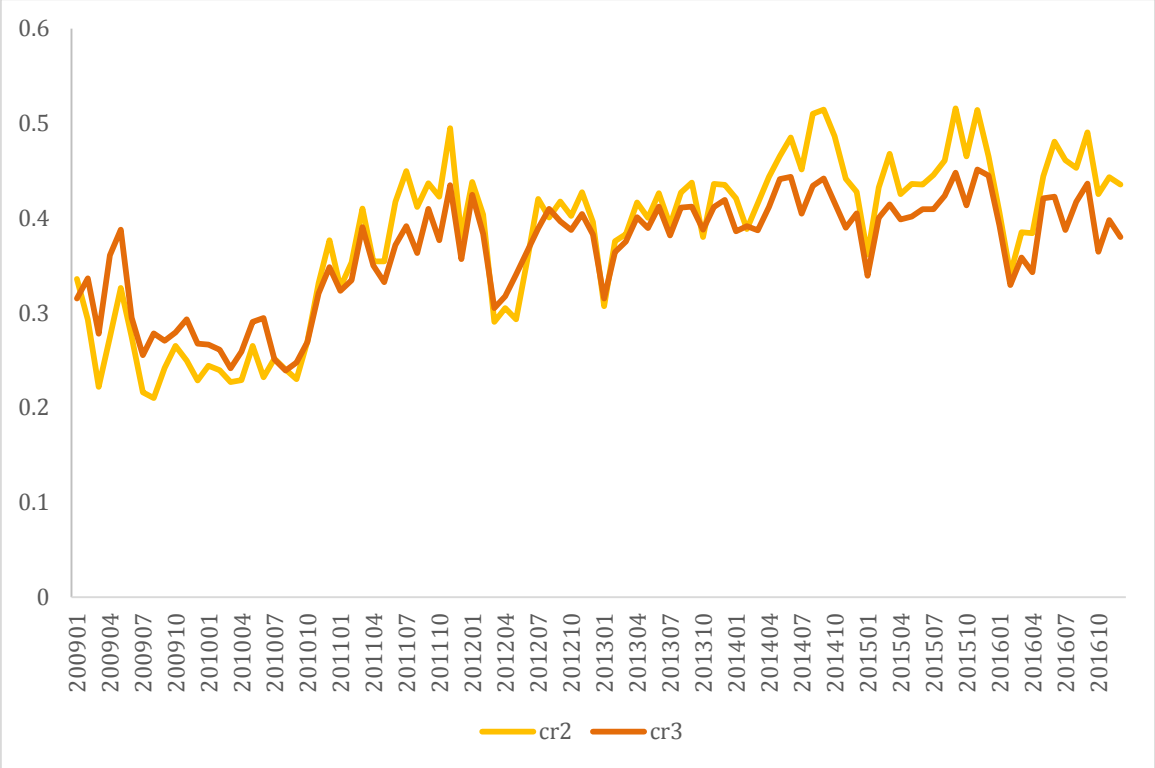
The distribution of Hungarian public tenders by CR3 see Annex 5.5. We summarise here the most important observations on the evolution of corruption indicators over the period:

- While showing an increasing trend between 2009 and 2015, the average values of composite corruption risk indicators (CR2 and CR3) fell slightly in 2016 but remained at a relatively high level. The CR2 decreased from 0.46 point to 0.43 point, and the CR3 decreased from 0.52 point to 0.5 point between 2015 and 2016 (see Figure 3.17. and 3.18.).
- The CR3 decreased in all industries except IT sector (see Figure 3.19.)
- The CR3 was higher for EU-funded tenders than non-EU-funded ones between 2010 and 2016 (see Figure 3.20.).

[17] On rounded contract prices see the section 5.1.

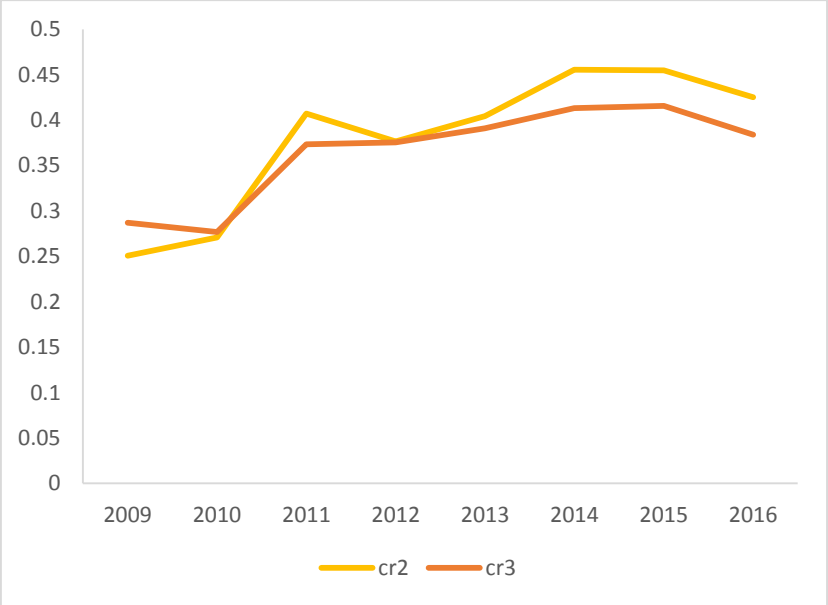
- During the period 2011 and 2015 the value of CR3 showed a much higher corruption risk for tenders below the EU threshold value than above it. This situation did not change in 2016 (see Figure 3.21.).
- Finally, we examined the amount of money spent on public tenders marked by the highest level of corruption risk (CR3=1). We defined this aggregate value taking into account tenders where the value of the corruption risk indicator was 1, and then we aggregated the contract value of these tenders. The results show that in 2016 the aggregate value of tenders with the highest level of corruption risk moved up compared to those in 2014–2015 and the relative share of these tenders in total value of all tenders grew from 30% to around 44% in 2016. (See Figure 3.22.).

Figure 3.17.: The Corruption Risk Indicators (CR2 and CR3) in Hungarian public procurement, 2009-2016, monthly average, N = 149,786



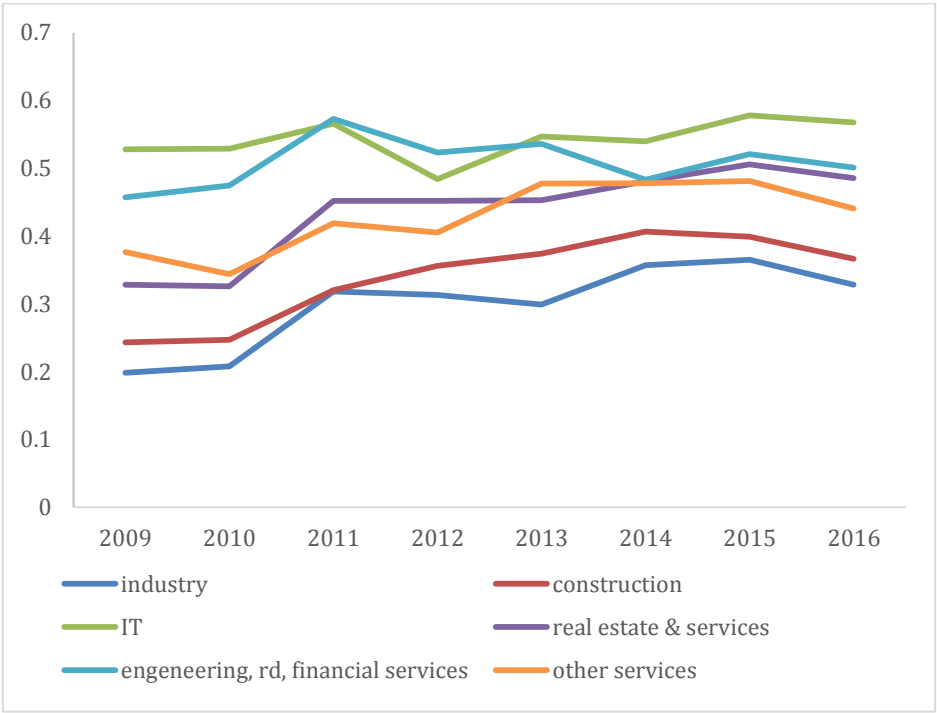
Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Figure 3.18.: The Corruption Risk Indicators (CR2 and CR3) in Hungarian public procurement, 2009-2016, yearly average, N = 149,786



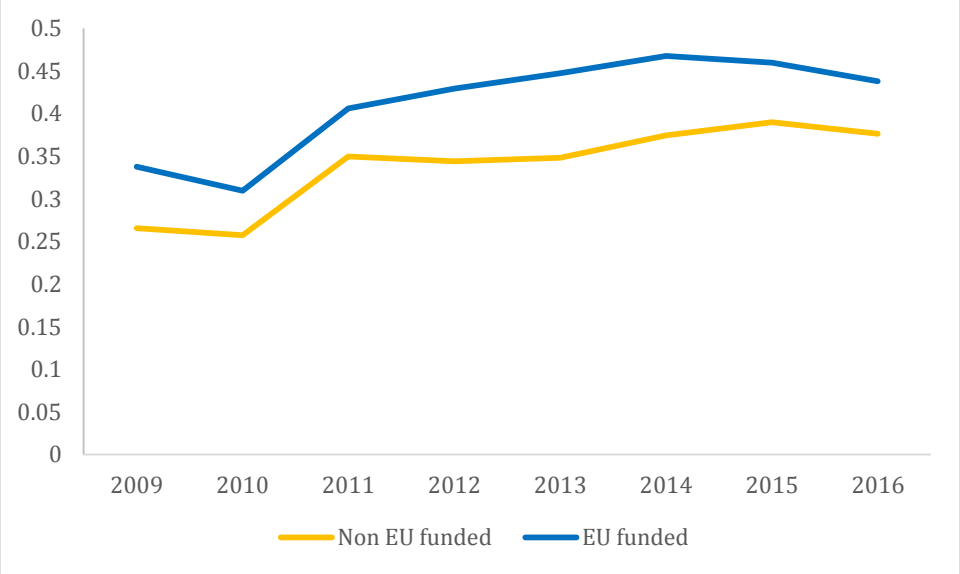
Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Figure 3.19.: The Corruption Risk Indicator (CR3) in Hungarian public procurement by industry, 2009-2016, yearly average, N = 146,150



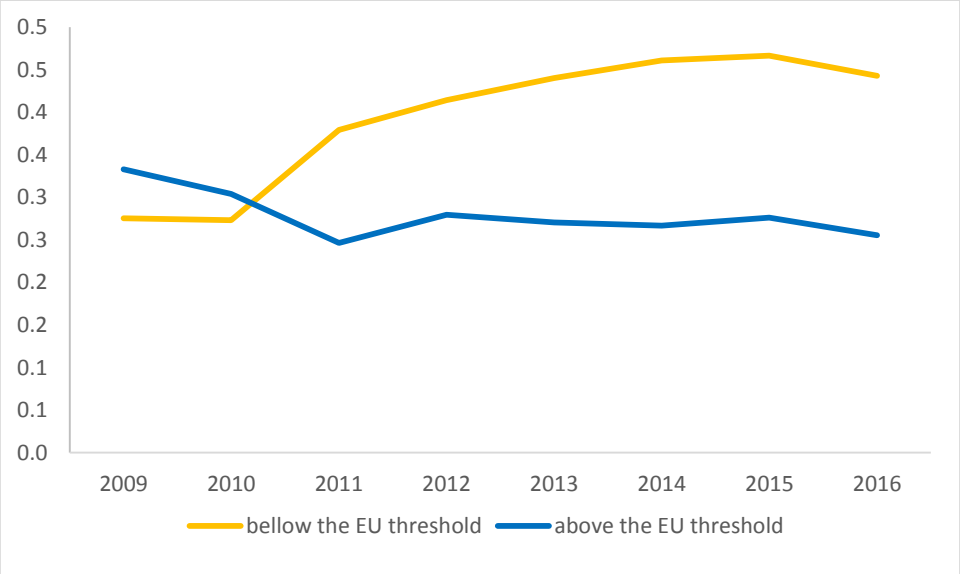
Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Figure 3.20.: The Corruption Risk Indicator (CR3) in EU-funded and non-EU-funded tenders, 2009-2016, yearly average, N = 149,288



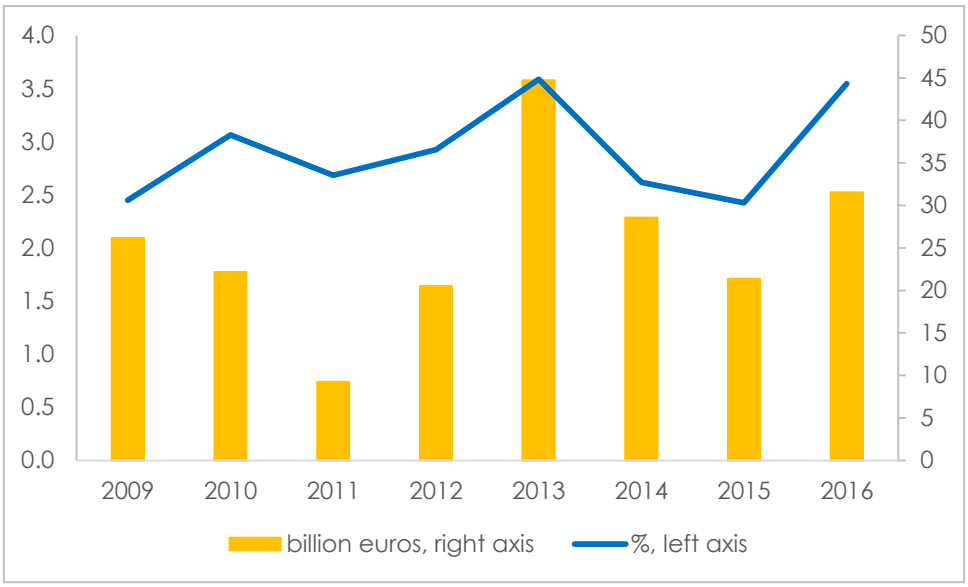
Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Figure 3.21.: The Corruption Risk Indicator (CR3) in tenders below and above the EU threshold, 2010-2016, yearly average, N = 149,786



Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)
Source: CRCB

Figure 3.22.: Weight of total net contract value with CR3=1 relative to total net contract value and total net contract value with CR3=1 by year, 2010-2016, billion HUF and %, N = 138,743



Note: without framework agreements;
Note: data are filtered by variable goodfwc (for details, see Table A1.7.)
Source: CRCB

4. Price distortion

In this section we focus on the analysis of net contract prices to detect price distortion or overpricing. The concept of the price distortion/overpricing is also related to corruption (see Table 1). We consider the former as an outcome of a corrupt situation. In the case of a corrupt tender, the contract price includes the economic rent generated by corruption in addition to the market price. As a consequence, price setting within corrupt tenders must be fundamentally different from that of tenders involving competition.

As a result, the prices of corrupt tenders contain additional information that is not included in the prices of tenders with competition. Compared to prices of tenders with competition, the prices of corrupt tenders have to show different characteristics. Besides our earlier indicators of corruption risk, as SB, or CR2, it is also important to pay attention to information in contract price, and to analyse them. While SB and CR2 purely focus on the (pre)conditions of corruption, the analysis of contract prices already takes into account its consequences, or outcomes. Indeed, because of corruption, contract prices of corrupt tenders could be distorted as compared to prices of tenders with high level of competition.

For the reasons explained above we interpret the price distortion as a sign of non-zero level of corruption risk. We use three methods to detect this phenomenon: we analyse (i) the rounded data in contract prices; (ii) the observed distribution of first digits of net contract price against distribution of first digits predicted by the Benford's law; and, finally (iii) the drop in contract prices compared to the estimated value of tenders (i.e. the price estimated by the issuer and published in the call for tenders).

4.1. Rounded data in contract prices

Rounded contract prices can be regarded as an indicator of existence of price distortion. The analysis of rounded data is one of tool the tools of fraud analytics to detect irregularities in prices (Miller, 2015, Nigrini, 2012 and Spann, 2013). We constructed three indicators for this analysis: *ROUND4, ROUND5* and *ROUNDR2*. We defined them in the following way:

ROUND4 = 1, if the contract price is divisible by at least 10^4 without remainder (rounded at thousands)
ROUND4 = 0, if the contract price is not divisible by 10^4 without remainder

ROUND5 = 1, if the contract price is divisible by at least 10^5 without remainder (rounded at thousands)
ROUND5 = 0, if the contract price is not divisible by 10^5

without remainder

Due to the fact that the weight of the possible rounding depends also on the size of the numbers we calculated a relative index, the round ratio (*ROUNDR*) using the following formula:

$$ROUNDR = \frac{R_{obs}}{Rmax} \qquad (3)$$

Where R_{obs} is the number of maximal level rounding of the given contract price. For instance, if the contract price is 24,500 HUF the value of R_{obs} is 2, and if it is 456,000,000 HUF the value of R_{obs} 6. The R_{max} means the maximum weight of rounding at certain size of numbers. For instance, for the contract prices between 10,000 and 99,999 HUF the value of R_{max} is 4 and prices between 100,000,000 and 999,999,999 HUF the R_{max} is 8.

In the next step we recoded the value of *ROUNDR* into a new variable (*ROUNDR2*) which has 4 categories [0.25, 0.5, 0.75 and 1] where the highest value means the highest weight of rounding at the given contract price.

We interpret the value the *ROUNDR2* as a proxy of the strength of non-competitive (or non-cost based) pricing: lower level of *ROUNDR2* means higher level of competition and lower level of corruption risk and higher level of *ROUNDR2* means a reverse tendency.

The indicators of rounded prices (ROUND4 and ROUND5) show a decreasing trend in price distortion in the last three years from 35.8% to 29.0%, however, the ROUND4 is still close 0.30, it means that around 30% of the contract prices were rounded by 10^4 in the Hungarian public procurement (see Figure 4.1.1.). This decline can be considered as an important feature of public tenders because the change in the price setting behaviour of winners is the result of a spontaneous agent-level based process, which, for instance, is not driven by the requirements by public procurement law or by regulators. (In the case of the number of bidders, we can expect such institutional effect when the public procurement law in certain procedures clearly specifies the minimum number of bidders.)

The decreasing trend in the share of rounded prices is not present in every segment of tenders, and it is largely driven by the construction sector. In the sector of engineering, RD, financial and other services and also in the industry, the share of rounded prices stagnated or showed a slight increase between 2012 and 2016 (see Figure 4.1.2.). Surprisingly in the construction sector the contract prices are significantly less frequently rounded than in other industries (only 29%-12% of the cases). We assume that this fact is related to the widespread

use of the cost estimation manuals[18] by the bidders from the construction sector. And additionally, in the construction sector the actors regularly use the method of supplementary works to raise the initial contract prices and thus, to get the rent generated by corruption. Unfortunately, due to the missing data, however we do not have accurate information on their frequency and extent. It can be seen that if we take the original contract prices into consideration, the cost based pricing could be more often found in construction than in other industrial sectors[19].

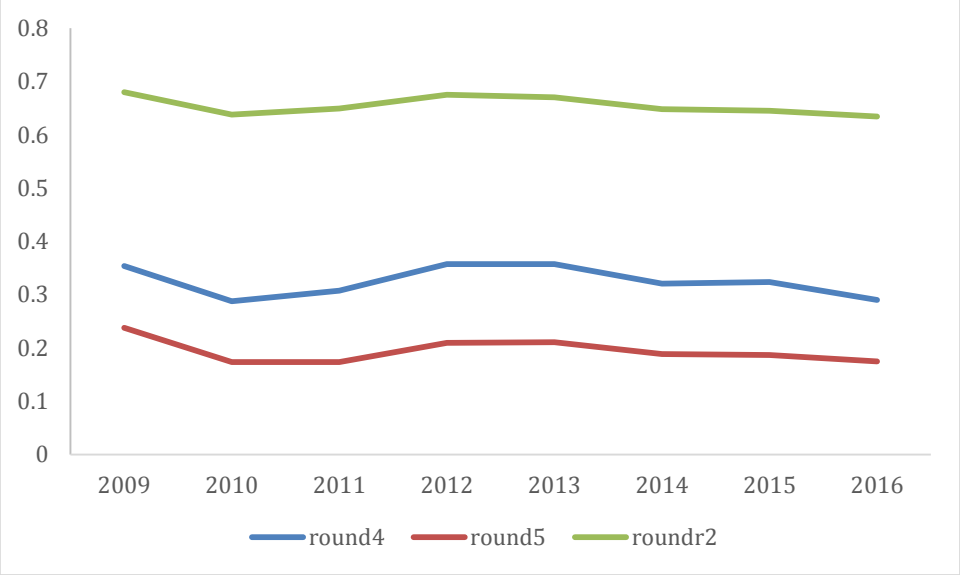
As it was expected, the occurrence of rounded data in contract prices has positive statistical relationship with the corruption risk: the winners of tenders with high level of corruption risk use the rounded data in their prices more often than in the case of tenders with low level of corruption risk (See Figure 4.1.3. and A5.6 and A5.7). Where the tender was performed with high corruption risk, a higher share of contract price was rounded by at least 10^4 (35.4%) than in the case of those with low corruption risk (26.8%). *The analysis of the weight of rounded data (ROUNDR) shows us the same picture (See Figure 4.1.4.).*

Finally, we analysed the price distortion measured by rounding (ROUND4, ROUND5) and the EU funding (See Figure 4.1.5.). The results point out that the EU-funded tenders have higher share of rounded data than the non-EU-funded ones. When we control for the contract value, sector and date of the tenders the results are contradictory. In case of ROUND4 there is strong positive and in case of ROUND5 there is less powerful negative correlation between the rounded price and the EU funding (see A5.6 and A5.7).

Given the fact that the corruption risks are higher and the intensity of competition is lower amongst the EU-funded projects than amongst the non-EU-funded ones, this new empirical evidence points out the hypothesis that the EU support can incur contradictory effects on price distortion. It cannot be demonstrated that the EU funding would clearly reduce the level of price distortion. (For the detailed analysis of effects of EU funds see the section 5.3.)

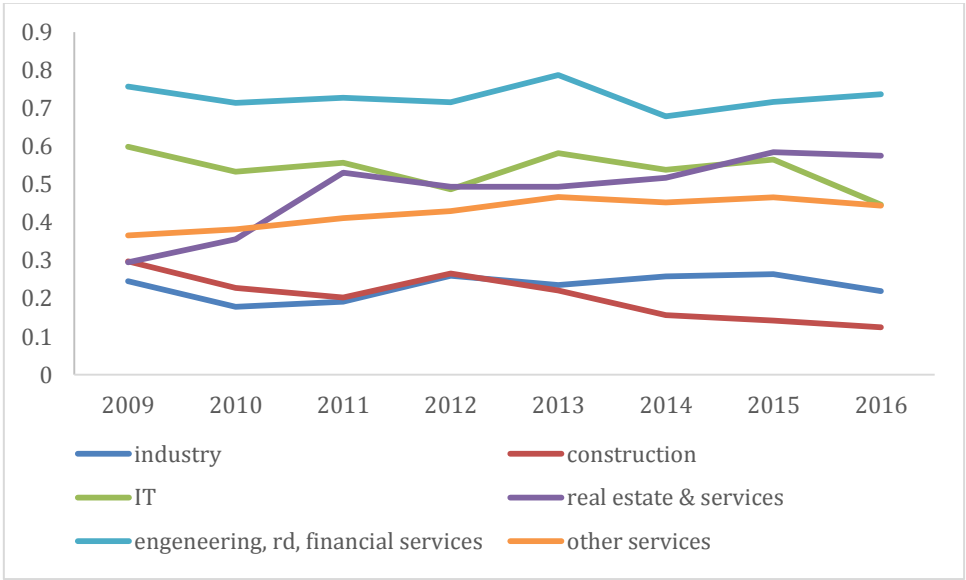
[18] See for instance: http://bit.ly/2k4MHA2 . The manual is published and refreshed yearly.
[19] In the construction sector corruption risks maybe related to a lesser degree to overpricing (in case of original contract price) rather than to enforcing supplementary work or bid rigging.

