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MASTER'S THESIS

Public investments and election cycle - microeconomic analysis

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Declaration of Authorship

The author hereby declares that he compiled the present thesis independently, using only the listed resources and literature. The present thesis was not used to obtain any other academic degree.

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Abstract

The present thesis is devoted to public procurements. Our data set consists of 58 largest municipalities in the Czech Republic and our time period is 2017-2018. The longer time period is not available in current data sources. We very broadly describe the process of data cleaning a then the creation of our testing data set. The primary aim of this thesis is to figure out whether higher expenses in different types of public procurements (e.g. small-scale contracts in different price limits, soft-service contracts, etc.) lead to a higher or lower probability of mayors‘ re-election. The regression equation is examined by the ordinary least squares method. We prove the hypotheses about the small-scale contracts in price limits around 6,0 million CZK and 200 000 CZK. These price limits lead to a higher probability of mayors' re-election. Whether mayors spend more through these procurements in these price limits in election year then they have a higher probability that they are going to be re-elected. The hypotheses about the soft-service purchases or about the concluding the amendments are not proved.

JEL Classification C12, D72, H57, H72

Keywords public procurement, political cycle

Abstrakt

Tato práce je věnována veřejným zakázkám. Náš soubor dat se skládá z 58 největších obcí v České republice a naše časové období je 2017–2018. V současných zdrojích dat není delší časové období k dispozici. Velmi podrobně popisujeme proces čištění dat a poté vytvoření naší sady testovacích dat. Primárním cílem této diplomové práce je zjistit, zda vyšší výdaje v různých typech veřejných zakázek (např. zakázky malého rozsahu v různých cenových limitech, zakázky na měkké služby atd.) vedou k vyšší či nižší pravděpodobnosti znovuzvolení starostů. Regresní rovnice je zkoumána metodou nejmenších čtverců. Hypotézy o zakázkách malého rozsahu v cenových limitech kolem 6,0 milionu Kč a 200 000 Kč jsou prokázány. Tyto cenové limity vedou k vyšší pravděpodobnosti znovuzvolení starostů. Jestliže starostové utratí více za zakázky v těchto cenových limitech ve volebním roce, pak mají vyšší pravděpodobnost, že budou znovuzvolení. Hypotézy o nákupech měkkých služeb nebo o uzavření dodatků nejsou prokázány.

Klasifikace JEL C12, D72, H57, H72
Klíčová slova veřejné zakázky, politický cyklus

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Acronyms

2SLS Two Stages Least Squares

CPV Common Procurement Vocabulary

CZK Czech Koruna

EU European Union

EUR Euro

GDP Gross Domestic Product

GMM Generalized method of moments

GNP Gross National Product

MP Member of Parliament

OECD Organisation for Economic Co-operation and Development

OLS Ordinary Least Squares

PR Public relations

US United States

Master's Thesis Proposal

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Proposed topic	Public investments and election cycle - microeconomic analysis

Motivation The objective of the paper is to analyse the behaviour of the public authorities (based on the expectation of re-election to the office). We want to figure out if spending patterns change before/during the election time (more public procurements, public procurements of longer duration, more costly public procurements, lower competition in the procurements...). We create 2 groups: mayors who got re-elected and mayors who did not. Then we compare these 2 groups a see how their public spending differs. Our motivation is to show that re-elected mayors do not create doubtful procurements.

We see the mayor as an agent who maximizes his profit from the public function. We describe his behaviour in two periods. Firstly, if the mayor has good chance for re-election (connected with expected lower but long-term profit from the function) then he is risk-averse mayor and he is making good policy. On the other hand, if he is not that good during his administration (lower popularity than in the beginning, etc.) then he become risk-free mayor (situation of "no tomorrow") because he suspect that he will not be re-elected. Then he maximizes the spendings with high level of discretion (these are the procurements which are mentioned in the hypotheses bellow). It is more valuable for him but also more risky but that is not important for him because he will not be probably re-elected.

Hypotheses We want to verify following hypotheses:

> Hypothesis #1: Before/during the election time there is an increase in small-scale contracts.
>
> Hypothesis #2: Before/during the election time there is an increase in soft services purchases.

Hypothesis #3: Before/during the election time there is an increase in awards with zero or small competition.

Hypothesis #4: Before/during the election time there is an increase in awards towards politically connected firms.

Hypothesis #5: Before/during the election time there is an increase in long-term projects.

Methodology The database of public procurements from Econlab database is provided as a data source. The source is basically the Bulletin of Public Procurements under the Information System on Public Procurements and also the Registry of contracts is used for the small-scale procurements. The source of the results about the election will be the data from the Czech Statistical Office.

We also need the information about the elected mayors which can be found on the municipality's websites. We use the materials from the city's assembly in September 2018 to find out who the mayor was in the city before the 2018's election.

We have this as a binary variable (re-elected / non re-elected). We take the mayor before 2018's election and see if he was re-elected. We do the same for the mayor's party (if the party has mayor again) and coalition (same coalition after the election).

For the regression we use some Probit/Logit model as in other papers for similar topic.

Expected Contribution The core of the paper is to analyse if the public authorities spend more money through the public procurements before/during the election time in order to drag the voters to their side or to persuade the swing voters. We will have 2 group (re-elected mayors and the mayors who were not re-elected) and we want to show that re-elected mayors behave with the finances more gently than non re-elected mayors (more transparent and thrifty).

We expect that the procurements given by the re-elected mayors have more competition, are not connected with the politically connected firms, do not have significant rise in procurements before/during the election time.

Outline

1. Introduction
2. Literature Overview
3. Election cycle
4. Data

5. Empirical analysis
6. Results
7. Conclusion

Core bibliography

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Chapter 1

Introduction

The market of public procurements is a field of interest where billions of Czech Crowns are spent each year. There was spent around 633 [1] billion CZK in the public procurements in the Czech Republic in 2018. It represents around 29% of all public spending in 2018. Despite the increasing presence of this topic in public debate, too little research devoted to public procurements exists. The spendings rise to 666 bn CZK in 2019 but numbers are not final yet.

The public procurements are listed in the Bulletin of Public Procurements. The Bulletin is the Information System on Public Contracts, which is under the administration of the Ministry of Regional Development. Since July 2006, all public procurements, which fulfill the conditions of the Public Procurement Act, are listed there. The price limit, when the procurement has to be published and competed, is 2 million CZK for goods and services and 6 million CZK for construction procurements. All procurements under these limits do not have to be competed and thus they are not in the information system and we do not have any information about them (if the procurements are competed then they are in the system but this is just a marginal number).

This way was common until July 1, 2016, when the legislation about Registry of contracts came into efficiency. Since then, all state and public institutions, municipalities, state enterprises and other legal entities with a majority ownership interest and other public institutions are obliged to publish new contracts with a value over 50 000 CZK without the value-added tax. The contracts have to be published in an open and machine-readable format, including metadata. If the contract is not published in 30 days since the contract was awarded then the contract is not effective. Therefore since this date, we have at least several information about the procurements under the lawful price limits.

[1] The Ministry of Regional Development, Accessed: 2020-07-08, http://www.portal-vz.cz/getmedia/bdb1b032-f6cf-4de2-aadd-76491f13f954/Vyrocni-zprava-za-rok-2019-f.pdf

We mention these limits in public procurements because half [2] of the procurements are under these lawful limits and thus do not have to be put under competition. We use these and other price limits in our analysis. The primary aim of this study is to figure out whether higher expenses in different types of public procurements (e.g. small-scale contracts in different price limits) lead to a higher or lower probability of mayors' re-election. The criteria are examined by the ordinary least squares (OLS) method. We focus on spending behavior in the municipalities which have 20 000 or more inhabitants. This covers 59 cities in the Czech Republic.

The present thesis is structured as follows. Chapter 2 includes various sources of literature and a theoretical background to our research. The literature deals with the spending behavior in various levels of the state system (states, regions, municipalities, etc.) and their effect on the re-election probability of elected representatives. Chapter 3 describes very broadly the data sources. It shows how we clean the data set, which procurements we delete and why. Each step is properly explained. Further it also shows how we create our testing data set and how we create the variables in it. Chapter 4 covers our empirical research. We describe the hypotheses we want to test, the methods we use in the analysis, how we deal with the present problems. Finally, we present and discuss our results. At the end, Chapter 5 concludes.

[2]The Ministry of Regional Development, Accessed: 2020-07-08, http://www.portal-vz.cz/getmedia/bdb1b032-f6cf-4de2-aadd-76491f13f954/Vyrocni-zprava-za-rok-2019-f.pdf

Chapter 2

Literature overview and theoretical background

This chapter focuses on theoretical background in various researches and papers which investigate the spending behavior in various levels of the state system (municipalities, regions, states, etc.) and their effect on the re-election probability of elected representatives. We cover different kinds of states in the literature: developed countries like Belgium, Czech Republic, Norway, Israel, but also developing countries like Brazil and Colombia. We mention researches on larger data like OECD economics or US states and we also mention large paper whose data set consists of 74 countries over 40 year time period and different groups like developed and less developed countries, new and old democracies, countries with different government or electoral systems, and countries with various levels of democracy.

We use two types of literature. The first type focuses on various papers which focus on re-election probabilities and political cycles and how these are affected by macroeconomic variables (GDP, unemployment, etc.), ideological variables (right-wing/left-wing), variables based on public investment, or sometimes even more specific, variables based on infrastructure investments in local governments. Mostly tested on panel data. The second type of literature is more connected to our research. The studies focus on re-election probabilities and public spending. For example, paper Dias *et al.* (2018), studies not only re-election probability of mayors, but also re-election of their parties and coalitions. Or the study which focuses on the re-election probability and how to influence the voters by changing the composition of government spending. The rest of the papers focuses on the studies on the data from the Czech Republic. They use data from the state level and also municipalities level. One paper even focuses on the public procurements which are awarded no competition (one bidder).

First we describe the first type of literature. Public investment and its connection to re-election in the level of municipalities are studied by Fiva & Natvik (2013). The paper studies the problem of re-election and public investment using Norwegian panel data. The authors use panel data from Norwegian municipal governments in the period 1972-1999 which covers 7 local election terms. The authors conclude that higher re-election probabilities stimulate investments, particularly in a way that in preferred more strongly by the incumbent parties (mayors' political parties). The authors also show that the parliamentary election results, which are in the middle of the local election periods (t+2 years), affect the re-election probabilities in the next local elections (t+4 years). In other words, the parliamentary election results provide new information to the mayors about their support among voters. The analysis is done separately for right-wing and left-wing mayors (parties) and the results are significant for both groups.

Other papers use Brazilian data in their research. Klein (2010) and Sakurai & Menezes-Filho (2008) also deal with the re-election probability problem. The former paper looks for the presence of political budget cycle in the municipal election and investigates whether there is a higher probability of re-election for mayors who adopt such policy as opposed to whose do not. The authors use panel data of 5 406 Brazilian municipalities (fiscal and electoral data). And they also use the econometric difference-in-differences method and logistic regression method to get the results. The results show that reelectables have a variation in government spending from 0% to 3% higher than non-re-electables. The results also show that an increase in public spending during electoral periods leads to a higher probability of re-election, as long as the spending is done within deficit limits. It shows that re-electables are not necessarily less fiscally responsible.

The latter paper, Sakurai & Menezes-Filho (2008), analyses the connection of mayors' re-election probability and public expenditure. The authors use panel data from 2 000 Brazilian municipalities in the period 1988-2000. There is used a logit fixed-effects model in the paper. The results show that mayors who spend more during their period increase their probability of re-election or the election of the mayor from the same political party (incumbent mayors). The authors analyze separately the spending behavior in election and non-election years. They study how spending behavior affects the chances of re-election for more than one term. The authors describe this as a fiscal manipulation which could potentially increase mayors' popularity among voters (persuade the swing voters) and their probability of re-election.

