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Competitive Intensity and Corruption Risks in the Hungarian Public Procurement 2009-2015

Main Findings & Descriptive Statistics

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„When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind...”

Lord Kelvin

Contents

Abstract

This short report examines data from Hungarian public procurement between 2009-2015. The data from 127,776 contracts and 135,300 awardees were used for the analysis. The data were downloaded from the website of the Hungarian Public Procurement Authority (http://www.kozbeszerzes.hu/). The Public Procurement Bulletin available online interface was used for data collection, and after data clarification procedures, the data were structured into a database. The data of analysed public tenders are downloadable from the website managed by CRCB (http://tendertracking.eu/).

The paper basically uses descriptive statistics and it reviews aspects of the contracts awarded in Hungary between the years of 2009-2015. The analysis primarily focuses on information regarding the competitive intensity, price distortion, and corruption risks. Based on these data we examine the trends of the public procurement procedures in different groups (type of procedure, EU funding and non EU funding, the size of contract value, market type, industrial differences). We also deal with the appearance of crony capitalism in Hungarian public procurement procedures. Price distortion was analysed using the Benford's Law.

The results show that between 2009-2015 the Hungarian public procurement are characterised by a reduction in competition, and increase in the number of procurements without competition, reduced transparency, and rising tendency toward price distortion and corruption risks.

The EU funded procurements have worse performance in case of corruption risks, competitive intensity, and transparency, compared with Hungarian-funded ones. The former ones are characterised by weaker competition, lower transparency, a higher level of price distortion, and higher corruption risks. The result points out the effects of crony capitalism on weakening competition and increasing price distortion, especially in EU funded public procurement.

According to our results in Hungary, the EU funds – besides their positive influence on the development of the Hungarian economy – have a special and perverse effect: they foster the practice of political favouritism and fuel crony capitalism.

Introduction

This brief report examines the competition intensity, the corruption risks and the price distortion of public procurement contracts in Hungary using the available data between 2009 and 2015. The data pertaining to 127,776 contracts and those of 135,300 awardees downloaded from the website of the Hungarian Public Procurement Authority and from the online version of the Public Procurement Bulletin were used for the analysis[1]. These data were cleansed and then structured into a statistical database[2]. Most significant data are available on and downloadable from our database, a continuously updated application started by CRCB on December 8th 2014 http://tendertracking.eu/ [3]

The database [4] allows us to statistically analyse the Hungarian public procurement data, on the one hand, to learn when, how much, on what, and how the Hungarian state institutions spent money. On the other hand, it also allows us to monitor and study the impacts of the changes in public procurement regulations on those concerned in public procurement, the patterns of public money spending, the existence of competition, procurement prices, and the nature of corruption frequently accompanying public procurement. Furthermore, a special focus is given to how these phenomena have changed during the years.

All these researches serve the interests of the European – among them the Hungarian – citizens.

The report surveys public procurements for the period of 2009 – 2015 by using descriptive statistics, and by certain points of emphasis demonstrated in 43 figures and 6 tables. Primarily, we focus on information pertaining to competition intensity and corruption risks, and we provide correlations based on our database.

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. But it is also true that conditions favourable for corruption and the existence of these do not necessarily indicate corruption. It is possible that these conditions are either 'accidentally' present, or that these conditions appear without any intention for corruption. It may also happen that after creating these conditions the corrupt actor does not make use of them, and in the end backs out of corruption. This latter form is an atypical result that contradicts the original corrupt plans of the actor, and could be extremely rare.

The most significant hurdle in achieving our planned goals is the quality of the data provided by the Hungarian government. The Hungarian public procurement data, and the setup procedures of the public procurement database administered by the Hungarian government, reveal fundamental errors, and above all, they have some minor or major deficiencies, some of which cannot be remedied[5]. While sorting and cleansing the data, it became evident that a significant part of the data of about 180,000 contracts of the Hungarian public procurement from 1997 can no longer be found or fixed. While sorting and cleansing the data, it became evident that a significant part of the data pertaining to 180,000 contracts of the Hungarian public procurement from 1997 is missing or incompatible. Consequentially, that part of the original database was unusable[6]. The database we use for our statistical analysis is the result of our data cleaning and data reconstruction activity. We have a database with fewer errors and inconsistencies than the database of the Public Procurement Authority with its partially organised data.

This report is meant to be the first step of an analysis of relationships amongst competition intensity, corruption risks, and price distortion over time.

In the following, the most significant results will be given, and then figures related to the findings will be presented.

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[5]   We have already drawn attention to these issues, and we have also analysed the roots of these errors in several reports. See in Hungarian 1, 2, 3, 4, 5, 6, and via volunteer work we have also made proposals how to fix and improve the setup procedures that create the public procurement database 7.

[6]   The more problems we faced during data cleansing (a part of which we managed to solve), the more problems this phenomenon generated at the next step of our study. We did not succeed in finding any solution to these problems because of the lack of data or because of data inconsistency. (See the Annex 2.)

1. Main Findings

1. The analysis of 127,776 Hungarian public procurement contracts demonstrate that between 2009 and 2014 the competition intensity of public procurement significantly decreased (F2.2.1., F2.2.2.). This tendency seems to stagnate in 2015.

2. The level of transparency of the Hungarian public procurement deteriorated during the years examined (F2.3.1., F2.3.2.). As a result of the modification of the public procurement law in 2010, from 2011 onward there were fewer announcements before public procurements than earlier.

3. The rate of successful public procurements without competition (with one bidder only) was above 30% between 2009-2010; later that rate declined (26-27%), and in 2014-2015 it started to increase again (31-32%) (F2.4.1., F2.4.2.).

4. The lack of competition was highly represented in public procurements targeting *IT services and products* among product markets between 2009-2010. 64-68% of these won without any competition with just one bidder in the tender. Among the product markets the level of transparency was the lowest in IT tenders during these two years (F2.4.3.).

5. The corruption risk index defined by the level of transparency and single bidders indicate that the Hungarian public procurement for the period of 2009-2014 was wholly characterized by raising tendency of corruption risk. This tendency stopped in 2015, when some improvement can be observed (F2.5.1. F2.5.2.).

6. We analysed the price distortion in the Hungarian public procurement by the distribution of the first digit in the contract prices based on Benford's law.

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[7]. The distribution of first digits in the decimal system (1,..,9) according to Benford's law is in Table 1.1.

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[7]   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: $P(d) = \log_{10}(d+1) - \log_{10}(d) = \log_{10}(1 + 1/d)$. See https://en.wikipedia.org/wiki/Benford%27s_law

Table 1.1. The distribution of first digit according to the Benford's law in the decimal system

First digit	%
1	30.1
2	17.6
3	12.5
4	9.7
5	7.9
6	6.7
7	5.8
8	5.1
9	4.6

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[8]. 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[9]. Ever since, Benford's Law has been common and it is a widely used method in several areas of social research for fraud detection[10].

For the analysis of irregularities in public procurement, we can use the information on procurement prices because these are public (a); and as such these may carry information on the process of price formation (b). Our research questions related to the price formation are the followings: whether the price formation differs significantly amongst different group of public procurement created by competitive intensity (i), the level of transparency (ii); the risks of corruption (iii), and the existence of political relations of the bidders (iv).

We examine these relationships with comparison of observed first digit's distribution to theoretical (Benford's) distribution of contact prices of tenders in

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[8]   See Varian, H. R (1972): Benford's law, The American Statistician, 26. Vol. no.3. pp. 65–66.
[9]   See 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; 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; see also 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
[10]   See Nigrini, M. J. (ed.) (2012): Benford's Law. Applications for Forensic Accounting, Auditing, and Fraud Detection, John Wiley & Sons, Hobonken, New Jersey, USA and S. J. Miller (ed.) (2015): Benford's Law: Theory and Applications, Princeton University Press, Princeton & Oxford, New Jersey, USA.

several analysed groups of the Hungarian public procurement.

7. The analysis of first digits indicates that the contract prices of all Hungarian public procurement fits into the theoretical distribution for the whole period (2009-15) (F2.6.1 and T2.6.1).

8. There are crucial differences in price distortion among the contract prices in each year. Price distortion was increasing throughout the whole period; while in 2009 and 2010 contract prices fitted well into the theoretical distribution, after those years the ratio of price distortion got more and more significant (F2.6.2., F2.6.3.). Our assumption is that this phenomenon indicates the frequency and the growing tendency of overpricing, which also signifies the weakening of competition and the increasing corruption risks.

9. Our results points out that the strength of price distortion decreases as competition intensity becomes more significant (F2.6.7.). The prices of public procurement are remarkably distorted when there is no competition and the level of transparency is low compared to those successful tenders with competition and transparency (F2.6.6., F2.6.8.). Our results indicate that the strength of price distortion increases significantly with the increase of corruption risk (F2.6.9.).

10. The transparency of public procurement projects funded by the EU deteriorated even more during the period, and after 2011 the level of transparency was much lower than the level of transparency in public procurement financed domestically (F2.3.5).

11. In 2009-2011 the rate of public procurements without competition was higher among EU projects, in 2012-2013 this rate got lower and in 2014-2015 the rate did not significantly differ from the rate of domestic projects. For the whole period there was no competition in 31% of the public procurements funded by the EU (F2.4.5.).

12. Except for 2009 the level of corruption risk was continuously higher in public procurements funded by the EU than those financed domestically (F2.5.5.).

13. Between the years 2009 and 2014 the pace of corruption risks accelerated in EU funded projects compared to domestically financed ones (F2.5.5.).

14. We assume that in 2015 the decrease in corruption risks could be attributed to the tendency change in purely EU funded projects.

15. Throughout the period, the price distortion of projects funded by the EU was stronger than that of the non-EU projects (F2.6.5.).

16. While the prices of projects financed domestically loosely fit into the theoretically expected distribution, those financed by the EU do not fit at all. Therefore, the phenomenon of overpricing could be much more frequent or it could have a much wider scale in EU funded public procurements than in case of other public procurements (T2.6.1.).

17. All of the findings suggest that in Hungary between 2009-2015 public

procurements financed with EU funds compared to non-EU financed ones were delivered at a higher corruption level (F2.5.5.).

18. It can be observed how the way the EU funds were spent in Hungary had anegative impact on the Hungarian economy in three fields in the period of 2009-2015. Public procurements financed by the EU

> (i) increased the corruption risks of public procurement;

> (ii) they decreased competition intensity;

> (iii) they enhanced the rate of overpricing within the Hungarian public procurement.

22. Therefore, based on our results of the analysis of public procurement tenders in the period 2009-2019 we should reject our initial hypothesis about the lack of political favouritism in the Hungarian public procurement.

23. We detected some negative characteristics of public procurement financed by the EU (high probability of lack of competition, less competitive intensity, less transparency and consequently higher corruption risks, and finally greater level of price distortion); we also discovered that the crony companies liked to get involved in and win public procurement financed by the EU; and the public procurement won by companies with political connections can be described with similar characteristics, such as the EU financed ones.

These results indicate a very special scenario: the practice of spending of the EU funds by public procurement in Hungary has probably a positive effect, i.e. it helps the convergence of the Hungarian economy with the EU countries, but - as a perverse effect – it results in the emergence and reinforcement of the economic model of crony capitalism as well.

2. Tables & Figures

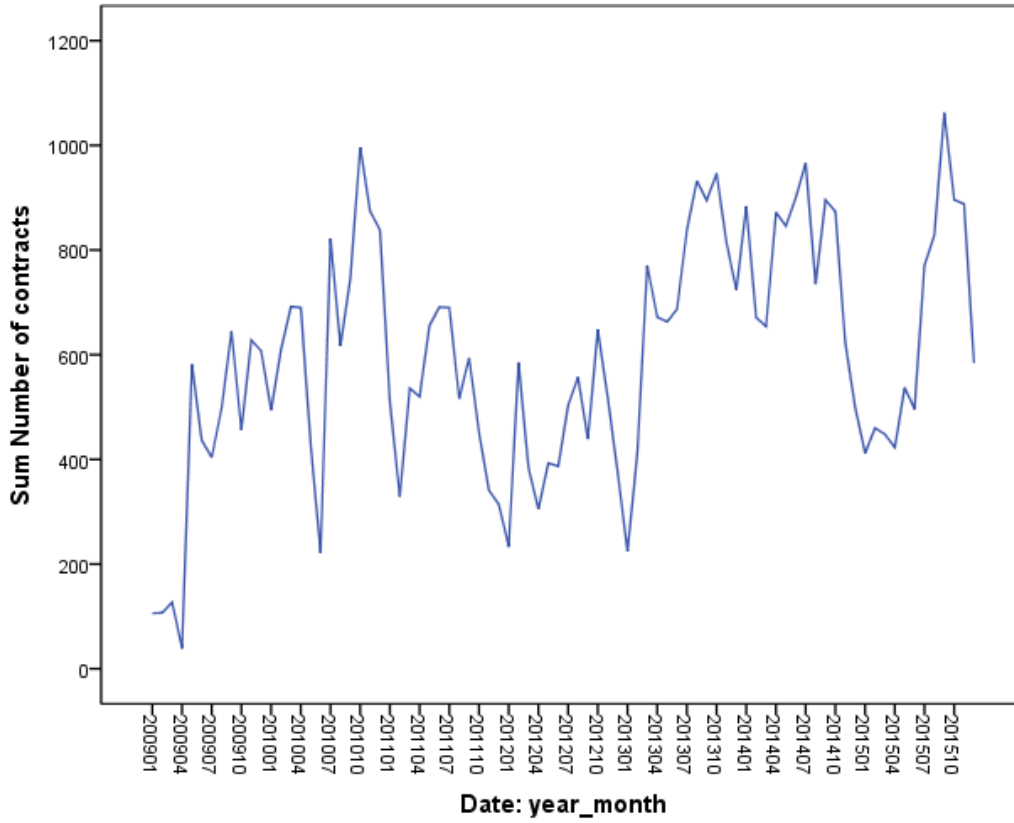## *2.1. Hungarian Public Procurement 2009-2015 – main statistics*