Figure 4.1.1.: Evolution of value of ROUND4, ROUND5 and ROUNDR2 over the period of 2009-2016, yearly average N (ROUND4 and ROUND5) = 138,743, N (ROUNDR2) = 93,004



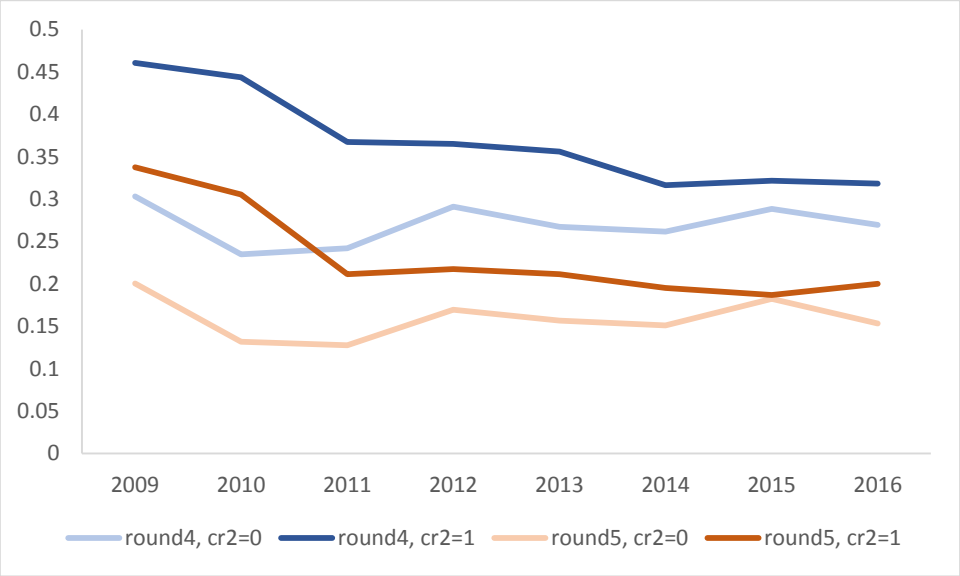
Note: without framework agreements;
data are filtered by goodfwc and the cases are excluded where currency is other than HUF
Source: CRCB

Figure 4.1.2.: The evolution of ROUND4 by industrial sectors, yearly average, 2010-2016, N = 135,327



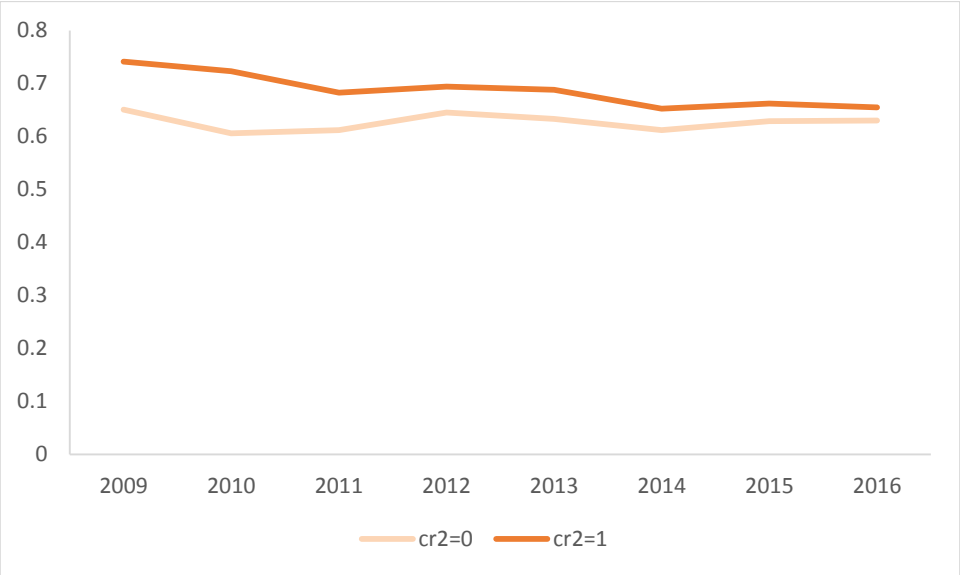
Note: without framework agreements;
data are filtered by goodfwc and the cases are excluded where currency is other than HUF
Source: CRCB

Figure 4.1.3.: The share of rounded data in contract price (ROUND4 and ROUND5) over the period by tenders with low and high level of corruption risk (CR2), yearly average, 2009-2016, N = 68,810



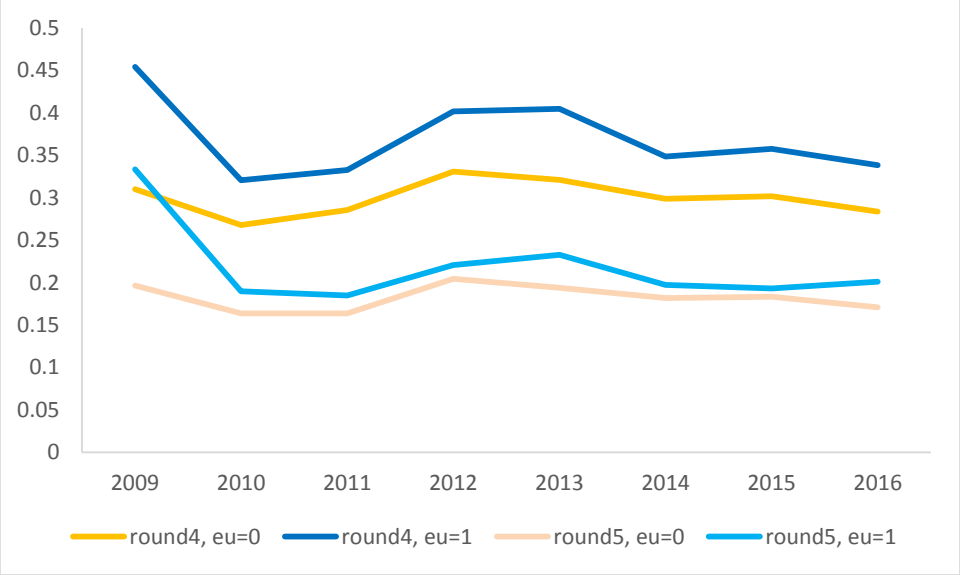
Note: without framework agreements;
data are filtered by goodfwc and the cases are excluded where currency is other than HUF
Source: CRCB

Figure 4.1.4.: Weight of rounded data (ROUNDR2) in contract prices in tenders with low and high level of corruption risk (CR2), 2010-2016, yearly average, 2010-2016, N = 45,032



Note: without framework agreements;
data are filtered by goodfwc and the cases are excluded where currency is other than HUF
Source: CRCB

Figure 4.1.5.: The average share of rounded contract price (ROUND4 and ROUND5) over the period by EU-funded and non-EU-funded-funded tenders, yearly average, 2019-2016, N = 138,262



Note: without framework agreements;
data are filtered by goodfwc and the cases are excluded where currency is other than HUF
Source: CRCB

4.2. The first digit test

Using the second method, we analyse the price distortion by the distribution of the first digit in the contract prices based on Benford's law[20] or Newcomb-Benford-s law[21].

According to Benford's law (also known as the First-Digit Phenomenon) in a non-artificially generated set of numbers (in any numeral system) the first digits in each, local values are distributed neither arbitrarily nor uniformly; the distribution instead follows the distribution set by Benford's law. A set of numbers is said to satisfy Benford's Law if the leading digit d (in 10 digit system, $d \in \{1, ..., 9\}$) occurs with probability:

$$P(d) = log10(d+1) - log10(d) = log10(1 + 1/d) \quad (4)$$

The distribution of first digits in the decimal system (1,..,9) according to Benford's law is in Table 4.2.1.

Table 4.2.1. The distribution of first digit according to the Benford's law in the decimal system

First digits	log(d)	log(d+1)	P(d) = log(d+1) - log(d)	cum [P(d)]
1	0.000	0.301	0.301	0.301
2	0.301	0.477	0.176	0.477
3	0.477	0.602	0.125	0.602
4	0.602	0.699	0.097	0.699
5	0.699	0.778	0.079	0.778
6	0.778	0.845	0.067	0.845
7	0.845	0.903	0.058	0.903
8	0.903	0.954	0.051	0.954
9	0.954	1.000	0.046	1.000

The economist Hal Varian first suggested in 1972 that Benford's law could be used to detect possible fraud in socio-economic data, and that it the performance of forecasting models could be evaluated (Varian, 1972). Mark Nigrini pointed out 25 years later that Benford's law is useful in forensic accounting and auditing as a tool to detect fraud and collusion (Nigrini, 1996). Ever since, Benford's law has been common and it is a widely used method in several areas of social research for fraud detection Drake & Nigrini, 2000; Durtschi et al. 2004; Spann,

[20] In the description of the concept of this method for the detection of price distortion we are using partially our earlier work. See CRCB, 2016.
[21] See https://en.wikipedia.org/wiki/Benford%27s_law

2013; Kossovsky, 2015; Miller, 2015).

Based on Bendford's law we examined whether the contract price differs significantly from the hypothetical distribution by the intensity of competition and the presence of corruption risks. We examine these relationships by comparing the observed first digit's distribution to theoretical (Benford's) distribution of contact prices of tenders in several analysed groups of tenders in the Hungarian public procurement.

The deviation from the distribution predicted by the Benford's law can be generated by three factors:

a) the price-setting behaviour of the issuer: the issuer sets the estimated value of the project by using non-market price methods but by considering how much money is accessible for the project;

b) the price setting behaviour of the winner: during the process to set the bid, the future winner already includes a corruption rent into the offer's price.

c) administrative factors or regulation: the laws or resolutions concerning public procurement arbitrary set thresholds for certain sectors and/or procedure types;

Of the above three factors the first (a) and the second (b) ones can be explained more easily. In the case of a) the issuer obviously does not act according to the initial objective of public procurement (i.e. to buy goods or services at market prices). That is, the public money is not treated by the issuer with the required manner: it does not conduct a market research before the call for tenders, it does not ensure that the products / services they want to buy at what price can be purchased on the market. In this case, one type of corruption is realised, the embezzlement or misappropriation of public funds (Lambsdorff, 2007). All of this results in the fact that the contract prices of purchased goods or services deviate from their expected or normal values (i.e. market prices) and those are rather determined by political / administrative factors (i.e. the political importance of the project; the bargaining power of the issuer in the negotiations for public resources, etc.). This situation results in obvious distorted prices compared to market prices and it can be detected by using the Benford's law.

In the second case (b) the price setting behaviour of future winner is influenced by several factors. First, to what extent the future winner would be able to establish a corrupt situation before the start of the procurement procedure, and how high the corruption risk is associated with this particular procedure. And, what the future winner's expectation or knowledge is on the intensity of competition during this tender or how much he/she knows about the other competitors' bids.

If there is a high risk of corruption, the rate of the rent due to corruption may be higher if it is small, then it is lower. If the winner expected a low intensity of competition or ex-ante colluded with the other competitors on the price, the

winner would be able to add a rent to his bid price. As a result, the winner's price will differ obviously from the market price.

The third case (c) has effects only indirectly. In theory, the thresholds related to types of procedure or product markets are neutral from the point of view of market competition so their impact cannot be seen in the price setting procedure.

In this case, the contracting authority determines the estimated value and then acts according to the law: if the estimated value is over a certain threshold, the contracting authority naturally applies the type of procedure determined for tenders over this threshold. Consequently, ideally, the threshold determined by the regulations should not have any impact on the estimated value or number of competitors or on the winner price. That is, the applied threshold does not have any effect on the distribution of first digit of winner prices, so we cannot detect any deviance from the theoretical distribution specified by the Benford's law.

But often this is not the case. A type of procedure can, in itself, have an impact on the intensity of competition, the level of corruption risks and, consequently, the weight of price distortion, and consequently the formation of rent. These effects related to the type of procedures can be considered as institutional impacts, which then directly affect the behaviour of the actors (issuers and bidders).

Sometimes, in case of certain types of procedure (e.g. in the accelerated procedures), contracting authorities can frequently be less prudent, more likely to skip market research or may be, due to the procedural rules themselves fewer competitors will participate in the procurement than otherwise. In these cases the institutional effects themselves cause to some extent the more restrictive competition, highest level of corruption risks and highest level of price distortion and the creation of rent. Then the thresholds determined by regulations and related to certain types of procedures or product markets have strong effects on setting the estimated value of purchase, they distort it and thus, result distortion in the winner price as well. Results of empirical research based on Czech and Hungarian data support the relevance of these effects (Palguta & Pertold, 2017; Toth & Hajdu, 2017)

That is, the thresholds set by law may affect the estimated value and thus the winner price as well. On the one hand, the contracting authorities like to use procedure types which allowed more simple and quicker public tender management and enable faster contracting. If these procedure types can only take place below a threshold, this will encourage them to implement the purchase at a price below that threshold. And on the other hand, a corrupt contracting authority consciously attempts to "target" the estimated value below a certain threshold to apply a procedure below that threshold with a higher corruption risk and thus to manage the planned corrupt transaction more easily.

All these effects described above result in the following: using the procedure types with low corruption risks and high level of competition the purchases

typically take place at market prices (and accordingly the first digits of contract prices are expected to fit well into the theoretical distribution predicted by the Benford's law), while at other procedure types (e.g. non-open procedures) where corruption risks are higher to a certain extent a corruption rent is incorporated into the winner prices.

Accordingly, prices are differently distorted compared to market prices, and these distortions must also be seen in the degree of deviation from the theoretical distribution of first (and second) digits predicted by the Benford's law.

The analysis of first digits indicates that the contract prices in Hungarian public procurement tenders fit the theoretical distribution well when the 2009-2016 period examined as a whole (see Figure 4.2.1). However, there are significant differences in price distortion across years: price distortion rose in the first seven years based on this measure. While contract prices fit the theoretical distribution well in 2009 and 2010, the magnitude of price distortion became significant thereafter (see Figure 4.2.2.). *This observation indicates a rising frequency of overpricing, rising tendency of anomaly in price setting, and consequently we can conclude that this could be a signal of the weakening pointing to weakening competition and growing corruption risks.* In 2016, the degree of price distortion fell compared to the peak level in 2015, but remained significantly high.

The construction sector and industry appear to display the lowest level of price distortion vis-à-vis Benford's distribution, while the IT sector is characterised by the highest (see Figure 4.2.3.). The high level of price distortion in the IT sector is probably related to the large share of heterogeneous and specific goods and services in this sector. *Our findings again show that EU-funded tenders are more affected by price distortion than nationally funded ones (see Figure 4.2.4.).* A possible explanation for this is that the former ones are assumed to be more special, heterogeneous and non-systematic projects than the latter ones.

Our findings highlight that the strength of price distortion falls as intensity of competition becomes stronger (see Figure 4.2.5.).

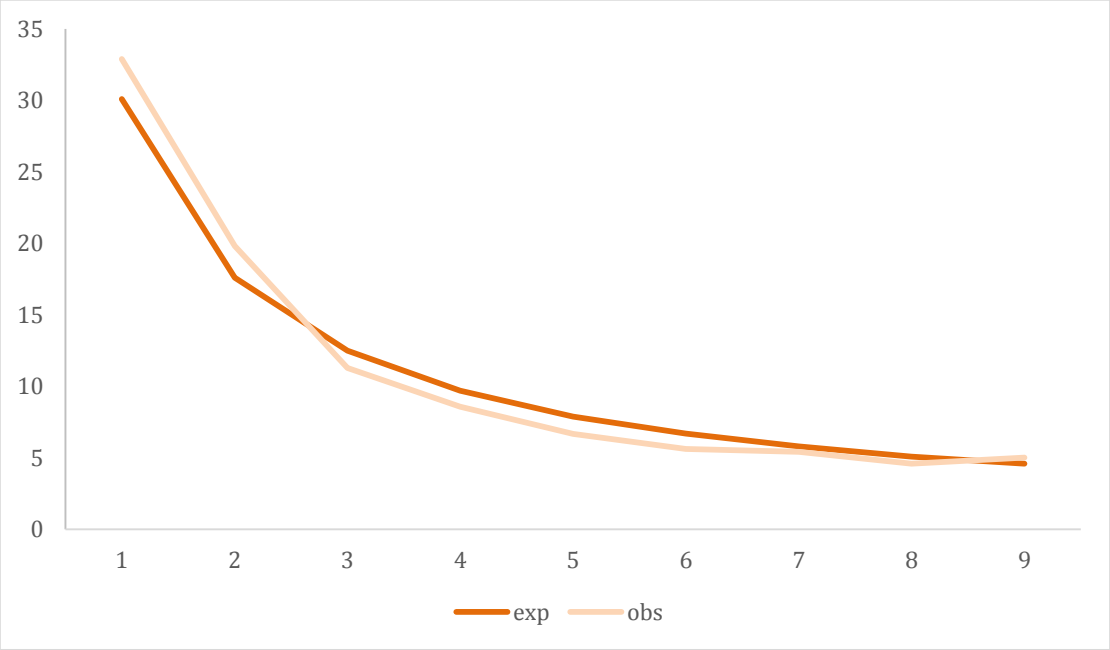
The prices in public procurement contracts are remarkably distorted when there is no competition (i.e. single-bid tenders) or when the level of transparency is low. There is also a positive correlation between the two independent indicators of price distortion: the level of price distortion measured by Benford's law is significantly higher for contracts with rounded prices than for those with non-rounded contract prices (see Figure 4.2.6.)[22]. Only for illustration purposes, we analysed the latter two relationships using not only Hungarian data, but European data as well. Using the public procurement data of the EURO area in the period of 2006-2015 we can conclude that results were the same as in Hungary: there is a strong relationship between the two indicators of price

[22] This relationship can be observed even if we exclude all public procurement in the construction sector from the analysis. The point is that, on the one hand, these tenders account for 50% of all tenders, and on the other hand, as we have seen before, in the construction projects less rounded data are used than in other sectors.

distortion (the results of the first digit test and occurrence of rounded prices) and between of price distortion and competition (see Figure 4.2.7.) [23].

Our analysis suggests that the significant increase in price distortion in the 2009-2015 period was driven by the effect of EU-funded projects (see Figure 4.2.8.).

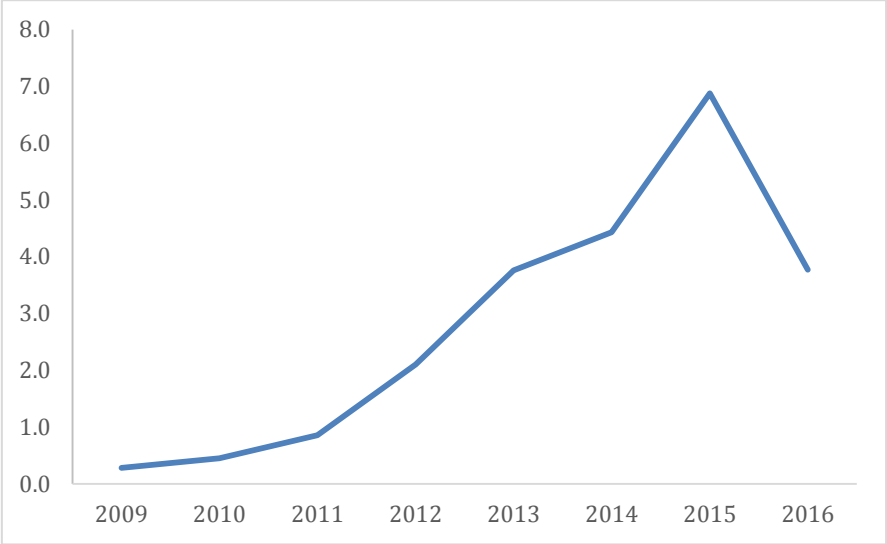
Figure 4.2.1.: The distribution of first digits by the Benford's law and by the contract prices of Hungarian public procurement, 2009-2016, N = 138,743



Note: without framework agreements; data are filtered by goodfwc
Source: CRCB

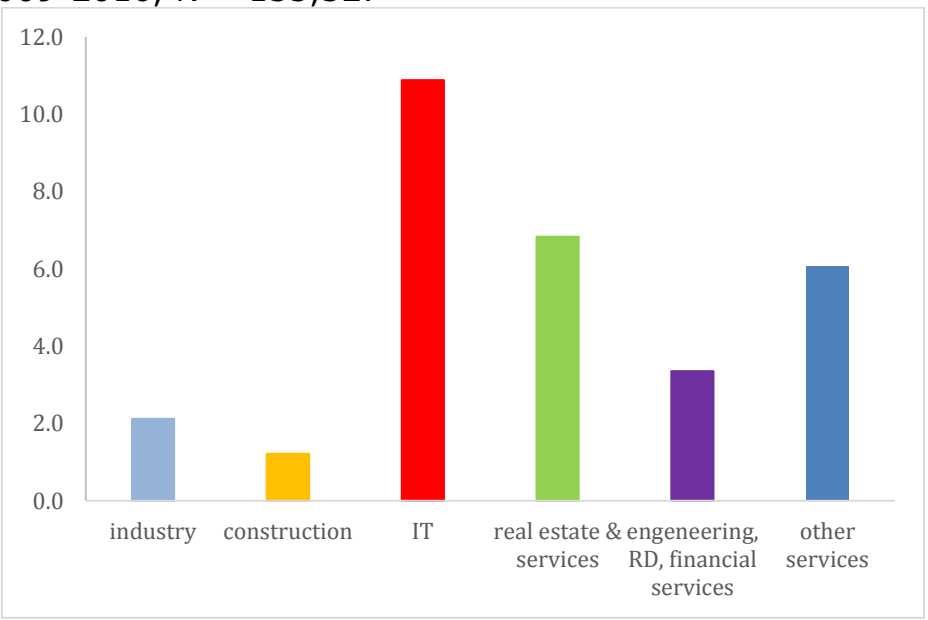
[23] Obviously, it would be useful to carry out a detailed EU-level analysis of public procurement data in this regard. However, this was not the aim of this study.

Figure 4.2.2.: The price distortion over the period: the mean squared error (MSE) of contract prices of HPP from the theoretical (Benford's) distribution by year, 2009-2016, N = 138,743



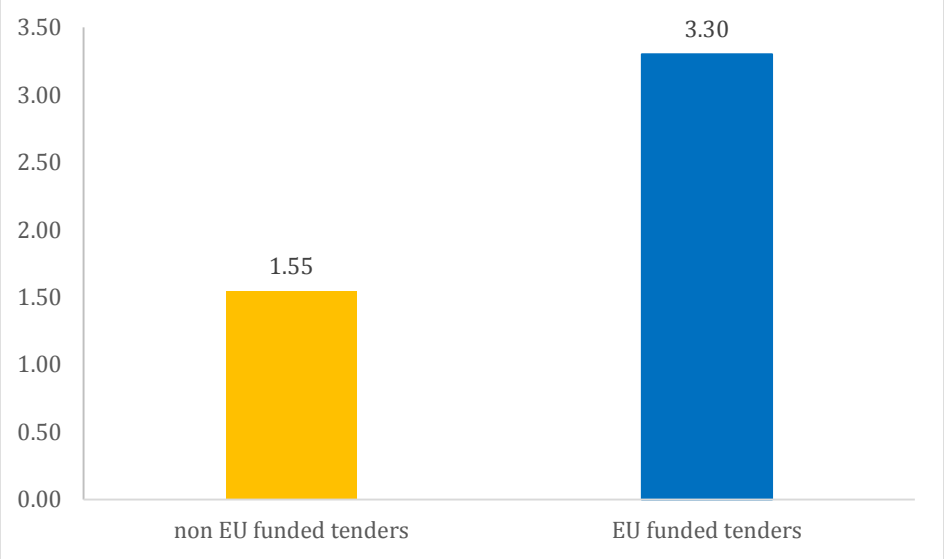
Note: without framework agreements;
data are filtered by goodfwc
MSE = $\frac{1}{n}\sum_{i=1}^{n}(\hat{Y}_i - Y)^2$ where $\hat{Y}$ is the predicted value and Y is the observed value in percentages. On the Y axis are the MSE values by year.
Source: CRCB

Figure 4.2.3.: The weight of price distortion: the mean squared error (MSE) of contract prices of HPP from the distribution predicted by the Benford's law by industry, 2009-2016, N = 135,327



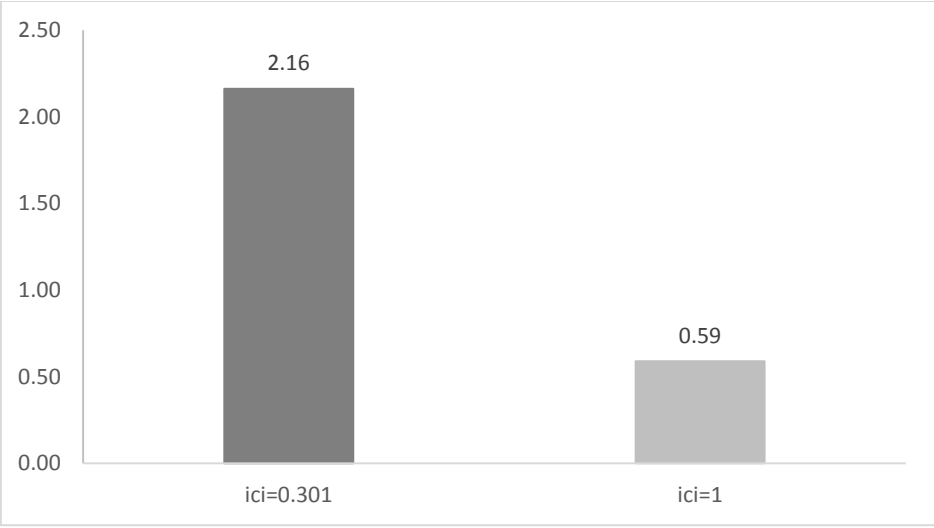
Note: without framework agreements; data are filtered by goodfwc
MSE = $\frac{1}{n}\sum_{i=1}^{n}(\hat{Y}_i - Y)^2$ where $\hat{Y}$ is the predicted value and Y is the observed value in percentages. On the Y axis are the MSE values.
Source: CRCB

Figure 4.2.4.: The weight of price distortion: the mean squared error (MSE) of contract prices of HPP from the distribution predicted by the Benford's law in EU-funded and non-EU-funded-funded tenders, 2009-2016, N = 138,262



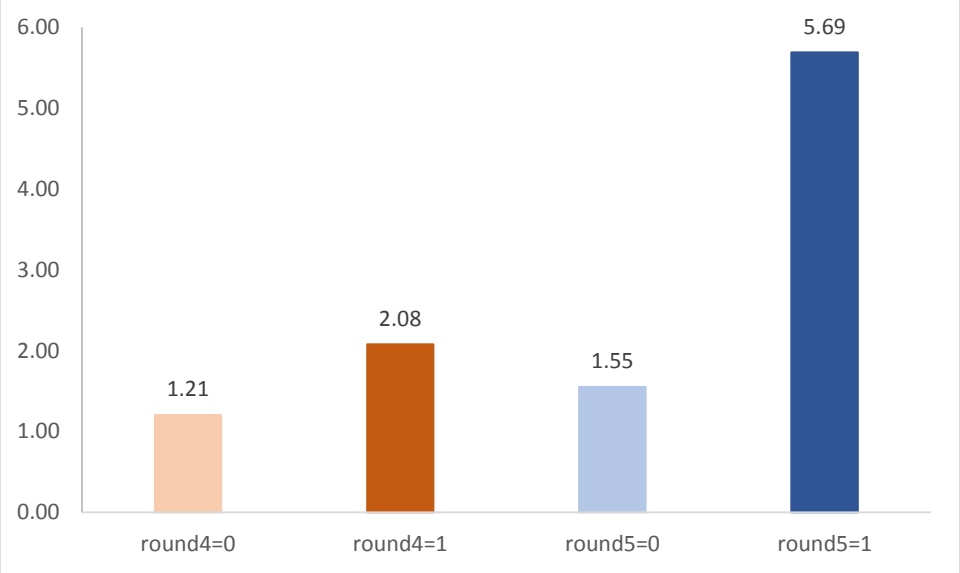
Note: without framework agreements; data are filtered by goodfwc
MSE $= \frac{1}{n}\sum_{i=1}^{n}(\hat{Y}_i - Y)^2$ *where* $\hat{Y}$ *is the predicted value and Y is the observed value in percentages. On the Y axis are the MSE values.*
Source: CRCB

Figure 4.2.5.: The weight of price distortion: mean squared error (MSE) from the distribution predicted by the Benford's law by the level of intensity of competition (ICI), 2009-2016, N = 33,483



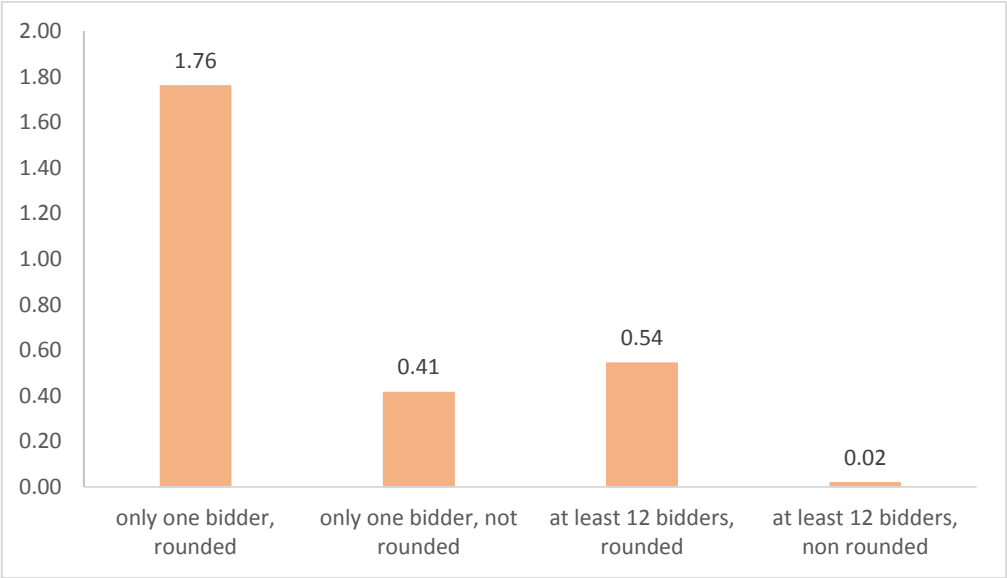
Note: without framework agreements;
data are filtered by goodfwc
MSE $= \frac{1}{n}\sum_{i=1}^{n}(\hat{Y}_i - Y)^2$ *where* $\hat{Y}$ *is the predicted value and Y is the observed value in percentages. On the Y axis are the MSE values.*
Source: CRCB