Goeminne & Smolders (2014) investigates the connection of politics and public infrastructure investments in local governments in Belgium. The authors use a panel

data set of 307 Flemish municipalities in the year 1996-2006. There is used a two stages least squares (2SLS) regression with random effects in the analysis (since the authors have data set with the small number of years comparing to the number of cross-sectional units, the random effects model estimators are more efficient than fixed effects model estimators [Hausman tests suggest that it is safe to do it]). The paper investigates that partisan affiliation and fragmentation affect the level of public infrastructure investments. There is also found that investment policy is affected by the investment policy of neighboring municipalities. The analysis finds a positive interaction effect (own investments changes by 20% of that of neighboring municipalities). As in other mentioned papers, there is found an increase in investments, especially in the year before elections.

Paper Orair *et al.* (2014) investigates the presence of political cycles in fiscal policy and public investments in Brazil. The authors use a different approach than other studies, state-space modeling. One of the differences is that this allows us to consider the presence of cycles in central, state, and local investments and capital transfers of the central government. The paper focuses on the presence of political cycles in economic policy variables and their impact on macroeconomic aggregates. According to the authors, *"the methodology employed is quite simple: it consists of adjusting univariate structural time series model for each series and then evaluating if the estimates of frequency and temporal trajectory of cyclical components are compatible with the political electoral cycles hypothesis."* Among other things, the paper shows that the government investments are influenced by the election year (local elections have a higher influence than state elections).

Brender (2003) focuses on the election results in Israel between 1989 and 1998. The paper focuses on the fiscal performance of local authorities and their re-election probability. The authors use the data for Israel local councils in the time period 1989-1998. There is used probit model for the estimation of the parameters. The authors find out that the fiscal performance was a relevant factor in the 1998 elections (it was not a relevant factor in the 1989 and 1993 campaigns). The authors mention progress in three areas which could be the reason that fiscal performance became a relevant factor. The tendency of voters to focus on local issues. Better availability of information. The imposition of a harder budget constraint by the central government. The authors also did a simulation of the potential effects of policy prescriptions on mayors' re-election probability. According to the authors: *"It appears that, if the new "rules of the game" remain in effect during the current term, relatively moderate policy measures can substantially increase re-election prospects. The two recommendations that stand out are: (I) avoid wage excesses, even if their budgetary effects are offset by other measures, (II) start early. For example, a 2 percent cut*

in current expenditure during the first year in office, used to reduce the deficit, can substantially increase re-election probability. Implementation of the same cut two years before the next election will have a much weaker effect."

A few papers test the hypothesis on a much larger time period and use many countries in the data set instead of one, like Brender & Drazen (2008). It uses a sample of 74 countries and the year period is 1960-2003. The authors use the Probit estimation to examine the effects of growth and deficits (basic statistical data about the countries) on the probability of re-election. The authors argue that incumbents re-election is supported by good economic conditions or expansionary fiscal policy. The authors divide countries into groups like developed/less developed, new/old democracies, countries with different government or electoral systems, and countries with different levels of democracy. The results show that budget deficits in election-year reduce the probability of re-election (developed countries, old democracies). Another finding is that higher growth rates (through the leader's term in office, not only in the election year) of real GDP per capita raise the probability of re-election (this holds for less developed countries and new democracies). Next, low inflation also raises the probability of re-election but only in the developed countries. The authors comment that the results can be connected with the political deficit cycle: *"The effects we find are not only statistically significant but also quite substantial quantitatively. An increase of 1 percentage point in the central government surplus ratio to GDP can increase the probability of re-election by 3-4.5 percentage points in the developed/established democracies and an increase of 1 percentage point in the surplus during an election year increases the probability of re-election by 7-9 percentage points."*

Then we have a few papers which show which other things influence the spending patterns in different types of government.

For example paper Gonçalves *et al.* (2017) investigates public investments in infrastructure and political cycle in connection with the government's ideological bias. This is tested on panel data from Brazilian states in the time period 2003-2014 (covers three political cycles) which covers 26 Brazilian states and the Federal District. The model is tested with fixed effects panel data regression. The results show that left-wing and centrist parties invest more in infrastructure projects in the pre-election period compared to right-wing parties. According to the authors, *"this result also contributes to the literature because it shows that cycles can be more influential depending on the party that is governing."* The paper also brings unexpected results about the infrastructure investment. They have a negative impact which occurs when the governor and the president are the members of the same political party (positive impact was expected).

Paper Rodríguez-Pose *et al.* (2016) finds out whether election results are related to the geographical allocation of public investment. It is tested on Greece data over the period 1975-2009. The results show that the national government focuses more on investments in regions which returned them to the office (better electoral results). The regions with higher electoral results experience a higher level of per capita investments. And apparently, constituencies that elect only one member of parliament (MP) are the greatest beneficiaries of this type of investment distribution (authors call it pork-barrel politics).

The next paper is similar to the previous one which studied ideological bias of government in Brazil. This paper, Štiková (2008), studies the political business cycle and also ideological political cycle (partisan theories) on panel data from the Czech Republic in the time period 1993-2006. The authors use general economic variables like GDP growth, unemployment, inflation, and test the political business cycle with autoregressive ARIMA model (stationary timelines) regression. The results proved the opportunistic behavior of politicians, thus political business cycle holds. On the other hand, the ideological bias is not proved. The author explains that it could be affected by the transformation of the Czech economy from a state-planed economy to a market economy.

Another paper, Azzimonti (2015), studies the connection of public investment and asymmetries in re-election probabilities. According to the author, the government is short-sighted (*"Systematic underinvestment in infrastructure and overspending on targeted goods arise, above and beyond what is observed in symmetric environments."*) due to the different political parties that disagree on targeted public spending. And the party, which is currently in the office, is less short-sighted (larger portion of productive investment). The author uses panel data from 47 US states (a state is the unit of analysis) because they all have the same institutional features and are heterogeneous in terms of citizens' political preferences (the data unavailable for the rest of the states). And the time period is 1970-2011. The results show that equilibrium is asymmetric and public investment is inefficiently low and also fluctuates. The party that has an electoral advantage wins the election more often. Both groups (democrats, republicans) have symmetric preferences over the size of spending and investment but the group with disadvantage spend more and invest less in equilibrium. The author also showed in the paper that *"there is a negative relationship between long-run targeted spending shares and party advantage, and a positive relationship between long-run public investment shares and the political bias."*

The next paper, Alesina & Roubini (1992), focuses on the political cycle in OECD economies with the connection of GNP growth, unemployment, and inflation. The authors *"test the implication of several models of political cycles, both of the "opportunistic" and the "partisan" type."* The authors use panel data of the OECD econo-

mies from the time period 1960-1987 (not all countries are counted because of the unavailability of the data). The results rejected the political business cycle hypothesis and also its extension with endogenous timing of elections (the exception is Japan). Next, the results prove the growth of inflation immediately after elections (could be connected with pre-electoral expansionary fiscal and monetary policy). About the partisan hypothesis, the results *"find evidence of temporary partisan differences in output and unemployment and log—run partisan differences in the inflation rate as implied by the "rational partisan theory" but the results find virtually no evidence of permanent partisan differences in output and unemployment."*

In the following text we discuss the second type of literature we use. The one which is more connected to our research. The paper Dias *et al.* (2018) studies the problem of re-election and public investment on Brazilian data, specifically in one of the Brazilian states (Espírito Santo) and the year 2001-2012. The authors point out that voters tend to evaluate the behavior of politicians in the pre-election period. According to the economic literature, public spending in the pre-election period affects the probability of re-election. The authors mark the 3^{rd} and 4^{th} years of the mandate as pre-election period and the 1^{st} and 2^{nd} year of the mandate as post-election period. The study runs the regression not only for the dependent variable mayor (1 if the mayor was re-elected, 0 otherwise) but also for the dependent variables party (1 if the mayor's party was re-elected, 0 otherwise) and coalition (1 if the coalition was re-elected, 0 otherwise). This is of interest as it shows whether the spending behavior affects only the mayor's chance for re-election or whether it affect also its party and the coalition re-election (we try to use this in our study too). The authors find out that expenses rise each time before the election. The authors *"observe that during the second half of city government terms in 2001-2004, 2005-2008 and 2009-2012, municipalities spent more than R$ 5 billion* [1] *in investment. In parallel to this, ever since the re-election of heads of the executive branch has been permitted by the Brazilian constitution, 82 mayors in the state of Espírito Santo have been re-elected. This constitutes a re-election rate of 43%, considering the municipal elections of 2000, 2004, 2008, and 2012."* The paper proves the pre-election spending with logistic regression, i.e. higher public investment in the pre-election period (compared with the post-election period) increases the probability of mayors' re-election (also parties and coalitions re-election). The mean variation of public investment is significantly greater in re-elected mayors. This could mean that mayors realize more "visible" investments in pre-election periods (investments in streets, schools, hospitals,etc.) Also, the study finds out that an increase in campaign contributions

[1] Brazilian real (BRL), 1 BRL = 5.9 CZK

(compared to other candidates) increases the chance of re-election for mayors, parties and also coalitions.

Drazen & Eslava (2010) study political budget cycle and mayors who try to influence voters by changing the composition of government spending (but not overall expenditures). The present thesis has a similar goal. We focus on the public procurements spending in certain price limits (around 100 000 CZK, 2 million CZK, etc.) or on specific types of public procurements (PR, consulting services, amendments, etc.). The model is tested on Colombian data, respectively on all Colombian municipalities. The time period for the first regression model is 1987-2002. The second model is tested in the time period 1992-2000. The idea of why the paper focuses on the composition of the expenditures is that voters dislike deficits and high government spending (a view consistent with arguments). Thus the electoral manipulation of the budget is understood as shifting spending towards goods voters (and also swing voters) which the party (mayor, coalition) wants to convince. The first model does a separate regression for (the log of) each type of government expenditure using an Arellano-Bond estimation. The second model is estimated with several methods (Generalized method of moments (GMM), ordinary least squares (OLS), Pooled-OLS). The results proved that in an election year the changes in the composition of the budget improve the incumbent's chances for re-election (components of expenditures expand significantly: infrastructure spending, road construction, power, and water plant construction). The authors also find that *"voters penalize the incumbent party for running large deficits before elections and reward it for increasing the amount of targeted spending observed before the election."*

Now we move to the research which was done with the data from the Czech Republic. Paper Plaček *et al.* (2016) studies whether the electoral cycle affects the changes in expenditures of municipalities. It studies expenditures of all municipalities over the period 2003-2013. The authors try to use linear, quadratic, and exponential regression models but in the end, they find out that only the linear model resulted in significant coefficients. The results prove that public expenditures of municipalities are affected by the political cycle. *"However, the political business cycle has at the level of municipalities (compared to the macroeconomic level) its peculiarities. These arise mainly from limited options of municipal politicians to use economic instruments to win electoral votes in elections."* Because the municipalities have limits in the level of debt which they can have. Therefore they have limited options in the usage of economic instruments to win the electoral votes. It is influenced by the public investments and projects that are "visible" to voters at the level of municipalities (try to persuade the swing/undecided voters). The nearer the elections the expenditures on investments rise for all size groups of municipalities (even higher for size groups

of over 50 000 residents).