Figure 2.1.1.: Number of public procurement announcements in Hungary 2009-2015, N = 127,776
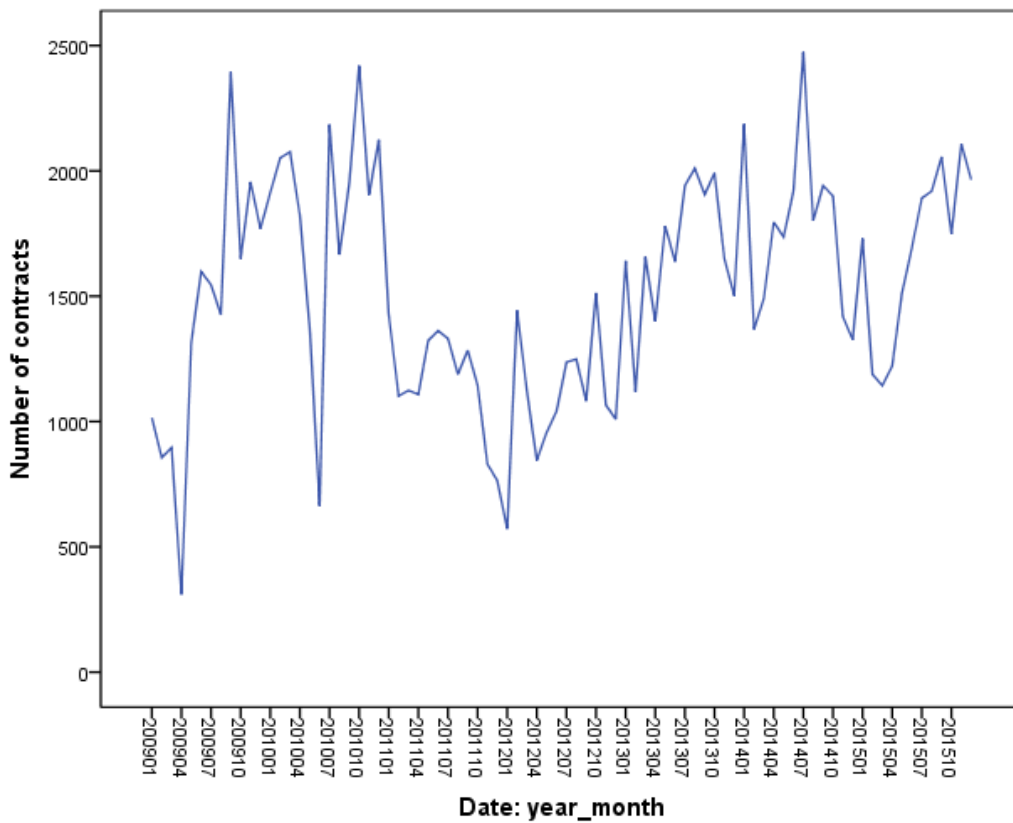
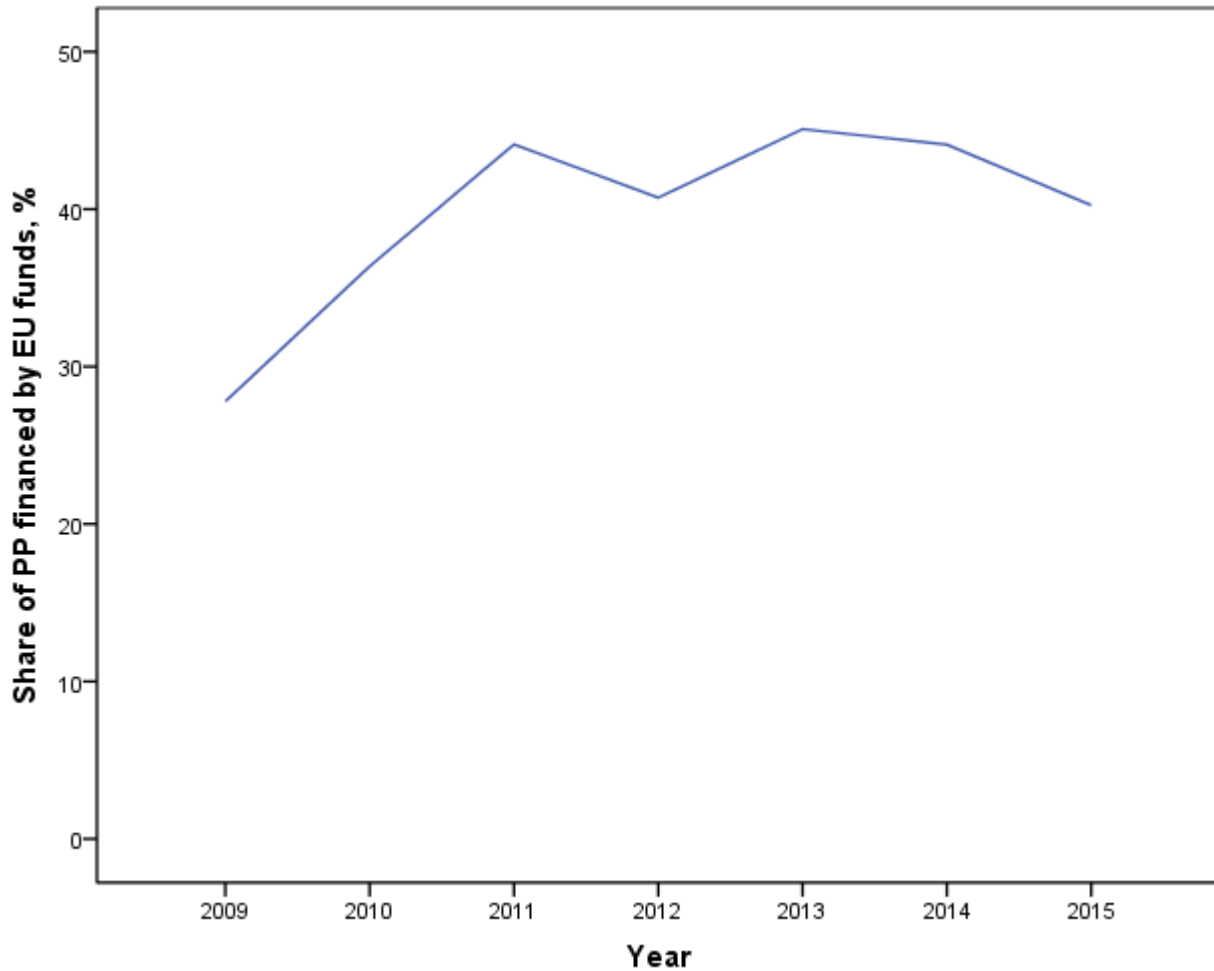*Note: data are filtered by goodc15*
Source: CRCB

Figure 2.1.2.: Number of public procurement announcements in Hungary financed by the EU, 2009-2015, N = 49,946
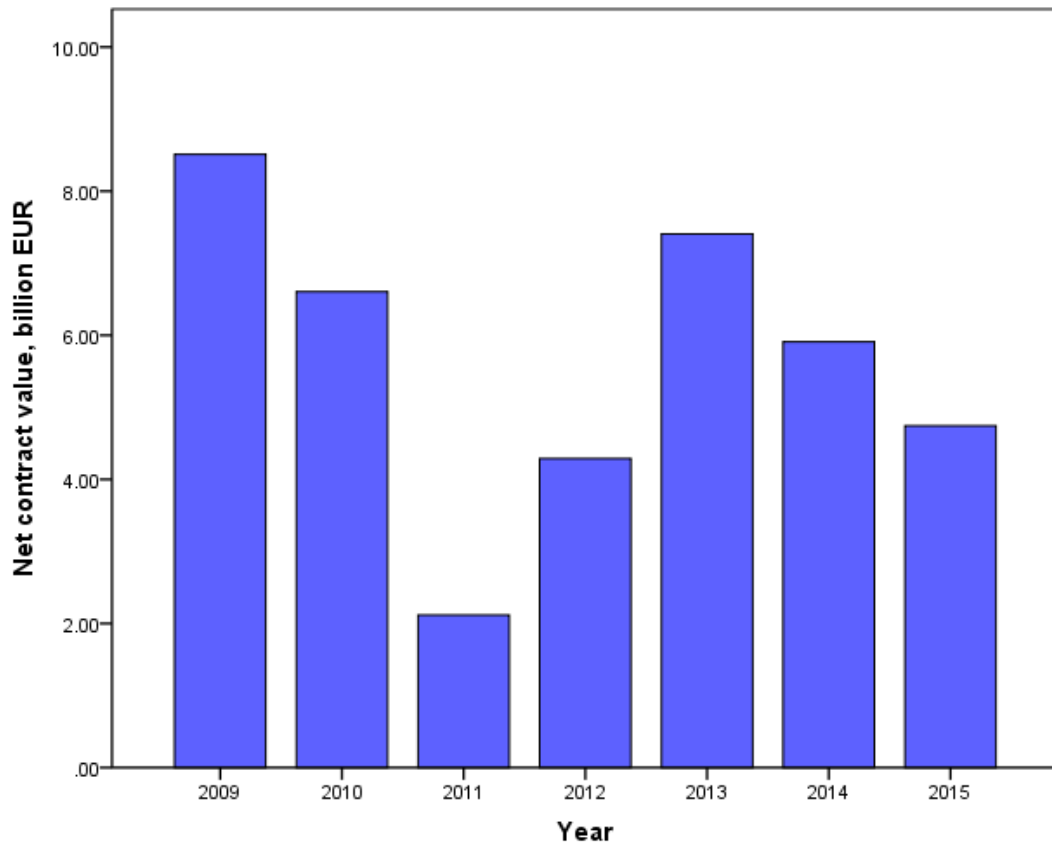

Note: data are filtered by goodc15
Source: CRCB

Figure 2.1.3.: Share of EU financed public procurement tenders in total Hungarian public procurement tenders, %, 2009-2015, N = 125,555

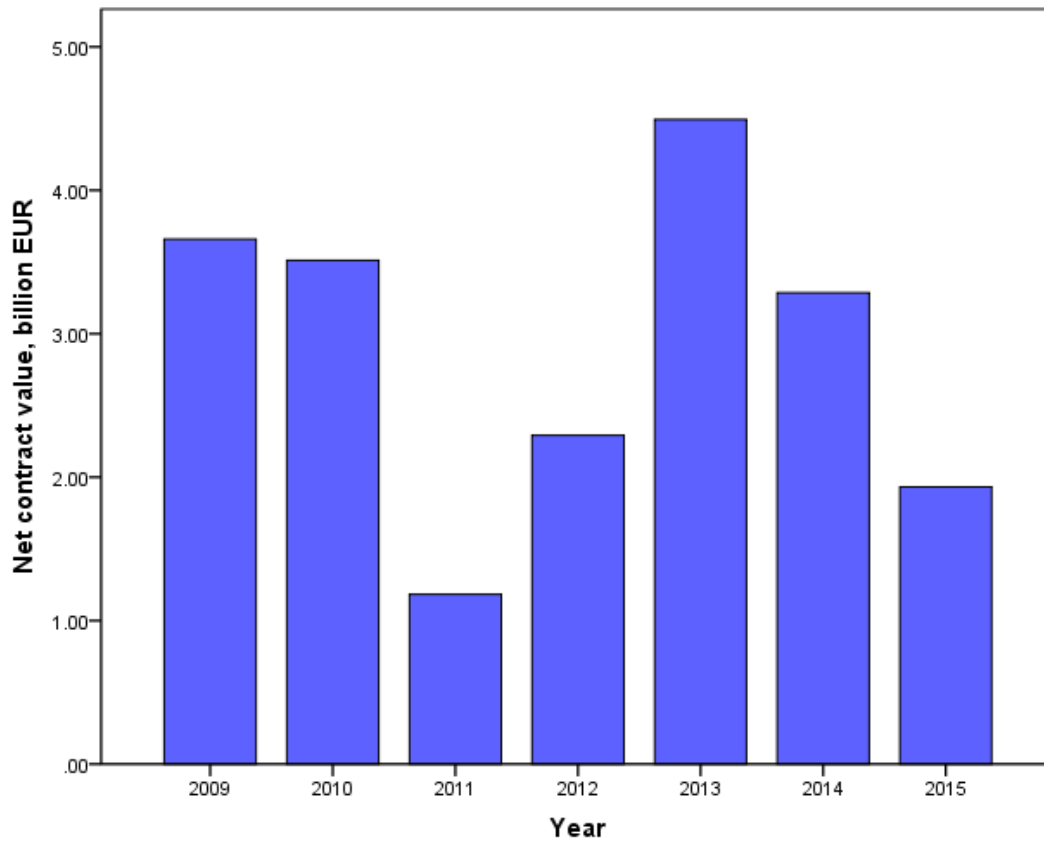Note: data are filtered by goodc15
Source: CRCB

Figure 2.1.4.: Net contract value of Hungarian public procurement by year, in billion EUR, 2009-2015, N = 123,224

Note: data are filtered by goodc15; we excluded the contracts with unit prices and framework agreements
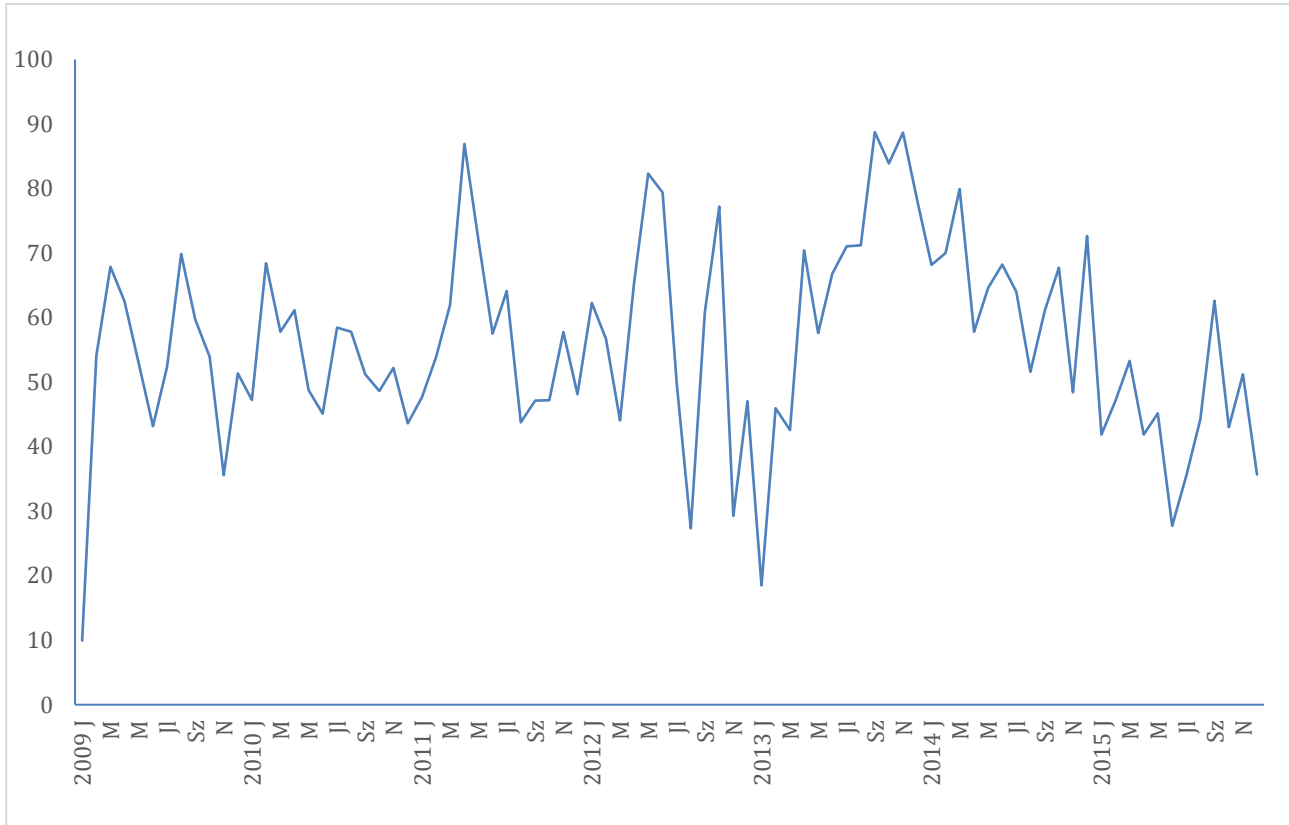*Source: CRCB*

Figure 2.1.5.: Net contact value of Hungarian public procurement financed by EU, in billion EUR, 2009-2015, N = 49,946

Note: data are filtered by goodc15; we excluded the contracts with unit prices and framework agreements
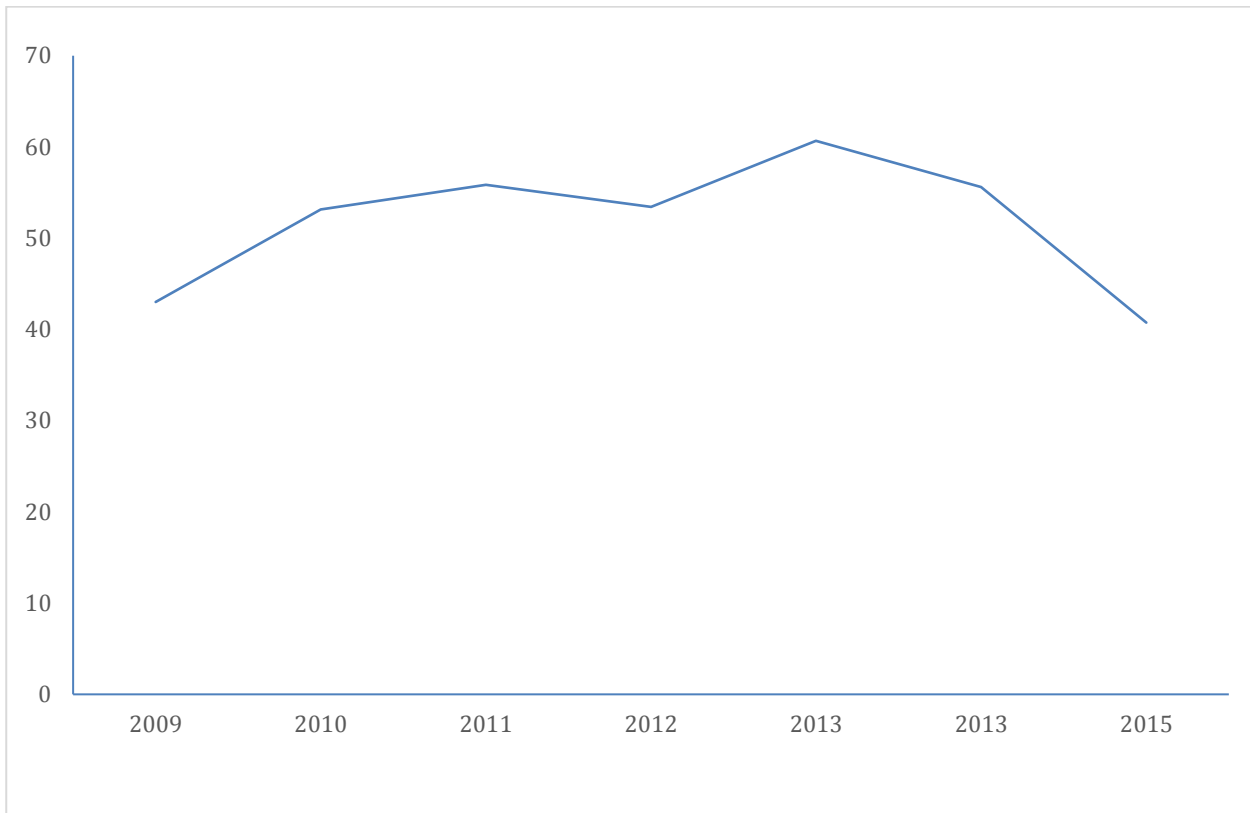*Source: CRCB*