Figure 4.2.6.: The weight of price distortion: mean squared error (MSE) from the distribution predicted by the Benford's law by rounding in the contract price (ROUND4 and ROUND5), 2009-2016, N = 119,265



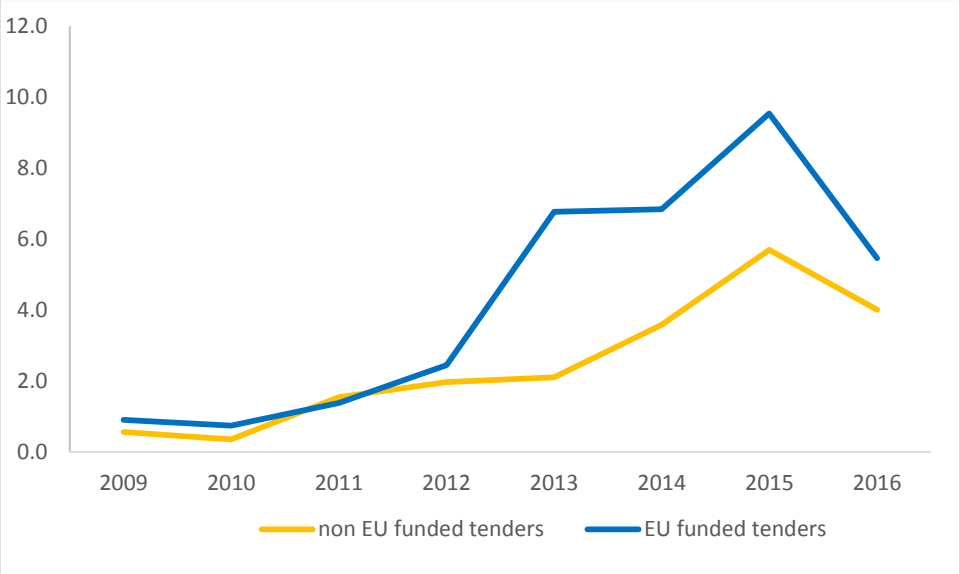
Note: without framework agreements;
data are filtered by goodfwc and in case of ROUNDD the cases are excluded where currency is other than HUF
MSE = $\frac{1}{n}\sum_{i=1}^{n}(\hat{Y}_i - Y)^2$ *where* $\hat{Y}$ *is the predicted value and Y is the observed value in percentages. On the Y axis are the MSE values.*
Source: CRCB

Figure 4.2.7. The mean squared error (MSE) of contract prices of tenders from the theoretical distribution by the Benford's law by competition and rounding (ROUND3) in the contract price in the Euro area, 2006-2015, N = 119,265



Source: own calculation of CRCB based on TED data

Figure 4.2.8. The mean squared error (MSE) of contract prices of HPP from the distribution predicted by the Benford's law by year and by EU funding, 2009-2016, N = 138,262



Note: without framework agreements; data are filtered by goodfwc
MSE = $\frac{1}{n}\sum_{i=1}^{n}(\hat{Y}_i - Y)^2$ where $\hat{Y}$ is the predicted value and Y is the observed value in percentages. On the Y axis are the MSE values by year.
Source: CRCB

4.3. Price drop compared to the estimated price

Before the issuers publish their calls for tenders, they have to calculate the estimated price of the procurement. This calculation can be based on their experience from previous tenders and on the results of market research. Furthermore, there are several national and European guidelines that help the issuers in these estimations[24].

The magnitude of the price drop in the actual contract price relative to the estimated value can be regarded as a proxy measure for the intensity of competition. The core assumption behind this is that increased competition between bidders will produce more intense price competition, which should lead to lower prices in the end. Thus, the greater magnitude of the price drop points to a higher level of competition intensity in public tenders, while a low or zero price drop represents low intensity or lack of competition. It can be assumed that this measure will indicate higher level of competition in the cases of public procurement with less or without corruption risks and low level of price distortion than in the cases of the tenders with higher level of corruption and price distortion.

We calculated the magnitude of price drop of the contract price compared to the estimated price using the following formula:

$$RPRD = \frac{(P^* - P)}{P} * 100 \qquad (5)$$

Where P^* is the estimated net price and P is the net contract price of the tender.

Figure 4.3.1. shows the distribution of tenders by *RPRD*[25]. Approximately in 18-24% of the cases the *RPRD* has negative value i.e. the net contract price exceeded the estimated price (See Table 4.3.1.). In depth analysis of the data shows that these values in many cases must be typos[26] and unfortunately, we cannot repair these errors *a posteriori*. To avoid misleading results, we also excluded these cases from the following analysis. We are aware of the fact that if some of these data are valid, then using this solution *we overestimate the magnitude of the price drop* of the Hungarian public tenders. However, it can be assumed that the data quality concerning estimated values has improved over the period: the share of contract awards that included the estimated value has increased from 2009 to 2016 (see Figure 4.3.2.).

The price drop weakened significantly over the period under examination: the

[24] For instance, see the guideline of the European Commission: http://bit.ly/1PW2F8p

[25] We had to exclude all cases where $|RPRD| > 100$ to avoid typos and suspicious cases, because the comparative analysis of the contract and the estimated values revealed that the validity of the former is uncertain in small number of cases: there are 2-3 or more times price drop compared to the estimated values. With this decision, we finally excluded 6,196 cases, 4.4% of the initial sample.

[26] For instance in some cases the contract value was ten times higher than the estimated price.

median values of the price drop measure declined from 9% in 2009 to 1% in 2014. There was some reversal of this trend in 2015 and in 2016: the magnitude of the median price drop increased from 1.1% to 1.8% (See Figure 4.3.3.).

The level of price drop tended to be greater over the period under examination in the case of non-EU-funded tenders than for EU-funded ones (See Figure 4.3.4).

Table 4.3.1.: Share of tenders by RPDR value, 2009-2016, %, N = 96,905

year	rprd<0	rprd=0	rprd>0	Total
2009	24.49	14.99	60.51	100
2010	24.71	10.69	64.60	100
2011	23.91	10.75	65.33	100
2012	22.27	13.88	63.85	100
2013	18.72	15.98	65.30	100
2014	21.1	17.65	61.25	100
2015	21.53	16.13	62.33	100
2016	22.69	18.02	59.30	100
Total	22.12	15.08	62.8	100

Note: without framework agreements; data are filtered by goodfwc
Source: CRCB

The results for the extent of the price drop support our assumption that price drop could be considered as a useful proxy for the level of competition, as intensity of competition is greater (i.e. it involves larger number of bids) when the magnitude of price drop is greater. The analysis also demonstrates a positive relationship between the magnitude of the price drop and our indicator of intensity of competition (See Figure 4.3.5.) and the composite indicator of corruption risks. First, in the case of tenders with only a single-bidder (non-competitive tenders), the extent of the price drop was significantly lower than for tenders with at least two bidders (See Figure 4.3.6.), and transparent tenders (tenders with announcement) showed a significantly greater price drop than non-transparent ones (See Figure 4.3.7.). The result is the same for the price distortion indicator based on rounded and non-rounded prices (See Figure 4.3.8. and 4.3.9.). All in all, our findings suggest that the lower the risk of corruption, the higher the magnitude of the price drop (See Figure 4.3.10.)[27].

Intuitively it is clear that a higher price drop is linked to a lower level of overpricing. In other words, price distortion must be less prevalent in cases where the contract prices dropped more compared to the estimated price than in cases where the price drop rate was zero. The empirical results support this

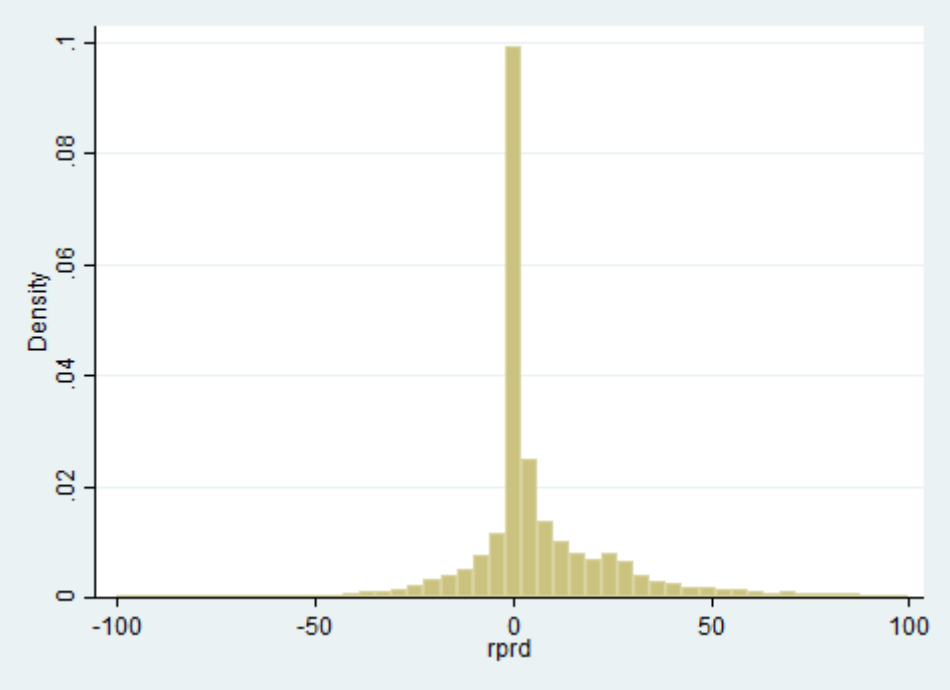
[27] We put all detailed statistics of these results to Annex.

insight: with regard to the magnitude of squared errors from the distribution of first digits of contract price predicted by Benford's law, the data do show that prices of tenders with large price drop conform more significantly to Benford's law than those with a small or zero price drop (See Figure 4.3.11).

To have more detailed analysis on the links between the rate of price drop (RPRD) and level of corruption risks, intensity of competition and indicators of price distortion we used multiple regression techniques. We control the effects of the latter factors to the rate of price drop with year of tender, sector (product market categories), EU funding and the contract value. We used quantile regression as estimation method. Our findings support the intuitively formulated hypotheses (see A6.2-A6.3): the lower level of corruption risks, and the higher intensity of competition are, the higher value of PRPR is. And there is a strong negative correlation between the magnitude of price drop and the presence of price distortion: when the winner price is rounded the low rate of price drop occurs. We need to add an interesting fact to these observations: according to the results of all three models the EU-funded tenders have significantly lower rate of price drop than the non-EU-funded ones. We can interpret this as a clear sign of low intensity of competition and highest level of anomalies in price setting of EU-funded tenders compared to other tenders, and the weakness of institutional control mechanism of EU-funded tenders in Hungary over the analysed period.

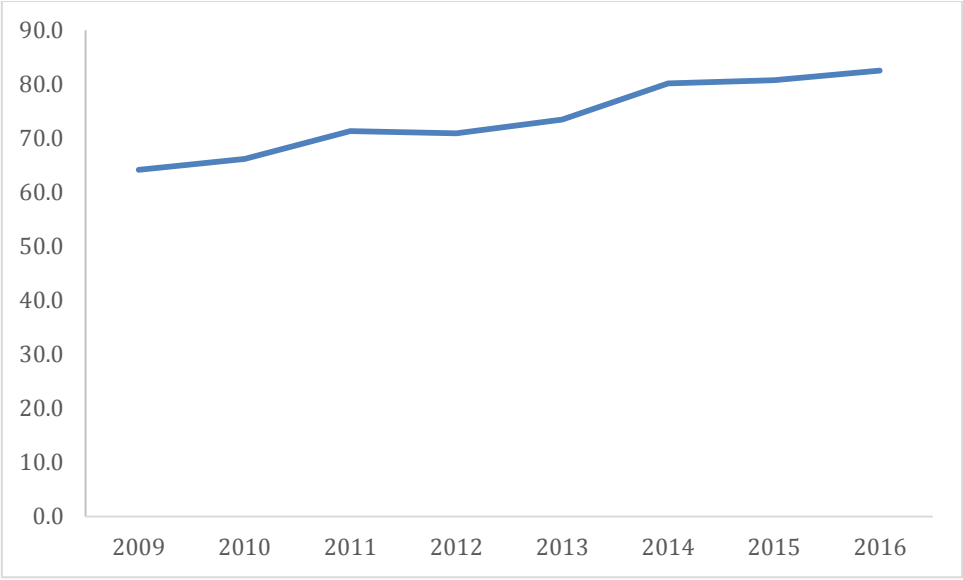
Taking into consideration the aforementioned correlation, we can conclude that the magnitude of the price drop (RPRD) provides us with information not only on the level of intensity of competition, but also on corruption risks and the existence of price distortion. Looking at the pattern of the price drop indicator over time, we found that the extent of the price drop decreased significantly between 2009 and 2015, but there was some reversal of this trend in 2016. The extent of the price drop was greater for non-EU-funded tenders than for EU-funded ones, and tenders above the EU threshold value were marked by a significantly greater price drop than those below this threshold.

Figure 4.3.1.: The distribution of tenders by magnitude of price drop from estimated value, 2009-2016, N = 96,905



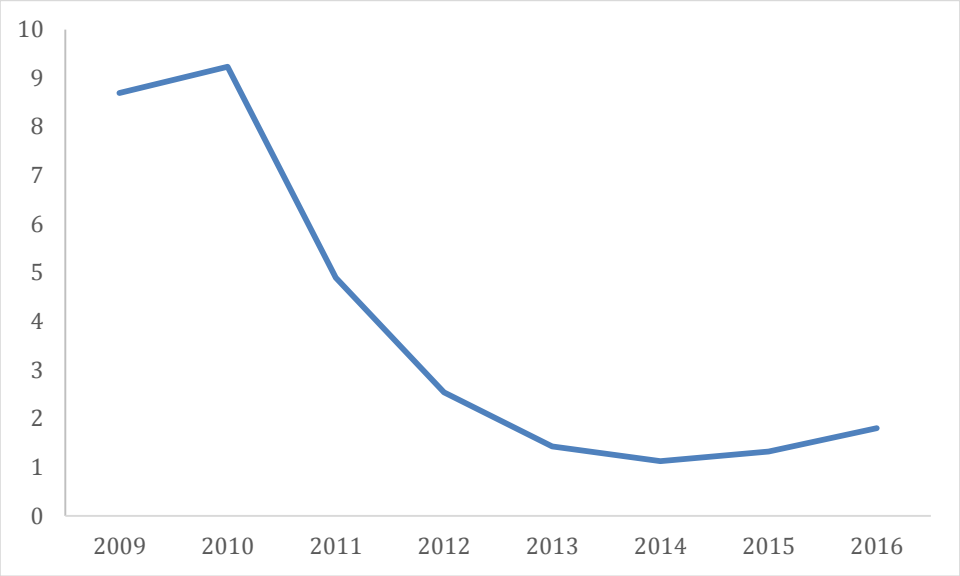
Note: without framework agreements; data are filtered by goodfwc
Source: CRCB

Figure 4.3.2.: Share of tenders where the estimated prices were published in the contract award notice, %, 2009-2016, N = 141,817



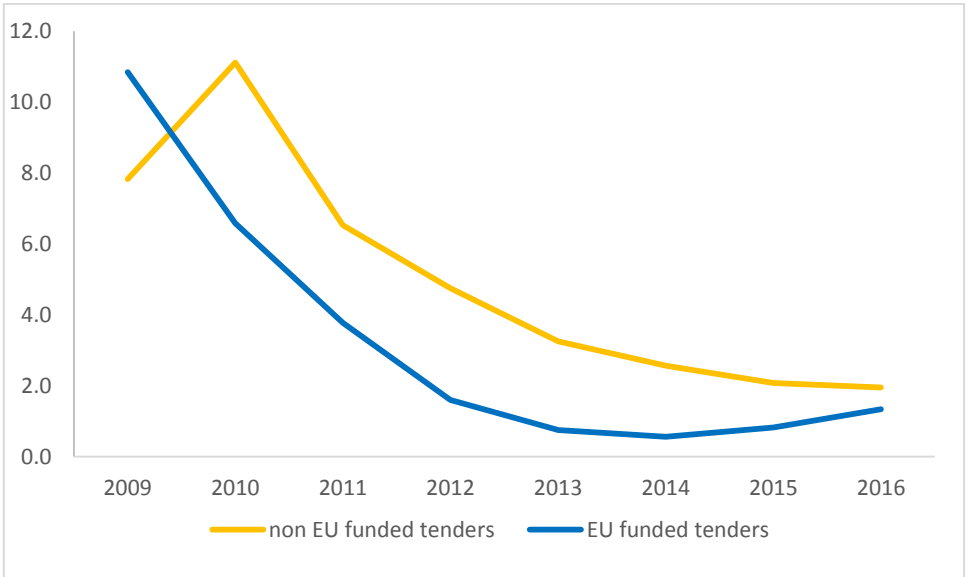
Note: without framework agreements; data are filtered by goodfwc
Source: CRCB

Figure 4.3.3.: The median RPRD values by year, %, 2009-2016, N = 81,145



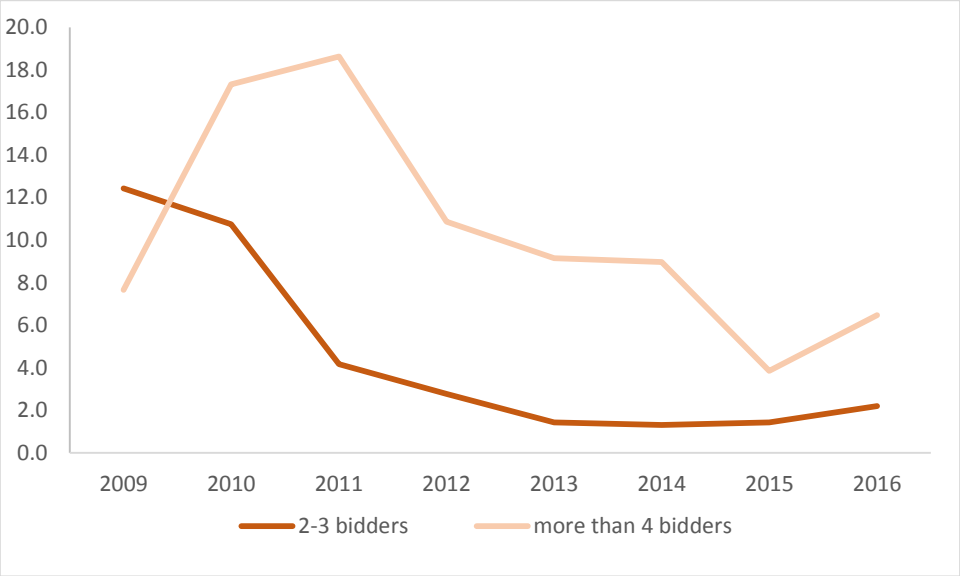
Note: without framework agreements; data are filtered by goodfwc and rprd ≥ 0
Source: CRCB

Figure 4.3.4.: The median value of RPRD by EU funding, %, 2009-2016, N = 80,915



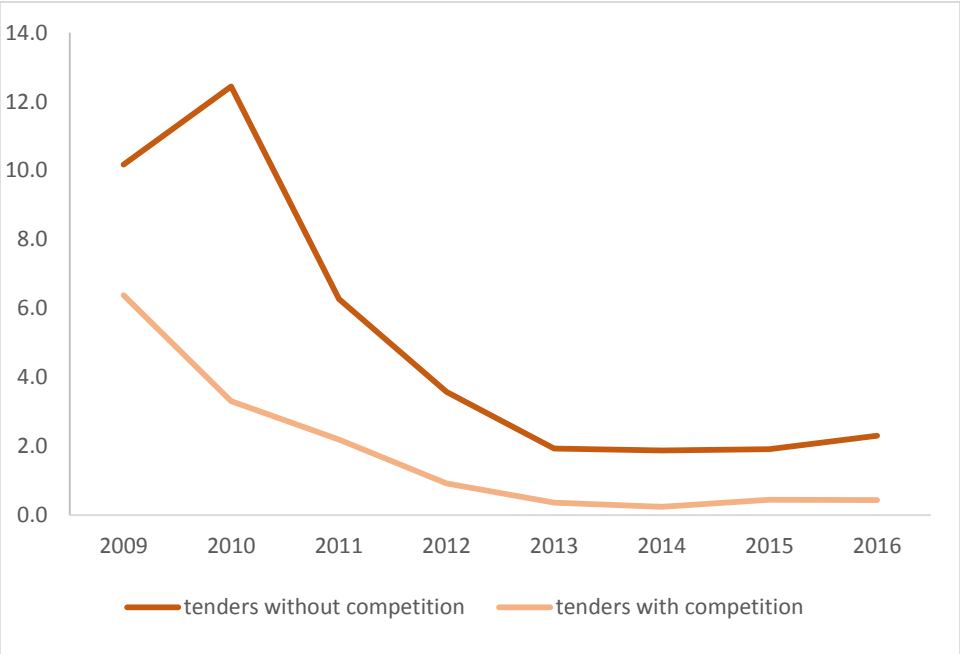
Note: without framework agreements; data are filtered by goodfwc and rprd ≥ 0
Source: CRCB

Figure 4.3.5.: The weight of RPRD in tenders low and high level of intensity of competition, median values, 2009-2016, N = 50,613



Note: without framework agreements; data are filtered by goodfwc and rprd ≥ 0
Source: CRCB

Figure 4.3.6.: The weight of RPRD in tenders with and without competition (SB), median values, 2009-2016, N = 80,722

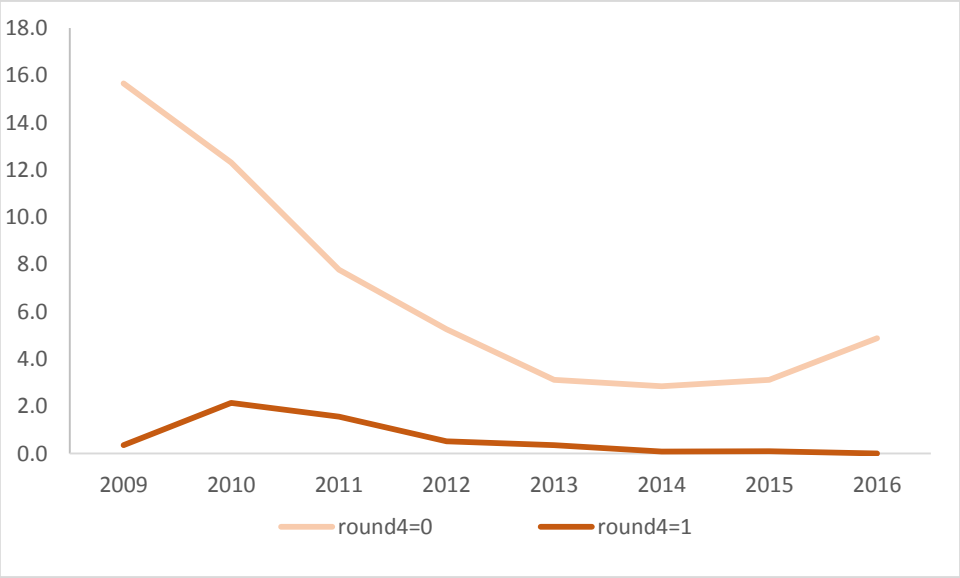


Note: without framework agreements; data are filtered by goodfwc and rprd ≥ 0
Source: CRCB

Figure 4.3.7.: The weight of RPRD by transparency (TI), median values, 2009-2016, N = 81,145

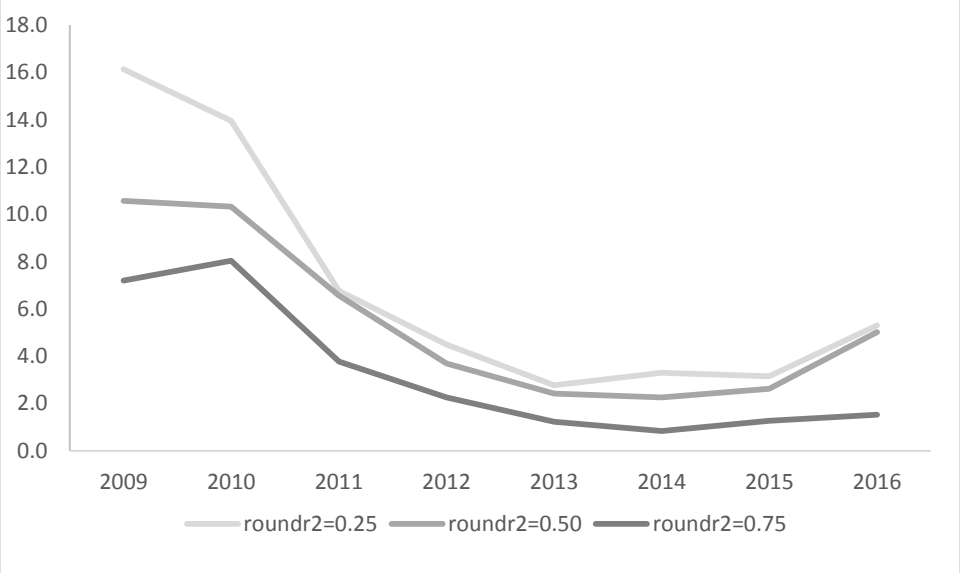
Note: without framework agreements; data are filtered by goodfwc and rprd ≥ 0
Source: CRCB

Figure 4.3.8.: The weight of RPRD in tenders with and without rounded contract prices (ROUND4), median values, 2009-2016, N = 81,145