Then we have papers that deal with the political business cycle on the data from the Czech Republic, JANKŮ (2013), and Sedmihradská *et al.* (2011). The first paper states that one of the failures of the political market is that the politically motivated cycle is driven by the tendency of politicians to maximize their profit from the public function. The goal of the first paper is to find out whether there is the political business cycle at the national level and in positive cases, which type. The authors use the macroeconomic quarterly data and political variables in the time period 1993-2012. There are used linear regression models with autoregressive form and the authors conclude that the *"indexes are influenced in the sense of the Nordhaus model of the political business cycle, which assumes the adaptive expectations of electors and opportunistic behavior by the political authorities."* The results proved that there is an increase in GDP growth rates before the elections which may point to a purposeful influence on this macroeconomic aggregate by the government.

The latter paper deals with the political business cycle at the municipal level. It analyses the influence of municipal council elections on municipal expenditures and whether the probability of re-election of incumbents is affected by the municipal expenditures. The authors use the data for 205 municipalities (those executing extended delegated powers, i.e. municipalities of extended scope) from the Czech Republic in the period 2001-2007 (covers two election years - 2002 and 2006). There are used empirical models with fixed-effects panel data (specifically Least Square Dummy Variable) which test the capital and current expenditure manipulation before elections (whether expenditures are higher before or in the election year). The results show that capital expenditures grow in the election and also the pre-election year(the increase in the election year is bigger). On the other hand, the current expenditures decrease within the same time period. However, according to the authors, *"the results also suggest that politicians are not successful in enhancing their chances for re-election through increased capital expenditures."* Thus the re-election probability is not increased by the capital expenditures manipulation.

Then we have two papers that focus on the expenditures through public procurement in the Czech Republic, Skuhrovec & Soudek (2016), and Centrum aplikované ekonomie (1/2015). The first one presents the first results of the zIndex. According to the authors, it is *"a public procurement benchmarking tool for contracting authorities that measures a deviation from best practice recommendations. zIndex is a composite index mapping many issues in the areas of openness, competition, and transparency."* The variables for the computation deal with things like using the competitive procedure types, procurement law violation, frequent cancellation of tenders, one or very limited number of bidders win a large portion of procurement, a number of bidders

in procurement, publishing the data in the national journal, suppliers connection to the political parties through donations, etc.. It is the first application of this methodology with the data. The sample is 194 Czech municipalities in the time period 2011-2013 and the public procurement used in the paper worth 3 billions EUR. One of the detection is that 10% of the public procurement awarded by the municipalities use the least transparent negotiated procedure without publication with only one bidder (three times above the EU average). The authors claim that the method shows the weak points of municipalities' procurement processes. The results show that public procurement has a low share (30%) on actual purchase volume or that large share (50%) of public procurement was canceled or modified. Finally, there is found a correlation of zIndex with procurement law violations and detected price savings.

The second paper focuses on public procurement with a single bid. It shows the timeline of this procurement for the year 2006-2015 (2006 is the year when the public procurement publishing started - public procurement act came into effectiveness). The authors of the paper emphasize that in 2015, the single bid procurement was the highest in history (they worth 55 billion Czech crowns). They accounted for almost 1/3 of all procurement which puts the Czech Republic among the worst EU countries in international comparison. The rise of the single bid procurement holds for the procurement financed with and also without the EU funds. But the rise is steeper for the procurement financed with the EU funds (they doubled since 2014). The authors argue that the latest trend could be created by the effort to use up the EU funds from the allocated period. The paper shows the division of this procurement among different public authorities in a graph. We are mainly interested in municipalities because we use them in our data set. The municipalities used the single bid procurement in 30% cases in 2015. It is somewhere in the middle among the other public authorities. This is connected to our research through one of the hypotheses which are about single bid procurement.

A few papers deal with the efficiency of public spending. Here we have paper Bendžiková (2018) which deals with the efficiency of the data from the Czech Republic. The former paper investigates the political-budget cycle with the connection of regional spending. The author focuses on the changes in the structure of regional expenditures (changes in current expenses/capital expenditure, but also changes in expenses on education, transportation, culture, health care, or environment). The author uses the data from thirteen Czech regions (Prague is excluded) in the time period 2001-2016. This time period covers four regional elections (2004, 2008, 2012 and 2016). The model is estimated with ordinary least squares method with fixed effects. The results show that there is the political-budget cycle in the level of re-

gions for both, current expenses and capital expenditure. The results also proved that the current expenses grow in the pre-election and election year where they are maximal (try to persuade the swing voters). The types of expenses that grow mostly are health care, culture, and the environment. The capital expenditures grow in the pre-election year because their impact is perceived late. The types that grow mostly are again health care and the environment. On the other hand, the capital expenditures in the election year are lower in transportation and education. The last finding is that there is a political party bias in the expenditures. When there is the same political representation on the national and regional level then in the pre-election year there is a growth of capital expenditures of about 1/3.

Chapter 3

Data Description

This chapter focuses on the description of our data sources and the description of the creation of our testing data set. We describe very broadly our three data sources (the election results, the Bulletin of Public Procurements, and the Registry of contracts). We describe the cleaning process of our original data sets and describe in detail what we delete and why. Next, we describe the creation of our own testing data set. We properly describe the time period we choose, the types of public procurements we use, and then the way how we create our variables. We also mention different methods of creation of our variables and describe why we select the first method. In the end, we show several summary statistics about our testing data set.

3.1 Original data sets

In the analysis, we focus on spending on public expenditures in the municipalities. We focus on the time period after the autumn municipalities' election in 2014 for one election period (October 2014 - September 2018). We take the municipalities which have 20 000 or more inhabitants. The number of these municipalities is 59 and these municipalities represent the largest cities in the Czech Republic. The data for this purpose is not available in just one place. Therefore in order to do our analysis, we have to use several data sources (data about election results and data about public procurements).

The first data data source is the election results. We need the information about the elected mayors which can be found on the municipalities' websites. We use the materials from the municipalities' assembly around January 2015 (after 2014's election and already with the new mayor) and September 2018 (closely before 2018's election) to find out who the mayor was in the municipality before the 2018's election and whether the mayor and coalitions change during the 4 years term. We also collect the information about the mayor's party and coalition which rule the town before

the 2018's election and during the period 2014-2018. Then we find out the elected mayors and coalitions after the 2018's election (in January/February 2019 all the mayors and coalitions were known).

For the collection of this information, we use several sources. We use mainly the website idnes.cz [1] to see the election results. These websites are much more user-friendly than the website of the Czech Statistical Office but they also take the information from the Czech Statistical Office (Czech Statistical Office is responsible for the publication of the election results). These websites are useful for the whole election results and to see how much percent each party got, and also contain the names of the elected representatives. We also use the municipalities' websites and web news articles to find out the created coalitions. The web news articles were also very useful to find out whether the coalition fell apart during the election term. Then we combine all these sources and information and create the binary variable (1 if re-elected, 0 not re-elected) from these data for the mayor, mayor's party, and coalition (same mayor, the same party has mayor, same coalition). The coalition has to be the same as in the previous election term. Then we see the coalition as re-elected. The final data about re-election can be seen in table 3.1.

Table 3.1: Information about the election results

	mayor	mayor's party	coalition
re-elected	23	28	5
not re-elected	35	30	53
sum	58	58	58

Source: Author's calculation

We just have to make several notes about the procedure of how we decided in several cases and why. Here is the list of towns where we have to make a few assumptions:

- Písek: The mayor is the same after the election in the year 2014 and the year 2018 but the mayor's party is different. But because the parties in 2014's election (Jihočeši 2012) and 2018's election (Pro Písek) contains the same representatives we see this as the same party. Thus we see the mayor and mayor's party as re-elected.

- Vsetín: In this case, there was a change of the mayor during the election term. The first mayor was in the office for 2,5 years. Then he was elected into the regional council. The new mayor was in the office for 1,5 years. We take the

[1] 2014: https://www.idnes.cz/volby/komunalni/2014
2018: https://www.idnes.cz/volby/komunalni

first mayor as mayor of town after the 2014's election because he was longer in the office. Both mayors were from the same party. Hence we take mayor as not re-elected and mayor's party as re-elected.

- Strakonice: This case is very special. The 2018's election was canceled by the court. The reason was the disruption of the election campaign. More specifically it was because the party Strakonická veřejnost was favored in Town's newsletter and other areas with political advertising. The party got around 51 percentage points in this canceled election. However, in the end, we decided to take this town into our data set because the pre-election behavior was the same as if the election had not been canceled. And with the result over the 50 percent, the party would not need any other party to make a coalition. We take mayor and mayor's party as re-elected but the coalition as not re-elected. But in December 2019 there was a change. The elections were finally repeated in December 2019 (after courts decided on several levels, even the Constitutional Court, that the elections will be repeated). The elections were dominated by the party Strakonická veřejnost. The party received 64.72% of votes in the repeated elections. Therefore the party can rule the town by itself. That means that our initial decision holds. We take the mayor and his party as re-elected but the coalition as not re-elected.

- Blansko: One part of the coalition has a different name after the 2014's election (Volba pro město) and after the 2018's election (Volba pro Blansko). But the party contains the same representatives. Then we see this as the same party and in this case, also like the same coalition.

- Kroměříž: One party (ANO) fell apart 6 months before the 2018's election but the coalition remains the same till the end of the election period. The mayor was among the people who left the original party (ANO). They created a new party and he became mayor again after the 2018's election. Therefore we take mayor as re-elected. But the mayor's party we take as not re-elected because now the mayor was in a different party. The coalition was different as well.

- Chomutov: The elections were canceled and were repeated in January 2015. The created coalition then fell apart and a new coalition was created. Each coalition was in the government for the same amount of time. We take the mayor, his party and coalition from the second coalition in government. We do this because this coalition rules before the election and is in a better position.

- Jihlava: The created coalition fell apart and a new coalition was created. Each coalition was in the government for the same amount of time. We take the

mayor, his party and coalition from the second coalition in government. We do this because this coalition rules before the election and is in a better position.

- Most: The mayor is the same after the election in the year 2014 and the year 2018 but the mayor's party is different. But because the parties in 2014's election (Severočeši Most) and 2018's election (ProMOST) contains the same representatives we see this as the same party. Thus we see the mayor and mayor's party as re-elected.

- Ústí nad Labem: This case is also very special. After the election in 2014, there was a coalition of parties ANO and PRO!Ústí. The coalition did not withstand even for a year. The ANO party broke up and the representatives elected a new mayor which was again from ANO party. But the representatives did not elect the whole municipal council because there was no coalition agreed. This situation lasted for at least a year. There were several attempts to call-off the mayor. But none of it was successful and the situation remained the same till the election in 2018. There was a situation that anyone can be called off anytime (unstable situation). Therefore we did not take this town (observation) into our data set.

This is the process of selection and description for doubtful cases. After all, the only town (observation) which is not in our data set is Ústí nad Labem and we have 58 observations. Again, the final results about re-election can be seen in table 3.1.

The second data source is the Econlab database (for the data set of 59 municipalities, municipalities with 20 000 inhabitants or more). The source for the Econlab database is the Bulletin of Public Procurements under the Information System on Public Contracts, which is under the administration of the Ministry of Regional Development. Since July 2006, all public procurements, which fulfill the conditions of the Public Procurement Act, are listed there. The data are sometimes incomplete (missing prices, bidders, procedure types, etc.) and inaccurate (wrong identification numbers, typing errors, etc.) but public authorities are not penalized for that. The price limit, when the procurement has to be published and competed, is 2 million CZK for goods and services and 6 million CZK for the construction procurements. All procurements which have greater or equal price are under the condition of the Public Procurement Act.