Figure: 2.1.6.: Share of net contract value of PP financed by the EU in total contract value, %, monthly data, 2009-2015, N=123,224

Note: data are filtered by goodc15; we excluded the contracts with unit prices and framework agreements
Source: CRCB

Figure 2.1.7.: Share of net contract value of public procurement financed by the EU in total contract value by year, %, 2009-2015, N=123,224

Note: data are filtered by goodc15; we excluded the contracts with unit prices and framework agreements
Source: CRCB

Table 2.1.1a.: Hungarian Public Procurement, 2009-2015, summary statistics

Groups of contracts	2009	2010	2011	2012	2013	2014	2015	Total
Number of record in the entire dataset	23442	31124	18668	19156	27620	29357	29143	178510
Total number of winners (goodw15=1)	17486	22919	14472	14017	21866	22895	21645	135300
Total number of contracts (goodc15=1)	16733	22145	13989	13134	20235	21360	20180	127776
Number of contacts with high transparency (goodc15=1 & TI=1)	13708	17899	6130	6114	8809	7974	7434	68069
Number of contracts financed by EU (goodc15=1 & eufund =1)	4635	8028	6149	5330	8578	9420	7806	49946
Number of contract in construction (goodc15=1)	4157	6144	4504	3310	4789	6125	5265	34294
Number of framework agreement (frwaggr=1)	3145	3647	1855	2556	2876	3335	4547	21961
Number of contracts with unit price (uprice=1)	120	183	165	296	256	209	188	1417
Number of contracts won by companies in countryside (goodc15=1)	8632	14235	9256	7770	11677	12757	11216	75543
Number of contract with single bidder (goodc15=1 & sb = 1)	5194	7197	3652	3470	5203	6770	6287	37773

Source: CRCB

Table 2.1.1b.: Hungarian Public Procurement 2009-2015, summary statistics

|	2009	2010	2011	2012	2013	2014	2015	Total
Total net contract value (net, bill. EUR, (goodc15=1)	2638	2048	657	1330	2296	1832	1470	12271
Total net contract value with transparent procedures, (bill. EUR, goodc15=1)	2286	1690	465	997	1909	1402	954	9703
Total net contract value in pp financed by EU (bill. EUR, goodc15=1)	1134	1089	367	711	1393	1018	599	6311
Total net contract value in construction (bill. EUR, goodc15=1)	1278	1065	368	660	1330	967	671	6338
Total net contact vale in procedures with single bidder (net, bill. EUR, goodc15=1)	1003	645	174	473	711	634	482	4122

Source: CRCB

2.2. The Index of Competitive Intensity (ICI)

Figure 2.2.1.: The Index of Competitive Intensity in Hungarian public procurement, monthly data, 2009-2015, N = 88,254
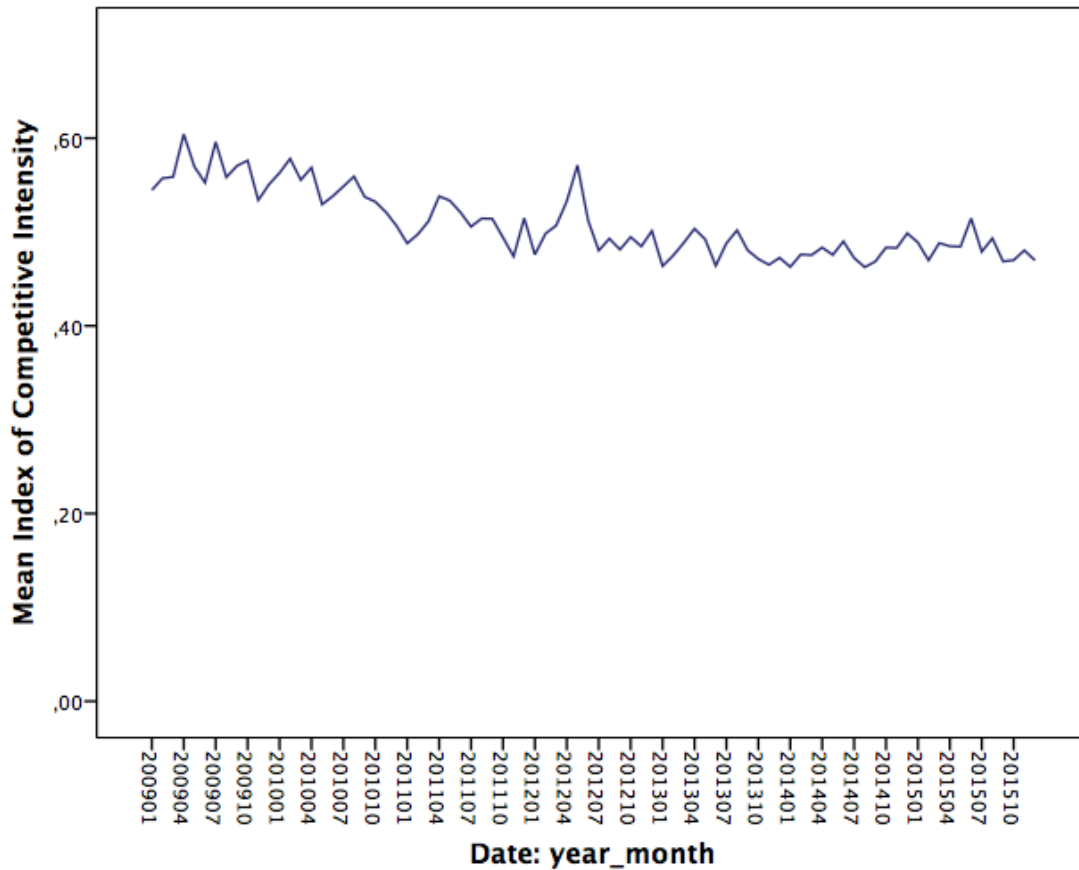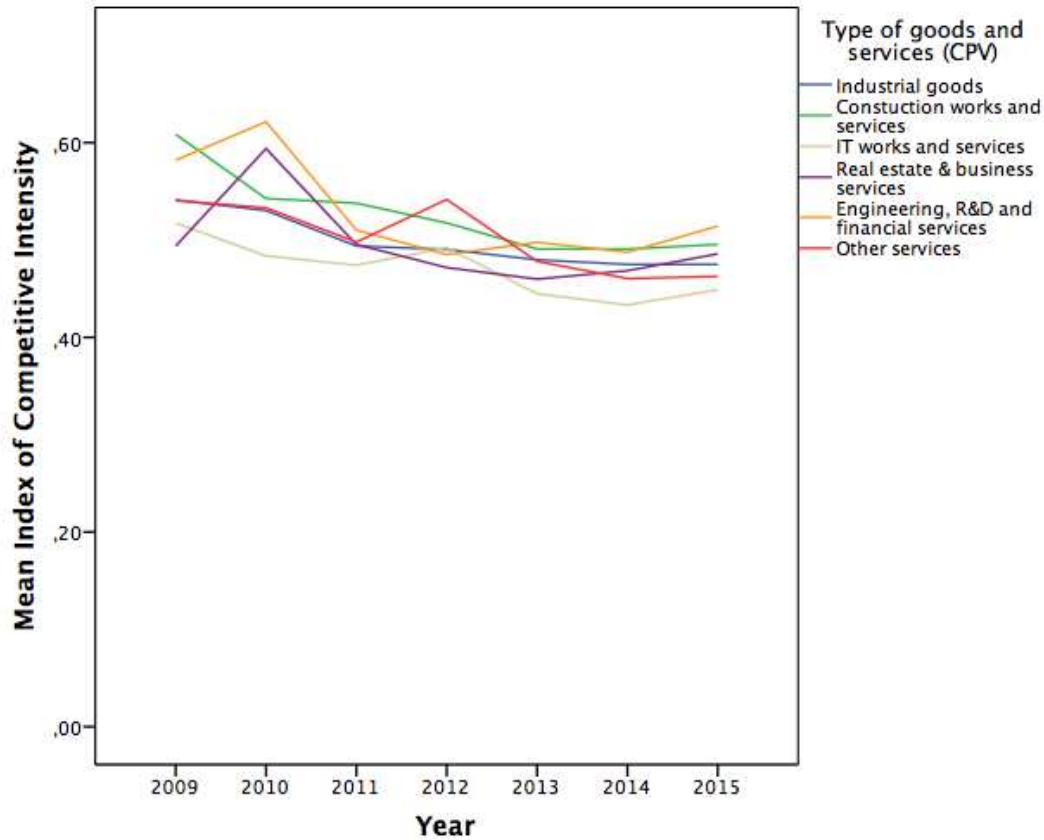

Note: data are filtered by goodc15;
Source: CRCB

Figure 2.2.2.: The Index of Competitive Intensity (ICI) in the Hungarian public procurement, 2009-2015, yearly data, N = 88,254

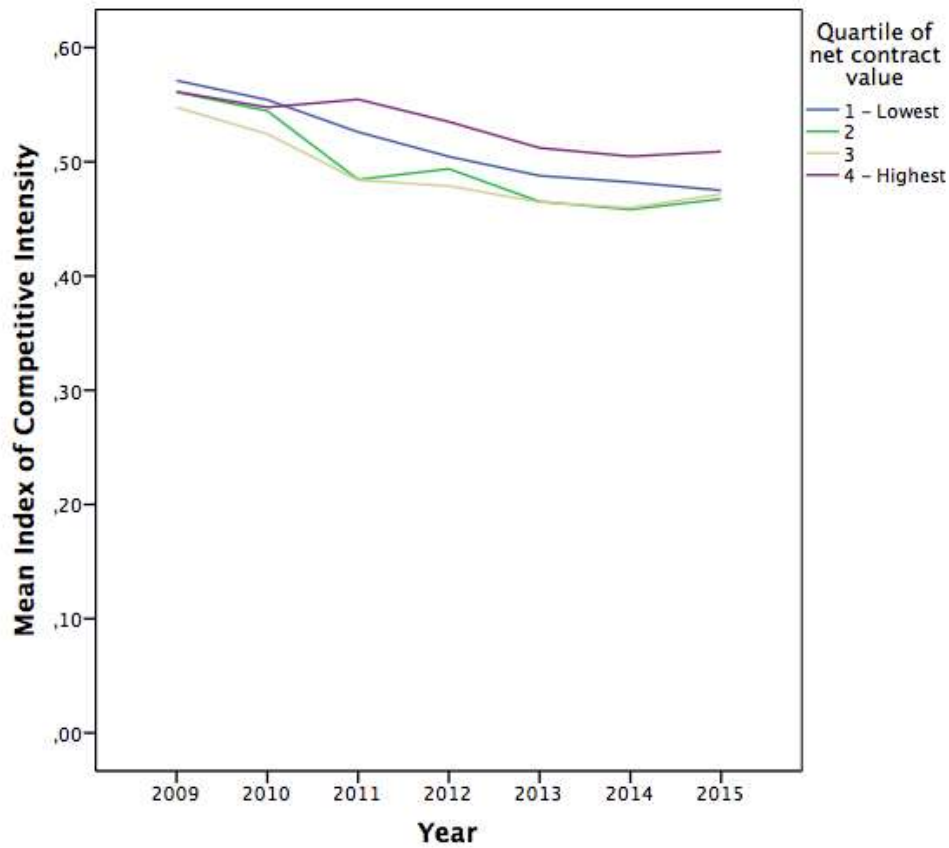*a: Y axis' (ICI) minimum: 0.0* *b: Y axis' (ICI) minimum: 0.46*
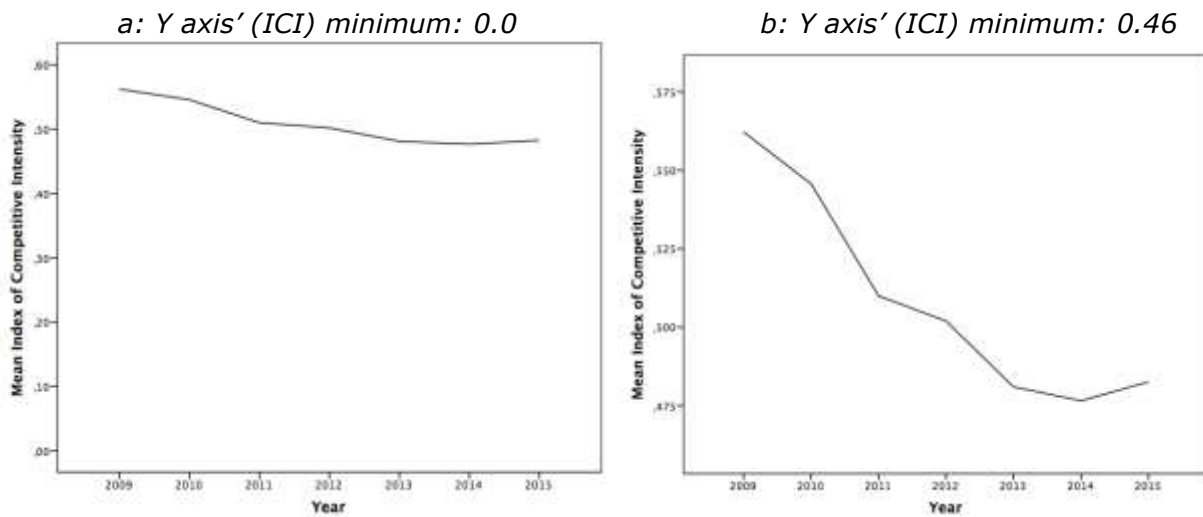
Note: data are filtered by goodc15;
Source: CRCB

Figure 2.2.3. The Index of Competitive Intensity (ICI) in Hungarian public procurement by industry, 2009-2015, yearly data, N = 87,980
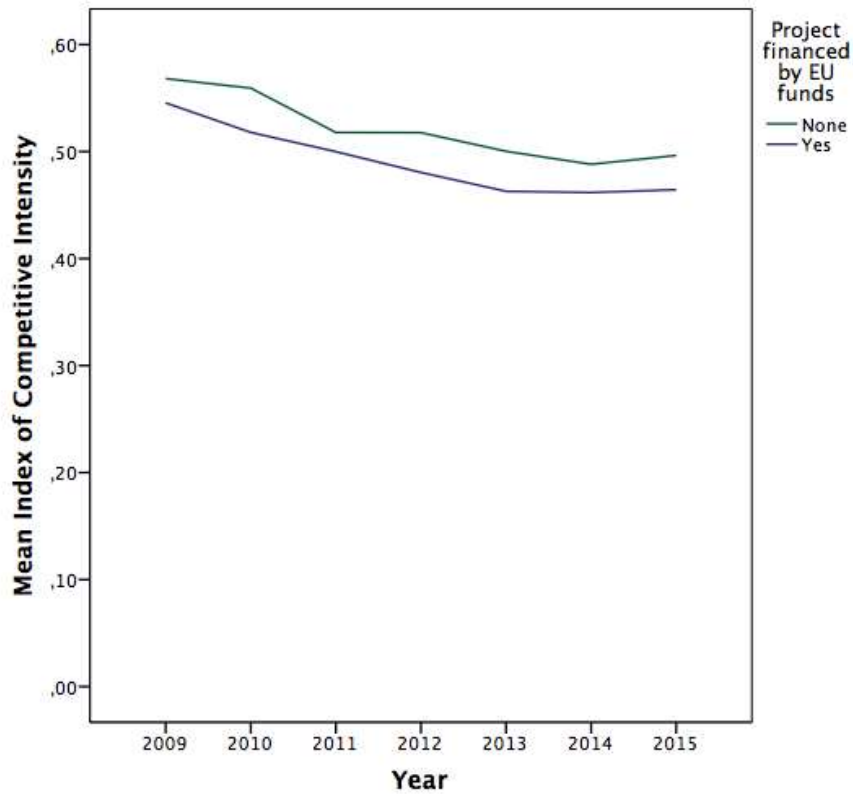