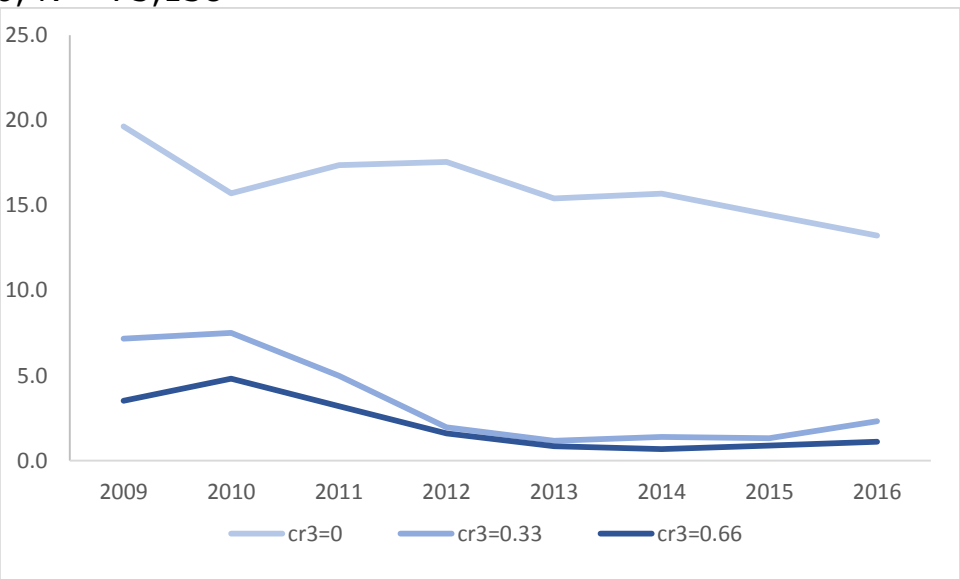
Note: without framework agreements; data are filtered by goodfwc and rprd ≥ 0
Source: CRCB

Figure 4.3.9.: The weight of RPRD by rounding rate (ROUNDR2), median values, 2009-2016, N = 42,029



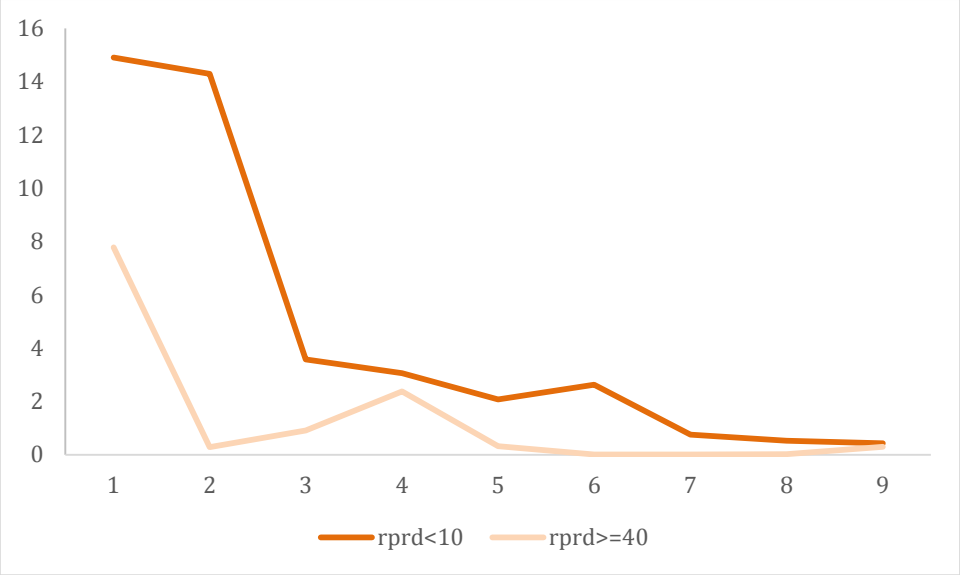
Note: without framework agreements; data are filtered by goodfwc and rprd ≥ 0
Source: CRCB

Figure 4.3.10.: The weight of RPRD by corruption risk (CR3), median values, 2009-2016, N = 75,138



Note: without framework agreements; data are filtered by goodfwc and rprd ≥ 0
Source: CRCB

Figure 4.3.11.: The weight of price distortion: the squared error (SE) of contract prices of HPP from the predicted distribution by the Benford's law by first digits and by the level of relative price drop (RPRD), 2009-2016, N = 61,228



Note: data are filtered by goodfwc and rprd ≥ 0
Source: CRCB

5. Special issues

5.1. Estimation of direct social loss (DSL) by weight of overpricing

The social losses attributable to high corruption risks and low competition intensity of public procurement have been barely analysed so far. The estimated direct social loss (DSL) of tenders with high corruption risks and a low level of intensity of competition takes the form of rent, which occurs when payments are made above competitive market prices. The high corruption risk and/or low level of intensity of competition in public procurement are regularly and closely associated with political favouritism and rent seeking. The indirect costs of these activities are associated with destructive effect of productive efforts and innovative activities (Murphy et al. 1993). The overpricing due to corrupt transactions creates rents for corrupt actors and thus indirectly destroys or hampers further efforts of economic actors toward production and innovation.

In this section, we present an approach to estimating direct social loss in public tenders due to high corruption risk and low intensity of competition. We concentrate the differences between the estimated and the real contract prices, and analyse the level of this gap taking consideration of the intensity of competition and level of corruption risks. We assume that the two latter factors have strong effect to the weight of estimated direct social loss. The higher the corruption risk and lower the intensity of competition are, the higher rate of direct social loss is.

In this section, we present an analysis for the estimation of direct social loss using information derived from the gap between the net estimated contract value and the actual contract price (RPRD). It was shown before that the rate of price drop correlates strongly with indicators of corruption risks, intensity of competition and other indicators of price distortion (i.e. the rate of rounded prices, the deviation of the distribution of first digits of contract prices from the Benford's distribution). In tenders with low corruption risk (CR3) and high level of competition intensity (ICI) the net contract prices dropped significantly at a higher rate compared to the estimated price than where the corruption risks remained high and the competition intensity was rather weak (see Tables A6.3.-A6.10.).

The estimation is based on assuming that the corruption risk of any tender can stay low and the intensity of competition can reach a high level. Observing the rate of price drop in tenders with low corruption risk and high level of competition we can mark out these high rates as yardsticks; as outcomes of the "ideal" or "clean" public procurement process. In this way, we can estimate for each and every tender how much the estimated price should have dropped compared to this reference level. Based on this approach, we can estimate the rate of direct social loss in a given tender by extracting the observed rate of price drop

($RPRD_{observed}$) from the reference rate, which is derived from the "ideal", non-corrupt cases, ($RPRD_{reference}$):

$$DSLR = RPRD_{reference} - RPRD_{observed}$$

So, for every *i* tenders, where we have data on *RPRD*, we calculate the rate of direct social loss ($DSLR_i$) as follows:

$$DSLR_i = RPRD_{reference} - RPRD_i$$

The multiplication of the $DSLR_i$ by the net contract value (P_i) of the *i* tender gives us the amount of social loss for every *i* tender. And finally, the aggregate estimated direct social loss for *n* tenders is given by:

$$DSL = \sum_{i=1}^{n}(RPRD_{reference} - RPRD_i) * P_i \qquad (6)$$

When using the method outlined above to estimate social losses, we have to confront three types of limitations. First, for a considerable number of tenders the RPRD values are not valid or missing, thus the estimation of social loss for these tenders does not seem to be feasible for the first sight. Second, the method is incapable to detect certain forms of corruption. Focusing on the price drop relative to the estimated price, we cannot detect cases which are related to so called "white elephant" projects[28] and the social losses of these projects. Finally, the corruption indicators and proxies of competition intensity which we have been using in the analysis certainly do not capture every form and type of corrupt activities. Obviously, there are forms of corrupt activities which are beyond the scope of our investigation (e.g. collusion and bid rigging which are used very frequently in the construction sector)[29].

The concept of "white elephant" projects is well known in the corruption literature (Rose-Ackermann, 2006; Rose-Ackerman-Soreide, 2011). These are projects without any social benefit or those that are ruined shortly after their completion. These types of projects immanently produce social loss while formally the intensity of competition of tenders related to them could be high and the type of procedures used during the public procurement could be transparent. There are several examples of the "white elephant" projects in Hungary such as projects without any rationality or sport investments which are

[28] On the etymology and definition of the „white elephant" project, see http://bit.ly/2kcTztl

[29] In addition, the estimated contract values and net prices on which the whole analysis is based are not fully exogenous variables and they can also be impacted by the conditions of the public procurement tenders. E.g. in more competitive markets, estimated prices may be ceteris paribus lower or these estimated values can evolve as more accurate over time.

closed shortly after finishing them[30].

We made an attempt to resolve the above mentioned first problem in this paper, but we were not able to deal with the other two limitations. Therefore we consider the estimation exercise presented below as lower bound estimation of direct social losses.

Using the concept presented above we relied on three different estimation approaches to tackle the problem of missing relative price drop values. In these estimations, we used different assumptions concerning the reference rate ($RPRD_{max}$), the notional price drop related to "ideal", non-corrupt public tenders.

First estimation (DSL1) – using data imputation

First, we tackled the missing value problem by imputing the data of *RPRD on the basis of observed values along the measured degree of corruption risks and the intensity of competition*. First we calculated the median value of *RPRD* for all tenders grouped by the level of corruption risk and number of bidders, where the value *RPRD* were non-missing (see Table 5.1.1.).

In this table, we can observe that there is a clear negative correlation between the level of corruption risks and the rate of price drop of the contract price compared to the estimated value (RPRD): the lower the value of RPRD is, the higher the level of the corruption risks is. And in case of low corruption risks there is a positive correlation between the number of bidders and the value of RPRD.

Table 5.1.1. Median value of RPRD in group of tenders defined by CR3 and number of bids 2009 - 2016, N= 80,722

	Corruption risk CR3			
Number of bidders	0	0.33	0.66	1
1		4.24	0.67	0.00
2	11.64	2.56	0.64	
3	13.38	1.60	0.83	
4	17.34	3.91	0.07	
5 or more	21.88	0.94	0.00	
N	17,027	33,938	24,976	4,781

Note: data are filtered by variable goodfwc
Source: CRCB

Since the data of number of bids and CR3 were available in the tenders where

[30] See for instance: http://bit.ly/2jz8HPN or http://bit.ly/2kQAoED or http://bit.ly/2csNOX9.

the RPRD data were missing, we put the median values of *RPRD* of each subgroup presented in Table 5.1.1. to each group of tenders defined by CR3 and number of bids where the values RPRD were missing. After this we picked out the highest median value amongst the median value of subgroups defined by the combination of number of bids and CR3 (21.88%). We considered that as the reference rate and we calculated the value of $DSLR1_i$ for every *i tender using the following formula*:

$$DSLR1_i = 21.88 - RPRD_i \qquad (7)$$

Where $RPRD_i > 21.88$, we did not calculate any direct social loss, so in these cases the value of $DSLR_i$ *will be 0*.

Second estimation (DSL2) – using projection

The second estimation is based on the projection of *RPRD* data; using this method we do not impute data at micro level to tenders where the value of *RPRD* data were missing. First we calculate the *DSLR* for those tenders, where we have *RPRD* data. Besides CR3 and number of bids, here we took into consideration the information on the date (*YEAR*) of tenders. We pointed out earlier that the main values of *RPRD* by year significantly differ from one year to another and between the years of 2009-2012 its level was significantly higher than from 2013 (the detailed results see in Table A6.1). For choosing the reference rate we picked up the data of each year. The decision behind this decision is that we have tried to give a prudent estimate and follow an estimation strategy that provides a realistic but minimal estimate of the level and weight of direct social loss. So, we selected the tenders from each year from 2009 to 2016 with value of CR3=0 and where at least was 5 bidders. Then we considered the median value of *RPRD* from these groups as reference rate.

Table 5.1.2. Median value of RPRD in group of tenders defined by CR3=0 and at least 5 bids from 2009 to 2016, N= 75,466

year	X_t (reference values)
2009	21.88
2010	21.76
2011	25.00
2012	25.19
2013	22.20
2014	22.90
2015	20.33
2016	17.84

Note: data are filtered by variable goodfwc
Source: CRCB

And we used the following formula for the calculation of *DSLR for every t year.*

$$DSLR2_{i,t} = X_t - RPRD_{i,t} \quad (8)$$

Similarly to the first estimation where $RPRD_{i,t} > X_t$, the value of $DSLR2_{i,t} = 0$.

Next, for each year we calculated the aggregated values of DSL per year using the subsample where we had RPRD values (N= 75,466) then the yearly average rate of direct social loss was defined compared to the total contract value for each year. Finally based on these rates we calculated the value of total direct social loss for all public tenders. Using this solution we assume that we could get the same rate of social loss in the case of those tenders where the RPRD value could not be calculated because of the lack of estimated values. However, this way we slightly overestimate the volume of social loss because for tenders where the values of estimated price were missing the corruption risks were lower and the intensity of competition was higher (See Tables A6.5 and A6.6.).

Third estimation (DSL3) – using estimated RPRD

In the third estimation we used a new estimated RPRD value instead of observed one. We estimated that on the basis of the corruption risk indicator (CR3) and that of the number of bids with robust regression[31]. For this purpose we used the following equation:

$$ERPRD3 = \beta_0 + \beta_1 CR3 + \beta_2 NB + \beta_3 YEAR + \beta_4 LNNCV + \beta_5 EU + \varepsilon \qquad (9)$$

where *CR3* is the corruption risk indicator, NB is the number of bids, *YEAR* is the year of contract*, LNNCV* is the logarithm of net contract value and EU a dummy variable on the EU funding. From (10) we get the estimated *RPRD (ERPRD3)* value, and using this we calculate the *DSLR3* for every *i* tender. We used here the maximum value of *ERPRD3* (30.2) as benchmark. Thus we used the following formulas for the calculation of $DSLR3_i$ and $DSL3_i$ for every *i* tender:

$$DSLR3_i = 30.2 - ERPRD3_i \qquad (10)$$

Finally, we get the estimated total direct social loss with aggregating *estimated loss for all tenders*:

$$DSL3 = \sum_{i=1}^{n}(30.2 - ERPRD3_i) * NCV_i \qquad (11)$$

Results: the esimated DSL values

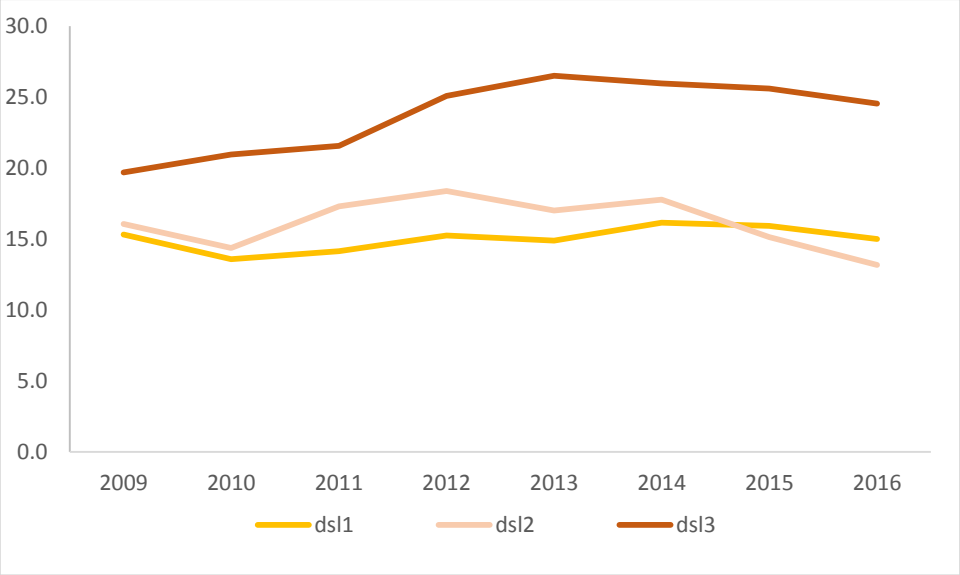
Although our estimation results on direct social loss due to high corruption risks and a low level of intensity of competition can be considered as lower bound estimates[32], they demonstrate an astonishingly high direct social loss in Hungarian public procurement (see Figure 5.1.1.). According to our findings, the aggregate amount of estimated direct social loss reached at least 2.1-3.3 trillion forints (6.7 -10.6 billion euros) during in the period of 2009-2016 (see Table

[31] We used the rreg command in Stata 13.1.

[32] It should be recalled here that during the estimation we used only those cases where the net estimated value was no more than twice of the net contract value. But amongst the tenders with low corruption risk and with high level of competition there was a higher gap between the estimated and contract price. According to this filtering method we excluded namely the tenders with significantly higher level of competition and lower level of corruption risk. Therefore, in the reality the rate of price drop considering as "ideal" or as benchmark should be higher than those we used in our estimations.

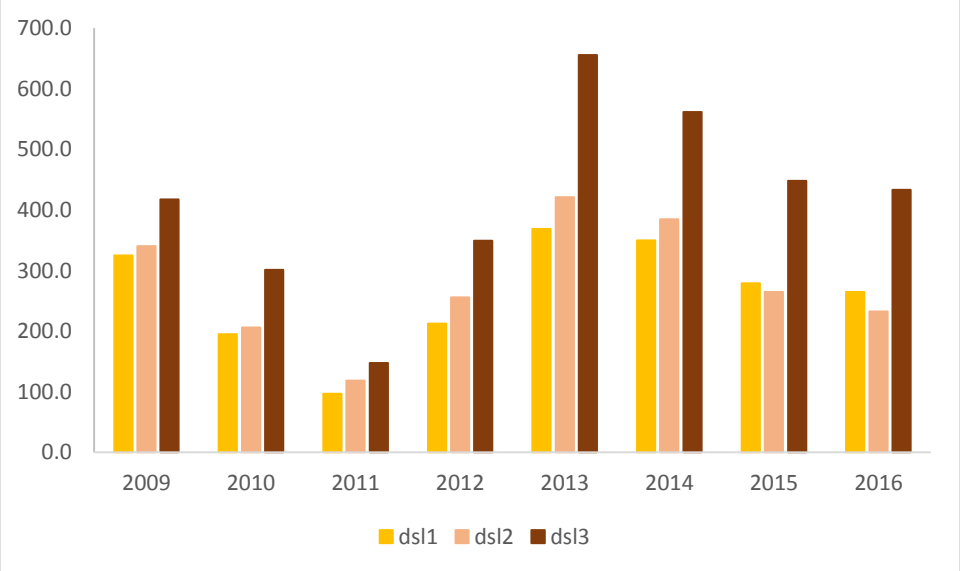
5.1.2.)

Figure 5.1.1.: The share of estimated direct social loss (DSL) in total contract value by year, 2009-2016, %, N = 138,743



Note: data are filtered by variable goodfwc
Source: CRCB

Figure 5.1.2.: Estimated direct social loss (DSL) by year, 2009-2016, Billion HUF, N = 138,743



Note: data are filtered by variable goodfwc
Source: CRCB

Table 5.1.2. Aggregated net contract value and estimated direct social loss (DSL) in the Hungarian Public Procurement by year, 2009-2016, Billion HUF, N = 138,743

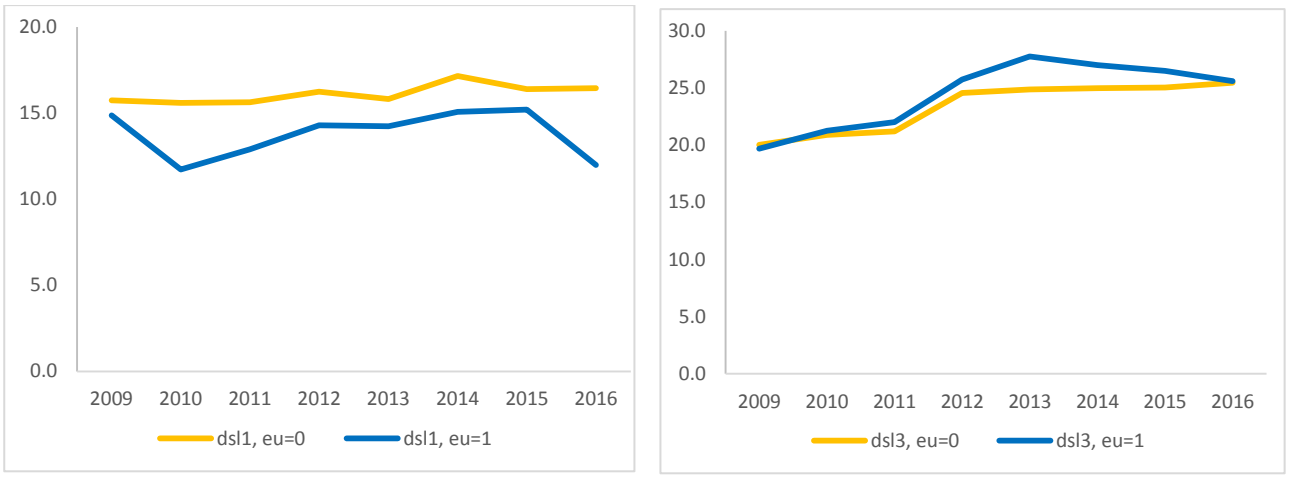
		Net contract value	Direct social loss DSL1	Direct social loss DSL2	Direct social loss DSL3
	2009	2120.1	324.9	340.3	417.5
	2010	1435.9	195.0	206.3	301.0
	2011	683.2	96.6	118.3	147.3
	2012	1392.0	212.4	255.8	349.1
	2013	2474.1	368.6	421.1	655.7
	2014	2163.8	349.6	384.6	561.8
	2015	1749.5	278.8	264.7	448.1
	2016	1765.7	264.8	232.7	433.3
Total		13,784.3	2090.8	2224.0	3314.0

Note: data are filtered by variable goodfwc
Source: CRCB

This amount of money was lost as a severe outcome of the lack of integrity of the Hungarian public institutions: the high level of corruption risk and low level of competition intensity. The share of estimated direct social loss comes to 13-26% of the total public spending on public procurement[33]. With regard to the trends between 2009 and 2015, the rate of estimated direct social loss relative to total net contract value increased in 2012 and thereafter remained stable. In 2016, the estimated rate of social loss did not change significantly; only a slight decrease could be detected compared to the previous year. The data shows that this fall was clearly driven by the improvement of EU-funded projects in 2016 (see Figures 5.1.3.) while the performance of non-EU-funded projects continued to deteriorate.

[33] This high rate does not seem to be counterintuitive and also it is very close to the expert estimation of the Hungarian company managers. According to the results of representative expert surveys based on responses of 1500 Hungarian company managers the average level of corruption rent varied between 13-15 percent in the period of 2010-2015 compared to the total contract value of tender. See IEER, 2016.

Figure 5.1.3.: Share of estimated direct social loss (DSL1 and DSL2) in total contract value by year and by EU funding, 2009-2016, %, N = 138,743

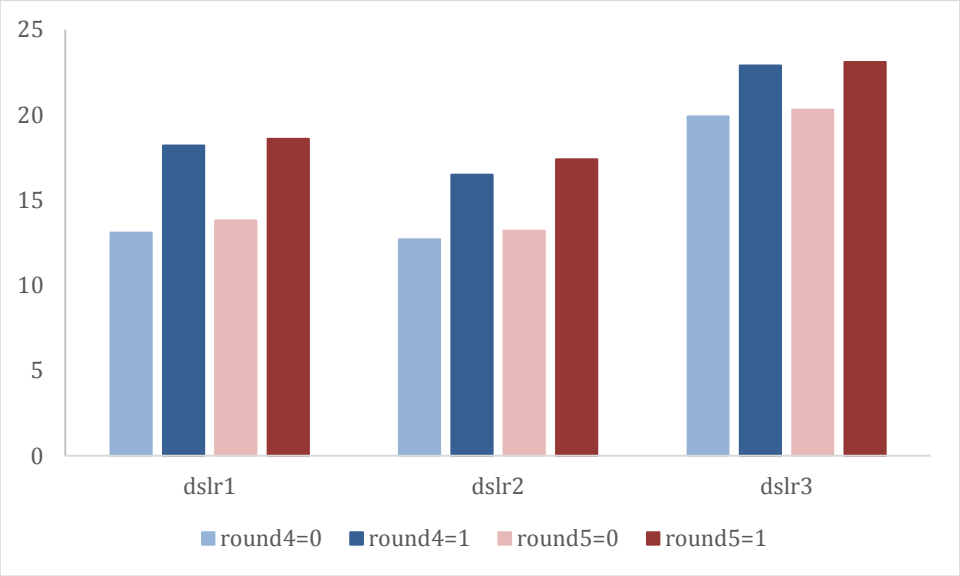


Note: data are filtered by variable goodfwc
Source: CRCB

The indicators of price distortion (rounding and first digit test of Benford's law) have strong correlation with the weight of estimated direct social loss: the higher the estimated direct social loss is, the greater level of the price distortion is. (see Figures 5.1.4. and 5.1.5.). These findings can be interpreted as an empirical evidence that the distortive behaviour of actors of public procurement is closely related to the level of social loss. Both phenomena, the estimated direct social loss and the level of price distortion can be considered as a clear sign of corrupt behaviour, which occurred during the public procurement process.

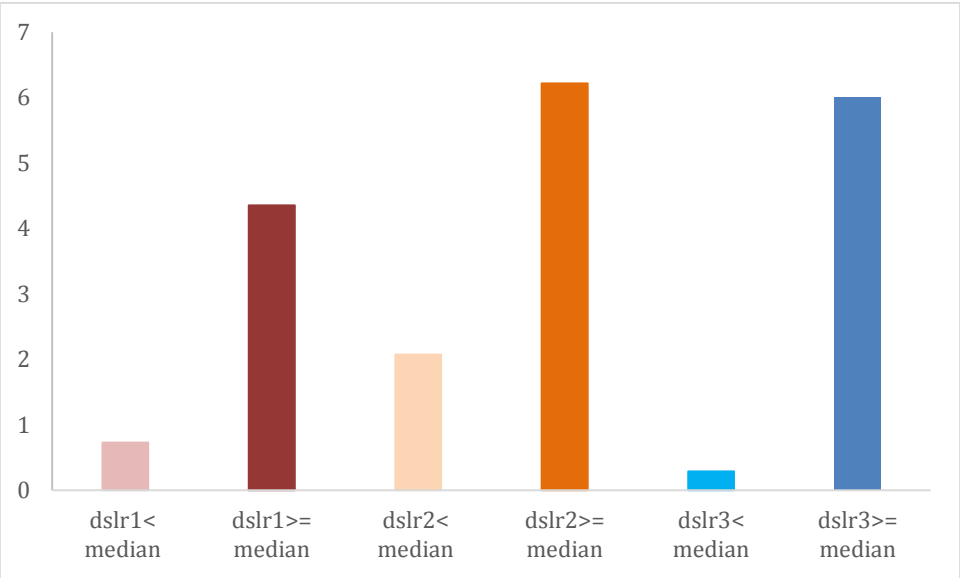
Finally, we have to add that obviously, if new and more appropriate indicators measuring special forms of corruption (including the detection of collusion and bid rigging) could be taken into consideration then the estimated weight and rate of social loss must be much higher.