The data set consists of all the information about each procurement. There is a lot of information from the price, procedure type, CPV codes, size of the procurement (below/above the threshold) or contract signature date to information about EU funds, electronic auction, and buyers'/bidders' contacts, contract date, bid dates, etc. We delete the unnecessary variables which are not useful to us. These are

the variables like contact information to buyers/bidders, information about the central/joint procurement, estimated prices, all EUR prices, or the information about subcontracts. The whole data set contains 20 396 procurements but not all of them are the subject of our interest and not all of them were realized. Therefore we need to clean the data set.

First, we delete the procurements which are connected with the municipality Ústí nad Labem because eventually, we are not using it in our analysis (it is minus 313 procurements). The reasons are mentioned in the section about the election results (a few lines above), but the main reason is the Council instability. Next, we have in our data set a variable called "*STATUS*". It shows at what stage the procurement is. Here we show which we select and why:

- AWARDED: This is the type of procurements we are looking for. The procurement is already awarded (finished). We know the price, the bidder, the type of procurement, etc. (all the information about the procurement).
- ANNOUNCED: The procurements were announced but yet the bidder is not known, or the price. But the contracts still do not have to be awarded. Thus we do not want them in our data set (it is minus 1 743 procurements).
- CANCELED: The procurements were canceled and thus they are not valid. Again, we do not want them in our data set (it is minus 2 026 procurements).
- PREPARED: The prepared procurements have a mostly missing bidder, final price, or award date. They are not in the stage of the closed (awarded) contract. Again, we do not want them in our data set (it is minus 92 procurements).
- "status is missing": This is a case with 7 procurements. Five procurements have missing prices, bidders, and most of the information. One of the contracts is also found among the AWARDED status procurements, and we do not take this one. And the last procurement is missing most of the information. We do not consider this one either. We do not use any of these procurements (it is minus 7 procurements).

Hence in the variable "*STATUS*" we take only the procurements which are AWARDED. This process has removed us 3 868 procurements.

The next thing we care about is the price. We need it because our variables will be based on the expenses. We do not want the procurements without the final price in our data set (it is minus 385 procurements).

Lastly, we have a variable "*AWARD_DATE*" in our data set. It says when the procurement was finally awarded. We care most about the year in this variable. In order to choose the right time period, again we have several notes here about the decisions we make:

- Time period 2015-2018: This is the time period we want. The elections were held in October 2014. But the new political representation and municipalities council were not put in charge of stuff right away (in general - the new political representation is not in charge the day after the election). The municipalities council were appointed during November or December 2014. We expect that it takes a little time before the office is under their direction. Thus for the unification, we expect that the municipalities council manages the municipality from January 2015 till the end of the year 2018. We have shifted the start of the "government of the new municipal council". For the same reason, we have to shift the "end of the council". The next election was held in October 2018 but the new political representation is not in charge the day after the election. The decisions which the old council made are in progress. Therefore we move the end of the council until the end of the year 2018. And thus we care about procurements for the years 2015, 2016, 2017, and 2018. These are the only ones that we want in our data set.

- "date is missing": We do not use these procurements because the date is missing and thus we cannot assign them to a specific year. We do not want these procurements in our data set (it is minus 23 procurements).

- Time period 2006-2014: The procurements in this time period are not the subject of our interest. The procurements in the time period 2006-2013 were assigned by the previous political representations. Also, the procurements in 2014 were assigned by the previous political representation even that the elections were held in October 2014. The reasons are mentioned a few lines above. Thus we do not want these procurements in our data set (it is minus 10 101 procurements).

- Year 2019: On the other hand, the procurements in 2019 were assigned by the next political representation. Thus we do not want these in our data set either (it is minus 366 procurements).

This step shrinks our data set by most. We have lost 10 490 procurements. And with this whole cleaning process, we shrink our data set by 15 056 procurements. Thus our cleaned data set consists of 5 340 public procurements.

We have described the second data source. Now it is time for the last one. The third source is the Registry of contracts. It is the legislation that came into efficiency on July 1, 2016. Since that, every state and public institutions, municipalities, state enterprises and other legal entities with a majority ownership interest and other public institutions are obliged to publish new contracts with a value over 50 000

CZK without the value-added tax. The contracts have to be published in an open and machine-readable format, including metadata. Whether the contract is not published within 30 days from the contract was awarded then the contract is not effective.

The data set consists of variables like contract ID, the title of the procurement, publication date, the authority which insert the contract into the register of contracts (marked as body1), identification number of body1, the logic variable whether body1 authority is a publisher (the authority which published the contract), the information whether the authority from body1 is payer or recipient, the authority which is the other side of the contract (marked as body2), identification number of body2, the logic variable whether body2 is a publisher, the information whether the authority from body2 is payer or recipient, currency, net price and price with value-added tax. The whole data set contains 177 298 procurements. But not all of them have the information we need, first we have to clean the data set a little.

Firstly, as we said, the public authority can be either in variable "*body1*" or in variable "*body2*". It depends who put the contract into the registry of contracts. We edit the data set into the state when "*body1*" is the public authority and "*body2*" is the supplier. Then we have a better view of the contracts and can work with it in a better way.

Next, we delete the public procurements which are connected with the town Ústí nad Labem (same way as in the Bulletin). As we said earlier, we do not take into consideration this municipality in our data set for the reasons that we have mentioned - an unstable situation in the Council (it is minus 3 062 procurements). Also, there is variable "*is_valid*" which represents whether the procurement is valid/rightful. Its value can be true or false. We delete the false ones (it is minus 43 procurements).

Next, there is a variable called "*signature_date*" in the data set. It shows when the procurement was signed. Again, we have several notes here about the decisions we make:

- Time period 2015-2018: We choose the procurements from this specific time period. The reasons for the selection are the same as in the selection in the Bulletin of Public Procurements (we are interested in this specific time period).
- "NULL": NULL means that the selected date is missing. We cannot assign these procurements to a specific year. We do not want these procurements in our data set (it is minus 171 procurements).
- Time period 2006-2014 and year 2019: The procurements from this time period are not the subject of our interest. Again, the reasons are the same as in the Bulletin of Public Procurements (it is minus 16 225 procurements).

Next, the most useful variables for us, which are in the data set, are the price variables, more specifically the variable "*price_net*" (it is the price without the Value-added tax) and the variable "*price_vat*" (it is the price with the Value-added tax). Also, the price does not have to be published in the registry of contracts whether it is part of the business secret. Hence when the price is not available for the variables "*price_net*" and "*price_vat*" at the same time, we take these contracts out of the data set. We cannot use the contracts without the price. When we delete only the contracts where the price is missing in both variables we lose a smaller amount of contracts. At least one price is still available. We lose 24 996 procurements with this step.

We have already deleted the procurements when both prices are missing. Now we calculate the prices without the tax from the prices with the tax (where the price without the tax is missing). We have several values of the value-added tax but we need only one of them. There is a standard rate of 21% (this is the one we use). Then there are two reduced rates, 10%, and 15%. But they are used only for special products (food, public transport, medicines, pharmaceuticals, books, baby foodstuffs). But none of these products is not used in our data set. All the types of procurements we use in our testing data set are in the standard rate tax (21%). We use the "*price_vat*" to calculate the "*price_net*" with the value-added tax rate 21%. This process allows us to use 30 668 procurements which could not be used without this calculation.

Next, the registry of contracts contains not only public procurements but also the contracts which have nothing to do with the procurements like gift contracts, donations, non - investment subsidies, public contracts, job creation agreements, land transfers, future agreements, etc. Therefore we use here the text filtering and delete the contracts which contain specific phrases or words (we use these phrases to identify these contracts which we do not need). This whole process shrinks our data set by 21 233 procurements. The list can be seen below:

- the phrase "poskytnutí dotace" (English: provision of subsidies) → minus 11 007 procurements
- the phrase "darovací smlouva" (English: gift contract) → minus 1 000 procurements
- the phrase "finanční dar" (English: money gift) → minus 56 procurmeents
- the word "darování" (English: donation) → minus 111 procurmeents
- the phrase "neinvestiční dotace" (English: non-investment subsidies) → minus 2 086 procurements

- the phrase "smlouva o budoucí darovací smlouvě" (English: contract for a future donation contract) → minus 24 procurements
- the phrase "poskytnutí finančního daru" (English: making a financial gift) → minus 22 procurements
- the phrase "veřejnoprávní smlouva" (English: public contract) → minus 2 197 procurements
- the phrase "veřejnosprávní smlouva" (English: public contract) → 4 procurements
- the phrase "dohoda o vyhrazení společensky účelného pracovního místa" (English: agreement on the reservation of a socially useful job) → minus 87 procurements
- the words "ekologické" (English: ecological) and "vytápění" (English: heating) at the same time → minus 111 procurements
- the phrase "dohoda o vytvoření pracovních příležitostí" (English: job creation agreement) → minus 376 procurmeents
- the phrase "smlouva o převodu pozemku" (English: land transfer agreement) → minus 21 procurements
- the words "nájem" (English: rent) and "nemovit" (English: real estate) at the same time → minus 49 procurements
- the words "nájem" (English: rent) and "pozemku" (English: land) → minus 363 procurements
- the phrase "smlouva o bezúplatném" (English: gratuitous contract) → 438 procurements
- the phrase "převod pozemků" (English: transfer of land) or "převod pozemku" (English: transfer of land) → minus 235 procurements
- the phrase "nákup pozemků" (English: purchase of a land) or "nákup pozemku" (English: purchase of a land) → minus 9 procurements
- the words "nájemní" (English: rent) and "pozem" (English: ground) at the same time → 183 procurements
- the phrase "zřízení věcn" (English: establishment of material) and the word "břemen" (English: burden) at the same time → minus 1 614 procurements

- the phrase "kupní smlouva" (English: purchase contract) and the word "pozemky" (English: grounds) at the same time → 182 procurements
- the word "směna" (English: shift) → 172 procurements
- the words "postoupení" (English: referral) and "pohledávky" (English: receivables) at the same time → 36 procurements
- the phrase "smlouva o smlouvě budoucí" (English: future agreement) → minus 336 zakázek
- the phrase "smlouva o budoucí" (English: future contract) and the word "smlouvě" (English: the contract) → minus 307 procurements
- the phrase "smlouva o udělení souhlasu" (English: consent agreement) → minus 13 procurements
- the words "smlouva" (English: contract) and "akcií" (English: shares) at the same time → 38 procurements
- the word "audit" (English: audit) → minus 136 procurmeents

From the phrases and words, we can see that it is necessary to use the words in many possible shapes and forms to cover most of the procurements which should be deleted (not used in our data set). This elimination process has deleted 21 233 procurements. These are the contracts that have nothing to do with public procurements (donations, subsidies, land transfers, etc.). We do not want them in our sample because it could distort our analysis.

Next, the registry of contracts contains not just the original contracts but also all of the amendments to the contract. The amendment could be just the original contract with little changes in the performance of the contract. But there is an original contract and also the amendment in the register. We have to make little changes because then we would have counted these contracts twice. Our data set contains also the name of the contracts. Again, we use the text filtering and find all the contracts which include the words "dodatek" (English "amendment") or "dod." (English "amdt.") in the name of the contract. And we delete these procurements from our data set. We shrink our data set by 10 758 procurements with this process. We also find the word "RSEM" in the title of the contracts. This was connected specifically to one municipality and one supplier who labeled the contracts with this word and a numerical code. But all the contracts were amendments to original contract or the contracts which we do not consider anyway. We delete these procurements from our data set too. We lose 197 procurements with this.

And with this whole cleaning process, we shrink our data set by 76 685 procurements. Thus our cleaned data set consists of 100 613 public procurements.