Note: data are filtered by goodc15;
Source: CRCB

Figure 2.2.4.: The Index of Competitive Intensity (ICI) in Hungarian public procurement by quintiles of contract value, 2009-2015, yearly data, N = 81,951

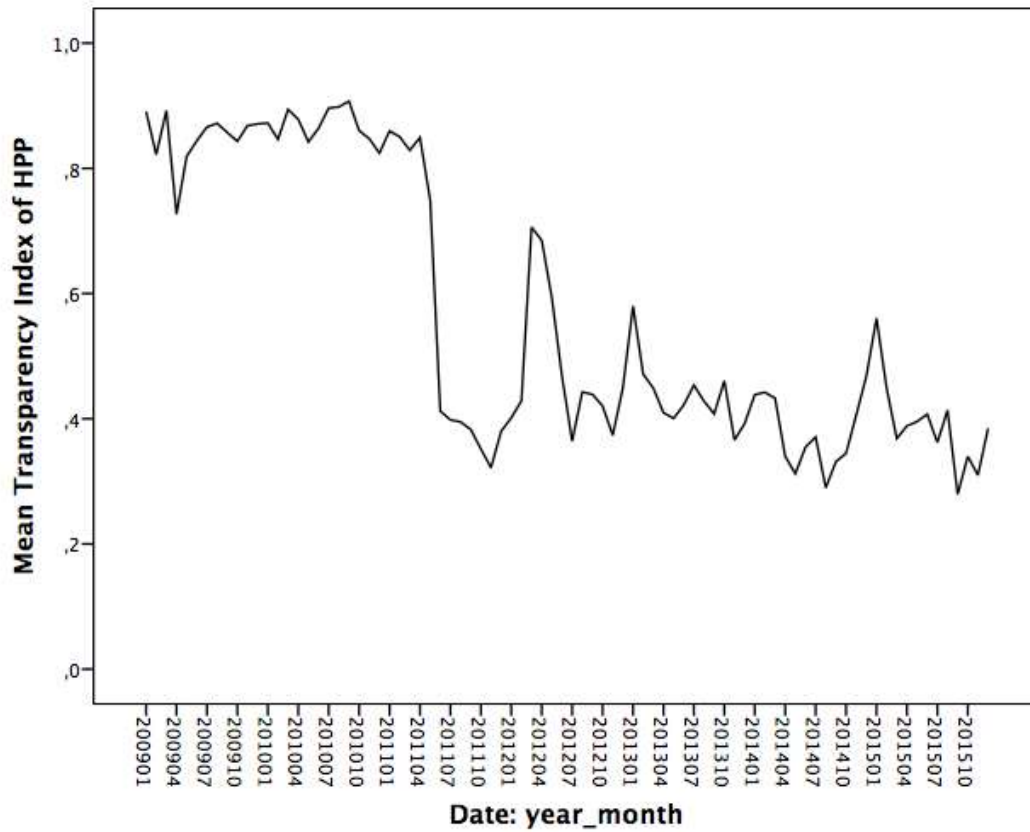*Note: data are filtered by goodc15;*
Source: CRCB

Figure 2.2.5.: The Index of Competitive Intensity (ICI) in Hungarian public procurement in EU funded and non-EU funded tenders, 2009-2015, yearly data, N = 86,722

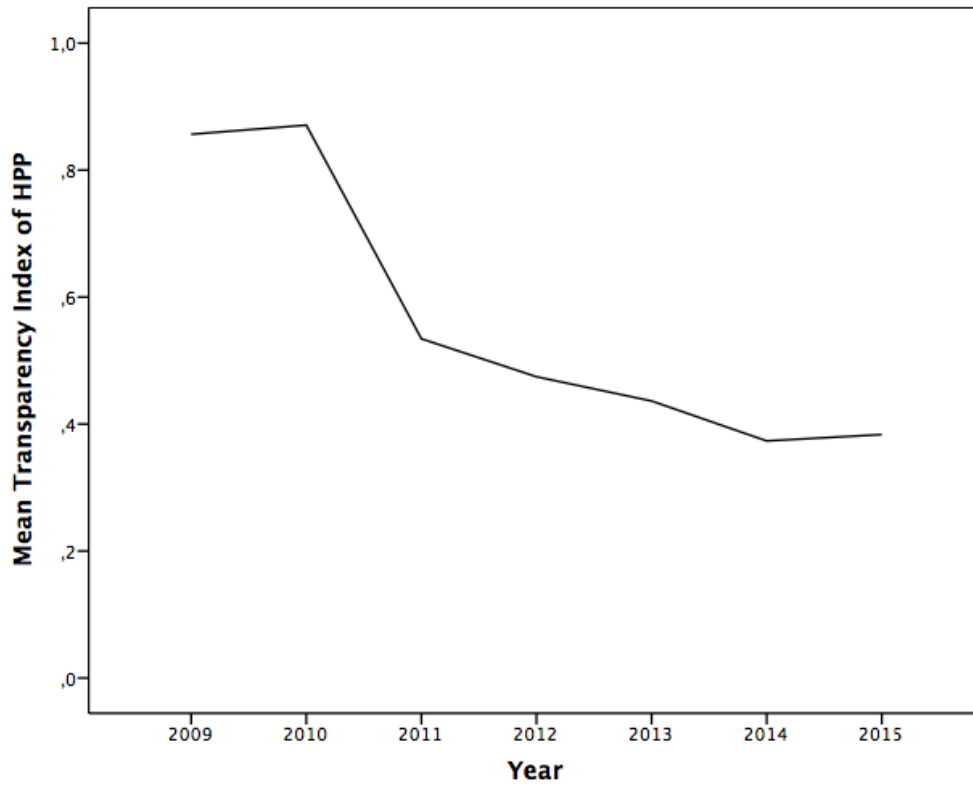*Note: the data are filtered by goodc15;*
Source: CRCB

2.3. Transparency of Hungarian Public Procurement

Figure 2.3.1.: The Transparency Index (TI) of Hungarian public procurement, 2009-2015, monthly data, N = 121,849
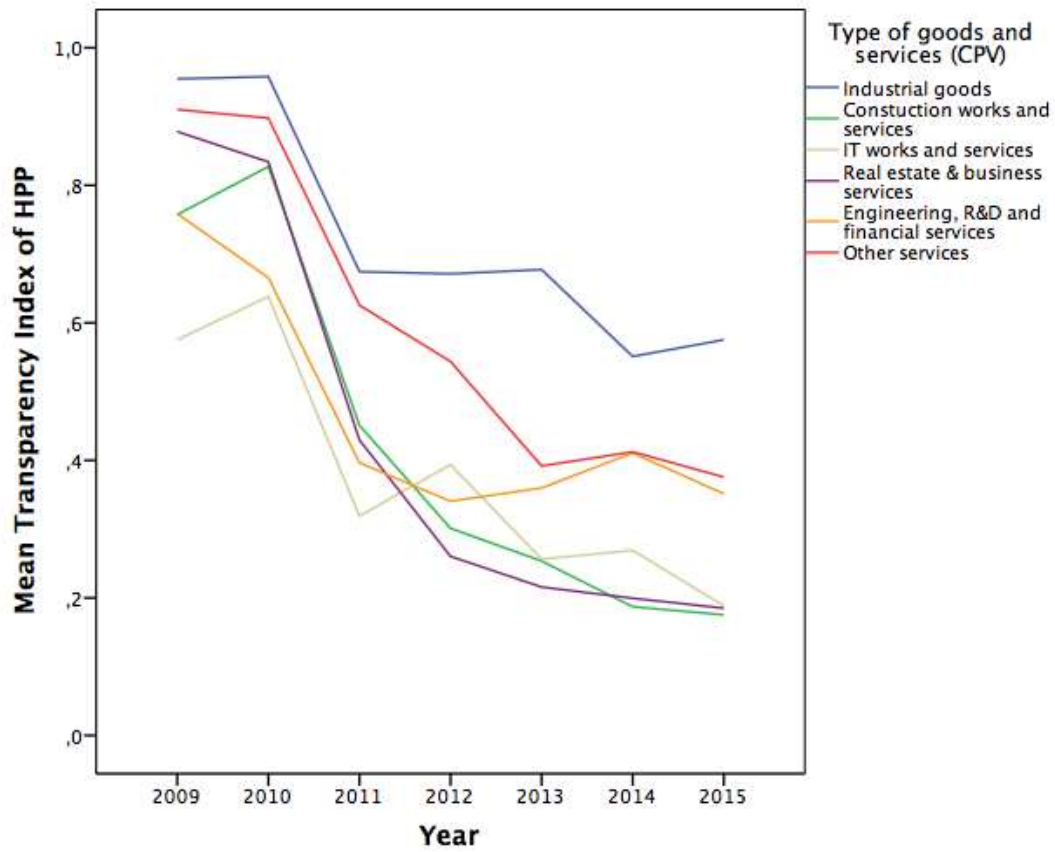

Note: data are filtered by goodc15;
Source: CRCB

Figure 2.3.2.: The Transparency Index (TI) of Hungarian public procurement, 2009-2015, yearly data, N = 121,849

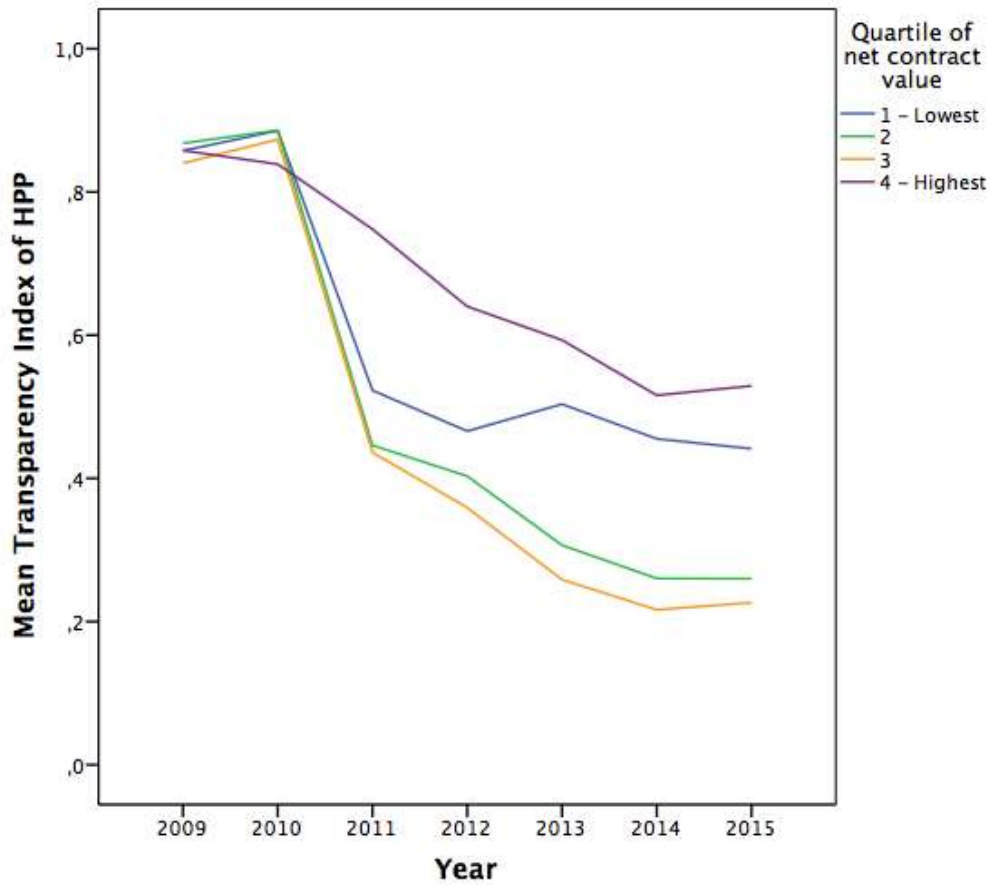
Note: data are filtered by goodc15;
Source: CRCB

Figure 2.3.3.: The Transparency Index (TI) by industry 2009-2015, yearly data,
N = 121,536

Note: data are filtered by goodc15;
Source: CRCB

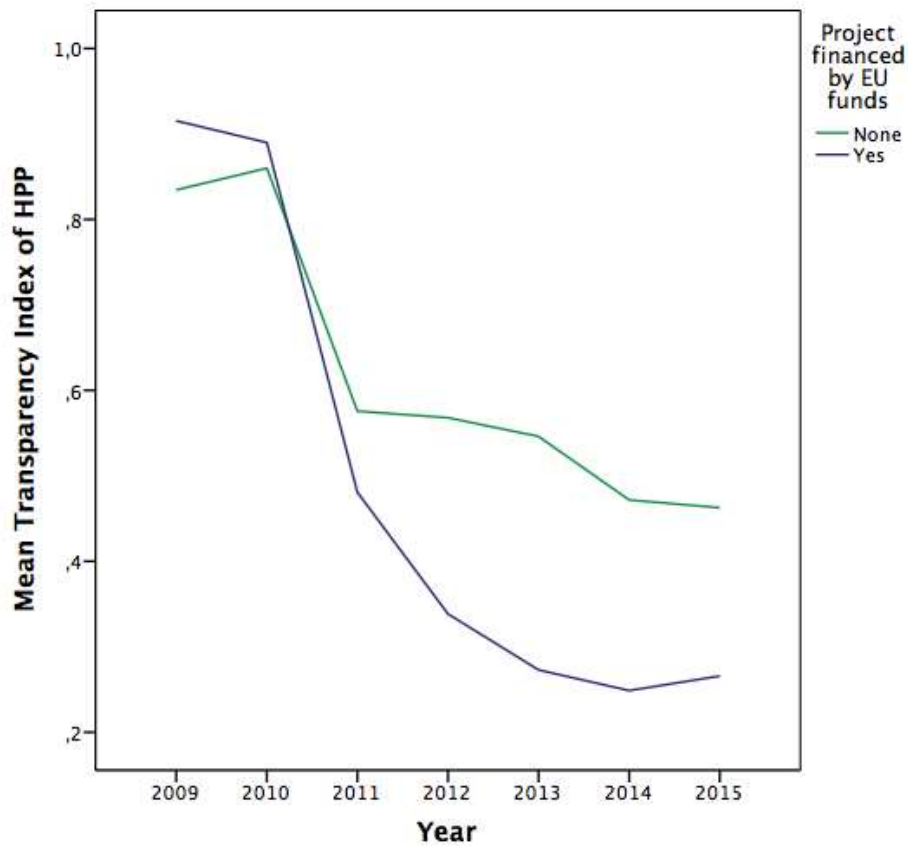Figure 2.3.4.: The Transparency Index (TI) in Hungarian public procurement by quintiles of contract value, 2009-2015, yearly data, N = 111,761

Note: data are filtered by goodc15;
Source: CRCB

Figure 2.3.5.: The Transparency Index (TI) in Hungarian public procurement in EU funded and non-Eu funded tenders, 2009-2015, yearly data, N = 120,432