Figure 5.1.4. The price distortion (rounded price) and the estimated direct social loss, 2009-2016, N = 138,743



Note: data are filtered by variable goodfwc
Source: CRCB

Figure 5.1.5. The price distortion and the estimated direct social loss: the mean squared error (MSE) of contract prices of HPP from the predicted distribution by the Benford's law by the weight of direct social loss (DSLR1, DSLR2, DSLR3), 2009-2016, N = 138,743



Note: data are filtered by variable goodfwc (for details, see Table A1.7.)
MSE = $\frac{1}{n}\sum_{i=1}^{n}(\hat{Y}_i - Y)^2$ where $\hat{Y}$ is the predicted value and Y is the observed value in percentages. On the Y axis are the MSE values by year.
Median values: dslr1=19.22; dslr2=17.84; dslr3=21.58
Source: CRCB

5.2. Some effects of the New Public Procurement Law

The bidders may have experienced that since the new Public Procurement Act (Act CXLIII of 2015 on Public Procurement) had entered into force, their administration costs have decreased in the EU procedures. This is primarily due to the enforcement of the European Single Procurement Document (ESPD)[34], which, after the initial difficulties arising from filling in and validating the forms, makes the participation of the bidder definitely much easier in the public procurement procedures, as its use is facilitated by a free, web-based system[35]. However, we also have to mention that for the issuers, the transformation of the assessment process involved a lot more administration and a prolonged procedure.

The new Public Procurement Act with regard to the assessment prefers selection based on quality. Three criteria for selection can be employed based on the new act:

1. the lowest price,
2. the lowest cost (which must be calculated with the method of cost-effectiveness),
3. and the best price-value ratio, based on either the price or the value is indicated (Public Procurement Act 76. § (2)).

The issuer can only employ the criterion of the lowest price as single assessment aspect in an exceptional case considered appropriate. Experience show that the Hungarian issuers are reluctant and slow to shift from the earlier and better-promoted price-based assessment to this newer, more complex system of assessment. On the one hand, this is due to the fact that the "best price-value ratio" criterion is vulnerable to attack, i.e., the objectivity of a selection can be questioned. On the other hand, this is due to the fact that neither the Public Procurement Authority nor any other authority gave any assessment guidelines showing how the techniques would be employed in the case of the assessment based on lowest expenses. Moreover, the guidelines concerning the assessment of tenders published by the Public Procurement Authority was only released on 12nd December 2016, more than one year following the enforcement of the new Act.

In the national order of procedures, in the case of procedures starting with summary information[36], the potential bidders have adapted to the new legislation. Moreover, the business actors have also discovered a new potential opportunity: the summary information, which is available for a significantly shorter period than in the case of open procedures (see A7. for the definition of

[34] https://ec.europa.eu/tools/espd
[35] http://ec.europa.eu/growth/tools-databases/newsroom/cf/itemdetail.cfm?item_id=8611
[36] A brief summary about the main characteristics of the procurement (e.g. the description and duration of the contracts, the type of the procedure, the location of the fulfilment).

open procedures), is closely monitored by both the potential bidders and by the market of public procurement services. The bidders have learned that the right behaviour is to take into account the short period and the limited public information, and to show their interest to the contracting authority in the case of every procedure belonging to their profile, since it does not imply any actual tender obligations. Later, knowing the actual tender and documentation, they will be able to make a real decision on whether they can or wish to apply. This is how it can happen that in one procedure having 20-25 bidders interested, only 3-4 or even fewer bidders remain.

Therefore, a system, which is based on showing interest in advance, decreases transparency in comparison with the real announcement system, and imposes an extra administrative burden on the bidder.

Public procurement experts also formulated several different expectations that can be tested empirically based on the data presented in this study. On the one hand, certain modifications should cause the increase of the number of bidders and thereby the intensity of competition. The scope of the public procurement documents that have to be published online was increased by the new law. It declares that all the documents related to the issuers must be made fully available electronically free of charge (Public Procurement Act 39. § (1)). Also, below certain value thresholds at least four bidders became required (Public Procurement Act 115. § (1), (2) and (3)) and it has to be investigated whether the procedures can be shared between several bidders – and if not, it has to be justified (Public Procurement Act 61. § (4)). In addition, the administrative burdens associated with the application to public procurement were reduced (Public Procurement Act 69. § (4)) and also only freely and electronically available certificates can be required by the issuers regarding the references of the bidders (321/2015. (X. 30.) Government Regulation).

But on the other hand, there are several changes that are supposed to reduce the intensity of competition. The deadlines for the application were shortened (Public Procurement Act 114. § (4)) and the minimum time duration of the call for tenders was cancelled (Public Procurement Act 115. § (1), (2) and (3)) regarding several types of procurement. Also, in the cases of construction works, the bid price cannot be taken more into account than the other evaluation criteria combined (321/2015. (X. 30.) Government Regulation). All in all, the index of competitive intensity slightly increased in 2016 (it moved from 0.48 to 0.53), as it was demonstrated in the second chapter of the present study.

The new law requires putting more emphasis on the estimation of the values of the procurements (Public Procurement Act 28. §), which would imply the growing number of public procurements with estimated contract values calculated. However, our data suggests that there was only a 1.5 percentage points increase regarding the contracts with estimated value between 2015 and 2016. Also, if we do not take into account the contracts with faulty estimated values (faults in

the estimated values were identified based on the comparison with the real contract value), the increase that can be pointed out is about only 1 percentage point.

Table 5.2.1. Ratio of contracts with estimated value between 2009 and 2016, N= 98,495

Year	Without estimated value	With estimated value	N
2009	36%	64%	15504
2010	35%	65%	20477
2011	29%	71%	14532
2012	29%	71%	14069
2013	27%	73%	20730
2014	20%	80%	21535
2015	19%	81%	20949
2016	17%	83%	14145

Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)[37]
Source: CRCB

In addition, as it has to be investigated whether the procedures can be shared between several bidders – and if not, it has to be justified (Public Procurement Act 61. § (4)) it could be expected that the mean number of contracts assigned to one procurement will increase. The actual tendencies are in line with this expectation, as there was a slight increase in this contracts per public procurement ratio the between 2015 and 2016.

[37] We had to filter out some contracts from our analyses that were published incorrectly – for more details, see the referred table in the Annex.

Table 5.2.2. Ratio of contracts/public procurement between 2009 and 2016

Year	Number of contracts	Number of public procurement	Contracts/public procurement
2009	16265	8323	1.95
2010	21197	11392	1.86
2011	15093	9707	1.55
2012	15144	8513	1.78
2013	21949	12339	1.78
2014	23135	14504	1.60
2015	22893	14300	1.60
2016	15756	8469	1.86

Note: with framework agreements;
data are filtered by variable goodx (for details, see Table A1.7.)[38]
Source: CRCB

Also, decrease was expected regarding the frequency of the procurements with negotiation procedures without announcement, as the new regulation stipulates the online publication of a detailed and reasoned explanation justifying the application of these procurement types (Public Procurement Act 113. § (1)). This expectation can be completely confirmed by the empirical analysis.

Table 5.2.3. Ratio of procurement procedure types in total number of contracts between 2009 and 2016, N= 139,618

	Negotiation without announcement	Negotiation with announcement	Open	Other transparent	Other non-transparent
2009	3%	16%	42%	27%	13%
2010	1%	10%	35%	42%	12%
2011	1%	13%	29%	48%	9%
2012	2%	7%	42%	8%	42%
2013	10%	5%	38%	2%	45%
2014	38%	3%	36%	1%	21%
2015	42%	5%	35%	2%	17%
2016	14%	5%	35%	13%	34%

Note: without framework agreements;
data are filtered by variable goodfwc
Source: CRCB

[38] We had to filter out some contracts from our analyses that were published incorrectly – for more details, see the referred table in the Annex.

5.3. The effects of EU funding

Our database and the concepts which we are using in this paper give us the opportunity to analyse the effect of EU funding from several aspects of competition and corruption. In the next paragraphs, we would like to evaluate the effects of EU funding on the intensity of competition, corruption risks, price distortion and the weight of direct social loss. Our research question, in general, is the following: are there any significant differences between EU-funded and non-EU-funded tenders in these aspects? And taking the strict regulation and strong institutional background of EU subsidies into consideration, our initial hypothesis is that the EU-funded projects should perform better than the non-EU-funded ones. The EU-funded tenders should be characterised by the highest level of intensity of competition, the lowest level of corruption risks and price distortion and by a smaller ratio of direct social loss of all. Some of our recent empirical findings have contradictory results concerning corruption risks (Chvalkovska et al. 2031; Fazekas & Toth, 2017). Now, in this paper we extend the scope of investigation and at the same time we have a unique chance to use our more comprehensive dataset (which contains public tender data from 2009 to 2016) than before.

The general model of our estimations is the following:

$$I_i = F_i(EU, X, T) \qquad (12)$$

Where I_i are the estimated indicators, F_i are the functions used, *EU* is the dummy variable which describes the effects of EU funding, *X* is the vector of tender characteristics (sector and size of contract), *T* is the variable of time (year of the contract) and *i* indicates the different equations.

We used ICI as a proxy of intensity of competition, SB, CR2 and CR3 to measure corruption risks, ROUND4 and ROUNDRO as indicators of price distortion and DSLR1, DSLR2 as the estimated rates of direct social loss and with EVALUE_MISS we quantified the fulfilment of the formal rules.

Thus, we controlled the effect of the EU funding with size and sector of the contract and the year of the contract. In case of CR2, CR3 and ICI we used robust and quantile regression estimations, in case of SB, ROUND4 logistic regression, in case of ROUNDRO ordered logistic regression, and finally in case of indicators of rate of direct social loss (DSLR1, DSLR2) quantile regressions.

The estimations gave us unexpected and clear results: during the analysed period the EU-funded tenders performed badly and had significantly worse outcomes than the non-EU-funded ones (see Table. 5.3.1.).

Table 5.3.1. The effects of EU funding on the Hungarian public procurement, 2009-2016

Estimated indicator	Model	Effect of EU funding (EU)	T value	Z value	Model Pseudo R^2	N
SB	logit	0.1472***	-	11.25	0.0221	133,948
CR2	ologit	0.4589***	-	39.69	0.0520	133,948
CR2	robust reg.	0.0813***	40.65	-	-	133,948
ROUND4	logit	0.1361***	-	10.14	0.1132	134,851
ROUNDRO	ologit	0.0545***	-	4.16	0.0317	90,928
CR3	ologit	0.4058***	-	36.71	0.0551	133,948
CR3	robust reg.	0.0601***	36.83	-	-	133,948
ICI	ologit	-0.3193***	-	-24.54	0.0115	93,772
ICI	robust reg.	-0.0337***	-25.49	-	-	93,772
DSLR1	quantile reg.	0.8783***	13.38	-	0.0441	134,332
DSLR2	Quantile reg.	1.5236***	13.75	-	0.0854	73,296
EVALUE_MISS	logit	-0.5404***	-	-37.34	0.0482	134,851

Note: without framework agreements;
****: p< 0.01; **: p <0.05; *: p < 0.1*
data are filtered by variable goodfwc
Controls are: sector, size of contract (lnncv), year of contract;
Source: CRCB

There is only one exception (EVALUE_MISS): in case of EU-funded tenders, the issuers provided the information on the estimated value significantly more often than in case of other tenders. But the most important indicators have the reverse results: at the EU-funded tenders the intensity of competition was significantly lower, the level of corruption risk higher, price distortion more likely, and the rate of estimated direct social loss considerably greater than for non-EU-funded one. Consequently, the quality of EU regulation and institutional background of the EU subsidies seem weak and ineffective in Hungary during the period under examination. It appears that these factors only helped to fulfil some formal criteria, but they are not sufficient to achieve the EU's general aims in public procurement: to assist in strengthening competition, to restrain the high level of corruption risk and to hinder social loss among public tenders.

In fact, based on our results, we can even say that the EU funding has perverse effects in public procurement in Hungary: it aided in reducing the intensity of

competition and increasing both the level of corruption risk and the weight of price distortion, and it spurred the growth of estimated direct social loss due to weak competition, and to high level of corruption risks during the period.

6. The evaluation of the year 2016

We extracted the data of 176,886 public procurement contracts. However, after the data cleaning steps, only the data of 151,432 contracts were kept for analysis. A great number of contracts had to be filtered out because of missing data or suspicious or wrong data which a posteriori cannot be repaired or tested.

The first lesson of the data analysis of public procurement tenders learnt in the period of 2009-2016 is that the year of 2016 was very special from different aspects. This year was characterised by a strong drop in the number of tenders and especially a massive drop in EU-funded ones. These events had effects on almost all areas of the analysis: the level of corruption risk, the intensity of competition, the weight of price distortion and the rates of direct social loss. Furthermore, that year the new public procurement law came into force, which had evidently effects on the actors' (issuers and bidders) behaviour. Third, attention should also be paid to the individual efforts of the government, public institutions and local governments to strengthen the compliant behaviour in public procurement.

Additionally, there are some promising and supposedly spontaneous positive tendencies which could clearly be observed during 2016: the share of the non-EU-funded tenders without competition reduced, the intensity of competition slightly increased, the price distortion dropped, the rate of direct social loss somewhat got lower, and the aggregate net contract value of those tenders which could be affected by corruption also decreased.

Taking the effect of 2016 into consideration and controlling it by contract size, sectors, EU funding, we can conclude that in 2016 there was a significant improvement in case of corruption risks, intensity of competition and level of price distortion compared to the previous year (see Table 6.1.-6.3.). But we can observe also some negative tendencies: the price drop rate rise did not changed and the level of transparency significantly deteriorated from 2015 to 2016 (see Table 6.4. and 6.5.).

But despite these promising tendencies the whole picture which characterised the recent years did not change substantially: the rate of tenders without competition remained extremely high not only in international comparison, but also compared to the level of years before 2011, the level of corruption risk stagnated at high level, and the estimated rate of direct social loss remained extraordinarily high (at least 15-25% of total public spent by public procurement). Additionally, the level of price distortion and overpricing do continue to be alarming which obviously is synonymous with the high level of social loss due to corrupt transactions (bribery, collusion and "white elephant"

projects). Meanwhile the expectations of public procurement experts of the Hungarian government regarding the effects of the new public procurement law to improve transparency of public tenders were not met empirically (See Table 6.5.).

Table 6.1. Robust regression and ordered logit estimation of CR3 in 2015 and 2016, N=33,489

```
Robust regression                                   Number of obs =   33489
                                                    F(  8, 33480) =  397.85
                                                    Prob > F      =  0.0000

------------------------------------------------------------------------------
         cr3 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       y2016 |  -.0170314   .0031188    -5.46   0.000    -.0231443   -.0109185
          eu |   .0663399   .0034568    19.19   0.000     .0595645    .0731153
             |
      sector6 |
construction |   .0377945   .0038691     9.77   0.000      .030211    .0453781
          it |   .2315356   .0071387    32.43   0.000     .2175435    .2455277
real estat.. |   .1784156   .0061474    29.02   0.000     .1663665    .1904647
engeneerin.. |   .1710091   .0058882    29.04   0.000     .1594679    .1825503
other serv.. |   .1270593   .0046683    27.22   0.000     .1179093    .1362093
             |
       lnncv |  -.0027004   .0008021    -3.37   0.001    -.0042726   -.0011282
       _cons |   .3696201    .012835    28.80   0.000      .344463    .3947772
------------------------------------------------------------------------------

Ordered logistic regression                      Number of obs   =      33489
                                                 LR chi2(8)      =    2973.28
                                                 Prob > chi2     =     0.0000
Log likelihood = -38353.154                      Pseudo R2       =     0.0373

------------------------------------------------------------------------------
         cr3 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       y2016 |  -.1186534   .0219162    -5.41   0.000    -.1616083   -.0756985
          eu |   .4681318   .0241473    19.39   0.000      .420804    .5154595
             |
      sector6 |
construction |   .2627551   .0268864     9.77   0.000     .2100587    .3154515
          it |   1.601155   .0511572    31.30   0.000     1.500889    1.701421
real estat.. |   1.226379   .0437148    28.05   0.000       1.1407    1.312059
engeneerin.. |   1.177585   .0417584    28.20   0.000      1.09574     1.25943
other serv.. |   .8806002   .0338681    26.00   0.000       .81422    .9469805
             |
       lnncv |  -.0181055   .0057643    -3.14   0.002    -.0294033   -.0068077
-------------+----------------------------------------------------------------
       /cut1 |  -1.365586   .0928807                     -1.547629   -1.183543
       /cut2 |   .8562125   .0927073                      .6745095    1.037916
       /cut3 |   3.222997   .0951661                      3.036475    3.409519
------------------------------------------------------------------------------
```

Note: without framework agreements;
data are filtered by variable goodfwc
Source: CRCB

Table 6.2. Robust regression and ordered logit estimation of ICI in 2015 and 2016, N=23,390

```
Robust regression                                       Number of obs =   23390
                                                        F(  8, 23381) =  117.12
                                                        Prob > F      =  0.0000

------------------------------------------------------------------------------
         ici |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       y2016 |   .0348833   .0022798    15.30   0.000     .0304147    .0393519
          eu |  -.0261827     .00255   -10.27   0.000    -.0311808   -.0211845
             |
      sector6 |
construction |   .0399501   .0028613    13.96   0.000     .0343418    .0455584
          it |  -.0018796   .0057086    -0.33   0.742    -.0130689    .0093097
real estat.. |   .0251516   .0044337     5.67   0.000     .0164614    .0338419
engeneerin.. |   .0527815    .004139    12.75   0.000     .0446689    .0608941
other serv.. |   -.020898    .003626    -5.76   0.000    -.0280051   -.0137909
             |
       lnncv |   .0028841   .0006249     4.62   0.000     .0016593    .0041089
       _cons |   .4128503   .0099774    41.38   0.000     .3932939    .4324067
------------------------------------------------------------------------------

Ordered logistic regression                     Number of obs   =      23390
                                                LR chi2(8)      =     952.68
                                                Prob > chi2     =     0.0000
Log likelihood = -35906.126                     Pseudo R2       =     0.0131

------------------------------------------------------------------------------
         ici |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       y2016 |   .4000757   .0255121    15.68   0.000     .3500728    .4500785
          eu |   -.290283   .0277559   -10.46   0.000    -.3446834   -.2358825
             |
      sector6 |
construction |   .4417132   .0316699    13.95   0.000     .3796413    .5037852
          it |  -.0134628   .0609475    -0.22   0.825    -.1329177    .1059921
real estat.. |   .3007502   .0477568     6.30   0.000     .2071487    .3943518
engeneerin.. |   .6075875   .0461976    13.15   0.000     .5170418    .6981331
other serv.. |  -.2316257   .0413343    -5.60   0.000    -.3126395   -.1506119
             |
       lnncv |   .0330002   .0071843     4.59   0.000     .0189192    .0470811
-------------+----------------------------------------------------------------
       /cut1 |  -.1288089   .1148842                     -.3539779    .0963601
       /cut2 |   1.607409   .1152847                      1.381455    1.833363
       /cut3 |    2.57521    .116144                      2.347572    2.802848
       /cut4 |   3.061611   .1169168                      2.832458    3.290764
       /cut5 |    3.41177   .1177239                      3.181035    3.642504
       /cut6 |   3.722982   .1186605                      3.490412    3.955552
       /cut7 |   3.977238   .1196264                      3.742775    4.211702
       /cut8 |   4.273081   .1210529                      4.035822     4.51034
------------------------------------------------------------------------------
```

Note: without framework agreements;
data are filtered by variable goodfwc
Source: CRCB

Table 6.3. Logit and ologit estimations of rounding (ROUND4, ROUNDRO) in 2015 and 2016, N=33,501 and N=22,557

```
Logistic regression                                     Number of obs   =      33501
                                                        LR chi2(8)      =    5879.11
                                                        Prob > chi2     =     0.0000
Log likelihood = -17908.223                             Pseudo R2       =     0.1410

------------------------------------------------------------------------------
      round4 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       y2016 |  -.0856864   .0279745    -3.06   0.002    -.1405154   -.0308573
          eu |   .2215821   .0302279     7.33   0.000     .1623364    .2808278
             |
     sector6 |
construction |  -1.109216    .038972   -28.46   0.000      -1.1856   -1.032832
          it |   1.044521   .0550043    18.99   0.000     .9367148    1.152328
real estat.. |   1.333343   .0482547    27.63   0.000     1.238765     1.42792
engeneerin.. |   1.957155   .0499729    39.16   0.000      1.85921      2.0551
other serv.. |   .8866519   .0370332    23.94   0.000     .8140682    .9592356
             |
       lnncv |    .206087   .0075034    27.47   0.000     .1913806    .2207934
       _cons |  -4.425087    .123364   -35.87   0.000    -4.666876   -4.183298
------------------------------------------------------------------------------

Ordered logistic regression                             Number of obs   =      22557
                                                        LR chi2(8)      =    2058.30
                                                        Prob > chi2     =     0.0000
Log likelihood = -28984.138                             Pseudo R2       =     0.0343

------------------------------------------------------------------------------
     roundro |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       y2016 |  -.0773278   .0262539    -2.95   0.003    -.1287844   -.0258711
          eu |    .016927   .0289141     0.59   0.558    -.0397436    .0735975
             |
     sector6 |
construction |  -.4806376   .0388165   -12.38   0.000    -.5567165   -.4045586
          it |   .6244554   .0527782    11.83   0.000      .521012    .7278989
real estat.. |   .9442784   .0461273    20.47   0.000     .8538707    1.034686
engeneerin.. |   1.373526    .042953    31.98   0.000      1.28934    1.457712
other serv.. |   .6909975   .0357136    19.35   0.000     .6210001    .7609948
             |
       lnncv |   .0003484   .0067251     0.05   0.959    -.0128324    .0135293
-------------+----------------------------------------------------------------
       /cut1 |  -1.356624    .108727                     -1.569725   -1.143523
       /cut2 |   .0202429   .1081707                     -.1917678    .2322536
       /cut3 |   1.927241   .1090092                      1.713587    2.140895
------------------------------------------------------------------------------
```

Note: without framework agreements; if the tender happened in 2015, the y2016=0, if it happened in 2016 the y2016=1; data are filtered by variable goodfwc
Source: CRCB

Table 6.4. Quantile regression of relative price drop (RPRD) in 2015 and 2016, N=20,475

```
Median regression                                       Number of obs =     20475
  Raw sum of deviations 100781.5 (about 1.8633541)
  Min sum of deviations 98923.38                        Pseudo R2     =    0.0184

------------------------------------------------------------------------------
       rprd2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       y2016 |    .214378    .162741     1.32   0.188    -.1046074    .5333633
          eu |  -1.000429   .1753355    -5.71   0.000      -1.3441   -.6567572
             |
      sector6 |
construction |  -.9953626   .2028527    -4.91   0.000     -1.39297   -.5977552
          it |  -1.761113   .3598132    -4.89   0.000    -2.466375    -1.05585
real estat.. |  -2.033371   .3015823    -6.74   0.000    -2.624496   -1.442245
engeneerin.. |  -1.048994   .2964922    -3.54   0.000    -1.630142   -.4678453
other serv.. |  -2.118228    .239698    -8.84   0.000    -2.588056   -1.648401
             |
       lnncv |  -.6771357   .0448306   -15.10   0.000    -.7650073   -.5892642
       _cons |   14.89904   .7220778    20.63   0.000     13.48371    16.31437
------------------------------------------------------------------------------
```

Note: without framework agreements; rprd ≥ 0; if the tender happened in 2015, the y2016=0, if it happened in 2016 the y2016=1; data are filtered by variable goodfwc
Source: CRCB

Table 6.5. Logit estimation of transparency index (TI) in 2015 and 2016, N=33,501

```
Logistic regression                                     Number of obs   =      33501
                                                        LR chi2(8)      =    6174.18
                                                        Prob > chi2     =     0.0000
Log likelihood = -19268.798                             Pseudo R2       =     0.1381

------------------------------------------------------------------------------
          ti |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       y2016 |  -.0602575   .0262559    -2.30   0.022    -.1117181   -.0087969
          eu |  -.8600103   .0309322   -27.80   0.000    -.9206364   -.7993843
             |
      sector6 |
construction |  -2.175588   .0362864   -59.96   0.000    -2.246708   -2.104468
          it |   -1.87764   .0680851   -27.58   0.000    -2.011084   -1.744195
real estat.. |  -1.488545   .0551324   -27.00   0.000    -1.596602   -1.380487
engeneerin.. |  -.9138535   .0474567   -19.26   0.000    -1.006867     -.82084
other serv.. |  -.6670071    .036655   -18.20   0.000    -.7388497   -.5951645
             |
       lnncv |   .2323983   .0068648    33.85   0.000     .2189436    .2458531
       _cons |  -3.183282   .1086498   -29.30   0.000    -3.396232   -2.970333
------------------------------------------------------------------------------
```

Note: without framework agreements; if the tender happened in 2015, the y2016=0, if it happened in 2016 the y2016=1; data are filtered by variable goodfwc
Source: CRCB

References

ACFE. 2016. Report to the Nations on Occupational Fraud and Abuse, 2016 Global Fraud Study. Association of Certified Fraud Examiners, USA: Austin, Texas.

Coviello, D., – Gagliarducci, S. 2010. Building Political Collusion: Evidence from Procurement Auctions. IZA DP No. 4939, Bonn: Institute for the Study of Labor (IZA). http://repec.iza.org/dp4939.pdf

Chvalkovska, J., Fazekas, M., Skuhrovec, J., Tóth, I. J., King L. P. 2013. Are EU funds a Corruption Risk? The Impact of EU Funds on Grand Corruption in Central and Eastern Europe. In: Pippidi-Mungiu, A. Controlling Corrution in Europe. The Anticorruption Report 2. Oplanden, Berlin & Toronto: Barbara Budrich Publishers. pp. 68-89.

Czibik, Á., Fazekas, M., Tóth, B., Tóth I. J. 2014. Toolkit for detecting collusive bidding in public procurement. With examples from Hungary. Working Paper Series: CRCB-WP/2014:02. CRCB, Budapest, 2014. http://bit.ly/2aDRYM7

CRCB. 2016. Competitive Intensity and Corruption Risks in the Hungarian Public Procurement 2009-2015. Main Findings & Descriptive Statistics. Budapest, CRCB. http://bit.ly/1TBpQDa

Durtschi, C. - Hillison, W.- Pacini, C. 2004. "The Effective Use of Benford's Law to Assist in. Detecting Fraud in Accounting Data", *Journal of Forensic Accounting*, Vol V. pp. 17-34, http://bit.ly/1QSUOER.

Drake, P. D. – Nigrini, M. J. 2000. "Computer assisted analytical procedures using Benford's law", *Journal of Accounting Education*, Vol. 18. no. 2. pp. 127-146;

Fazekas, M., Tóth, I.J., King. L. P. 2013a. Anatomy of grand corruption: A composite corruption risk index based on objective data. Budapest, CRCB. http://bit.ly/1Yc7zQL

Fazekas, M., King, L. P., Tóth, I. J. 2013b. Hidden Depths. The Case of Hungary. In: Pippidi-Mungiu, A. Controlling Corrution in Europe. The Anticorruption Report 1. Oplanden, Berlin & Toronto: Barbara Budrich Publishers. pp74-82.