The Bulletin of Public Procurements consists of 5 340 public procurements and the Registry of contracts consists of 100 613 public procurements. We can see the huge difference in the number of procurements. This means that we use mainly the procurements from the Registry of contracts and the Bulletin of public procurements is used for the information which is not included in the register (like the number of bidders in the procurement or competition by the price criterion).

3.2 Creation of our testing data set

Now we have our original data sets clean and ready to create our testing data set and its variables.

In the beginning, we have mentioned that we focus on the time period 2015-2018. But the registry of contracts is efficient since July 1, 2016. Hence our time period shrinks into years 2017-2018 (This is also supported by the numbers from the registry of contracts. In figure 3.1 we can see that the total expenses for the years 2015-2016 are much smaller than for the years 2017-2018. Several municipalities even do not have any contracts in the register for the year 2015.). And the penalty for invalidity of the contract is efficient since July 1, 2017. The penalty is that if the contract is not published in 30 days since the contract was awarded then the contract is not effective. Thus the registry of contracts is fully operational since July 1, 2017. Technically there are not all contracts for the year 2017. But from figure 3.1 we can see that the total expenses for the years 2017-2018 are very similar. We can expect that the vast majority of all contracts are already in the registry of contracts. This means that we have only the years 2017 and 2018 and it leads to the assumption that we take the year 2017 as a pre-election year and 2018 as an election year.

From figure 3.1 we can see that several municipalities have higher expenses in 2018 than in 2017 (sometimes even double). But we also can see that a few municipalities have higher expenses in 2017 than in 2018 (also sometimes even double). And we expect that this does not have to mean that there are missing contracts. It can just mean that the overall expenses through public procurements were smaller.

We also have the number of contracts for individual years in figure 3.2. Again, we can see that the total number of contracts for years 2015-2016 is much smaller than for the years 2017-2018. And again, several municipalities even do not have any contracts in the register for the year 2015. And also we can see that the total number of contracts for years 2017-2018 is very similar. The difference is around 3 000 procurements which are quite a small number in the overall amount of the procurements. As we said we expect that the vast majority of all contracts are

Figure 3.1: Municipalities' expenses from the Registry of contracts

municipality	2015	2016	2017	2018
Hlavní město Praha	438 332 167	11 585 999 879	100 911 359 899	97 720 114 383
Město Blansko	12 955 800	133 245 452	210 142 311	271 068 488
Město Bohumín	3 070 932	99 454 032	227 232 388	305 717 766
Město Břeclav	91 429 729	47 776 648	164 167 295	303 924 430
Město Česká Lípa	10 762 924	99 837 290	221 921 444	1 256 274 200
Město Český Těšín		19 614 788	192 513 957	215 549 482
Město Havlíčkův Brod	22 241 242	83 171 705	235 862 031	310 849 107
Město Hodonín	12 812 718	198 381 855	576 796 344	461 887 735
Město Cheb		186 932 784	274 769 147	410 797 318
Město Chrudim	935 604	69 194 625	138 389 393	137 088 289
Město Jindřichův Hradec	144 054 475	143 546 520	131 672 866	364 894 913
Město Klatovy		37 490 704	113 519 693	243 886 347
Město Kolín	9 015 405	109 708 371	403 451 222	332 079 970
Město Kopřivnice	222 368 433	87 365 275	202 290 665	286 415 965
Město Krnov	58 685 579	85 962 384	229 300 253	276 828 376
Město Kroměříž	844 907	41 080 939	136 517 980	135 502 783
Město Litoměřice		45 768 555	564 041 451	136 436 744
Město Litvínov	215 565	345 419 944	360 659 950	322 268 132
Město Nový Jičín	7 810 899	46 763 458	157 495 622	148 208 974
Město Orlová	48 193 019	219 107 507	154 839 603	276 133 331
Město Písek	40 286 642	189 120 189	781 817 942	353 694 241
Město Sokolov		26 168 175	188 452 837	237 417 696
Město Strakonice	662 661	40 822 199	138 545 614	136 635 954
Město Šumperk	3 149 399	198 030 306	656 085 489	404 907 054
Město Tábor	3 999 280	165 737 435	1 598 610 916	3 898 675 738
Město Trutnov	208 088	96 742 927	571 924 418	183 353 077
Město Třebíč	330 560	69 231 822	415 371 036	515 298 686
Město Třinec		158 979 237	536 317 937	916 716 451
Město Uherské Hradiště	5 974 215	81 785 953	228 951 283	705 623 464
Město Valašské Meziříčí	10 183 948	61 170 973	586 164 676	301 570 348
Město Vsetín	3 460 498	102 303 162	120 778 814	279 034 531
Město Vyškov	3 962 672	240 807 523	135 628 157	93 261 476
Město Znojmo	30 965 830	92 452 836	173 491 208	233 638 791
Město Žďár nad Sázavou	21 669	72 483 874	224 914 080	428 872 091
Statutární město Brno	511 419 557	3 429 875 734	9 333 160 468	13 245 654 075
Statutární město České Budějovice	547 051 336	447 261 431	4 882 820 776	1 123 947 821
Statutární město Děčín	63 451 109	178 673 478	584 098 321	1 238 604 077
Statutární město Frýdek-Místek	77 213 765	127 185 088	619 831 331	570 753 215
Statutární město Havířov	512 500	417 573 344	756 734 038	954 129 324
Statutární město Hradec Králové	290 768 341	307 583 707	1 535 922 739	905 326 185
Statutární město Chomutov	231 016	132 203 816	381 000 969	911 943 772
Statutární město Jablonec nad Nisou	295 652	283 085 675	624 007 661	650 671 423
Statutární město Jihlava	400 000	389 547 025	490 200 726	887 209 811
Statutární město Karlovy Vary	1 971 442	345 239 126	426 719 176	590 035 187
Statutární město Karviná	4 292 508	521 846 265	334 242 707	1 527 810 350
Statutární město Kladno	10 557 569	1 182 146 518	1 480 659 580	2 483 639 027
Statutární město Liberec	41 309 192	197 505 302	3 511 433 701	2 041 448 925
Statutární město Mladá Boleslav	8 705 856	748 090 264	1 422 664 051	975 909 504
Statutární město Most	13 920 263	969 985 185	1 536 742 210	3 026 174 145
Statutární město Olomouc	51 245 015	264 923 997	786 147 728	1 008 952 034
Statutární město Opava	2 212 169	156 931 874	1 169 156 389	1 505 695 844
Statutární město Ostrava	41 176 320	2 186 475 002	4 191 469 003	11 207 131 851
Statutární město Pardubice	6 200 000	440 397 456	1 856 625 547	993 979 985
Statutární město Plzeň	364 822 617	2 951 657 302	13 094 025 520	3 168 322 883
Statutární město Prostějov	2 009 000	900 828 052	453 577 271	740 457 554
Statutární město Přerov	22 849 744	108 461 263	1 148 626 787	403 654 813
Statutární město Teplice	1 953 096	54 987 551	446 389 440	807 715 160
Statutární město Zlín	45 416 796	309 105 306	820 864 683	1 028 205 276
Total expenses	**3 296 919 721**	**32 333 229 090**	**163 851 118 745**	**164 601 998 569**

Figure 3.2: Municipalities' number of contracts from the Registry of contracts

Municipalities	2015	2016	2017	2018
Hlavní město Praha	95	2 681	6 526	6 403
Město Blansko	2	118	346	362
Město Bohumín	6	236	591	613
Město Břeclav	3	125	348	398
Město Česká Lípa	12	86	239	365
Město Český Těšín		73	195	208
Město Havlíčkův Brod	2	96	246	230
Město Hodonín	14	799	1 936	2 014
Město Cheb		238	423	407
Město Chrudim	3	84	305	312
Město Jindřichův Hradec	2	107	193	201
Město Klatovy		69	208	241
Město Kolín	11	161	335	326
Město Kopřivnice	2	85	176	238
Město Krnov	7	144	333	426
Město Kroměříž	1	72	192	188
Město Litoměřice		103	241	287
Město Litvínov	2	81	189	187
Město Nový Jičín	5	94	231	201
Město Orlová	10	129	277	272
Město Písek	3	154	282	261
Město Sokolov		99	283	350
Město Strakonice	2	55	166	247
Město Šumperk	14	144	291	299
Město Tábor	8	215	622	662
Město Trutnov	2	105	183	182
Město Třebíč	2	87	342	439
Město Třinec		118	276	277
Město Uherské Hradiště	5	130	319	296
Město Valašské Meziříčí	3	120	322	264
Město Vsetín	12	60	110	180
Město Vyškov	6	81	132	168
Město Znojmo	10	81	223	201
Město Žďár nad Sázavou	1	86	265	331
Statutární město Brno	43	1 681	3 641	3 858
Statutární město České Budějovice	16	295	507	529
Statutární město Děčín	11	122	304	418
Statutární město Frýdek-Místek	10	161	371	426
Statutární město Havířov	1	314	1 058	1 410
Statutární město Hradec Králové	9	208	578	542
Statutární město Chomutov	10	819	620	587
Statutární město Jablonec nad Nisou	2	214	466	496
Statutární město Jihlava	1	301	647	761
Statutární město Karlovy Vary	4	194	619	744
Statutární město Karviná	7	187	332	450
Statutární město Kladno	11	208	536	645
Statutární město Liberec	13	264	728	664
Statutární město Mladá Boleslav	4	167	363	399
Statutární město Most	12	263	556	697
Statutární město Olomouc	11	390	719	771
Statutární město Opava	2	271	791	897
Statutární město Ostrava	21	1 499	3 653	4 076
Statutární město Pardubice	4	503	1 103	1 050
Statutární město Plzeň	27	1 145	3 374	3 541
Statutární město Prostějov	5	126	302	318
Statutární město Přerov	4	168	331	397
Statutární město Teplice	2	48	232	322
Statutární město Zlín	15	358	881	1 009
Total sum	**490**	**17 022**	**40 058**	**43 043**

already in the registry of contracts and we take only the years 2017 and 2018 and we take the year 2017 as a pre-election year and 2018 as an election year.

Now it is time to show how we create the variables in our testing data set. We are interested in several types of public procurements. The list can be seen below. The data source for the soft services procurements, red flag companies procurements, price limits procurements, and amendments is the Registry of contracts. And the Bulletin of Public Procurements is used for the procurements with zero or small competition and the price criterion procurements.

- **Soft services**: We consider soft services to be things like PR contracts, legal contracts, and consulting contracts.
- **Red flag companies**: Public procurements that are awarded towards the red flag companies. We consider red flag companies to be companies with no employees, offshore companies (companies that are based in a different country from the country of residence of the stakeholder), and companies marked as a firm nest (many companies (hundreds or thousands) that have a residence at the same address (building), also typically only with the reception and no offices, etc.).
- **Price limits**: We are interested in public procurements that are under certain price limits. We have 2 types of these limits. First are the lawful limits (procurements at 2 or 6 million CZK limit). The second is the internal limits (procurements at 1 million CZK limit, 500 000 CZK limit, 200 000 CZK limit, and 100 000 CZK limit). The lawful limits are given by the Public Procurement Act. On the other hand, the internal limits are given by the internal regulations of the municipalities.
- **Amendments**: Here we are interested in the contract amendments.
- **Zero or small competition**: Public procurements with only one bidder.
- **Only price criterion**: The procurements were awarded only by the price criterion.