Note: data are filtered by goodc15;
Source: CRCB

2.4. Procurement without Competition: the Single Bidder (SB)

Figure 2.4.1.: Share of public procurement tenders with Single Bidder (SB) in total number of tenders, 2009-2015, monthly data, N = 127,776
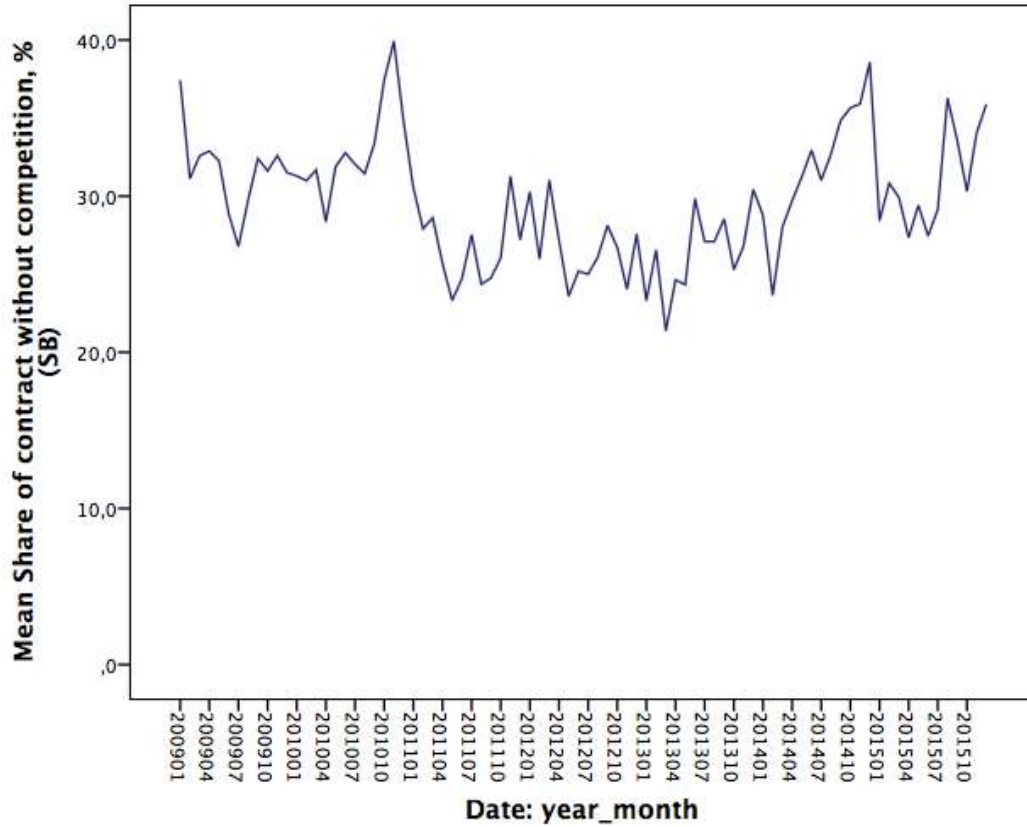
Note data are filtered by goodc15;
Source: CRCB

Figure 2.4.2.: Share of public procurement tenders with Single Bidder (SB) in total number of tenders, 2009-2015, yearly data, N = 127,776
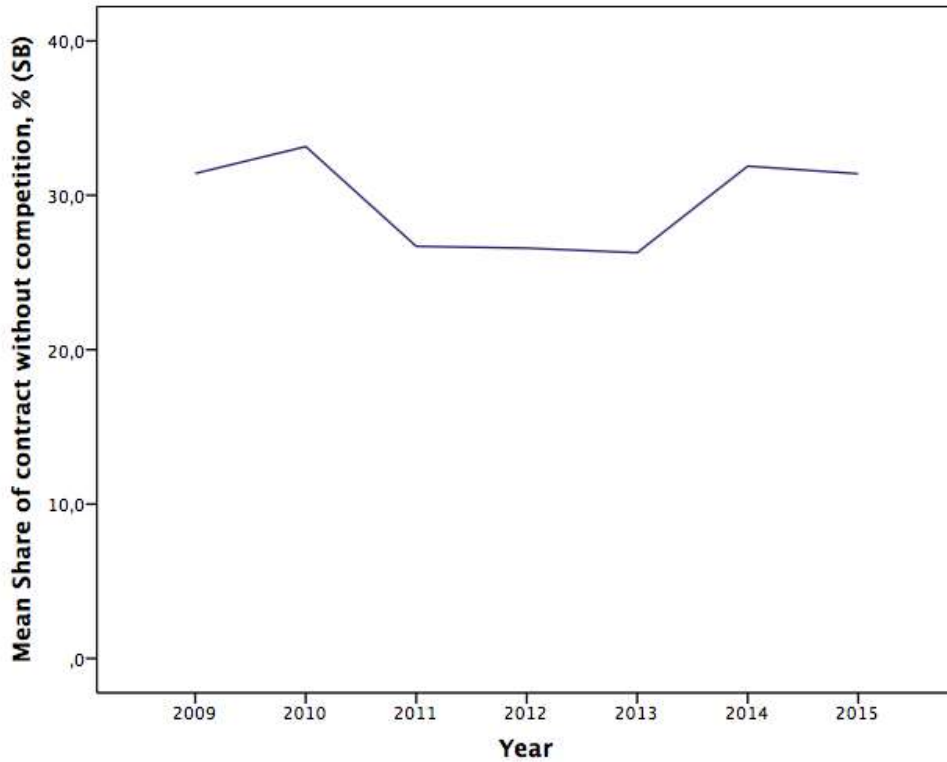
Note: data are filtered by goodc15;
Source: CRCB

Figure 2.4.3.: Share of public procurement tenders with Single Bidder (SB) in total number of tenders by Industry, 2009-2015, yearly data, N = 133,069

Note: data are filtered by goodc15;
Source: CRCB

Figure 2.4.4.: Share of public procurement tenders with Single Bidder (SB) in total number of tenders by quintiles of contract value, 2009-2015, yearly data, N = 129,888
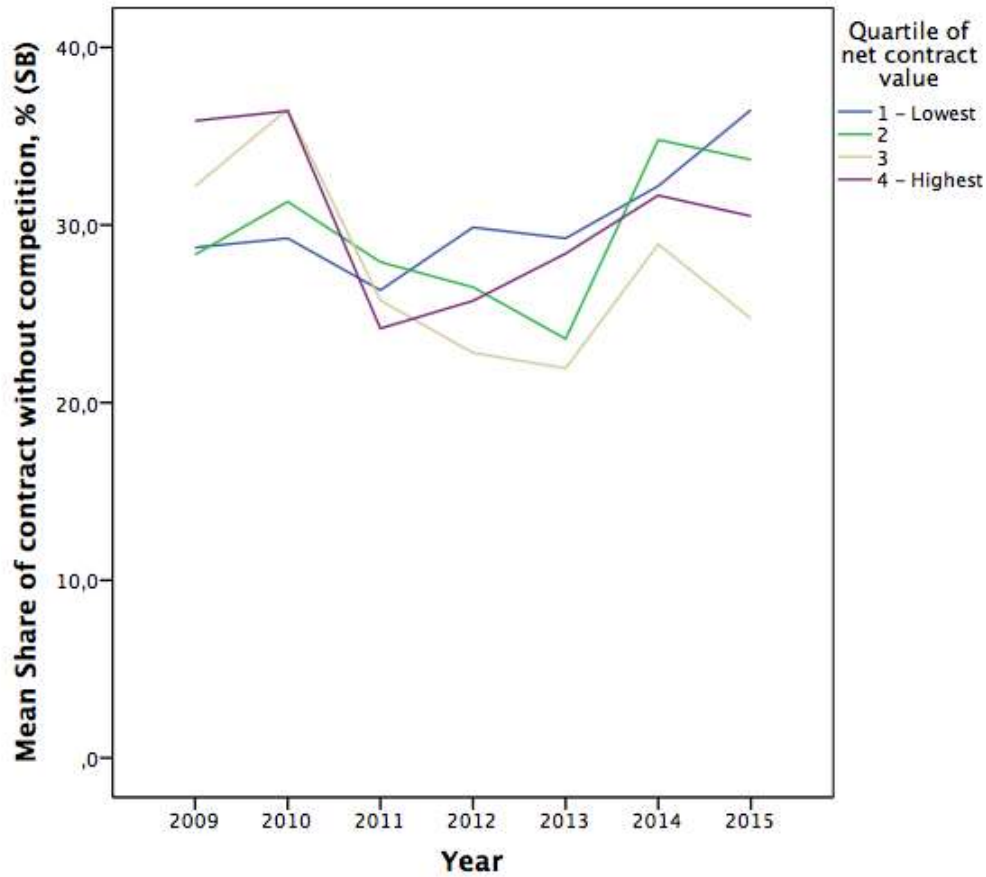
Note: data are filtered by goodc15;
Source: CRCB

Figure 2.4.5.: Share of public procurement tenders with Single Bidder (SB) in Eu funded and non-EU funded tenders, 2009-2015, yearly data, N = 131,208
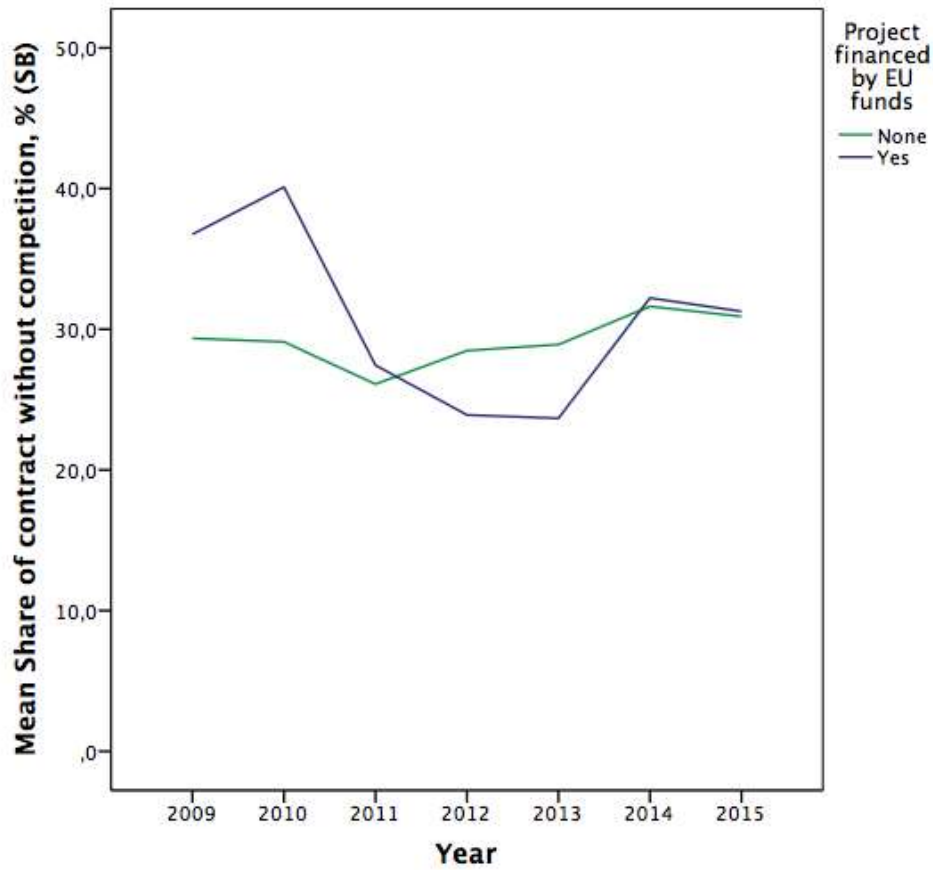
Note: data are filtered by goodc15;
Source: CRCB

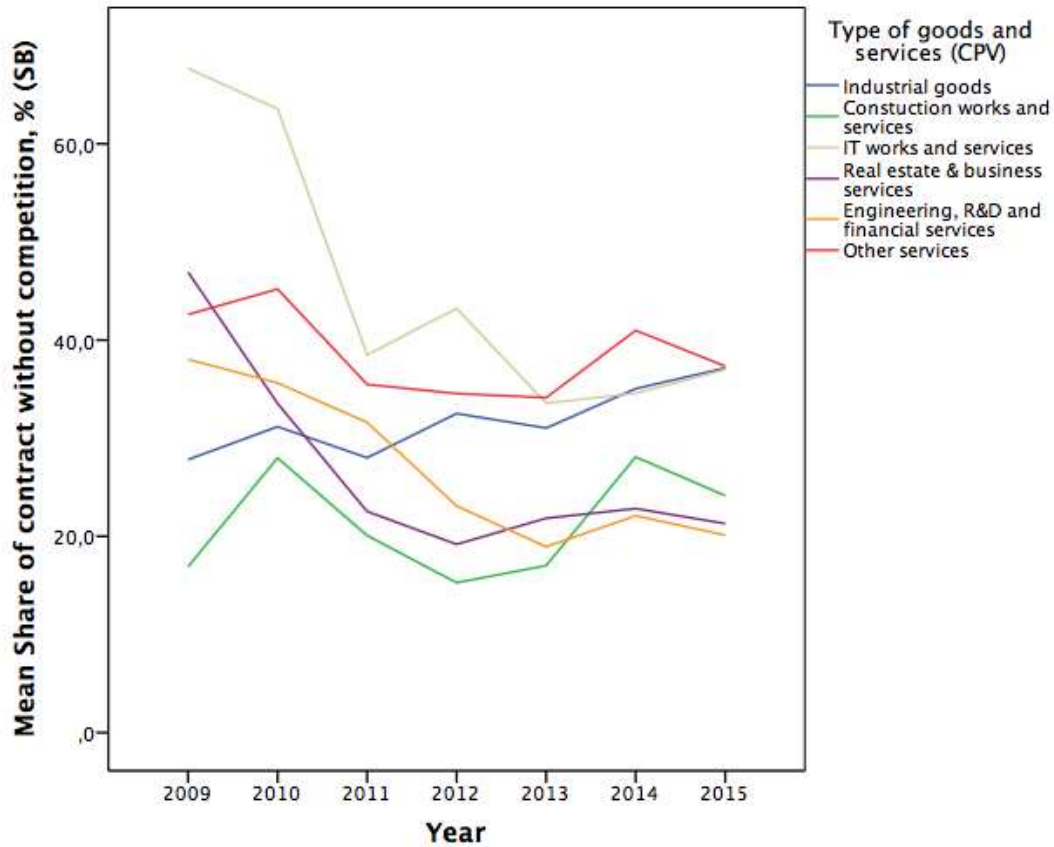## 2.5. Corruption Risk Indicator (CR2)

Figure 2.5.1.: The Corruption Risk Indicator (CR2) in Hungarian public procurement (CR2), 2009-2015, monthly data, N = 120,221
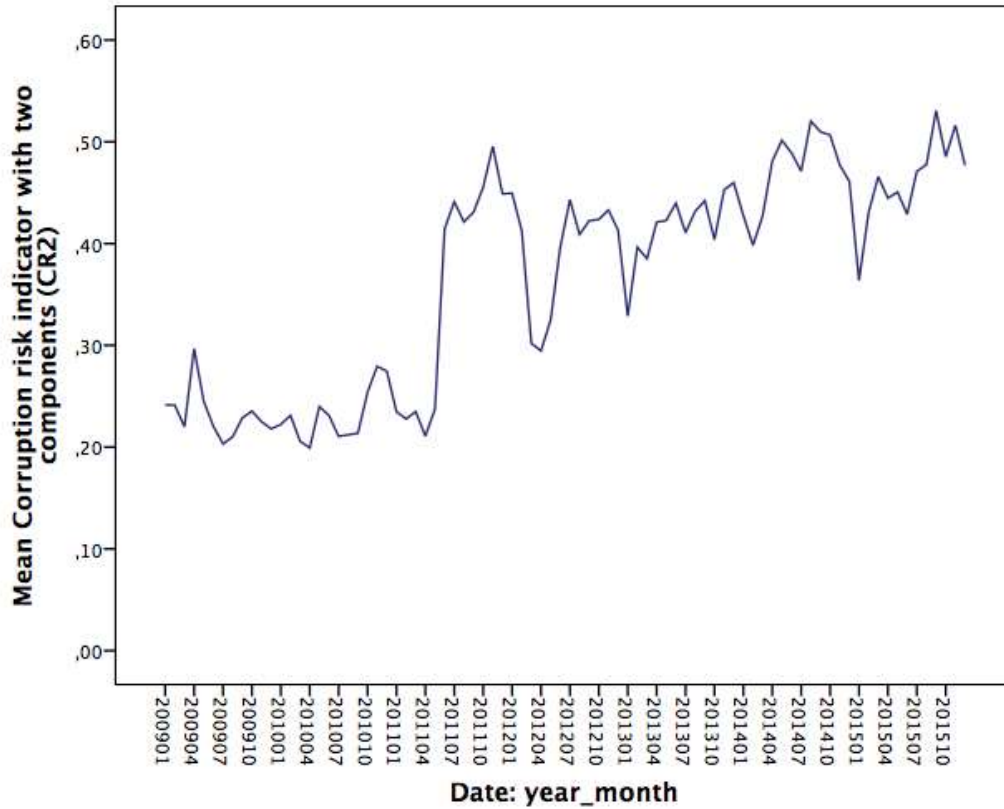
Note: data are filtered by goodc15;
Source: CRCB