Fazekas, M., Tóth, I. J., King, L. P. 2016. "An Objective Corruption Risk Index Using Public Procurement Data". European Journal on Criminal Policy and Research, First Online: 25 April 2016 doi: 10.1007/s10610-016-9308-z.

Fazekas, M., and Tóth, I. J. 2016. "From Corruption to State Capture. A New Analytical Framework with Empirical Applications from Hungary". Political Research Quarterly, June 2016, vol. 69. no. 2. pp. 320-334, doi: 10.1177/1065912916639137.

Fazekas, M. - Tóth, I. J. 2017. Corruption in EU Funds? Europe-wide evidence of

the corruption effect of EU-funded public contracting. In: Bachler, J., Berkowitz, P., Hardy S., Muravska, T.: EU Cohesion Policy. Reassessing Performance and Direction, Routledge, London & New York., pp. 186-205.

Garrido, Melissa M, Amy S. Kelley, Julia Paris, Katherine Roza, Diane E. Meier, R. Sean Morrison. 2014. Methods for Constructing and Assessing Propensity Scores. *Health Services Research,* 49 (5): 1701–20. doi:10.1111/1475-6773.12182

IEER. 2016. Integrity and corruption risks within the Hungarian corporate sector. Budapest: Institute for Economic and Enterprise Research. http://bit.ly/2jzzdZj

King, G., Nielsen, R. 2016. Why Propensity Scores Should Not Be Used for Matching. http://bit.ly/2iWZSUd

Kossovsky, A. E. 2015. Benford's Law. Theory, the General Law of Relative Quantities, and Forensic Fraud Detection Applications. Hackensack, New Jersey, USA: World Scientific

Lambsdorff, J. G. 2007. The Institutional Economics of Corruption and Reform. Theory, Evidences and Policy. Cambridge, UK: Cambridge University Press

Lechner, Michael. 2002. Program Heterogeneity and Propensity Score Matching: An Application to the Evaluation of Active Labour Market Policies. *The Review of Economics and Statistics* (84): 205-220. http://bit.ly/2j6kZPi

Miller, S. J. (ed.). 2015. Benford's Law: Theory and Applications. Princeton, New Jersey, USA: Princeton University Press

Kevin M. Murphy, Andrei Shleifer and Robert W. Vishny. 1993. "Why Is Rent-Seeking So Costly to Growth?" *The American Economic Review* Vol. 83, No. 2, Papers and Proceedings of the Hundred and Fifth Annual Meeting of the American Economic Association (May, 1993), pp. 409-414. http://bit.ly/2ahOOJg

Nigrini, M. J. 1996. "A taxpayer compliance application of Benford's law". Journal of the American Taxation Association. Vol. 18. no 1. pp. 72–91.

Nigrini, M. J. (ed.). 2012. Benford's Law. Applications for Forensic Accounting, Auditing, and Fraud Detection. Hoboken, New Jersey, USA: John Wiley & Sons

Spann, Delena D. 2013. Fraud Analytics: Strategies and Methods for Detection and Prevention, Hoboken. New Jersey, USA: John Wiley & Sons

Szanto, Z., Tóth, I. J., Varga, S. 2012. The social and institutional structure of corruption: some typical network configurations of corruption transactions in Hungary, In: Vedres, B., Scotti, M. (eds.): Network sin Social Policy Problems. Cambridge, UK: Cambridge University Press Cambridge, UK: Cambridge University Press.

Palguta, Ján & Pertold, Filip. 2017. Manipulation of Procurement Contracts: Evidence from the Introduction of Discretionary Thresholds, American Economic Journal: Economic Policy, vol 9. no. 2. May, pp. 293-315.

Rose-Ackerman, S. (ed.). 2006. International Handbook on the Economics of

Corruption, Cheltenham, UK: Edward Elgar.

Rose-Ackerman, S. – Soreide, T. 2011. International Handbook on the Economics of Corruption. Volume Two. Cheltenham, UK: Edward Elgar.

Rosenbaum, Paul R., Donald B. Rubin. 1983. The Central Role of the Propensity Score in Observational Studies for Causal Effects. *Biometrika*. 70 (1): 41–55. doi:10.1093/biomet/70.1.41

Tóth, I. J., Hajdu, M. 2016a. Competitive Intensity and Corruption Risks in the Hungarian Public Procurement 2009-2015. Paper presented at the University of Cambridge, „Data for Policy" Conference, http://bit.ly/2b8p8kW

Toth, I. J., Hajdu, M. 2016b. Korrupciós kockázatok, átláthatóság, közbeszerzések. Magyar közbeszerzések 2009–2015 közötti adatainak elemzése. In: Kolosi, T.- Tóth, I. Gy. (szerk.): Társadalmi Riport. Tárki, Budapest. 33-53. old. [Corruption risks, transparency, public procurement. Analysis of Hungarian Public Procurement in the period of 2009 and 2015. In: Kolosi, T. – Tóth, I. Gy. (eds): Social Report – 2016. Budapest: Tárki, pp. 33 -53.] http://bit.ly/2dA9XlI

Tóth, I. J., Hajdu, M. 2017. Intensity of competition, social loss and the enigma of 25 million HUF threshold. Statistical analysis of Hungarian public procurement in the period of 2009-2016 (Versenyerősség, társadalmi veszteségek és a 25 millió forintos értékhatár rejtélye. 2009-2016 közötti magyar közbeszerzések statisztikai vizsgálata). CRCB, Working Papers: CRCB-WP/2017:1, September, http://bit.ly/2wWe6Me

Competitive Intensity and Corruption Risks in the Hungarian Public Procurement 2009-2015. Paper presented at the University of Cambridge, „Data for Policy" Conference, http://bit.ly/2b8p8kW

Varian, H. R.1972.: "Benford's law", *The American Statistician*, 26. Vol. no.3. pp. 65–66.

Annex

A1. Data & Indicators

The Hungarian Public Procurement Authority (HPPA) publishes the notices about the results of the Hungarian public procurements on its homepage [39] on dedicated pages for each public procurement call [40]. These html files are downloaded and processed by a web crawler developed by the CRCB and the extracted data is organized into a database. The html files contain free text fields that are prepared by the crawler for the further data cleaning steps. As the links of these html files are based on the registration number of the notices, the web crawler requests the html files of notices from the server by attempting to open links with all the different plausible registration numbers.

The result of this attempt was the extraction of 209,408 notices between 2009 and 2016, including corrigendum, calls for tenders, cancellation of tenders besides the notices announcing the results of public procurements (see Annex 3. for details about the types of the extracted notices in Hungarian).

Table A1.1.: Total number of notices found between 2009 and 2016

Year	Number of notices (pcs)
2009	29,204
2010	36,330
2011	31,690
2012	18,778
2013	23,261
2014	26,725
2015	27,914
2016	15,506
Total	209,408

Source: CRCB (based on the data extraction from the HPPA website)

However, as only the notices announcing the results, containing the details about the contracts between the issuers and the winners, are in the scope of this study, the rest was filtered out. After this selection, 100,708 contract award notices remained, and the data regarding the contacts was extracted from these notices.

[39] See: www.kozbeszerzes.hu
[40] For instance, see: http://bit.ly/2jpDWRk

Table A1.2.: Total number of contract award notices of Hungarian public procurements found between 2009 and 2016

Year	Number of notices (pcs)
2009	11,478
2010	14,805
2011	11,012
2012	9,556
2013	13,446
2014	15,667
2015	15,438
2016	9,306
Total	100,708

Source: CRCB (based on the data extraction from the HPPA website)
Contract award notices = " Tájékoztató az eljárás eredményéről"

In comparison, the dataset of Tenders Electronic Daily[41] contains information about 43,632 Hungarian notices between 2009 and 2015, what is the 48% of the amount of notices for announcing the results of public procurements that could be extracted from the website of the HPPA.

Table A1.3.: Total number of Hungarian notices in the TED database between 2009 and 2015

Year	Number of notices (pcs)
2009	6,444
2010	6,210
2011	6,278
2012	5,074
2013	7,265
2014	6,074
2015	6,287
Total	43,632

Source: TED

The cases of the database containing information extracted from the website of HPPA are the contracts between public organizations and the successful bidders in the public procurement calls. As one notice on the webpage of the HPPA may

[41] The online version of the 'Supplement to the Official Journal' (http://ted.europa.eu/) of the European Union, containing information about the tenders above the EU threshold value (for the thresholds see: https://ec.europa.eu/growth/single-market/public-procurement/rules-implementation/thresholds_en).

contain information about several contracts, some general data about the procurements may be represented repeatedly in the cases of the dataset (for instance the characteristics of the issuer). The following features of the public procurement contracts were extracted:

- Registration number
- Type of notice
- Date of publication
- Name of the issuer
- City of the issuer
- Name of the winner
- City of the winner
- Number of bids
- Contract value
- Currency of the contract value
- VAT on the contract value
- Estimated value
- Currency of the estimated value
- VAT on the estimated value
- Type of the procurement (the types specified by the Hungarian Act on Public Procurement[42])
- CPV code (the code that classifies the subject of procurement contracts)
- EU funding (was the procurement at least partially funded by the EU or not)
- Days between the publication and the deadline of application for the call for tenders
- Description of the contract (the brief summary of its subject)
- Result of the procurement (was it successful or not).

In total, 176,886 contracts were extracted from the notices announcing the results of public procurements.

[42] See: http://bit.ly/2iA4LgT

Table A1.4.: Total number of contracts of public procurements found between 2009 and 2016

Year	Number of contracts (pcs)
2009	22,349
2010	27,528
2011	16,864
2012	17,098
2013	24,315
2014	25,485
2015	25,298
2016	17,949
Total	176,886

Source: CRCB (based on the data extraction from the HPPA website)

However, some of these entries still required filtering due to of several reasons. These include:

- The unsuccessful procurements were dropped;
- Some contracts were announced with data known by the CRCB to be incorrect were dropped[43];
- The duplicate entries for contracts that were published in both the Hungarian Public Procurement Bulletin and in the Supplement to the Official Journal of the EU were dropped (the cases deriving from the notices of the Hungarian Public Procurement Bulletin were dropped).

Finally, as a result of this filtering method, 151,457 contracts were selected for the analyses presented in the upcoming chapters.

[43] The information published online by the HPPA may contain mistakes. The Public Procurement Board may be informed about these errors (for example by the issuers) and can resolve the inaccuracies by two methods: 1) publishing a correction notice, 2) republishing the original announcement with the corrected information. Unfortunately, even after a thorough research, the matching of correction notices and the original announcements cannot be always done. See for instance: http://bit.ly/2iA5Q8r and http://bit.ly/2abN8Aw p. 5-7. and p. 14-15.

Table A1.5.: Number of contracts of public procurements selected for analysis between 2009 and 2016

Year	Number of contracts (pcs)
2009	16,248
2010	21,192
2011	15,078
2012	15,118
2013	21,944
2014	23,119
2015	23,029
2016	15,729
Total	151,457

Source: CRCB (based on the data extraction from the HPPA website)

Unfortunately, even after several careful steps of data extraction and cleaning, we could not obtain valid values for all the main variables of our analyses in all of the cases. The ratio of missing data is below 10 percent regarding all the main variables in the final, cleaned version of the database. Also, we would like to emphasize that during the analysis of the contract values, our results are based on the contract values published on the webpages of the notices. Unfortunately, in some cases this field contains the value of the complete procurement repeatedly for every contract[44]. We filtered out such cases that we are aware of, but there is the chance that further faulty contract values remained in the database. In addition, during the analyses of contract values, the framework agreements were filtered out because of the presumably differing methods of pricing from the regular contracts. The framework agreements were not excluded from the analyses of other aspects of public procurement.

[44] See for instance: http://bit.ly/2jD2Ny8

Table A1.6.: Ratio of missing values for certain main variables considered during the analysis between 2009 and 2016

Variable	Ratio of missing values (%)
Net contract value	2.4
Type of the public procurement	8.0
EU funding	0.3
Sector	2.4
Single-bidder	1.0
Location of the winner company	0.9
Location where the procurement had to be fulfilled	0.5
Type of issuer	4.8

N=151,432
Source: CRCB (based on the data extraction from the HPPA website)

The variables we used during the data analysis are explained in Table A1.7.

Table A1.7. Definition of variables used

	Variable names	Definition
1	GOODX	Filter variable [0,1]; it filters the dataset to contract level data, excluding the cases deriving from notices published with known mistakes, unsuccessful procurements and published in both the Hungarian Public Procurement Bulletin and in the Supplement to the Official Journal of the EU were dropped (the cases deriving from the notices of the Hungarian Public Procurement Bulletin were dropped)
2	GOODFWC	Filter variable [0,1]; it drops the framework agreements from the analysis – useful for analysing the contract values as the cases of framework agreements may bias the results
3	DATE_	Date variable for monthly data;
4	DATEY	Date variable for yearly data;
5	EU	Tender is funded by the EU [0,1]; If the tender was funded by EU, EU=1 else, EU=0
6	NCVALUE	Net contract price (in HUF)
7	LNNCV	Logarithm of net contract price
87	NCV9	Net contract price (in billion HUF)
9	NCV12	Net contract price (in trillion HUF)
10	ICI	Index of Competition Intensity [0.301 ≤ ICI ≤ 1]; It measures the intensity of competition: low value means low intensity, high value means high intensity. X: the number of bidders in a tender. ICI = lgX in case where 2 ≤ X ≤ 10, and ICI = 1 if X > 10. ICI = 99 if X = 1; ICI = 99 if X value is missing; If ICI = 99, this is a missing value.
11	ICIO	Competition Intensity [1,2,3,4]; It measures the intensity of competition at ordinal level. ICIO = 1: 2-3 bidders 2: 4 bidders 3: 5 bidders 4: 6 or more bidders
12	SECTOR6	Product market [1,2,3,4,5,6] of tenders; the information came from cpv codes published in tender documentation; The values are: 1 "Industrial goods" 2 "Construction works and services" 3 "IT works and services", 4 "Real estate and business services", and 5 "Engineering, R&D and financial services", 6 "Other services".

13	SB	Single-bidder [0,1]; the value of 0 means there were more than one bids; the value of 1 means there was only one bid.
14	CR2	Corruption Risk Indicator [0, 0.5, 1]; The value of 0 means low corruption risk (more than one bids and tender with announcement), the value of 1 means high corruption risk (only one bid and tender without announcement). The formula of CR" is the following: $$CR2 = \frac{(1-TI)+SB}{2}$$
15	ROUND4	If the contract price is divisible by 10^4 without remainder (rounded at thousands), ROUND4 = 1 If the contract price is not divisible by 10^4 without remainder, ROUND4 = 0,
16	ROUND5	If the contract price is divisible by 10^5 without remainder (rounded at thousands), ROUND5 = 1, If the contract price is not divisible by 10^5 without remainder, ROUND5 = 0
17	ROUNDR	$$ROUNDR = \frac{R}{Rmax}$$ Where *R* is the number of maximal level rounding of given contract price. For instance if the contract price is 24,500 HUF the value of *R* is 2, and if it is 456,000,000 HUF the value of *R* is *6*. The R_{max} means the maximum weight of rounding at certain size of numbers. For instance for the contract prices between 10,000 and 99,999 HUF the value of R_{max} is 4 and prices between 100,000,000 and 999,999,999 HUF the R_{max} is 8.
18	ROUNDR2	If 0 < ROUNDR < 0.25 then ROUNDR2 = 0.25 If 0.25 ≤ ROUNDR < 0.50 then ROUNDR2 = 0.50 If 0.50 ≤ ROUNDR < 0.75 then ROUNDR2 = 0.75 If 0.75 ≤ ROUNDR then ROUNDR2 = 1 otherwise ROUNDR2 = 9 (missing value)
19	ROUNDRO	[1,2,3,4] Recoded version of (ROUNR2): ROUNDRO (1): ROUNDR (0.25), ROUNDRO (2): ROUNDR (0.50), e.t.c.
20	CR3	Corruption Risk Indicator [0, 0.33, 0.66, 1]; The value of 0 means low corruption risk (more than one bidder, tender with announcement, and not rounded price), the value of 1 means high corruption risk (only one bidder, tender without announcement and rounded price). We constructed the CR3 using the following formula: If CR2=0 & ROUND4 =0 THEN CR3 =0 If CR2=0 & ROUND4 =1 THEN CR3=0.33 If CR2=0.5 & ROUND4 =0 THEN CR3=0.33

		If CR2=0.5 & ROUND4 =1 THEN CR3=0.66 If CR2=1 & ROUND4 =0 THEN CR3=0.66 If CR2=1 & ROUND4 =1 THEN CR3=1; the value of 999 means missing value.
21	BENFORD1	The first digit of net contract price [1,…,9];
22	RPRD	$RPRD = \frac{(P^* - P)}{P} * 100$ Where P* is the estimated net price and P is the net contract price of the tender.
23	DSL1	Direct social loss from the first estimation method
24	DSL2	Direct social loss from the second estimation method
25	DSL3	Direct social loss from the third estimation method
26	RPRD_MISS	If the value of RPRD is missing RPRD_MISS= 1, else 0
27	EVALUE_MISS	If the value of EVALUE is missing EVALUE_MISS = 0, else 0
28	EV_ERR3	[0,1] Filter variable If RPRD>100 & RPRD<5,622,847, EV_ERR3 = 1 else EV_ERR3=0
29	RPRD2	Filtered version of RPRD by EV_ERR3 RPRD2 is valid if EV_ERR3=0
30	ERPRD_1	Estimated RPRD2, first estimation
31	ERPRD_3	Estimated RPRD2, third estimation
32	NCV9CR3	NCV9CR3= NCV9*CR3
33	NBID	Number of bids
34	RPRDO	The quartiles of RPRD, ordered level [1,2,3,4]; We constructed the RPRDO from RPRD using the following formula: If 0 <= RPRD < 0.07 THEN RPRDO= 1 If 0.07 <= RPRD < 3.04 THEN RPRDO= 2 If 3.04 <= RPRD < 17.4 THEN RPRDO= 3 If 17.4 <= RPRD <= 100 THEN RPRDO= 4

A2. Some specific problems and errors of the official data management of the Hungarian public procurement

Our data collection procedure revealed several problems regarding the official data management of the public procurement in Hungary. These problems basically derive from the lack of validation of the fields on the data sheets. Several fields can be filled in as free text even if the requested information can be categorized.

The most problematic parts of the data sheet are about the contract value. The usage of thousand separators is not consistent, as both spaces[45] and dots[46] are used if there are separators at all[47]. We could detect five cases between 2012 and 2013 when the contract value was entered repeatedly[48] by inspecting the top ten raw contract values. In some cases we suspect that this fault occurred because the submitter of the data was not sure about the required form and entered the value several times but in different ways[49]. Also the use of the '.-' suffix that is for monetary sums in Hungary is inconsistent; in some cases the contract value ends with '.-'[50] but in other cases not[51].

The decision whether the contract value is defined as a unit price or not is quite uncertain as unit prices can only be indicated indirectly by the specification of the unit after contract value[52]. However, in several cases there is no unit described, but the amount of the contract value suggests that it is calculated as a unit price[53]. The indication of the VAT rate also demonstrated in an inconsistent way. The 27% Hungarian standard VAT rate is indicated in four ways:

- 0.27[54];
- 27.[55];
- 27.0[56];
- 1.27[57].

The indication method of the main activity of the contracting body gives the

[45] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_7483_2012/
[46] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_1235_2012/
[47] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_7483_2013/
[48] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_1793_2012/
[49] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_5747_2012/
[50] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_19240_2012/
[51] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_1120_2012/
[52] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_11150_2012/
[53] http://kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_10751_2013/
[54] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_16473_2014/
[55] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_20362_2014/
[56] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_10142_2012/
[57] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_12141_2014/

opportunity for the submitter to mark several activities[58] from a list with twenty predefined items; or by choosing the "Other" option, the submitter can describe the activity of the contracting body by his or her own words[59].

[58] http://kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_10031_2013/
[59] http://kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_10127_2013/

A3. Extracted types of notices from the website of the HPPA

Table A3.1.: Total number of notices found by type between 2009 and 2016

Type of notice (in Hungarian)	Amount of notices (pcs)
Ajánlati felhívás - egyes ágazatokban EUHL	443
Ajánlati felhívás - egyes ágazatokban KÉ	20
Ajánlati felhívás - Egyes ágazatokban/EU/2011.08.19. EUHL	681
Ajánlati felhívás - Honvédelem és biztonság/EU/2011.08.19. EUHL	2
Ajánlati felhívás EUHL	5860
Ajánlati felhívás KÉ	498
Ajánlati felhívás_ KÉ	5
Ajánlati felhívás/EU/2011.08.19. EUHL	5621
Ajánlati/Részvételi felhívás - Közszolgáltatások/2015 EUHL	262
Ajánlati/Részvételi felhívás/2015 EUHL	1239
Ajánlati/részvételi felhívás/2015 KÉ	94
az egyszerű eljárás ajánlattételi felhívása KÉ	12739
Az egyszerű eljárás ajánlattételi felhívása KÉ	444
az egyszerű eljárás ajánlattételi felhívása_ KÉ	1956
Az egyszerűsített eljárás ajánlati felhívása KÉ	127
Az éves statisztikai összegezés KÉ	10
Bírósági határozat KÉ	1036
Eljárást megindító felhívás - 121. § (1) bekezdés b) pontja/KÉ/2011.12.30 KÉ	2963
Eljárást megindító felhívás - 121. § (1) bekezdés b) pontja/KÉ/2013.07.01 KÉ	5155
Eljárást megindító felhívás - 123. §/KÉ/2011.12.30 KÉ	108
Eljárást megindító felhívás - 123. §/KÉ/2013.07.01 KÉ	218
Eljárást megindító felhívás/2015 KÉ	125
Előminősítési hirdetmény – Közszolgáltatások/2015 EUHL	1
Előminősítési rendszer - egyes ágazatokban EUHL	11
Előminősítési rendszer - Egyes ágazatokban/EU/2011.08.19. EUHL	10
Előzetes összesített tájékoztató KÉ	19
Előzetes tájékoztató hirdetmény EUHL	65
Előzetes tájékoztató hirdetmény_ KÉ	1
Előzetes tájékoztató/EU/2011.08.19. EUHL	140
Előzetes/időszakos előzetes tájékoztató/2015 KÉ	6
Építési koncesszió EUHL	6
éves statisztikai összegezés, a Kbt. IV./VI. fejezete szerinti ajánlatkérők KÉ	5
éves statisztikai összegezés, a Kbt. IV./VI. fejezete szerinti ajánlatkérők_ KÉ	5
Felhasználói oldalon közzétett hirdetmény/EU/2011.08.19. EUHL	15

Fővárosi Ítélőtábla ítélete KÉ	262
Helyesbítés EUHL	183
Helyesbítés KÉ	280
Helyesbítés/2015 EUHL	827
Helyesbítés/KÉ/2011.12.30 KÉ	14
Hirdetmény a felhasználói oldalon EUHL	15
hirdetmény visszavonása, módosítása, ajánlattételi határidő meghosszabbítása KÉ	1696
hirdetmény visszavonása, módosítása, ajánlattételi határidő meghosszabbítása_ KÉ	723
Időszakos előzetes tájékoztató - egyes ágazatokban KÉ	1
Időszakos előzetes tájékoztató - Egyes ágazatokban_/EU/2011.08.19. EUHL	39
Időszakos előzetes tájékoztató - Egyes ágazatokban/KÉ/2013.07.01. KÉ	2
Időszakos előzetes tájékoztató – Közszolgáltatások/2015 EUHL	22
Időszakos tájékoztató - egyes ágazatokban EUHL	58
Időszakos tájékoztató - egyes ágazatokban_ KÉ	1
II. rész: Vállalkozási szerződés \\"Lé\""	1
Koncessziós hirdetmény/2015 EUHL	3
Koncessziós hirdetmény/2015 KÉ	5
Legfelsőbb Bíróság ítélete KÉ	51
Módosítás EUHL	153
Módosítás/helyesbítés/visszavonás/2015 KÉ	144
Önkéntes előzetes átláthatóságra vonatkozó hirdetmény/2015 EUHL	10
Önkéntes előzetes átláthatóságra vonatkozó hirdetmény/2015 KÉ	4
Önkéntes előzetes átláthatóságra vonatkozó hirdetmény/EU/2011.08.19. EUHL	2
Önkéntes előzetes átláthatóságra vonatkozó hirdetmény/KÉ/2011.08.19. KÉ	3
összegezés a részvételi jelentkezések elbírálásáról KÉ	29
Összegezés a részvételi jelentkezések elbírálásáról KÉ	10
összegezés a részvételi jelentkezések elbírálásáról_ KÉ	5
Összegezés az ajánlatok elbírálásáról KÉ	5
összegezés az ajánlatok elbírálásáról_ KÉ	6
Összegezés az egyszerű közbeszerzési eljárásban az ajánlatok elbírálásáról KÉ	21
Részvételi felhívás - egyes ágazatokban EUHL	547
Részvételi felhívás - egyes ágazatokban KÉ	3
Részvételi felhívás - egyes ágazatokban_ KÉ	1
Részvételi felhívás - Egyes ágazatokban/EU/2011.08.19. EUHL	820
Részvételi felhívás - Honvédelem és biztonság/EU/2011.08.19. EUHL	13
Részvételi felhívás EUHL	1375
Részvételi felhívás KÉ	118
Részvételi felhívás/EU/2011.08.19. EUHL	993
szerződés odaítéléséről szóló hirdetmény - egyes ágazatokban EUHL	383