Now it is time to show how we create our variables. As previously stated, we have only 2 years, 2017, and 2018. Each variable is created for each of these years. And we take one municipality as one observation. This means that for each municipality we have 2 variables for each type of procurements. One for the year 2017 and the other for the year 2018.

$$\frac{ProcurementType_{year}}{TotalExpenses_{year}}; year = 2017, 2018 \tag{3.1}$$

The value in the numerator represents total expenses for different type of procurements (e.g. Soft services or procurements at the 2 million limit) in the selected year (it is 2017 or 2018). On the other hand, the value in denominator represents the total expenses in public procurements of the municipality for the selected year (again, 2017, or 2018). With this process we create all the variables: Soft_services_2017, Soft_services_2018, Red_flags_2017, Red_flags_2018, Amendments_2017, Amendments_2018, etc. The advantage of this method is that the variables are always defined (never gets zero in the denominator because there are always expenses).

Now it is time to show how we create the value in the numerator in equation 3.1. Sometimes it is very easy, like price limits variables. Sometimes it is a little harder, like amendments or soft services variables. Also, in the brackets, we show the names we use for the variables.

- Soft services (**soft**): Here, the logic behind the creation of the variables is very similar. We have the list of companies' identification numbers and the companies' names who historically supply these types of services. The list of identification numbers is based on the Bulletin of Public Procurements. We have separate lists for PR companies, companies for legal contracts, and companies for consulting services. In the analysis, we take these 3 types of procurements together and mark them as "soft services".

  - PR contracts: We take the procurements whose suppliers' identification numbers are on the list for PR companies (the list contains 160 identification numbers) which is mentioned above. With this method, we get 505 procurements. But this process covers only the companies which historically have won at least one procurement in the Bulletin of Public Procurements. It does not cover small procurements which were awarded as procurement below the limit (thus no public competition). We try to solve this problem by the text mining method (which is also used in the cleaning process in the registry of contracts). We take the names of these 505 contracts which we get from the identification numbers. And we find the most frequent words or phrases which are used in the names of these contracts. Then we use these words or phrases to find other procurements that contain them to enlarge our list of procurements (we expect that same words or phrases in the names of the contracts lead to the delivery of the same type of services). We use these specific words, separately: "*reklamní*" (English: advertising), "*inzerce*" (English: advertising), "*marketing*" (English: marketing), "*propagace*" (English: propagation), "*monitoring médi*" (English: media monitoring), "*inzerát*" (English:

advertisement), "*propagaci*" (English: propagation). We also use these specific combinations of words: "*zajištění*" (English: ensurement) and "*prezentace*" (English: presentation), "*zpracování*" (English: processing) and "*tisk*" (English: press), "*vydání*" (English: publication) and "*tisk*" (English: press), "*mediální*" (English: media) and "*objednávka*" (English: order), "*mediální*" (English: media) and "*smlouva*" (English: contract). This process gives us additional 959 procurements. We can see that we almost tripled our list of procurements with this process. This whole process gives us a sample of 1 464 procurements.

– Legal contracts: This type of procurement is easier. We use only the identification numbers. We take the procurements whose suppliers' identification numbers are on the list for legal contract companies (the list contains 215 identification numbers) which is mentioned above. With this method, we get 1 055 procurements.

– Consulting contracts: Here, the process is very similar to the process at the PR contracts. We take the procurements whose suppliers' identification numbers are on the list for Consulting companies (the list contains 23 identification numbers) which is mentioned above. With this method, we get 387 procurements. But this process covers only the companies which historically have won at least one procurement in the Bulletin of Public Procurements. It does not cover small procurements which were awarded as procurement below the limit (thus no public competition). We try to solve this problem by the text mining method (which is also used in the cleaning process in the registry of contracts). We take the names of these 387 contracts which we get from the identification numbers. And we find the most frequent words or phrases which are used in the names of these contracts. Then we use these words or phrases to find other procurements that contain them to enlarge our list of procurements (we expect that same words or phrases in the names of the contracts lead to the delivery of the same type of services). We use these specific combinations of words: "*poradens*" (English: consulting) and "*smlouva*" (English: contract), "*poradens*" (English: consulting) and "*zajištění*" (English: ensurement), "*poradens*" (English: consulting) and "*služeb*" (English: services), "*poradens*" (English: consulting) and "*objednávka*" (English: order), "*poradens*" (English: consulting) and "*činnost*" (English: activity), "*poradens*" (English: consulting) and "*projekt*" (English: project), "*poradens*" (English: consulting) and "*služ*" (English: services). This process gives us an additional 307 procurements. We can

see that we almost doubled our list of procurements with this process. This whole process gives us a sample of 694 procurements.

- Red flag companies (**red_flags**): The logic behind the creation of the variables is very similar. We have a list of companies' identification numbers. The list of identification numbers is based on the internal database of Datlab company (it is the company which focuses on public procurements in the Czech Republic and harvest and clean the data from public sources). We have separate lists for companies with no employees, offshore companies, and companies that have a residence in a firm nest. In the analysis, we take these 3 types of procurements together and mark them as "red flag companies". Also, we can see that the lists of identification numbers contain many more companies than the lists for soft services.

  - No-employees companies: This variable is very easy. It contains companies with zero employees. These companies are also often offshore companies and can have a residence in a firm nest. We take the procurements whose suppliers' identification numbers are on the list for no employees companies (the list contains 72 871 identification numbers) which is mentioned above. With this method, we get 1 162 procurements.
  - Offshore companies: As we said earlier, offshore companies are companies that are based in a different country from the country of residence of the stakeholder. We take the procurements whose suppliers' identification numbers are on the list for offshore companies (the list contains 25 018 identification numbers). With this method, we get 3 466 procurements.
  - Firm-nest companies: A firm nest is an address (building) where many companies (hundreds or thousands) have their residence. Also, typically building only with the reception and no offices, etc.). The companies have here just a virtual address. We take the procurements whose suppliers' identification numbers are on the list for firm nest companies (the list contains 266 471 identification numbers). With this method, we get 7 234 procurements.

- Price limits: The logic behind the creation of the price limit variables is also very similar. The only difference is the values of the limits. We take 5% - 10% range around the limits.

  - 6 million CZK limit (**limitA**): We take the public procurements which price without the Value-added tax is between 5.5 and 6.0 million CZK. The lower limit value is included and the upper limit value is excluded.

The reason is that from the value of 6 million CZK, the procurement is under the conditions of the Public Procurement Act. The sample for this type of procurements consists of 405 procurements.

- 2 million CZK limit (**limitB**): We take the public procurements which price without the Value-added tax is between 1.9 and 2.0 million CZK. The lower limit value is included and the upper limit value is excluded. The reason is that from the value of 2 million CZK, the procurement is under the conditions of the Public Procurement Act. The sample for this type of procurements consists of 639 procurements.
- 1 million CZK limit (**limitC**): We take the public procurements which price without the Value-added tax is between 0.9 and 1.0 million CZK. We use the same logic as in previous cases. The lower limit value is included and the upper limit value is excluded. The sample for this type of procurements consists of 1 126 procurements.
- 500 000 CZK limit (**limitD**): We take the public procurements which price without the Value-added tax is between 450 thousand and 500 thousand CZK. We use the same logic as in previous cases. The lower limit value is included and the upper limit value is excluded. The sample for this type of procurements consists of 1 964 procurements.
- 200 000 CZK limit (**limitE**): We take the public procurements which price without the Value-added tax is between 190 thousand and 200 thousand CZK. We use the same logic as in previous cases. The lower limit value is included and the upper limit value is excluded. The sample for this type of procurements consists of 2 032 procurements.
- 100 000 CZK limit (**limitF**): We take the public procurements which price without the Value-added tax is between 90 thousand and 100 thousand CZK. We use the same logic as in previous cases. The lower limit value is included and the upper limit value is excluded. The sample for this type of procurements consists of 6 510 procurements.

- Amendments (**dodatky**): We have mentioned deleting the amendments from the Registry of contracts data set. Here, we take exactly the expanses on these procurements. These procurements create our value in the numerator in 3.1. The only thing that we have to take care of is that the value in the denominator (the total expenses in the municipality) has to include these amendments procurements to preserve the same logic as in the rest of the variables (percentage value out of total expenses). The sample for this type of procurements consists of 10 955 procurements.

- Zero competition (**bidder**): Here it is simple, we take the public procurements which have only 1 bidder. The sample for this type of procurements consists of 4 000 procurements.
- Price criterion (**price**): Here it is also quite simple again. We take the public procurements which only evaluation criterion was the price criterion. The sample for this type of procurements consists of 1 405 procurements.

We have also tried to use different ways to create our variables. Mainly we have tried to create the variables in a way that each procurement type would have only one variable instead of two (one for each year). But in the end, the methodology mentioned above in equation 3.1 is the best of them.

One way is that we have included only expenses on the types of procurement but not the overall expenses on public procurements. This form is displayed in equation 3.2.

$$\frac{ProcurementType_{2018}}{ProcurementType_{2017}} \tag{3.2}$$

But the negative thing in this procedure is that several municipalities have no expenses in the year 2017 (in some types of procurements). This leads to a problem that we cannot define the variable due to the zero in the denominator. We would have to delete these observations from our data set. This would shrink our data set by about 20 observations and would make our quite small data set even smaller. This is the reason why we have left this way of the creation of the variables.

Another way of the creation is displayed in equation 3.3. We also included only expenses on the types of procurements but not the overall expenses. We use the difference in the expenses between the years 2018 and 2017.

$$\frac{ProcurementType_{2018} - ProcurementType_{2017}}{ProcurementType_{2018} + ProcurementType_{2017}} \tag{3.3}$$

This procedure seems better than the previous one. We can define the variables for all the observations. But in the end, the results are worse than for our original definition (3.1), and the overall model is worse. Also, the assumptions for the model are worse. Therefore we decide to use our original definition.

Based on the information mentioned above, we choose the first method (3.1) for creating the variables which we have also mentioned above. In table 3.2 we can see the basic statistics about the variables. The most important thing is that we have the same number of observations for all the variables. Then the interesting thing is the variable "price". We can see that the maximum is 1.0 which means that at

least one municipality uses only price criterion in their public procurements in the Bulletin of Public Procurements. Also, the minimum is 0.0 in 2017 which means that at least one municipality never uses only price criterion in their public procurements. And the interesting thing here, at the price variables, is also the mean value. We can see that it is very close to 1.0 (2017: 0.96, 2018: 0.91) which means that public procurements in the Bulletin of Public Procurements are very often awarded only by the price criterion. And of course, all the variables are between 0 and 1. This results from our definition of the variables (the type of procurement over the total expenses).

Table 3.2: Summary statistics

variable	Minimum	Median	Mean	Maximum	observations
dodatky_2017	0.00000	0.23188	0.26940	0.79426	58
dodatky_2018	0.00055	0.23753	0.28746	0.82913	58
limitA_2017	0.00000	0.00556	0.01135	0.09323	58
limitA_2018	0.00000	0.01318	0.01872	0.10246	58
limitB_2017	0.00000	0.00382	0.00763	0.07082	58
limitB_2018	0.00000	0.00534	0.00830	0.04232	58
limitC_2017	0.00000	0.00733	0.01014	0.04056	58
limitC_2018	0.00000	0.00706	0.00949	0.05450	58
limitD_2017	0.00000	0.00611	0.00805	0.02930	58
limitD_2018	0.00000	0.00566	0.00746	0.02153	58
limitE_2017	0.00000	0.00295	0.00466	0.02859	58
limitE_2018	0.00000	0.00329	0.00483	0.02455	58
limitF_2017	0.00025	0.00394	0.00603	0.03444	58
limitF_2018	0.00064	0.00344	0.00476	0.02324	58
soft_2017	0.00000	0.00381	0.00696	0.05450	58
soft_2018	0.00020	0.00426	0.00952	0.08935	58
red_flags_2017	0.00543	0.04903	0.12404	0.72351	58
red_flags_2018	0.00539	0.04482	0.08352	0.79559	58
bidder_2017	0.00000	0.06154	0.13630	0.55597	58
bidder_2018	0.00000	0.15683	0.23081	0.98043	58
price_2017	0.00000	0.96030	0.80260	1.00000	58
price_2018	0.13660	0.90780	0.80570	1.00000	58

Source: Author's calculation

Chapter 4

Empirical analysis

Now our testing data set is ready to use. In this chapter we focus on our empirical analysis. We describe our hypotheses and the methods we use. We mention the work with outliers, winsorizing technique (a method which works with outliers), how and whether we group the price limit variables, variables for soft services, and red flag companies. Then we mention our original equation and then our modified equation which is used for the regression. The equation is estimated by the OLS method. Finally, we discuss our results.