Figure 2.5.2.: The Corruption Risk Indicator (CR2) in Hungarian public procurement (CR2), 2009-2015, yearly data, N = 120,221
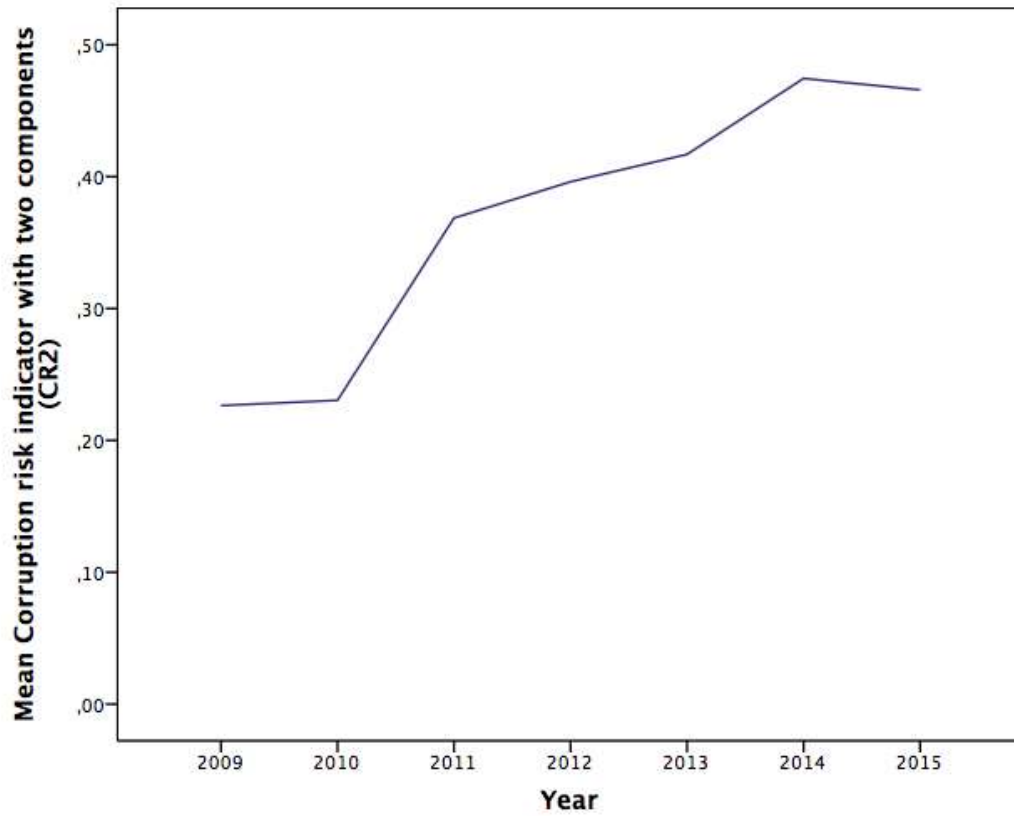
Note: data are filtered by goodc15;
Source: CRCB

Figure 2.5.3.: The Corruption Risk Indicator (CR2) in Hungarian public procurement (CR2) by Industry, 2009-2015, yearly data, N = 119,916

Note: data are filtered by goodc15;
Source: CRCB

Figure 2.5.4.: The Corruption Risk Indicator (CR2) in Hungarian public procurement (CR2) by quintiles of contract value, 2009-2015, yearly data, N = 111,180
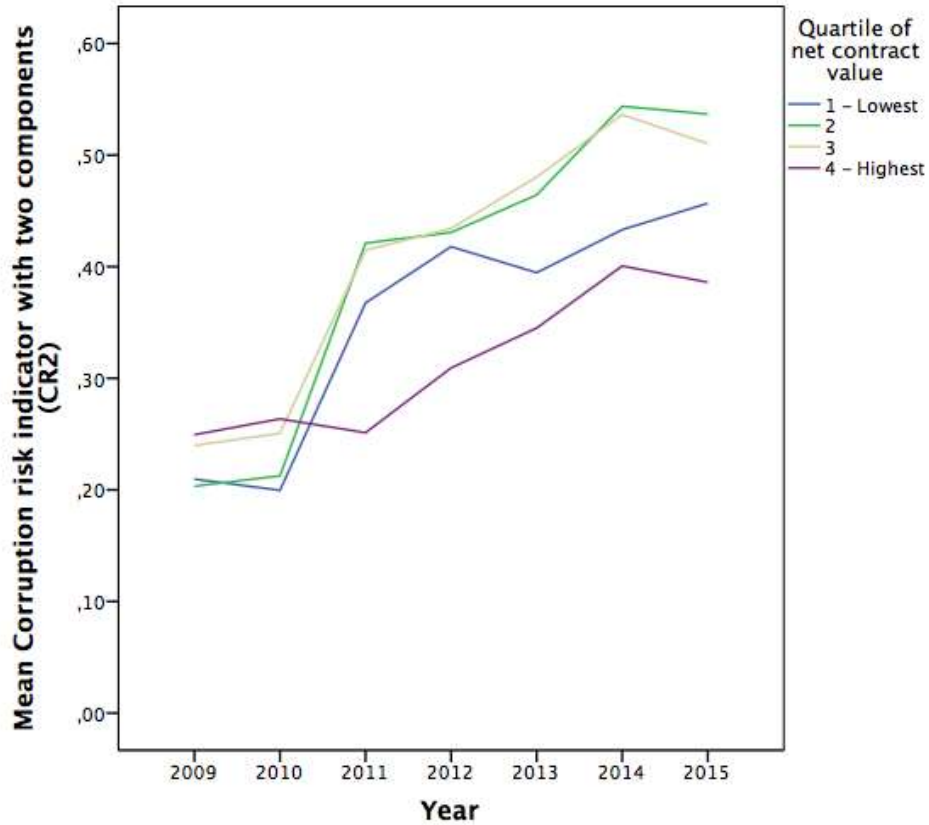
Note: data are filtered by goodc15;
Source: CRCB

Figure 2.5.5.: The Corruption Risk Indicator (CR2) in Hungarian public procurement (CR2) in EU funded and non-EU funded tenders, 2009-2015, yearly data, N = 118,843
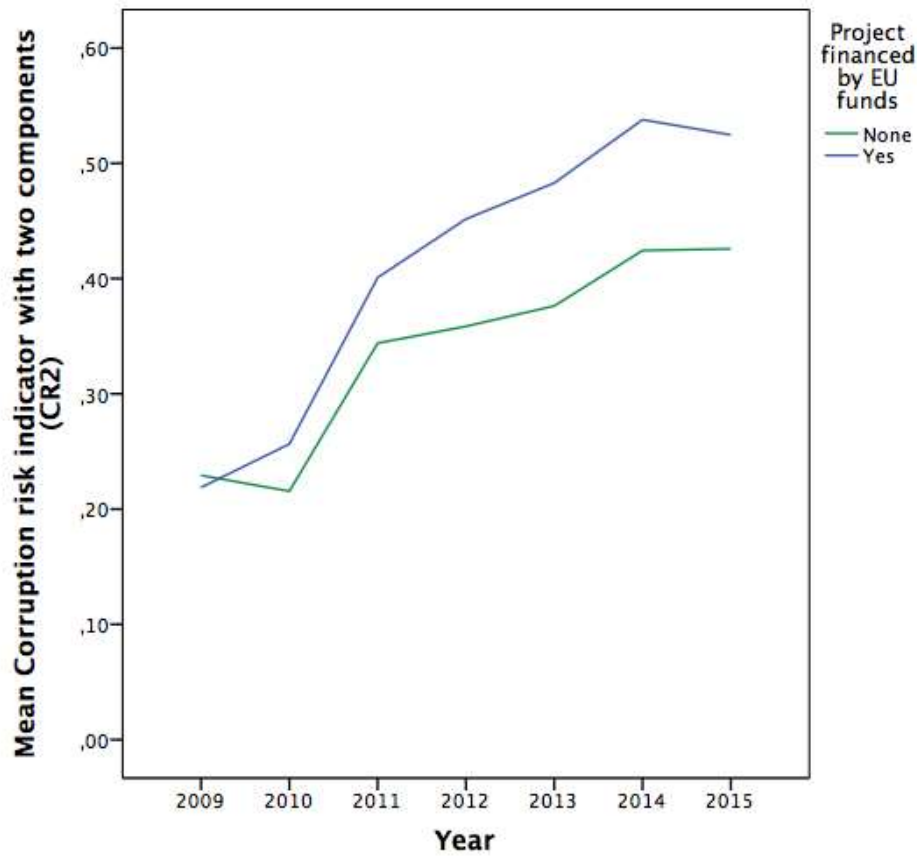
Note: data are filtered by goodc15;
Source: CRCB

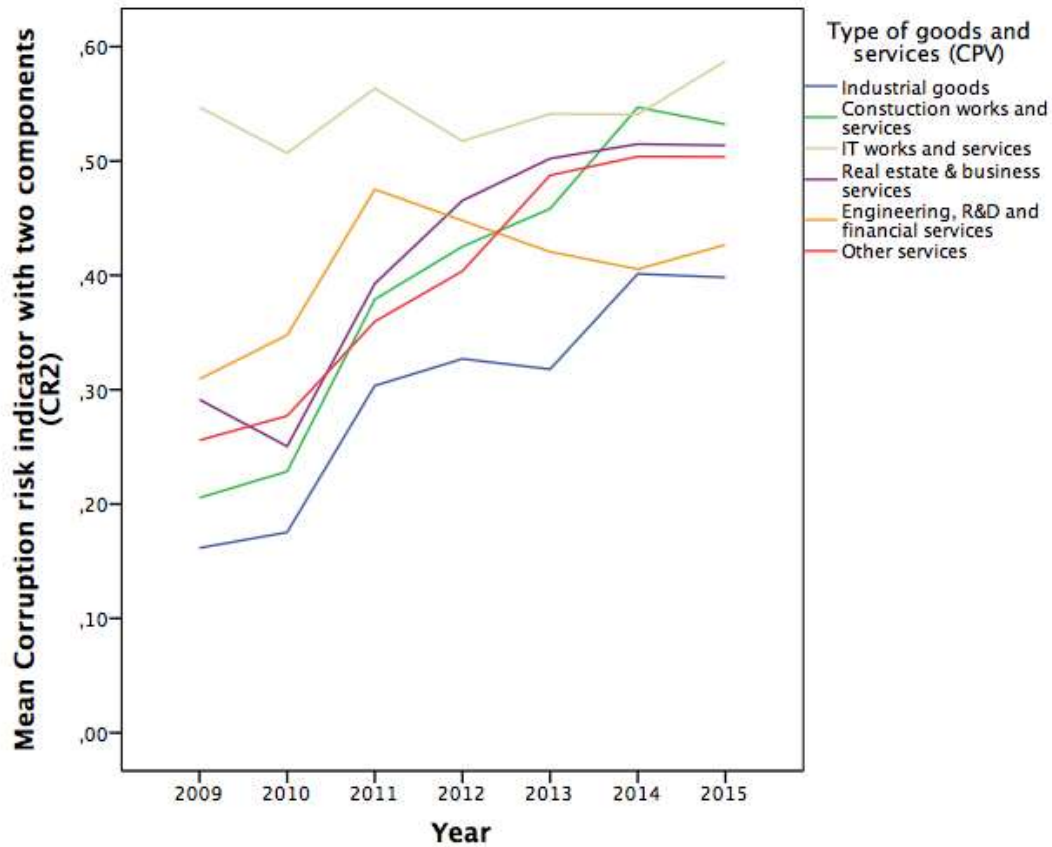## *2.6. Price Distortion and Overpricing*

Figure 2.6.1.: The distribution of first digits by the Benford's Law and by the contract prices of Hungarian public procurement, 2009-2015, N = 123,224

The distribution of 1st digits by the Benford's Law and by the contract prices of Hungarian public procurement, 2009-2015, N = 123,224

	1	2	3	4	5	6	7	8	9
Benford's Law	30.1	17.6	12.5	9.7	7.9	6.7	5.8	5.1	4.6
Prices of Hungarian PP	32.6	20.2	11.3	8.5	6.7	5.6	5.4	4.6	5.0
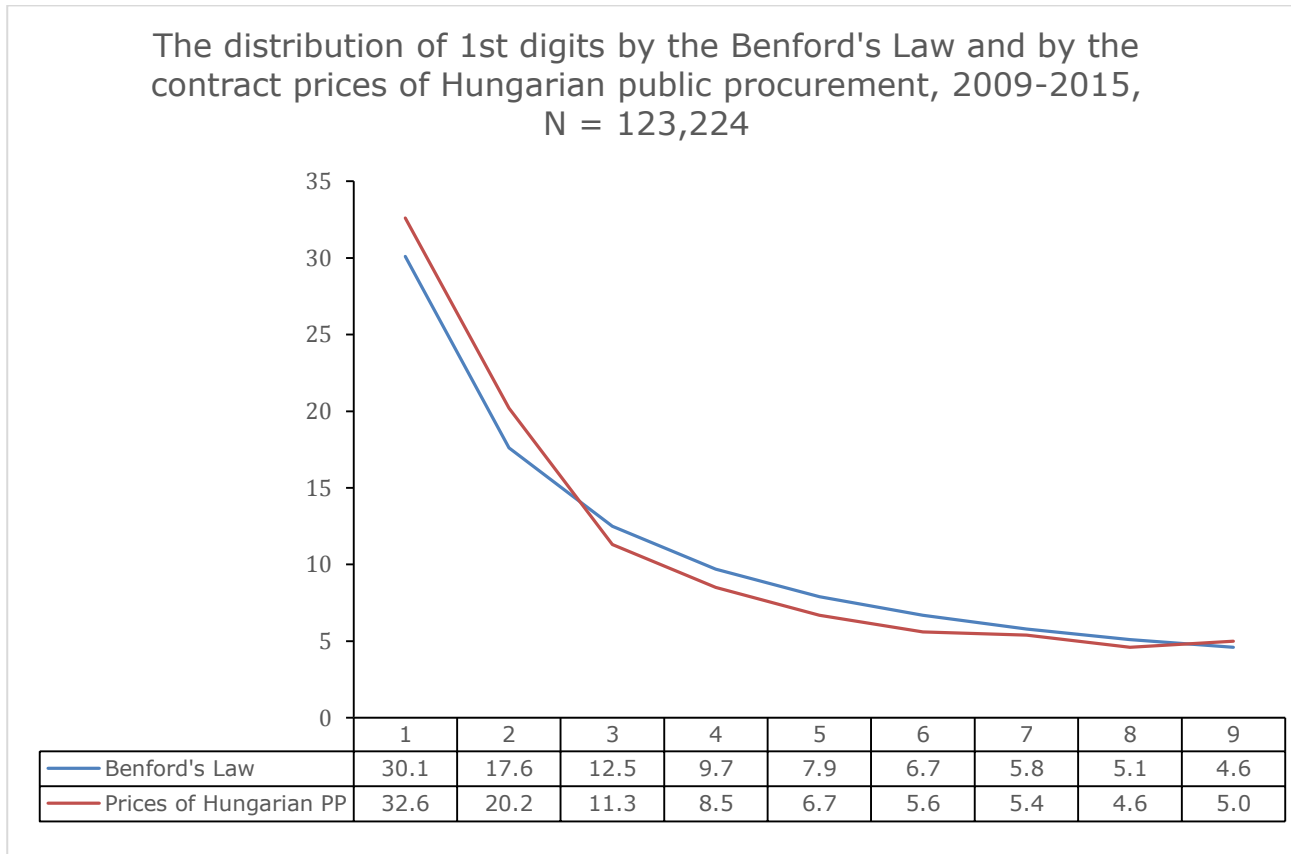
Note: Data are filtered by goodc15
Source: CRCB