Szerződés odaítéléséről szóló hirdetmény egyes ágazatokban_ KÉ	3
szerződés odaítéléséről szóló hirdetmény EUHL	2506
Szerződés odaítéléséről szóló hirdetmény_ KÉ	9
Szociális és egyéb meghatározott szolgáltatások – Általános közbeszerzés/2015 EUHL	106
Tájékoztató a hirdetmény visszavonásáról vagy módosításáról KÉ	182
Tájékoztató a hirdetmény visszavonásáról, módosításáról/KÉ/2011.12.30 KÉ	2960
Tájékoztató a koncesszió odaítéléséről/2015 EUHL	1
Tájékoztató a koncessziós eljárás eredményéről/2015 KÉ	4
Tájékoztató a részvételi szakasz eredményéről KÉ	168
tájékoztató a szerződés módosításáról KÉ	4713
Tájékoztató a szerződés módosításáról KÉ	2779
tájékoztató a szerződés módosításáról_ KÉ	2395
Tájékoztató a szerződés módosításáról/2015 EUHL	376
Tájékoztató a szerződés módosításáról/2015 KÉ	913
Tájékoztató a szerződés módosításáról/KÉ/2011.12.30 KÉ	4940
Tájékoztató a szerződés módosításáról/KÉ/2013.07.01 KÉ	11885
tájékoztató a szerződés teljesítéséről KÉ	8776
Tájékoztató a szerződés teljesítéséről KÉ	7431
tájékoztató a szerződés teljesítéséről_ KÉ	3593
Tájékoztató a tervpályázati eljárás eredményéről EUHL	12
Tájékoztató a tervpályázati eljárás eredményéről KÉ	5
Tájékoztató a tervpályázati eljárás eredményéről/2015 EUHL	10
Tájékoztató a tervpályázati eljárás eredményéről/EU/2011.08.19. EUHL	21
Tájékoztató a tervpályázati eljárás eredményéről/KÉ/2011.08.19. KÉ	2
Tájékoztató az eljárás eredményéről - egyes ágazatokban EUHL	984
Tájékoztató az eljárás eredményéről - Egyes ágazatokban/EU/2011.08.19. EUHL	1573
Tájékoztató az eljárás eredményéről - Honvédelem és biztonság/EU/2011.08.19. EUHL	22
Tájékoztató az eljárás eredményéről – Közszolgáltatások/2015 EUHL	223
tájékoztató az eljárás eredményéről (1-es minta) KÉ	20621
tájékoztató az eljárás eredményéről (1-es minta)_ KÉ	8552
Tájékoztató az eljárás eredményéről (1-es minta)/KÉ/2011.12.30 KÉ	12085
Tájékoztató az eljárás eredményéről (1-es minta)/KÉ/2013.07.01 KÉ	31647
tájékoztató az eljárás eredményéről (2-es minta) KÉ	695
Tájékoztató az eljárás eredményéről (2-es minta) KÉ	2010
tájékoztató az eljárás eredményéről (2-es minta)_ KÉ	369
Tájékoztató az eljárás eredményéről (2-es minta)/KÉ/2011.12.30 KÉ	886
Tájékoztató az eljárás eredményéről (8-as minta) KÉ	1452
Tájékoztató az eljárás eredményéről EUHL	4993
Tájékoztató az eljárás eredményéről/2015 EUHL	896

Tájékoztató az eljárás eredményéről/2015 KÉ	5749
Tájékoztató az eljárás eredményéről/EU/2011.08.19. EUHL	8031
Tervpályázati kiírás EUHL	10
Tervpályázati kiírás KÉ	2
Tervpályázati kiírás/2015 EUHL	6
Tervpályázati kiírás/EU/2011.08.19. EUHL	26
Tervpályázati kiírás/KÉ/2011.08.19. KÉ	4
további információ, befejezetlen eljárás vagy korrigendum EUHL	1998
további információ, befejezetlen eljárás vagy korrigendum_ KÉ	3
További információ, befejezetlen eljárás vagy korrigendum/EU/2011.12.30 EUHL	3925
Visszavonás EUHL	67

Notes: 1) the types are listed as they were spelled on the websites of the notices; they were not cleaned from typos. 2) In 71 cases the type of the notice was not indicated.
Source: CRCB

Table A3.2.: Total number of notices for announcing the results of public procurements found by type between 2009 and 2016

Type of notice (in Hungarian)	Amount of notices (pcs)
Tájékoztató a koncessziós eljárás eredményéről/2015 KÉ	7
Tájékoztató az eljárás eredményéről - egyes ágazatokban EUHL	2404
Tájékoztató az eljárás eredményéről - Egyes ágazatokban/EU/2011.08.19. EUHL	4365
Tájékoztató az eljárás eredményéről - Honvédelem és biztonság/EU/2011.08.19. EUHL	29
Tájékoztató az eljárás eredményéről – Közszolgáltatások/2015 EUHL	525
tájékoztató az eljárás eredményéről (1-es minta) KÉ	33871
tájékoztató az eljárás eredményéről (1-es minta)_ KÉ	12236
Tájékoztató az eljárás eredményéről (1-es minta)/KÉ/2011.12.30 KÉ	18328
Tájékoztató az eljárás eredményéről (1-es minta)/KÉ/2013.07.01 KÉ	43127
tájékoztató az eljárás eredményéről (2-es minta) KÉ	2565
Tájékoztató az eljárás eredményéről (2-es minta) KÉ	5121
tájékoztató az eljárás eredményéről (2-es minta)_ KÉ	1297
Tájékoztató az eljárás eredményéről (2-es minta)/KÉ/2011.12.30 KÉ	4693
Tájékoztató az eljárás eredményéről (8-as minta) KÉ	2788
Tájékoztató az eljárás eredményéről EUHL	10879
Tájékoztató az eljárás eredményéről/2015 EUHL	2860
Tájékoztató az eljárás eredményéről/2015 KÉ	8039
Tájékoztató az eljárás eredményéről/EU/2011.08.19. EUHL	23752

Notes: 1) the types are listed as they were spelled on the websites of the notices; they were not cleaned from typos. 2) In 71 cases the type of the notice was not indicated.
Source: CRCB

A4. Original wordings from the website of the HPPA

A4.1. Original descriptions / wordings of procedure types of 115 and 113 articles in 2016

Description in Hungarian	Freq.	%
A Kbt. 113. § szerinti meghívásos eljárás	10	.1
A Kbt. 113. § szerinti nyílt eljárás	310	4.5
A Kbt. 113. § szerinti tárgyalásos eljárás	12	.2
A Kbt. 115. § szerinti hirdetmény nélküli tárgyalásos eljárás	192	2.8
A Kbt. 115. § szerinti nyílt eljárás	847	12.3
Eljárást megindító felhívás Közbeszerzési Értesítőben történt közzététele nélkül odaítélt szerződés az alább felsorolt esetekben A Kbt. 113. § szerinti meghívásos eljárás	26	.4
Eljárást megindító felhívás Közbeszerzési Értesítőben történt közzététele nélkül odaítélt szerződés az alább felsorolt esetekben A Kbt. 113. § szerinti nyílt eljárás	1487	21.6
Eljárást megindító felhívás Közbeszerzési Értesítőben történt közzététele nélkül odaítélt szerződés az alább felsorolt esetekben A Kbt. 113. § szerinti tárgyalásos eljárás	87	1.3
Eljárást megindító felhívás Közbeszerzési Értesítőben történt közzététele nélkül odaítélt szerződés az alább felsorolt esetekben A Kbt. 115. § szerinti hirdetmény nélküli tárgyalásos eljárás	446	6.5
Eljárást megindító felhívás Közbeszerzési Értesítőben történt közzététele nélkül odaítélt szerződés az alább felsorolt esetekben A Kbt. 115. § szerinti nyílt eljárás	3459	50.3
Előzetes/időszakos előzetes tájékoztatóval meghirdetett meghívásos eljárás	1	.0
Eljárást megindító felhívás Közbeszerzési Értesítőben történt közzététele nélkül odaítélt szerződés az alább felsorolt esetekben A Kbt. 113. § szerinti nyílt eljárás		
Innovációs partnerség A Kbt. 115. § szerinti hirdetmény nélküli tárgyalásos eljárás	1	.0
Nyílt eljárás A Kbt. 113. § szerinti nyílt eljárás	3	.0
Total	6881	100.0

Source: CRCB

A5. Tables & Figures

A5.1. Transparency Index in EU-funded and non-EU-funded-funded contracts, in 2015 and 2016, N = 38,625

			Transparency Index		
EU funding			0	1	Total
NO		2015	7496	6985	14481
			51.8%	48.2%	100.0%
		2016	7394	6319	13713
			53.9%	46.1%	100.0%
	Total		14890	13304	28194
			52.8%	47.2%	100.0%
YES		2015	6047	2497	8544
			70.8%	29.2%	100.0%
		2016	1521	366	1887
			80.6%	19.4%	100.0%
	Total		7568	2863	10431
			72.6%	27.4%	100.0%
Total		2015	13543	9482	23025
			58.8%	41.2%	100.0%
		2016	8915	6685	15600
			57.1%	42.9%	100.0%
	Total		22458	16167	38625
			58.1%	41.9%	100.0%

Note: data are filtered by goodx
Source: CRCB

A5.2. The number and share the EU-funded and non-EU-funded-funded contracts in total number of contracts, original data, 2009-2016, N = 150,942

		EU funding		
		none	yes	Total
year	2009	11369	4812	16181
		70.3%	29.7%	100.0%
	2010	13310	7795	21105
		63.1%	36.9%	100.0%
	2011	8746	6247	14993
		58.3%	41.7%	100.0%
	2012	9366	5638	15004
		62.4%	37.6%	100.0%
	2013	12521	9394	21915
		57.1%	42.9%	100.0%
	2014	13575	9544	23119
		58.7%	41.3%	100.0%
	2015	14481	8544	23025
		62.9%	37.1%	100.0%
	2016	13713	1887	15600
		87.9%	12.1%	100.0%
Total		97081	53861	150942
		64.3%	35.7%	100.0%

Note: data are filtered by goodx
Source: CRCB

A5.3. The number and share the EU-funded and non-EU-funded-funded contracts in total number of contracts, hypothetical data, 2009-2016, N = 157,322

		EU funding		
		none	yes	Total
year	2009	11369	4812	16181
		70.3%	29.7%	100.0%
	2010	13310	7795	21105
		63.1%	36.9%	100.0%
	2011	8746	6247	14993
		58.3%	41.7%	100.0%
	2012	9366	5638	15004
		62.4%	37.6%	100.0%
	2013	12521	9394	21915
		57.1%	42.9%	100.0%
	2014	13575	9544	23119
		58.7%	41.3%	100.0%
	2015	14481	8544	23025
		62.9%	37.1%	100.0%
	2016	13713	8267	21980
		62.4%	37.6%	100.0%
Total		97081	60241	157322
		61.7%	38.3%	100.0%

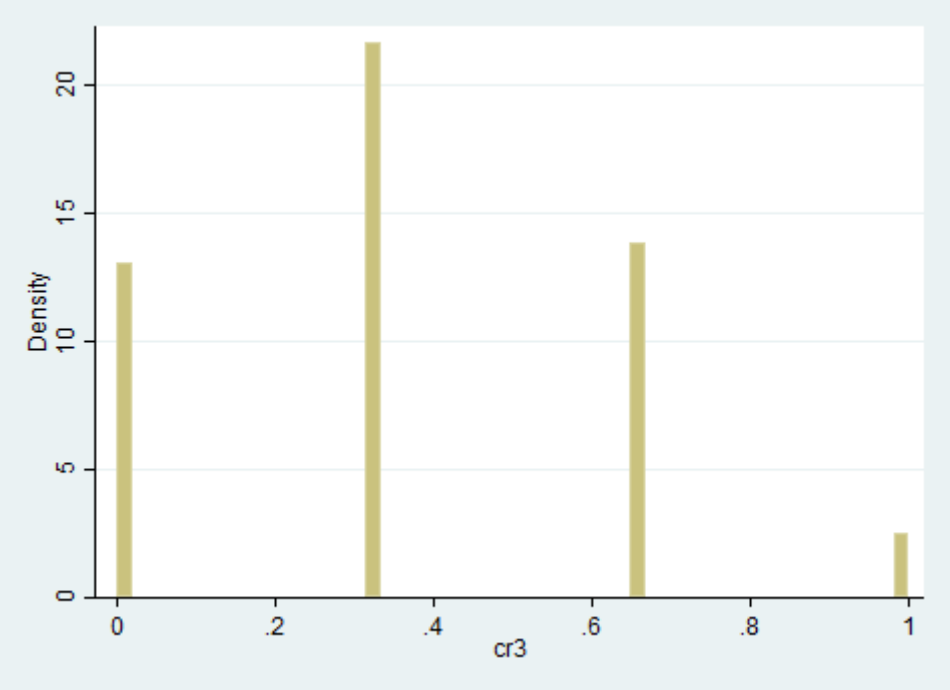
Note: data are filtered by goodsx
Source: CRCB

A5.4. The distribution of Hungarian public procurement by CR2 and by year, 2009-2016, N = 149,950

year	0	0.5	1	Total
2009	10,949	4,296	770	16,015
2010	11,476	7,214	1,817	20,507
2011	5,048	7,391	2,256	14,695
2012	5,529	7,638	1,811	14,978
2013	6,976	12,136	2,795	21,907
2014	6,247	12,656	4,202	23,105
2015	6,182	12,730	4,109	23,021
2016	4,318	9,429	1,975	15,722
Total	56,725	73,490	19,735	149,950

Note: with framework agreements; data are filtered by goodx
Source: CRCB

A5.5. The distribution of Hungarian public procurement by CR3, 2009-2016, N = 146,964



year	0	0.33	0.66	1	Total
2009	6,074	5,978	2,822	613	15,487
2010	8,277	7,501	3,437	796	20,011
2011	3,614	6,135	3,839	821	14,409
2012	3,461	6,137	4,157	640	14,395
2013	4,777	9,091	6,729	1,008	21,605
2014	4,326	9,843	7,396	1,336	22,901
2015	4,087	10,079	7,288	1,350	22,804
2016	2,965	7,560	4,191	636	15,352
Total	37,581	62,324	39,859	7,200	146,964

Note: with framework agreements; data are filtered by goodx
Source: CRCB

A5.6. Estimation of rounded data in contract price (ROUND4) 2009-2016

```
Logistic regression                                     Number of obs   =     133948
                                                        LR chi2(15)     =   19631.06
                                                        Prob > chi2     =     0.0000
Log likelihood = -74926.185                             Pseudo R2       =     0.1158

------------------------------------------------------------------------------
      round4 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         cr2 |   .4219788   .0196359    21.49   0.000     .3834932    .4604645
             |
        year |
        2010 |  -.1513859   .0258699    -5.85   0.000      -.20209   -.1006819
        2011 |  -.0844041   .0280639    -3.01   0.003    -.1394083   -.0293999
        2012 |    .079098   .0277537     2.85   0.004     .0247018    .1334942
        2013 |    .025945   .0251848     1.03   0.303    -.0234164    .0753063
        2014 |  -.1443503   .0252849    -5.71   0.000    -.1939078   -.0947928
        2015 |  -.1050213   .0253957    -4.14   0.000     -.154796   -.0552466
        2016 |   -.206774   .0284347    -7.27   0.000    -.2625051    -.151043
             |
      sector6 |
construction |  -.5180353   .0178318   -29.05   0.000    -.5529849   -.4830857
          it |   1.105789   .0307935    35.91   0.000     1.045435    1.166143
real estat.. |   1.010466    .022088    45.75   0.000     .9671745    1.053758
engeneerin.. |   2.097503    .023759    88.28   0.000     2.050936    2.144069
other serv.. |   .8132044    .018992    42.82   0.000     .7759808     .850428
             |
       lnncv9 |   .1839037   .0036394    50.53   0.000     .1767707    .1910368
           eu |   .1083271   .0135412     8.00   0.000     .0817868    .1348674
        _cons |  -.3885392   .0272866   -14.24   0.000      -.44202   -.3350584
------------------------------------------------------------------------------
```

A5.7. Estimation of rounded data in contract price (ROUND5) 2009-2016

```
Logistic regression                                     Number of obs   =     133948
                                                        LR chi2(15)     =   13696.89
                                                        Prob > chi2     =     0.0000
Log likelihood = -59442.934                             Pseudo R2       =     0.1033

------------------------------------------------------------------------------
      round5 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         cr2 |   .4627551   .0226797    20.40   0.000     .4183036    .5072066
             |
        year |
        2010 |   -.201907   .0292856    -6.89   0.000    -.2593058   -.1445083
        2011 |  -.2374246   .0321374    -7.39   0.000    -.3004127   -.1744365
        2012 |  -.0897918   .0311803    -2.88   0.004    -.1509042   -.0286795
        2013 |  -.1203402   .0281858    -4.27   0.000    -.1755833    -.065097
        2014 |  -.2879377   .0284651   -10.12   0.000    -.3437283   -.2321471
        2015 |  -.2917771    .028696   -10.17   0.000    -.3480201    -.235534
        2016 |  -.3496363   .0323945   -10.79   0.000    -.4131284   -.2861443
             |
      sector6 |
construction |   -.316347   .0216382   -14.62   0.000     -.358757   -.2739369
          it |   .9534422   .0341455    27.92   0.000     .8865184    1.020366
real estat.. |   1.027994   .0257117    39.98   0.000     .9775997    1.078388
engeneerin.. |   1.699284   .0239491    70.95   0.000     1.652345    1.746224
other serv.. |   .7737918   .0228178    33.91   0.000     .7290697    .8185139
             |
       lnncv9 |   .2985614   .0044176    67.59   0.000     .2899031    .3072196
           eu |  -.0440146   .0155483    -2.83   0.005    -.0744888   -.0135405
        _cons |   -.523158   .0309839   -16.88   0.000    -.5838853   -.4624307
------------------------------------------------------------------------------
```

A6. Relative price drop (RPRD)

A6.1. Basic statistics of relative price drop (RPRD) by year, 2009-2016, N = 75,466

year	median	mean	Std. dev.	N
2009	10.11	17.86	21.28	6,456
2010	9.95	17.42	20.88	8,828
2011	5.26	14.51	19.93	7,302
2012	3.26	12.23	18.94	7,055
2013	1.65	10.35	17.91	11,711
2014	1.29	9.58	17.11	12,961
2015	1.69	9.57	16.92	12,674
2016	2.42	11.48	18.52	8,479

A6.2. Effect of corruption risks on relative price drop. Estimation of RPRD by quantile regression model

```
Median regression                                       Number of obs =     72908
  Raw sum of deviations 425087.8 (about 2.9069767)
  Min sum of deviations 394422.2                        Pseudo R2     =    0.0721

------------------------------------------------------------------------------
       rprd2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         cr3 |  -9.366039   .2126431   -44.05   0.000    -9.782819   -8.949259
             |
        year |
        2010 |  -1.034247   .2530525    -4.09   0.000    -1.530229   -.5382647
        2011 |  -3.126821   .2663399   -11.74   0.000    -3.648846   -2.604795
        2012 |  -4.389143    .267749   -16.39   0.000     -4.91393   -3.864356
        2013 |  -5.212727   .2408883   -21.64   0.000    -5.684867   -4.740587
        2014 |  -5.153199   .2368759   -21.75   0.000    -5.617475   -4.688923
        2015 |  -5.089201   .2377932   -21.40   0.000    -5.555275   -4.623127
        2016 |  -5.475698   .2574291   -21.27   0.000    -5.980258   -4.971138
             |
     sector6 |
construction |   -1.47648   .1509602    -9.78   0.000    -1.772361   -1.180598
          it |  -.9086839   .2932105    -3.10   0.002    -1.483376   -.3339922
real estat.. |  -1.613564   .2168776    -7.44   0.000    -2.038644   -1.188485
engeneerin.. |  -.0813688   .2154932    -0.38   0.706    -.5037347    .3409971
other serv.. |   -1.86692   .1811166   -10.31   0.000    -2.221908   -1.511932
             |
        lnncv |  -.8993997   .0335131   -26.84   0.000    -.9650852   -.8337142
           eu |  -1.150592   .1201161    -9.58   0.000    -1.386019   -.9151651
        _cons |   29.38052   .5766919    50.95   0.000     28.25021    30.51084
------------------------------------------------------------------------------
```

A6.3. The effect of intensity of competition on relative price drop. Estimation of RPRD by quantile regression model

```
Median regression                                       Number of obs =     51894
  Raw sum of deviations 332547.8 (about 4.1666665)
  Min sum of deviations 311163.1                        Pseudo R2     =    0.0643

------------------------------------------------------------------------------
       rprd2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         ici |   11.17715   .4105663    27.22   0.000     10.37244    11.98186
             |
        year |
        2010 |    .496697   .3385265     1.47   0.142    -.1668183    1.160212
        2011 |  -4.075973   .3440928   -11.85   0.000    -4.750398   -3.401548
        2012 |  -5.897475   .3466581   -17.01   0.000    -6.576928   -5.218022
        2013 |  -7.313933   .3141634   -23.28   0.000    -7.929696   -6.698169
        2014 |  -7.367205   .3125081   -23.57   0.000    -7.979724   -6.754686
        2015 |  -7.419052   .3122727   -23.76   0.000     -8.03111   -6.806995
        2016 |  -7.975661   .3317248   -24.04   0.000    -8.625845   -7.325477
             |
     sector6 |
construction |  -3.007745   .1970653   -15.26   0.000    -3.393994   -2.621495
          it |  -3.681031   .4008591    -9.18   0.000    -4.466719   -2.895343
real estat.. |  -4.547051   .2776127   -16.38   0.000    -5.091174   -4.002927
engeneerin.. |  -3.037675   .2737738   -11.10   0.000    -3.574274   -2.501075
other serv.. |  -4.174814   .2446025   -17.07   0.000    -4.654238   -3.695391
             |
       lnncv |  -1.035819   .0452063   -22.91   0.000    -1.124424   -.9472141
          eu |   -1.63608   .1581217   -10.35   0.000       -1.946    -1.32616
       _cons |   26.51008   .7879357    33.64   0.000     24.96571    28.05444
------------------------------------------------------------------------------
```

A6.4. The effect of price distortion (rounded price) on relative price drop. Estimation of RPRD by quantile regression model

```
Median regression                                       Number of obs =     73296
  Raw sum of deviations 427267.2 (about 2.9068129)
  Min sum of deviations 405469.1                        Pseudo R2     =    0.0510

------------------------------------------------------------------------------
       rprd2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      round4 |  -2.947832   .1229849   -23.97   0.000    -3.188882   -2.706782
             |
        year |
        2010 |  -.8323249   .2442718    -3.41   0.001    -1.311097    -.353553
        2011 |  -4.396736   .2559973   -17.17   0.000     -4.89849   -3.894982
        2012 |  -5.908742   .2579096   -22.91   0.000    -6.414244   -5.403241
        2013 |  -6.712607   .2316619   -28.98   0.000    -7.166664   -6.258551
        2014 |  -7.162247   .2270991   -31.54   0.000    -7.607361   -6.717134
        2015 |   -7.05222   .2278596   -30.95   0.000    -7.498824   -6.605616
        2016 |  -7.073065   .2478483   -28.54   0.000    -7.558847   -6.587283
             |
     sector6 |
construction |  -1.465708   .1469152    -9.98   0.000    -1.753661   -1.177755
          it |  -.9150877   .2832676    -3.23   0.001    -1.470291   -.3598843
real estat.. |  -1.127455   .2108475    -5.35   0.000    -1.540716   -.7141951
engeneerin.. |   .1532924    .213169     0.72   0.472     -.264518    .5711029
other serv.. |   -1.79786   .1757158   -10.23   0.000    -2.142262   -1.453458
             |
       lnncv |  -.6499105   .0328097   -19.81   0.000    -.7142174   -.5856037
          eu |  -1.508259   .1160014   -13.00   0.000    -1.735621   -1.280897
       _cons |   23.34007   .5577917    41.84   0.000      22.2468    24.43334
------------------------------------------------------------------------------
```

A6.5. Estimation of lack of estimated value (EVAULE_MISS) by corruption risk index – logit model

```
Logistic regression                                     Number of obs   =     133948
                                                        LR chi2(15)     =    7958.03
                                                        Prob > chi2     =     0.0000
Log likelihood = -71850.137                             Pseudo R2       =     0.0525

------------------------------------------------------------------------------
  evalue_miss |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
--------------+---------------------------------------------------------------
          cr3 |  -.6496147    .024751   -26.25   0.000    -.6981259   -.6011036
        lnncv |    -.02944   .0034749    -8.47   0.000    -.0362508   -.0226293
              |
         year |
        2010  |  -.1700568   .0239684    -7.10   0.000     -.217034   -.1230797
        2011  |   -.213913   .0266723    -8.02   0.000    -.2661897   -.1616363
        2012  |  -.2650555   .0269741    -9.83   0.000    -.3179237   -.2121872
        2013  |  -.3581622   .0244554   -14.65   0.000    -.4060938   -.3102306
        2014  |  -.7137517   .0254195   -28.08   0.000     -.763573   -.6639305
        2015  |  -.7795597   .0256828   -30.35   0.000    -.8298971   -.7292224
        2016  |   -1.07994   .0296715   -36.40   0.000    -1.138095   -1.021785
              |
      sector6 |
construction  |  -.6791903   .0175402   -38.72   0.000    -.7135684   -.6448121
          it  |  -.2551128   .0364333    -7.00   0.000    -.3265207   -.1837049
real estat..  |  -.0562547   .0238197    -2.36   0.018    -.1029405   -.0095689
engeneerin..  |  -.3664485   .0253168   -14.47   0.000    -.4160685   -.3168284
other serv..  |  -.4010979   .0210847   -19.02   0.000    -.4424231   -.3597727
              |
           eu |   -.505843   .0146481   -34.53   0.000    -.5345528   -.4771332
        _cons |   .5074209   .0579933     8.75   0.000     .3937561    .6210857
------------------------------------------------------------------------------
```

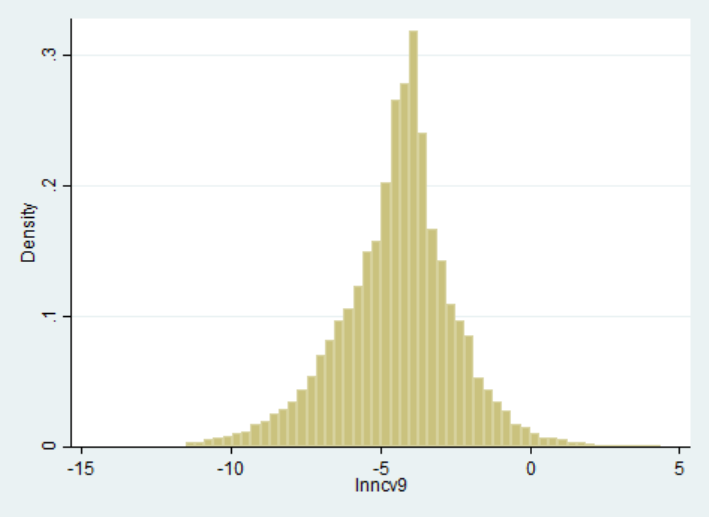
A6.6. Estimation of lack of estimated value (EVAULE_MISS) by intensity of competition – logit model

```
Logistic regression                                     Number of obs   =      93772
                                                        LR chi2(15)     =    5518.76
                                                        Prob > chi2     =     0.0000
Log likelihood = -49736.613                             Pseudo R2       =     0.0526

------------------------------------------------------------------------------
  evalue_miss |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
--------------+---------------------------------------------------------------
          ici |     .58655   .0393486    14.91   0.000     .5094281    .6636719
        lnncv |  -.0444703   .0043231   -10.29   0.000    -.0529435   -.0359972
              |
         year |
         2010 |  -.1130326   .0292311    -3.87   0.000    -.1703246   -.0557406
         2011 |  -.2448271   .0316397    -7.74   0.000    -.3068398   -.1828145
         2012 |  -.2847383   .0321551    -8.86   0.000    -.3477612   -.2217155
         2013 |  -.3995468   .0293287   -13.62   0.000    -.4570301   -.3420635
         2014 |  -.7066417   .0307444   -22.98   0.000    -.7668996   -.6463837
         2015 |  -.8054158   .0311383   -25.87   0.000    -.8664457    -.744386
         2016 |  -1.200756   .0360576   -33.30   0.000    -1.271428   -1.130084
              |
       sector6 |
construction  |   -.715652   .0206764   -34.61   0.000     -.756177    -.675127
          it  |  -.4674676   .0487955    -9.58   0.000     -.563105   -.3718303
real estat..  |  -.1582481   .0284364    -5.56   0.000    -.2139825   -.1025137
engeneerin..  |   -.548683   .0296303   -18.52   0.000    -.6067573   -.4906088
other serv..  |  -.4741498   .0263713   -17.98   0.000    -.5258365   -.4224631
              |
           eu |  -.4954899   .0178909   -27.70   0.000    -.5305553   -.4604244
        _cons |   .2641458   .0740806     3.57   0.000     .1189504    .4093412
------------------------------------------------------------------------------
```