4.1 Hypotheses

The primary aim of this study is to figure out whether higher expenses in different types of public procurements lead to a higher or lower probability of re-election. The criteria are examined by the ordinary least square method. The idea behind all the hypotheses is that before the election the elected representatives, who are in charge, can tend to award more small-scale contracts (in different price limits which come out from the lawful limits or from internal limits), more contracts to red flag companies, more soft services contracts, more contracts with small or no competition or more contracts which are awarded only by the price criterion. And we want to determine whether awarding these contracts leads to a higher or lower probability of re-election.

The idea behind the price limit variables is that mayors want to show that they care about the public area (make visible investments). As Dias *et al.* (2018), we want to prove that *"to signal their competence, local leaders tend to realize more "visible" investments in pre-election periods, such as investments in streets, schools, hospitals, etc., taking advantage of the asymmetry of information between leaders and voters."* The reason for amendments is that before the election the mayor can update old contracts and the supplier is bonded to the office even when the political representation changes. It is similar to the soft services but here we also can see it as a quick

expense to a friendly PR, law company before leaving the office. Similarly, paper Plaček *et al.* (2016), studies electoral cycle on data from municipalities in the Czech Republic. The authors conclude that the political business cycle influences the public investments and projects that are "visible" to voters at the level of municipalities. Bellow, we can see the list of hypotheses for testing.

Hypothesis #1: Increased expenses in soft-service purchases during the election year lead to a lower probability of re-election.

Hypothesis #2: Increased expenses in contracts for red flag companies during the election year lead to a lower probability of re-election.

Hypothesis #3: Increased expenses in small-scale contracts with a price between 5.5 and 6.0 million CZK (limitA) during the election year lead to a higher probability of re-election.

Hypothesis #4: Increased expenses in small-scale contracts with a price between 1.9 and 2.0 million CZK (limitB) during the election year lead to a higher probability of re-election.

Hypothesis #5: Increased expenses in small-scale contracts with a price between 0.9 and 1.0 million CZK (limitC) during the election year lead to a higher probability of re-election.

Hypothesis #6: Increased expenses in small-scale contracts with a price between 450 and 500 thousand CZK (limitD) during the election year lead to a higher probability of re-election.

Hypothesis #7: Increased expenses in small-scale contracts with a price between 190 and 200 thousand CZK (limitE) during the election year lead to a higher probability of re-election.

Hypothesis #8: Increased expenses in small-scale contracts with a price between 90 and 100 thousand CZK (limitF) during the election year lead to a higher probability of re-election.

Hypothesis #9: Increased expenses in concluding of amendments during the election year lead to a lower probability of re-election.

Hypothesis #10: Increased expenses in awards with zero competition during the election year lead to a lower probability of re-election.

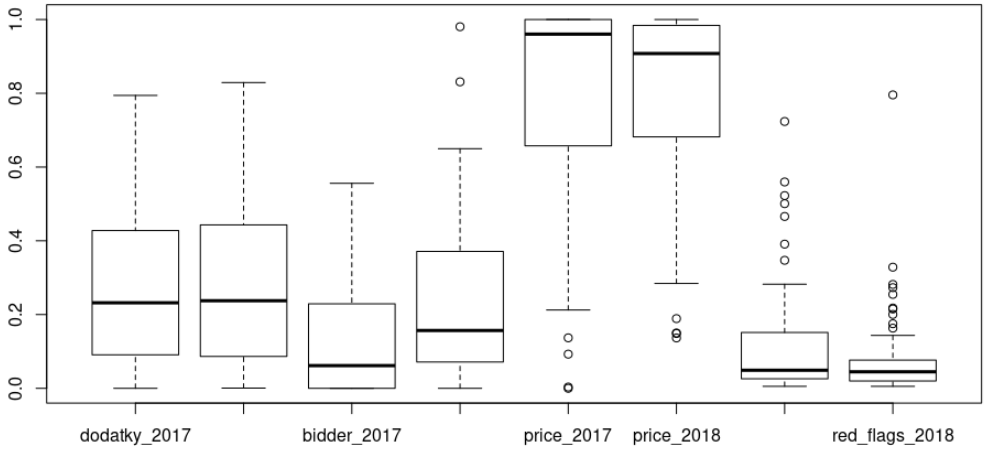
Hypothesis #11: Increased expenses in contracts with only price criterion during the election year lead to a lower probability of re-election.

4.2 Methods

We run the model with the OLS method. But we also try several methods to improve our data to have better results. Below we can see these methods and explanations to each of them.

Outliers: The outliers can be a problem in the model. The outlier is an observation (data point) which is situated in an abnormal distance from other observations (it lies far away from other observations). From figure 4.1 we can see that several variables have no outliers (like "dodatky_2017" or "dodatky_2018"). But a few variables (like "red_flags_2017" or "red_flags_2018") have quite a lot of outliers (a lot compare to the overall 58 observations). Since the price limit variables and soft services variables do not have that big range as other variables, their boxplots, and their outliers can be seen in more detail in figure 4.2. And we can see that each variable has at least one outliers.

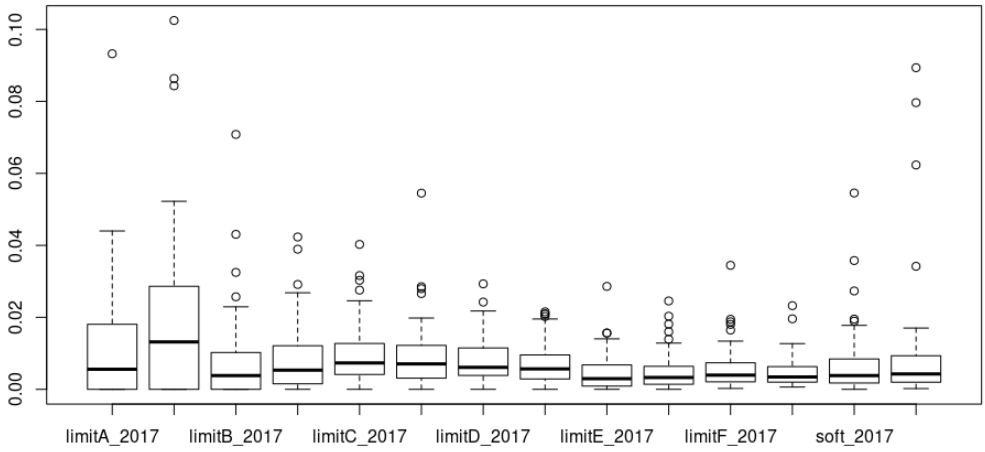
Figure 4.1: Boxplots with amendments, one bidder, only price and red flags variables



In order to fix this problem, we try to remove the outliers. We want to use OLS regression. Whether we remove outlier in one variable we have to remove the whole observation for the whole data set. But our outliers are spread out in a way that when we remove all outliers we remain with 0 observations. Which is rather problematic.

In order to remove at least a few outliers we first try to run the model and see which variables stay in our model (based on their significance). And as a second step we remove the outliers in these variables. We lose observations with this but not all of them like in the previous case. But this step does not lead to any improvement in our

Figure 4.2: Boxplots with price limit and soft services variables



model (worse p-value from F-statistic, lower adjusted R-squared, lower t-statistics). Based on our small sample of observations we decide to keep the outliers in our data set. Because apparently it does not corrupt our model that much based on similar results from both cases.

Winsorizing: But as we know, it is preferable not to have outliers in the model. We do not satisfy ourselves with the conclusion mentioned above. We try to use a statistical method called winsorizing (or winsorization) which works with extreme values (outliers). The method is a way how to minimize the influence of outliers in our data. According to Glen (2016), *"Winsorization can be an effective way to deal with this problem, improve statistical efficiency, and increase the robustness of statistical inferences. The downside is that bias is introduced into your results, although the bias is a lot less than if you had simply deleted the data point. The alternative is to keep the data point as-is, but that may not be the best choice as it could dramatically skew your results."* We use 90% winsorization, where all data below the 5^{th} percentile are set to the 5^{th} percentile, and data above the 95^{th} percentile are set to the 95^{th} percentile. We try to run the model with the data modified this way but the results are not better than our original estimation (again worse p-value from F-statistic, lower adjusted R-squared, lower t-statistics). The direction of the coefficients in the regression in the same, the significance of the variables is a little worse and the overall model is less explanatory than the original model.

Therefore, removing outliers from our data set does not lead to better results. Either adjustment of the outliers does not give us better results. Apparently the outliers are not a big problem in our data.

Grouping price limit variables: We also try to group the price limit variables to reduce the number of our variables. We form two groups from these variables. One of them is the lawful limit variable which contains the procurements at the 2 million and 6 million CZK limits (limitA and limitB). The second variable is the internal limits variable (different price limits which have the municipalities itself). It contains the procurements at 1 million CZK, 500 000, 200 000, and 100 000 CZK limits (limitC, limitD, limitE and limitF).

But this process does not lead to any improvements in our model (again worse p-value from F-statistic, lower adjusted R-squared, lower t-statistics). Moreover, the model is worse when we group the limit variables. Hence we decide to keep these variables separately and then delete the least significant from our model because they do not explain much from our model.

Grouping variables for soft services and red flag companies: In the beginning, we try to take the soft services variables separately and also the red flag companies variables separately. Instead of having the variables soft services, we have variables PR contracts, legal contracts and consulting contracts. Similarly, we have it for red flag companies. Instead of having 2 variables, we have 6 of them. But the model is worse when we split-up these variables. In this case we decide to group these variables into the "soft services" variable and "red flags" variable.

Mayor, party, coalition: We also try to run the same model for different types of dependent variables, as the authors use it in paper Dias *et al.* (2018). The authors use the same model with the dependent variable mayor, party, or coalition to see whether the results are the same or whether they differ. But in the end, we cannot use coalition because we do not have enough re-elected coalitions (only 5) as can be seen in table 3.1. At least we try to run the same regression for the dependent variable "party". But in the end, the results are completely insignificant. Therefore we use only the dependent variable "mayor".