Figure: 2.6.2.: The squared difference between the Benford's distribution and the contract prices of Hungarian public procurement by the first digits, 2009-2015, N = 123,224
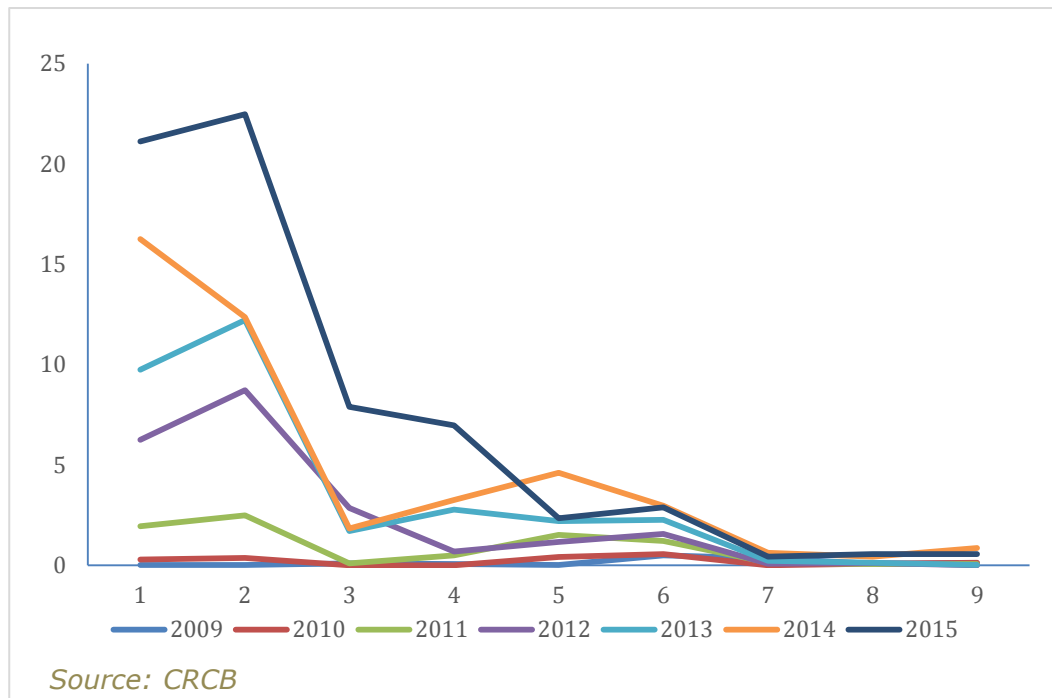
Source: CRCB

Note: Data are filtered by goodc15. On the Y axis are the squared difference between the theoretical (Benford's) and observed (form contract prices of HPP) distribution.
Source: CRCB

Figure 2.6.3.: The mean squared error (MSE) of contract prices of HPP from the theoretical (Benford's) distribution by year, first digits, 2009-2015, N = 123,224
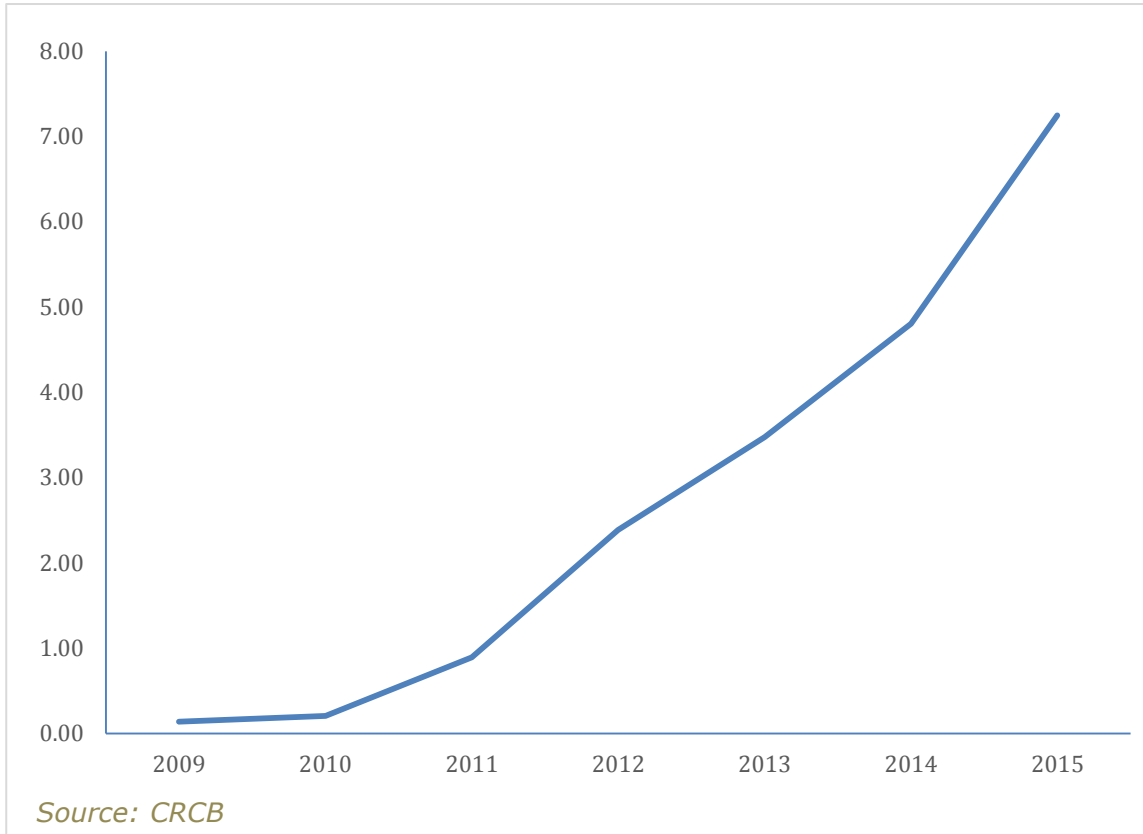
Source: CRCB

Note: Data are filtered by goodc15
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 2.6.4.: The squared difference between the Benford's distribution and the contract prices of Hungarian public procurement by digits and by Industry, 2009-2015, N = 123,224
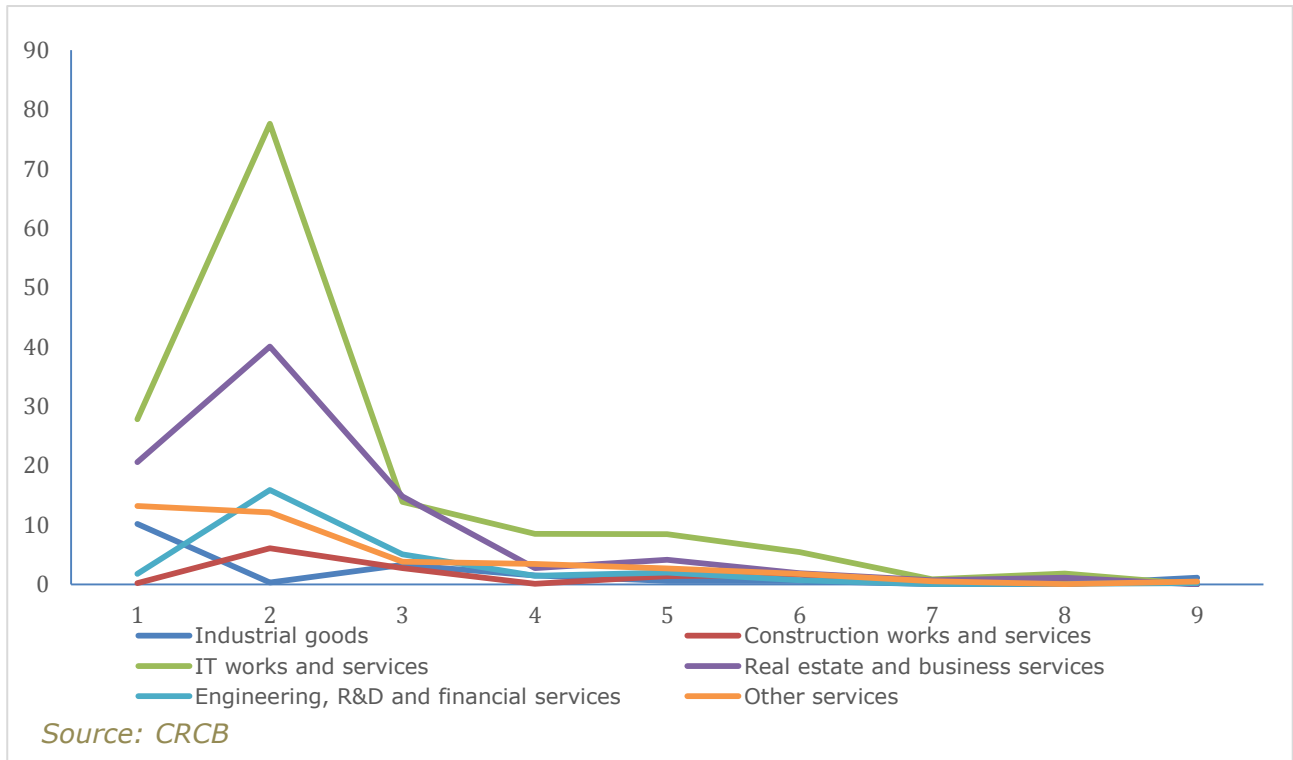
Source: CRCB

Note: Data are filtered by goodc15. On the Y axis are the squared difference between the theoretical (Benford's) and observed (form contract prices of HPP) distribution.
Source: CRCB

Figure 2.6.5.: Price distortion of contract prices of Hungarian public procurement by EU funded and non-EU funded tenders, 2009-2015, N = 128,422
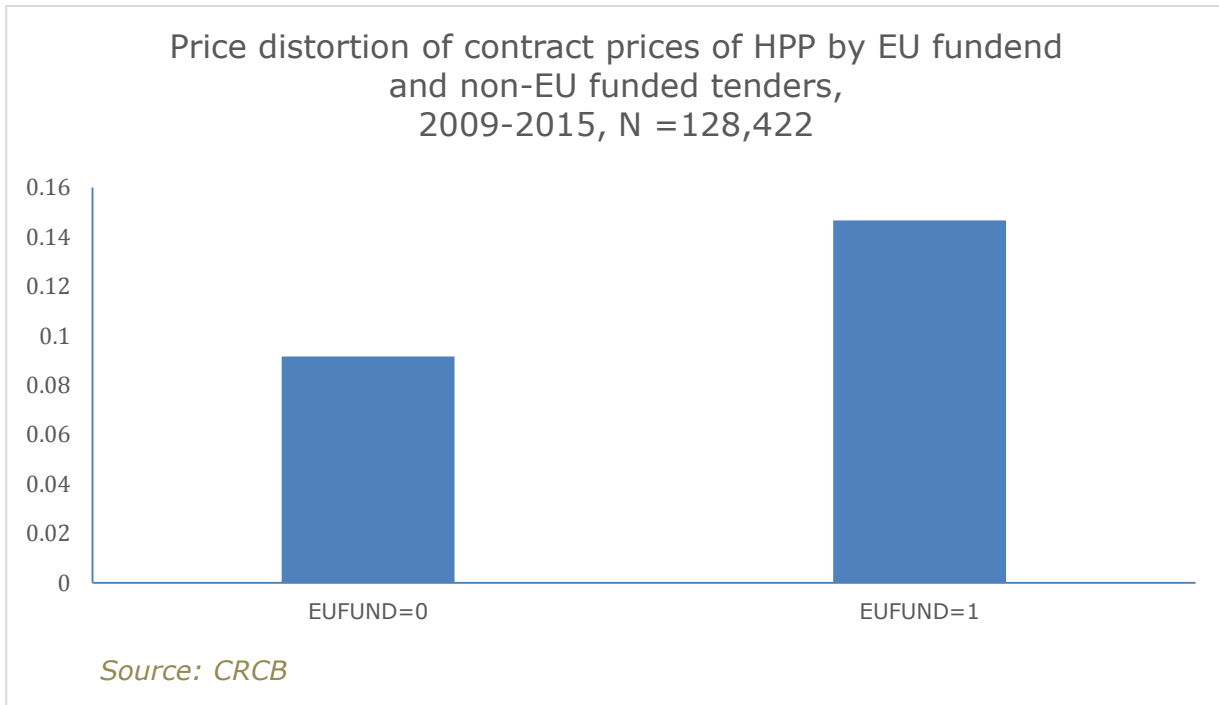
Price distortion of contract prices of HPP by EU fundend and non-EU funded tenders, 2009-2015, N =128,422

Source: CRCB

Note: Data are filtered by goodc15=1, The Cramer's V values are on the Y axis.
Source: CRCB

Figure 2.6.6.: Price distortion of contract prices of Hungarian public procurement by procurement methods, 2009-2015, N = 124,693
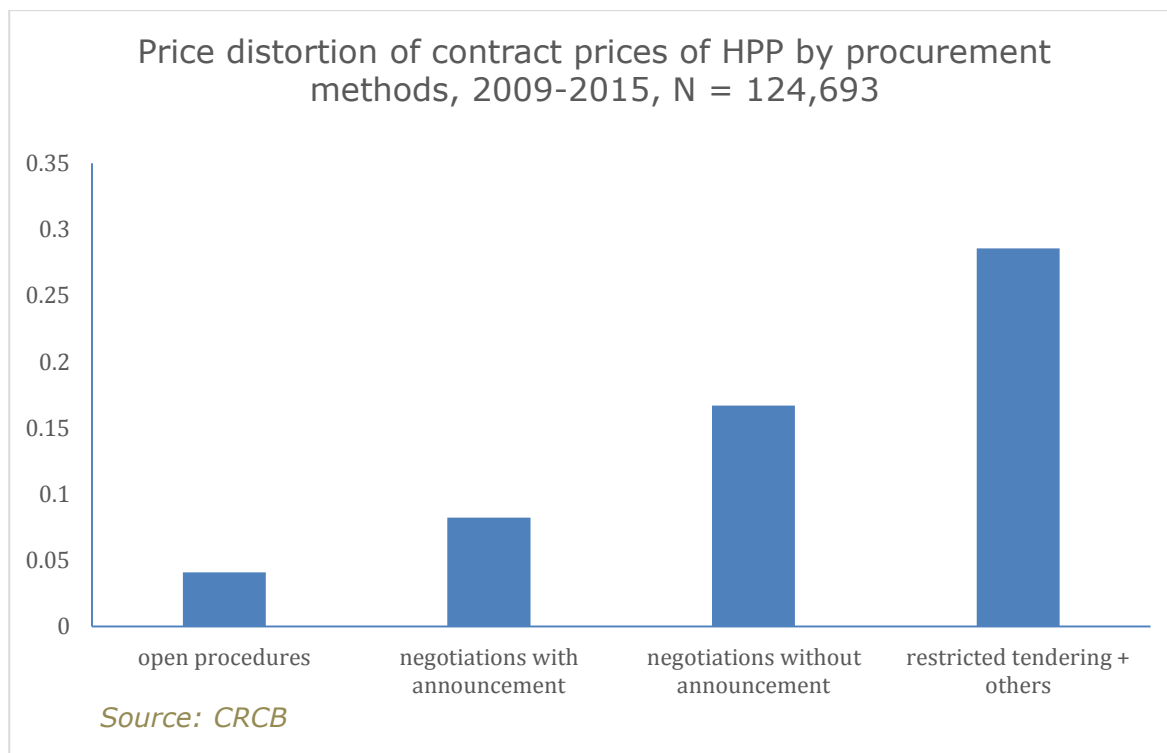
Note: Data are filtered by goodc15=1, The Cramer's V values are on the Y axis.
Source: CRCB

Figure 2.6.7.: Price distortion in Hungarian public procurement by the competitive intensity, 2009-2015, N = 129,888

Squared difference from the Benford's Law of contract prices
in two groups of tenders in Hungary
(with no competition and high level of competition),
2009-2015, N = 129,888