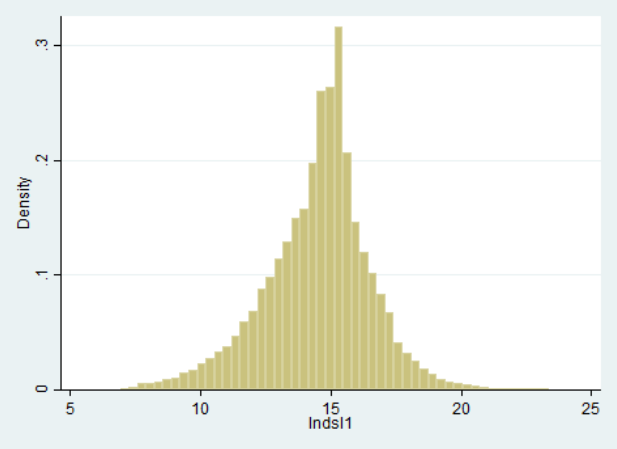
A7. Estimations of Direct Social Loss

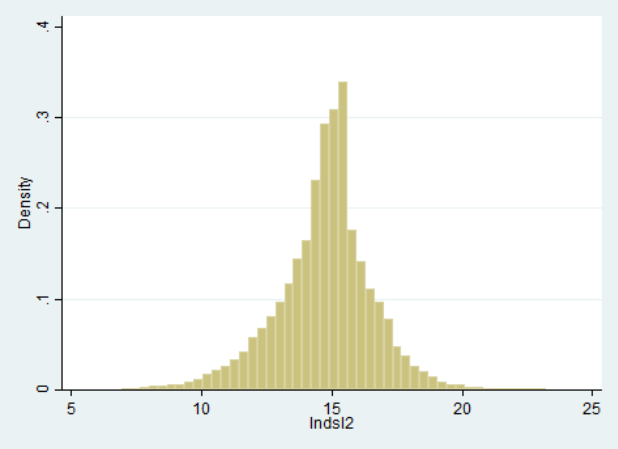
A7.1. Histogram of net contract value in the Hungarian Public Procurement, 2009-2016, N = 138,743

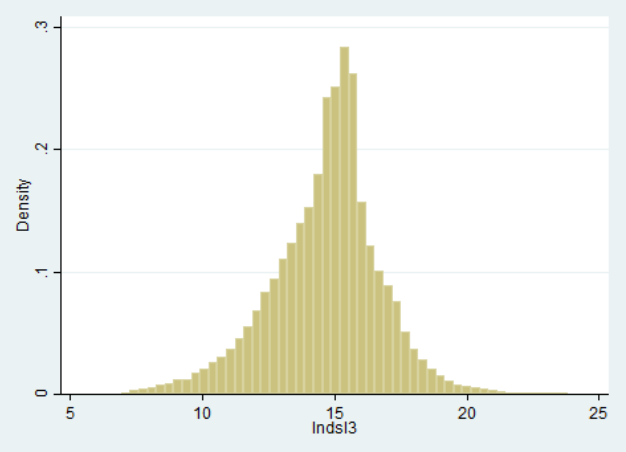


Note: data are filtered by goodsfwc
lnncv9: logarithm of net contract value (Billion HUF)
Source: CRCB

A7.2. Histogram of logarithm of estimated direct social loss (DSL1) due to corruption in the Hungarian Public Procurement, 2009-2016, N = 138,743







Note: data are filtered by goodfwc
lndsl1, lndsl2, lndsl3:
logarithm of estimated direct social loss (Billion HUF)
Source: CRCB

A7.3. Estimation of ERPRD_3

A7.3.a

Robust regression

Number of obs = 60375
F(17, 60357) = 805.64
Prob > F = 0.0000

rprd2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
x2						
1	-3.772724	.1172127	-32.19	0.000	-4.002461	-3.542987
2	-5.322652	.1456191	-36.55	0.000	-5.608066	-5.037238
3	-5.023079	.2641611	-19.02	0.000	-5.540835	-4.505322
year						
2010	-1.792721	.1882646	-9.52	0.000	-2.16172	-1.423721
2011	-3.077047	.1987789	-15.48	0.000	-3.466654	-2.68744
2012	-3.976224	.2021392	-19.67	0.000	-4.372418	-3.580031
2013	-5.129324	.1843947	-27.82	0.000	-5.490738	-4.767909
2014	-5.015647	.1816692	-27.61	0.000	-5.37172	-4.659575
2015	-5.244963	.1816447	-28.87	0.000	-5.600987	-4.888939
2016	-5.636111	.199395	-28.27	0.000	-6.026926	-5.245296
nbid_o2						
2	-.5213184	.1410839	-3.70	0.000	-.7978433	-.2447935
3	-.8295768	.1283219	-6.46	0.000	-1.081088	-.5780654
4	1.728528	.1794757	9.63	0.000	1.376755	2.080301
5	5.075439	.235258	21.57	0.000	4.614332	5.536545
6	7.357466	.2038119	36.10	0.000	6.957994	7.756938
lnncv9	-.9357045	.0240619	-38.89	0.000	-.9828659	-.8885432
eu	-2.358892	.0905426	-26.05	0.000	-2.536356	-2.181428
_cons	12.48599	.2194459	56.90	0.000	12.05588	12.91611

A7.3.b

```
      Source |       SS       df       MS              Number of obs =   60375
-------------+------------------------------           F( 17, 60357) =  687.92
       Model |  3912612.86    17  230153.698           Prob > F      =  0.0000
    Residual |  20193229.3 60357  334.563171           R-squared     =  0.1623
-------------+------------------------------           Adj R-squared =  0.1621
       Total |  24105842.1 60374   399.27522           Root MSE      =  18.291

------------------------------------------------------------------------------
       rprd2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x2 |
           1 |  -5.175405   .2074974   -24.94   0.000      -5.5821   -4.768709
           2 |  -8.650347   .2577841   -33.56   0.000    -9.155605    -8.14509
           3 |  -9.077491   .4676348   -19.41   0.000    -9.994057   -8.160925
             |
        year |
        2010 |  -1.818304    .333278    -5.46   0.000     -2.47153   -1.165078
        2011 |  -3.055477   .3518909    -8.68   0.000    -3.745184   -2.365769
        2012 |  -4.323655   .3578396   -12.08   0.000    -5.025022   -3.622289
        2013 |  -5.765504   .3264271   -17.66   0.000    -6.405303   -5.125706
        2014 |  -5.876738   .3216023   -18.27   0.000    -6.507079   -5.246396
        2015 |  -6.420383   .3215589   -19.97   0.000     -7.05064   -5.790126
        2016 |  -6.820472   .3529817   -19.32   0.000    -7.512317   -6.128626
             |
     nbid_o2 |
           2 |  -.6148626   .2497557    -2.46   0.014    -1.104384   -.1253407
           3 |  -1.680861   .2271635    -7.40   0.000    -2.126102    -1.23562
           4 |   3.447465   .3177192    10.85   0.000     2.824735    4.070196
           5 |   7.248083   .4164686    17.40   0.000     6.431803    8.064363
           6 |    11.5375   .3608008    31.98   0.000     10.83033    12.24467
             |
      lnncv9 |  -2.130572   .0425959   -50.02   0.000     -2.21406   -2.047084
          eu |   -3.78153   .1602842   -23.59   0.000    -4.095688   -3.467373
       _cons |   16.39439    .388477    42.20   0.000     15.63298    17.15581
------------------------------------------------------------------------------
```

Note: data are filtered by goodfwc and rprd2>0
Source: CRCB

A8. Analysis of EU effects on intensity of competition, level of corruption risks, price distortion and rate of estimated direct social loss

A8.1. Estimation of single-bidder (SB)

```
Logistic regression                                     Number of obs   =     133948
                                                        LR chi2(14)     =    3618.84
                                                        Prob > chi2     =     0.0000
Log likelihood = -80007.512                             Pseudo R2       =     0.0221

------------------------------------------------------------------------------
          sb |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          eu |   .1471629    .013076    11.25   0.000     .1215344    .1727914
             |
        year |
        2010 |   .1501959   .0238244     6.30   0.000      .103501    .1968908
        2011 |  -.2529358   .0269765    -9.38   0.000    -.3058087   -.2000629
        2012 |  -.2731001    .027151   -10.06   0.000     -.326315   -.2198852
        2013 |  -.3238867   .0243875   -13.28   0.000    -.3716853   -.2760881
        2014 |  -.0148276   .0235537    -0.63   0.529    -.0609921    .0313369
        2015 |  -.0505424   .0237042    -2.13   0.033    -.0970017   -.0040831
        2016 |  -.2417414   .0268551    -9.00   0.000    -.2943765   -.1891064
             |
      sector6 |
construction |  -.6927486   .0166313   -41.65   0.000    -.7253453   -.6601518
          it |     .30224   .0303704     9.95   0.000     .2427151    .3617649
real estat.. |  -.2948126    .023071   -12.78   0.000    -.3400309   -.2495943
engeneerin.. |  -.4197039   .0233034   -18.01   0.000    -.4653778   -.3740301
other serv.. |    .186951   .0183954    10.16   0.000     .1508968    .2230053
             |
        lnncv |   .0487829   .0033354    14.63   0.000     .0422456    .0553202
        _cons |  -1.381107   .0564083   -24.48   0.000    -1.491666   -1.270549
------------------------------------------------------------------------------
```

A8.2. Estimation of corruption risks (CR2 and CR3)

A8.2.a. Ordered logit regression

Ordered logistic regression — Number of obs = 133948
LR chi2(14) = 13789.83
Prob > chi2 = 0.0000
Log likelihood = -125820.68 — Pseudo R2 = 0.0520

cr2	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
eu	.4588662	.0115627	39.69	0.000	.4362038	.4815286
year						
2010	.0936664	.0223964	4.18	0.000	.0497702	.1375626
2011	.9186824	.0239901	38.29	0.000	.8716627	.9657021
2012	.8588651	.024069	35.68	0.000	.8116907	.9060395
2013	.9700661	.0217902	44.52	0.000	.9273581	1.012774
2014	1.323018	.0218068	60.67	0.000	1.280277	1.365758
2015	1.350671	.0219506	61.53	0.000	1.307648	1.393693
2016	1.256085	.0238652	52.63	0.000	1.20931	1.30286
sector6						
construction	.5003885	.0141618	35.33	0.000	.4726318	.5281451
it	1.198865	.0289085	41.47	0.000	1.142206	1.255525
real estat..	.5309492	.0200989	26.42	0.000	.491556	.5703424
engeneerin..	.3619995	.0203412	17.80	0.000	.3221315	.4018674
other serv..	.5916079	.0173542	34.09	0.000	.5575942	.6256215
lnncv	-.062853	.0029951	-20.98	0.000	-.0687234	-.0569826
/cut1	-.2825054	.0505168			-.3815165	-.1834942
/cut2	2.307847	.0508879			2.208108	2.407585

A8.2.b. Robust regression

Robust regression

Number of obs = 133948
F(14,133933) = 1049.55
Prob > F = 0.0000

cr2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
eu	.0812857	.0019997	40.65	0.000	.0773663	.0852051
year						
2010	.014117	.0037282	3.79	0.000	.0068098	.0214241
2011	.1578851	.0040544	38.94	0.000	.1499385	.1658317
2012	.1473608	.0040936	36.00	0.000	.1393374	.1553842
2013	.1677795	.0036915	45.45	0.000	.1605442	.1750148
2014	.2308817	.0036575	63.13	0.000	.2237131	.2380503
2015	.235433	.0036776	64.02	0.000	.228225	.2426411
2016	.2184779	.0040682	53.70	0.000	.2105044	.2264515
sector6						
construction	.0882933	.0024452	36.11	0.000	.0835007	.0930859
it	.2124934	.0049977	42.52	0.000	.202698	.2222889
real estat..	.0922918	.003517	26.24	0.000	.0853985	.0991851
engeneerin..	.0606325	.0034873	17.39	0.000	.0537974	.0674677
other serv..	.1032178	.0029746	34.70	0.000	.0973876	.109048
lnncv	-.0112146	.0005079	-22.08	0.000	-.0122101	-.0102191
_cons	.3251602	.0085679	37.95	0.000	.3083674	.3419531

A8.2.c. ordered logit

```
Ordered logistic regression                       Number of obs   =     133948
                                                  LR chi2(14)     =   13789.83
                                                  Prob > chi2     =     0.0000
Log likelihood = -125820.68                       Pseudo R2       =     0.0520

------------------------------------------------------------------------------
          cr2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
--------------+---------------------------------------------------------------
           eu |   .4588662   .0115627    39.69   0.000     .4362038    .4815286
              |
         year |
         2010 |   .0936664   .0223964     4.18   0.000     .0497702    .1375626
         2011 |   .9186824   .0239901    38.29   0.000     .8716627    .9657021
         2012 |   .8588651    .024069    35.68   0.000     .8116907    .9060395
         2013 |   .9700661   .0217902    44.52   0.000     .9273581    1.012774
         2014 |   1.323018   .0218068    60.67   0.000     1.280277    1.365758
         2015 |   1.350671   .0219506    61.53   0.000     1.307648    1.393693
         2016 |   1.256085   .0238652    52.63   0.000      1.20931     1.30286
              |
      sector6 |
construction  |   .5003885   .0141618    35.33   0.000     .4726318    .5281451
          it  |   1.198865   .0289085    41.47   0.000     1.142206    1.255525
real estat..  |   .5309492   .0200989    26.42   0.000      .491556    .5703424
engeneerin..  |   .3619995   .0203412    17.80   0.000     .3221315    .4018674
other serv..  |   .5916079   .0173542    34.09   0.000     .5575942    .6256215
              |
        lnncv |   -.062853   .0029951   -20.98   0.000    -.0687234   -.0569826
--------------+---------------------------------------------------------------
        /cut1 |  -.2825054   .0505168                     -.3815165   -.1834942
        /cut2 |   2.307847   .0508879                      2.208108    2.407585
------------------------------------------------------------------------------
```

A8.2.d. robust regression

Robust regression

Number of obs = 133948
F(14,133933) = 1049.55
Prob > F = 0.0000

cr2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
eu	.0812857	.0019997	40.65	0.000	.0773663	.0852051
year						
2010	.014117	.0037282	3.79	0.000	.0068098	.0214241
2011	.1578851	.0040544	38.94	0.000	.1499385	.1658317
2012	.1473608	.0040936	36.00	0.000	.1393374	.1553842
2013	.1677795	.0036915	45.45	0.000	.1605442	.1750148
2014	.2308817	.0036575	63.13	0.000	.2237131	.2380503
2015	.235433	.0036776	64.02	0.000	.228225	.2426411
2016	.2184779	.0040682	53.70	0.000	.2105044	.2264515
sector6						
construction	.0882933	.0024452	36.11	0.000	.0835007	.0930859
it	.2124934	.0049977	42.52	0.000	.202698	.2222889
real estat..	.0922918	.003517	26.24	0.000	.0853985	.0991851
engeneerin..	.0606325	.0034873	17.39	0.000	.0537974	.0674677
other serv..	.1032178	.0029746	34.70	0.000	.0973876	.109048
lnncv	-.0112146	.0005079	-22.08	0.000	-.0122101	-.0102191
_cons	.3251602	.0085679	37.95	0.000	.3083674	.3419531

A8.3. Estimation of price distortion (ROUNDRO and ROUND4)

A8.3.a.

```
Ordered logistic regression                       Number of obs   =      90928
                                                  LR chi2(14)     =    7709.08
                                                  Prob > chi2     =     0.0000
Log likelihood = -117801.77                       Pseudo R2       =     0.0317

------------------------------------------------------------------------------
     roundro |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          eu |   .0544714   .0130959     4.16   0.000     .0288039    .0801389
             |
        year |
        2010 |  -.2767284   .0252905   -10.94   0.000    -.3262969   -.2271599
        2011 |  -.2092807   .0272202    -7.69   0.000    -.2626313   -.1559302
        2012 |  -.0277515   .0271567    -1.02   0.307    -.0809776    .0254745
        2013 |  -.0901849   .0245424    -3.67   0.000     -.138287   -.0420827
        2014 |  -.2296423   .0245512    -9.35   0.000    -.2777618   -.1815229
        2015 |  -.2084161   .0246837    -8.44   0.000    -.2567953   -.1600369
        2016 |  -.2698828   .0272131    -9.92   0.000    -.3232195   -.2165461
             |
      sector6 |
construction |   .1149738     .01844     6.24   0.000      .078832    .1511156
          it |   .7870212   .0288769    27.25   0.000     .7304234    .8436189
real estat.. |   .8701554   .0215391    40.40   0.000     .8279396    .9123713
engeneerin.. |   1.491778   .0205183    72.70   0.000     1.451563    1.531994
other serv.. |   .7251781   .0182159    39.81   0.000     .6894756    .7608807
             |
        lnncv |  -.0175099   .0034065    -5.14   0.000    -.0241865   -.0108332
-------------+----------------------------------------------------------------
        /cut1 |  -1.649412   .0579393                     -1.76297   -1.535853
        /cut2 |  -.3473801   .0576904                    -.4604511   -.2343091
        /cut3 |   1.469788   .0578466                      1.35641    1.583165
------------------------------------------------------------------------------
```

A8.3.b.

```
Logistic regression                                     Number of obs   =     134851
                                                        LR chi2(14)     =   19310.24
                                                        Prob > chi2     =     0.0000
Log likelihood =  -75657.12                             Pseudo R2       =     0.1132

------------------------------------------------------------------------------
       round4 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
--------------+---------------------------------------------------------------
           eu |   .1360649   .0134146    10.14   0.000     .1097728     .162357
              |
         year |
         2010 |  -.1608478    .025516    -6.30   0.000    -.2108582   -.1108375
         2011 |  -.0414752   .0275405    -1.51   0.132    -.0954536    .0125032
         2012 |   .1126644    .027363     4.12   0.000     .0590338    .1662949
         2013 |    .073932   .0247558     2.99   0.003     .0254115    .1224525
         2014 |  -.0726157   .0247241    -2.94   0.003    -.1210741   -.0241573
         2015 |  -.0306231    .024822    -1.23   0.217    -.0792734    .0180271
         2016 |  -.1409953   .0279708    -5.04   0.000     -.195817   -.0861736
              |
      sector6 |
construction  |  -.4782054   .0177028   -27.01   0.000    -.5129021   -.4435086
          it  |   1.191924   .0304734    39.11   0.000     1.132198    1.251651
real estat..  |   1.051208   .0219128    47.97   0.000      1.00826    1.094156
engeneerin..  |   2.118114   .0236485    89.57   0.000     2.071764    2.164465
other serv..  |   .8570709   .0188246    45.53   0.000     .8201753    .8939665
              |
        lnncv |   .1780146   .0035908    49.57   0.000     .1709768    .1850525
        _cons |  -4.012395   .0615856   -65.15   0.000    -4.133101    -3.89169
------------------------------------------------------------------------------
```

A8.4. Estimation of rate of direct social loss (DSLR1 and DSLR2)

A8.4.a.

```
Median regression                                       Number of obs =    134332
  Raw sum of deviations 423529.6 (about 19.32)
  Min sum of deviations 404854.1                        Pseudo R2     =    0.0441

------------------------------------------------------------------------------
       dslr_1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------+---------------------------------------------------------------
           eu |   .8783196   .0656232    13.38   0.000     .7496993     1.00694
              |
         year |
         2010 |   .0816608   .1221623     0.67   0.504    -.1577751    .3210968
         2011 |   2.770347   .1326696    20.88   0.000     2.510317    3.030377
         2012 |   3.019033   .1342007    22.50   0.000     2.756002    3.282064
         2013 |   3.339165   .1210414    27.59   0.000     3.101926    3.576404
         2014 |   3.538494   .1199322    29.50   0.000      3.30343    3.773559
         2015 |   3.506167   .1205932    29.07   0.000     3.269806    3.742527
         2016 |   3.511943   .1334352    26.32   0.000     3.250412    3.773473
              |
      sector6 |
construction |   1.567629   .0802537    19.53   0.000     1.410333    1.724924
          it |   2.624178   .1640792    15.99   0.000     2.302585     2.94577
real estat.. |   2.516181   .1153593    21.81   0.000     2.290079    2.742283
engeneerin.. |   2.495124   .1144839    21.79   0.000     2.270737     2.71951
other serv.. |   2.615643   .0976391    26.79   0.000     2.424273    2.807014
              |
        lnncv |   .2616699   .0166733    15.69   0.000     .2289906    .2943493
        _cons |   10.01506   .2813233    35.60   0.000     9.463676    10.56645
------------------------------------------------------------------------------
```

A8.4.b.

Median regression — Number of obs = 73296
Raw sum of deviations 272914.8 (about 17.84)
Min sum of deviations 249599 — Pseudo R2 = 0.0854

dslr_2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
eu	1.523589	.1108234	13.75	0.000	1.306376	1.740803
year						
2010	.6002965	.2333061	2.57	0.010	.1430173	1.057576
2011	7.56014	.2445743	30.91	0.000	7.080775	8.039505
2012	9.566031	.2464262	38.82	0.000	9.083036	10.04903
2013	7.574057	.2213473	34.22	0.000	7.140217	8.007897
2014	8.512506	.2169511	39.24	0.000	8.087282	8.937729
2015	5.889221	.2177	27.05	0.000	5.462529	6.315912
2016	3.395706	.2367659	14.34	0.000	2.931646	3.859766
sector6						
construction	1.254229	.1398146	8.97	0.000	.9801932	1.528265
it	2.215403	.2688041	8.24	0.000	1.688548	2.742258
real estat..	2.575016	.1983841	12.98	0.000	2.186184	2.963848
engeneerin..	1.317946	.1962058	6.72	0.000	.9333829	1.702508
other serv..	2.77264	.1661236	16.69	0.000	2.447038	3.098241
lnncv	.7261318	.0310408	23.39	0.000	.6652919	.7869718
_cons	-2.058164	.5318204	-3.87	0.000	-3.10053	-1.015798

A8.5. Estimation of compliance with administrative rules (EVALUE_MISS)

```
Logistic regression                                     Number of obs   =     134851
                                                        LR chi2(14)     =    7360.83
                                                        Prob > chi2     =     0.0000
Log likelihood = -72745.281                             Pseudo R2       =     0.0482

------------------------------------------------------------------------------
  evalue_miss |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
--------------+---------------------------------------------------------------
           eu |  -.5404469   .0144739   -37.34   0.000    -.5688153   -.5120784
              |
         year |
         2010 |  -.1601771   .0236978    -6.76   0.000     -.206624   -.1137303
         2011 |  -.2768684   .0263026   -10.53   0.000    -.3284206   -.2253162
         2012 |   -.319362   .0266366   -11.99   0.000    -.3715687   -.2671553
         2013 |  -.4191874   .0241344   -17.37   0.000    -.4664899   -.3718849
         2014 |  -.7911675   .0250497   -31.58   0.000    -.8402639    -.742071
         2015 |  -.8640651   .0253082   -34.14   0.000    -.9136682   -.8144619
         2016 |  -1.153162   .0293814   -39.25   0.000    -1.210748   -1.095575
              |
      sector6 |
construction  |  -.6992774   .0174006   -40.19   0.000     -.733382   -.6651728
          it  |   -.408283   .0358612   -11.39   0.000    -.4785696   -.3379964
real estat..  |    -.14826   .0234104    -6.33   0.000    -.1941436   -.1023764
engeneerin..  |  -.5018863   .0247388   -20.29   0.000    -.5503735    -.453399
other serv..  |  -.4843935   .0207702   -23.32   0.000    -.5251023   -.4436846
              |
        lnncv |  -.0345911   .0034668    -9.98   0.000     -.041386   -.0277963
        _cons |   .4649334   .0579015     8.03   0.000     .3514486    .5784182
------------------------------------------------------------------------------
```

A9. Definition of open procedures

We defined the procedures as open procedure, if in the type of procedure section[60] of the contract award notice the issuer indicated 'open'[61] or 'open procedure'[62]. If the issuers indicated more than one type, but one of them was 'open' or 'open procedure' we considered these procedures as open ones. Table A7.1. presents the types of procedures (represented by the character strings found in the aforementioned field of the notices) that were classified as open procedure based on the aforementioned conditions.

Table A9.1. Definition of open procedure, 2009-2016, N = 50,961

Type of procedure in Hungarian	Type of procedure translated to English	Frequency	Percent
A Kbt. 123. §-a szerinti, szabadon kialakított eljárás Nyílt	Deliberate procedure based on the 123rd § of the Act on Public Procurement, Open	12	.0
Nyílt	Open	48647	95.2
Nyílt eljárás	Open procedure	2219	4.3
Nyílt eljárás A Kbt. 113. § szerinti nyílt eljárás	Open procedure, Open procedure based on the 113rd § of the Act on Public Procurement	3	.0
Nyílt eljárás Gyorsított eljárás	Open procedure, Accelerated procedure	106	.2
Nyílt Hirdetménnyel induló, tárgyalás nélküli	Open, Starting with announcement, without negotiation	36	.1
Nyílt Hirdetmény közzétételével induló tárgyalásos	Open, Starting with publishing the announcement, with negotiation	8	.0
Nyílt Hirdetmény közzétételével induló tárgyalásos Ajánlati/részvételi felhívásnak az Európai Unió Hivatalos Lapjában történő közzététele nélkül megvalósított beszerzés	Open, Starting with publishing the announcement, with negotiation, Call for tenders is not published in the Official Journal of the European Union	1	.0
Nyílt Hirdetmény nélküli tárgyalásos	Open, without announcement, with negotiation	5	.0
Nyílt Keretmegállapodásos	Open, With framework agreement	26	.1
Nyílt Nyílt	Open, Open	5	.0
Nyílt Tárgyalásos	Open, With negotiation	11	.0
Total		51079	100.0

Source: CRCB

U

[60] 'Eljárás eredménye' in Hungarian.
[61] 'Nyílt' in Hungarian.
[62] 'Nyílt eljárás' in Hungarian.