— one bidder   — at least 10 bidders

Source: CRCB

Note: Data are filtered by goodc15, On the Y axis are the squared difference between the theoretical (Benford's) and observed (form contract prices of HPP) distribution.
Source: CRCB

Figure 2.6.8.: Price distortion in Hungarian public procurement by level of the transparency, 2009-2015, N = 124,693

Source: CRCB

Note: Data are filtered by goodc15=1, The Cramer's V values are on the Y axis.
Source: CRCB

Figure 2.6.9.: Price distortion in the Hungarian public procurement by level of the Corruption Risk Indicator (CR2), 2009-2015, N = 124,062
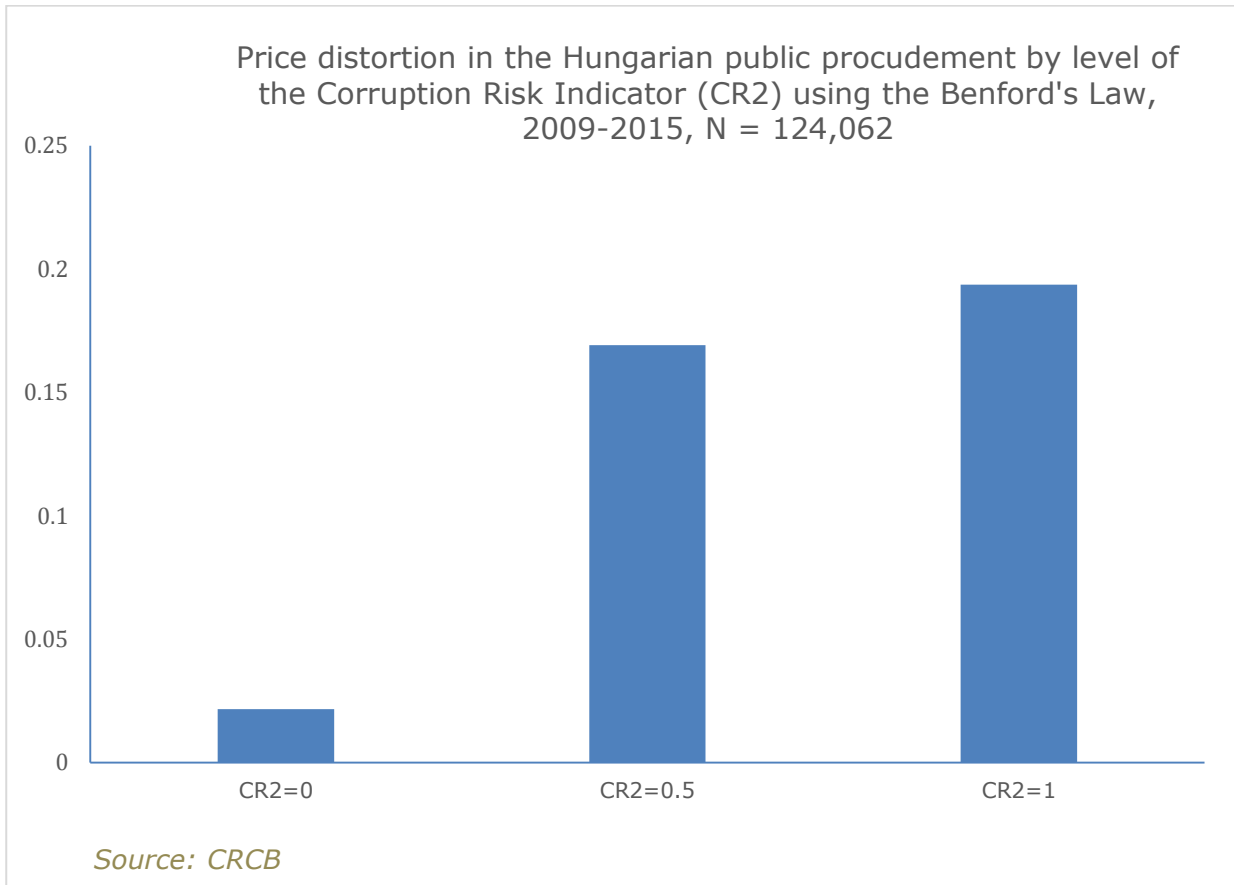
Note: The Cramer's V value are on the Y axis.
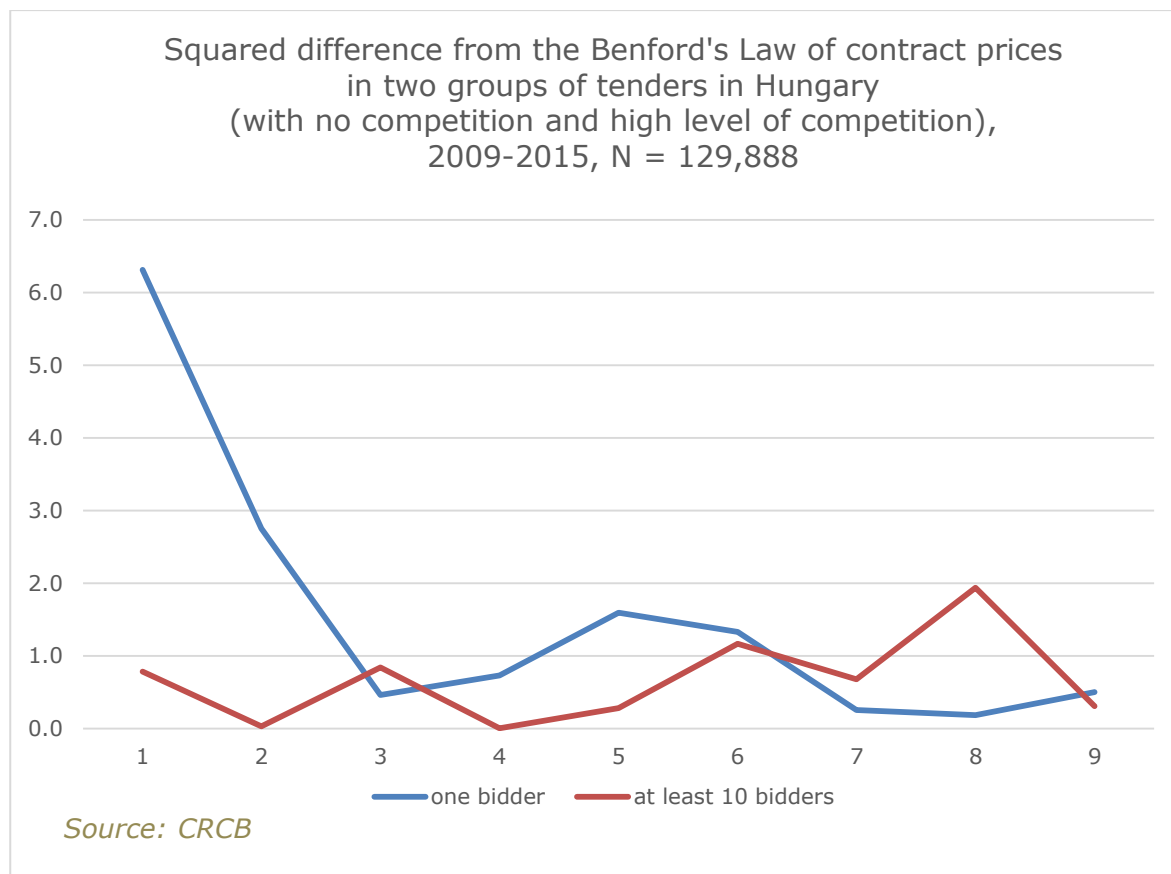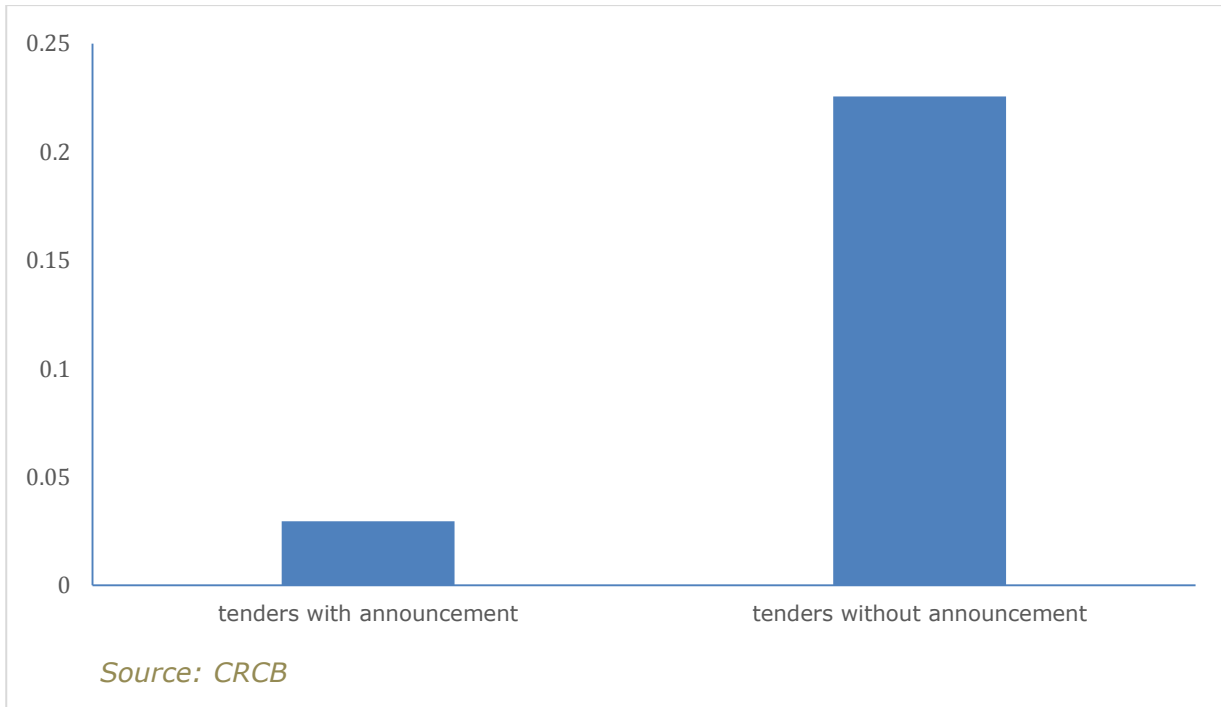Source: CRCB

Table 2.6.1.: Price distortion of contract price in Hungarian public procurement by several tender subgroups 2009-2015

tender subgroups	chi2	Cramer's V	MAD	N
Industrial goods [SECTOR6=1]	559,7231	0,1085	0,0107	47582
Construction works and services [SECTOR6=2]	426,0375	0,1082	0,0098	36406
IT works and services [SECTOR6=3]	438,2328	0,3051	0,0308	4708
Real estate and business services[SECTOR6=4]	603,6278	0,2341	0,0239	11014
Engineering, R&D and financial services [SECTOR6=5]	213,4399	0,1297	0,0125	12696
Other services [SECTOR6=6]	477,1312	0,1638	0,0176	17776
10 or more bidders [X11=1]	36,0084	0,0931	0,0071	4152
2009	32,9524	0,0439	0,0032	17112
2010	45,7192	0,0459	0,0037	21678
2011	96,4456	0,0832	0,0080	13948
2012	196,3701	0,1192	0,0122	13812
2013	442,4965	0,1458	0,0151	20823
2014	701,3961	0,1770	0,0188	22386
2015	909,4062	0,2088	0,0224	20850
minimal corruption risk [CR2=0]	22,7685	0,0216	0,0019	48626
CR2=0.5	1680,6321	0,1691	0,0175	58760
maximal corruption risk [CR2=1]	625,8054	0,1937	0,0209	16676
EUFUND=0	635,8625	0,0917	0,0096	75685
EUFUND=1	1135,0194	0,1467	0,0150	52737
open procedure [PTYPE=4]	105,2030	0,0410	0,0037	62618
negotiation with announcement [PTYPE=3]	63,5620	0,0822	0,0077	9409
negotiation without announcement [PTYPE=2]	837,1757	0,1670	0,0174	30014
restricted and other procedures [PTYPE=1]	1849,5806	0,2857	0,0310	22652
mgts = 1	10,3966	0,1537	0,0152	440
without announcement [PTRANS=0]	2810,3491	0,2256	0,0241	55210
with announcement [PTRANS=1]	61,1593	0,0297	0,0027	69483
GOODW15=1	1636,061	0,11192	0,0113	130609

Note: MAD: The sum of absolute values of the difference between the theoretical (Benford's) and observed distribution – indicator suggested by Nigrini, 2000. If MAD < 0.006 there is good fit,; 0.006 ≤ MAD < 0.012 is acceptable fit; 0.012 ≤ MAD < 0.015 is weak fit; and 0.015 ≤ MAD shows the lack of fit. See Nigrini, 2012, p. 160. Table 7.1.
The dark green cells show the good fit, the cells with light green show good and acceptable fit. The white cells show the lack of fit, in these groups the contract prices are distorted.
Source: CRCB

Annex

A1. Definition of variables used

	Variable names	Definition
1	GOODC15	Filter variable [0,1]; It filters the dataset to contract level data
2	GOODW15	Filter variable [0,1]; It filters the dataset to winner level data (one contract but more winners, because a consortium has won the tender)
3	FILTER_S2	Filter variable [0,1]; It filters the dataset and creates a subsample of 7% at contract level.
4	DATE_	Date variable for monthly data;
5	DATEY	Date variable for yearly data;
6	EUFUND	Tender is funded by the EU [0,1]; The value of 1 means that the tender is funded by the EU, 0 otherwise.
7	XEUFUND	Tender is funded by the EU [0,100]; The value of 100 means that the tender is funded by the EU, 0 otherwise.
8	NCVALUE	Net contract price (in HUF)
9	XNCVALUE	Net contract price (in billion EURO)
10	LNNCVALUE	Natural logarithm of net contract price (in HUF)
11	NLNNCVAL	Quartiles of the natural logarithm of net contract price [1,..,4]
12	ICI	Index of Competitive Intensity $[0.3 \leq ICI \leq 1]$; It measures the competitive intensity: low value means low intensity, high value means high intensity. X: the number of bidders in a tender. $ICI = lnX/ln10$ in case where $2 \leq X \leq 10$, 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.
13	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".
14	S1	Product market dummy variable [0,1]; the value of 1 means "Industrial goods", 0 otherwise.
15	S2	Product market dummy variable [0,1] the value of 1 means "Construction works and services", 0 otherwise.
16	S3	Product market dummy variable [0,1] the value of 1 means "IT works and services", 0 otherwise.
17	S4	Product market dummy variable [0,1] the value of 1 means

		"Real estate and business services", 0 otherwise.
18	S5	Product market dummy variable [0,1] the value of 1 means 5 "Engineering, R&D and financial services", 0 otherwise.
19	TI	Transparency Index [0,1]; the value of 0 means the tender was issued without announcement; the value of 1 means the tender was issued with announcement.
20	SB	Single bidder [0,1]; the value of 0 means there were more than one bidder; the value of 1 means there was only one bidder.
21	XSB	Single bidder [0,100]; the value of 0 means there were more than one bidder; the value of 100 means there was only one bidder.
22	CR2	Corruption Risk Indicator [0, 0.5, 1]; 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).
23	BENFORD	The first digit of contract prices [1,…,9];

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[11] and dots[12] are used if there are separators at all[13]. We could detect five cases between 2012 and 2013 when the contract value was entered repeatedly[14] 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[15]. Also the use of the '.-' suffix that is for monetary sums in Hungary is inconsistent; in some cases the contract value ends with '.-'[16] but in other cases not[17].

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[18]. 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[19]. 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[20];
- 27,[21];
- 27,0[22];
- 1,27[23].

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[11] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_7483_2012/
[12] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_1235_2012/
[13] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_7483_2013/
[14] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_1793_2012/
[15] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_5747_2012/
[16] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_19240_2012/
[17] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_1120_2012/
[18] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_11150_2012/
[19] http://kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_10751_2013/
[20] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_16473_2014/
[21] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_20362_2014/
[22] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_10142_2012/
[23] http://www.kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_12141_2014/

The indication method of the main activity of the contracting body gives the opportunity for the submitter to mark several activities[24] 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[25].

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[24] http://kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_10031_2013/
[25] http://kozbeszerzes.hu/adatbazis/mutat/hirdetmeny/portal_10127_2013/