Based on the information mentioned above we create our regression equation. From equation 4.1, we can see that we have 22 variables. It is not a small number and it could cause a model uncertainty. We decide to run the model and delete the variables which are the least significant (we always delete the variable for both years

but we make sure that we do not delete any significant one).

$$\begin{aligned}\text{Mayor}_i = \beta_0 &+ \beta_1\,\text{dodatky\_2017}_i + \beta_2\,\text{dodatky\_2018}_i + \\ &+ \beta_3\,\text{limitA\_2017}_i + \beta_4\,\text{limitA\_2018}_i + \\ &+ \beta_5\,\text{limitB\_2017}_i + \beta_6\,\text{limitB\_2018}_i + \\ &+ \beta_7\,\text{limitC\_2017}_i + \beta_8\,\text{limitC\_2018}_i + \\ &+ \beta_9\,\text{limitD\_2017}_i + \beta_{10}\,\text{limitD\_2018}_i + \\ &+ \beta_{11}\,\text{limitE\_2017}_i + \beta_{12}\,\text{limitE\_2018}_i + \\ &+ \beta_{13}\,\text{limitF\_2017}_i + \beta_{14}\,\text{limitF\_2018}_i + \\ &+ \beta_{15}\,\text{soft\_2017}_i + \beta_{16}\,\text{soft\_2018}_i + \\ &+ \beta_{17}\,\text{red\_flags\_2017}_i + \beta_{18}\,\text{red\_flags\_2018}_i + \\ &+ \beta_{19}\,\text{bidder\_2017}_i + \beta_{20}\,\text{bidder\_2018}_i + \\ &+ \beta_{21}\,\text{price\_2017}_i + \beta_{22}\,\text{price\_2018}_i + u_i\end{aligned} \tag{4.1}$$

We do this step by step. We always delete one type of the variable and then run the model. We check the significance of the variables and also multiple R-squared, adjusted R-squared, and p-value from F-statistic to see whether these numbers rise or fall after deleting the variable. After deleting a variable we want our p-value from F-statistic to fall and multiple R-squared not to fall a lot and adjusted R-squared to rise. It means that our model is more significant and has almost the same explanatory value as the previous one. Little by little, we delete variables **limitC**, **red_flags**, **price**, **limitB**, and **bidder** (every time we delete variable for both years - 2017 and 2018). The results of these models can be seen in Appendix in tables A.1, A.2, A.3, A.4, and A.5. We can see that Residual standard error falls, Adjusted R-squared rises, and p-value from F-statistic falls when we delete variables (in each case).

In the end, our regression equation has a smaller number of variables and can be seen in equation 4.2. Because of the reduction of our model, also the number of our tested hypotheses is reduced. Our tested hypotheses are now Hypothesis #1, Hypothesis #3, Hypothesis #6, Hypothesis #7, Hypothesis #8, and Hypothesis #9.

$$\begin{aligned}\text{Mayor}_i = \beta_0 &+ \beta_1\,\text{dodatky\_2017}_i + \beta_2\,\text{dodatky\_2018}_i + \\ &+ \beta_3\,\text{limitA\_2017}_i + \beta_4\,\text{limitA\_2018}_i + \\ &+ \beta_9\,\text{limitD\_2017}_i + \beta_{10}\,\text{limitD\_2018}_i + \\ &+ \beta_{11}\,\text{limitE\_2017}_i + \beta_{12}\,\text{limitE\_2018}_i + \\ &+ \beta_{13}\,\text{limitF\_2017}_i + \beta_{14}\,\text{limitF\_2018}_i + \\ &+ \beta_{15}\,\text{soft\_2017}_i + \beta_{16}\,\text{soft\_2018}_i + u_i\end{aligned} \tag{4.2}$$

Now we have our model and let us have a discussion over the results.

4.3 Results and discussion

As we mentioned before, our model is tested with the OLS regression. We also mentioned that we run the original model (equation 4.1) and then step by step delete variables which are the least significant. We provide the results of the original model to see how our variables' coefficients change and also how the multiple R-squared, adjusted R-squared, and p-value from F-statistic change. These results can be seen in table 4.1. We can see that the p-value from F-statistic is very high (0.4589, we need 0.05 or lower to see our model better than the model with just intercept) and our adjusted R-squared (value between 0 and 1) is very low (almost 0, thus independent variables do not explain our dependent variable very well) . Thus our model is not very explanatory. We can see that several variables' significance levels is very low, like variables limitC, red_flags, bidder, price, and limitB. These variables are the ones we delete and then run the regression again to see whether we get better results.

The results of the reduced model (equation 4.2) can be seen in table 4.2. We can see that now our Adjusted R-squared is significantly higher (now 0.1995). Thus the model is better than the original one. Also, our p-value from F-statistic is now much lower. Now the F-statistics tells us that the overall addition of variables is significantly improving our model (compare to the model with just intercept).

From the results in table 4.2, we can see that variable limitD is also not very significant (low t value). The presence of this type of variable makes our variable dodatky_2018 significant but the overall model is worse. This comparison can be seen in table 4.3 where are the results of the model without the variable limitD. We can see that our p-value from F-statistic (now 0.01405) is now half compare to the results in the previous model, therefore the variables are more jointly significant. Also, our Adjusted R-squared is bigger. In the end, omitting the variable limitD is a good thing.

Now we can see that insignificant variables are only dodatky and soft services. But these variables prove to be important in the model. We can see that when we delete them from the model (results in table 4.4) then the model is worse (p-value from F-statistic rises, Adjusted R-squared is about one-quarter lower than the previous one, multiple R-squared is also significantly lower). Based on these results from the models we decided to keep our model in table 4.3 as final.

We take our model in table 4.3 as final. But as we can see our F-statistics is not that large (for a small number of observations larger F-statistics value would be better). We need something to support our results, e.g. another model which would confirm our results. And here we help ourselves with the Probit model. Probit model regression results can be seen in table 4.5. We can see that the direction of all the

Table 4.1: Regression results - OLS 1 - original model

	Estimate	Std. Error	t value	Pr(>|t|)	significance
(Intercept)	0.2282	0.3588	0.64	0.5289	
dodatky_2017	0.0710	0.4509	0.16	0.8758	
dodatky_2018	-0.6007	0.3961	-1.52	0.1384	
limitA_2017	-5.1032	5.2704	-0.97	0.3395	
limitA_2018	7.7993	3.7514	2.08	0.0450	*
limitB_2017	0.1615	7.2341	0.02	0.9823	
limitB_2018	-5.4700	7.9733	-0.69	0.4972	
limitC_2017	-0.1073	13.2251	-0.01	0.9936	
limitC_2018	-1.8738	12.7309	-0.15	0.8838	
limitD_2017	-18.9763	19.1585	-0.99	0.3287	
limitD_2018	-1.9523	18.2965	-0.11	0.9156	
limitE_2017	-55.6549	34.2854	-1.62	0.1135	
limitE_2018	41.9117	30.6414	1.37	0.1801	
limitF_2017	30.0162	16.5485	1.81	0.0783	.
limitF_2018	-5.2859	23.7721	-0.22	0.8253	
bidder_2017	0.1079	0.4746	0.23	0.8215	
bidder_2018	0.2333	0.4241	0.55	0.5857	
red_flags_2017	0.1014	0.5145	0.20	0.8449	
red_flags_2018	0.0379	0.6310	0.06	0.9524	
soft_2017	9.0113	8.0627	1.12	0.2713	
soft_2018	5.0948	4.8318	1.05	0.2989	
price_2017	0.1068	0.3325	0.32	0.7500	
price_2018	0.1045	0.4081	0.26	0.7994	

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
Residual standard error: 0.4907 on 35 degrees of freedom
Multiple R-squared: 0.3928, Adjusted R-squared: 0.01108
F-statistic: 1.029 on 22 and 35 DF, p-value: 0.4589

variables is the same (except dodatky_2017, but the values are both very close to zero) which is a good sign. Also, the same variables are seen as significant but also other variables are significant here which is good (but we did not use this model as our main because of the small sample size). And the p-value from F-statistic is very low thus the model is trustworthy. Based on these results and comparing various models we can take our model in table 4.3 as final and reliable.

Now it is time for the interpretation of our results. But first, let us repeat the hypotheses we want to test because with our model with a lower amount of variables we have also a lower amount of hypotheses. Originally, we wanted to test also hypothesis #6 which is about small scale contracts (limitD) but in the end, we omit this variable from our model. The hypotheses which we test are these:

Table 4.2: Regression results - OLS 2 - reduced model

	Estimate	Std. Error	t value	Pr(>|t|)	significance
(Intercept)	0.4640	0.1668	2.78	0.0079	**
dodatky_2017	0.0292	0.3919	0.07	0.9409	
dodatky_2018	-0.5910	0.3347	-1.77	0.0842	.
soft_2017	8.8824	6.6020	1.35	0.1852	
soft_2018	4.5926	3.6881	1.25	0.2195	
limitA_2017	-5.2470	3.8979	-1.35	0.1850	
limitA_2018	7.2066	2.9045	2.48	0.0169	*
limitD_2017	-13.6597	15.0359	-0.91	0.3685	
limitD_2018	-3.0731	13.3606	-0.23	0.8191	
limitE_2017	-58.5263	22.6874	-2.58	0.0132	*
limitE_2018	42.7160	20.7313	2.06	0.0452	*
limitF_2017	27.1659	13.2049	2.06	0.0455	*
limitF_2018	-10.6449	19.5238	-0.55	0.5883	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.4415 on 45 degrees of freedom
Multiple R-squared: 0.3681, Adjusted R-squared: 0.1995
F-statistic: 2.184 on 12 and 45 DF, p-value: 0.02942

Hypothesis #1: Increased expenses in soft services purchases during the election year lead to a lower probability of re-election.

Hypothesis #3: Increased expenses in small-scale contracts with a price between 5.5 and 6.0 million CZK (limitA) during the election year lead to a higher probability of re-election.

Hypothesis #7: Increased expenses in small-scale contracts with a price between 190 and 200 thousand CZK (limitE) during the election year lead to a higher probability of re-election.

Hypothesis #8: Increased expenses in small-scale contracts with a price between 90 and 100 thousand CZK (limitF) during the election year lead to a higher probability of re-election.

Hypothesis #9: Increased expenses in concluding of amendments during the election year lead to a lower probability of re-election.

We have 5 hypotheses for testing. Our results for the hypotheses about the soft services (variables soft) and concluding amendments (variables dodatky) are found not to have a significant effect on mayors' re-election probability. Also, the signs of the variables for soft services are not as we would expect (we expect negative signs, same as the variable dodatky). On the other hand, the signs of the variables dodatky

Table 4.3: Regression results - OLS 3 - final model

	Estimate	Std. Error	t value	Pr(>|t|)	significance
(Intercept)	0.4343	0.1618	2.68	0.0100	*
dodatky_2017	-0.1136	0.3486	-0.33	0.7459	
dodatky_2018	-0.4838	0.3087	-1.57	0.1238	
soft_2017	9.2457	6.5088	1.42	0.1621	
soft_2018	4.8731	3.5863	1.36	0.1807	
limitA_2017	-6.0908	3.7547	-1.62	0.1115	
limitA_2018	6.4605	2.7725	2.33	0.0241	*
limitE_2017	-66.9644	20.7294	-3.23	0.0023	**
limitE_2018	46.5059	19.7550	2.35	0.0228	*
limitF_2017	22.5767	11.8789	1.90	0.0635	.
limitF_2018	-16.6221	16.3456	-1.02	0.3144	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.4367 on 47 degrees of freedom
Multiple R-squared: 0.3543, Adjusted R-squared: 0.217
F-statistic: 2.579 on 10 and 47 DF, p-value: 0.01405

are the same as we would expect (variables lower the probability of re-election). But none of these results is seen as significant.

The variable about the smallest contract value (limitF - 90-100 thousand CZK) is found insignificant for the election year (limitF_2018). On the other hand, we found the variable significant for the pre-election year. Thus mayors who have more contracts in these price limits in the pre-election year tend to have a higher probability of re-election. From table 4.6 we can see that our median value for variable limitF_2017 is 0.00394. When contracting these procurements the probability is higher by about 9% (0.00394*22.5767 = 0.089). But our hypothesis (hypothesis 8) is about the election year (variables limitF_2018). Here we also reject the hypothesis.

Now the rest of our variables for the election year (limitA_2018 and limitE_2018) are found to have a significant effect on the mayors' probability of re-election. Both variables have the signs as we would expect. When the mayors spend money in contracts in price limits around 6 million CZK (limitA) and in price limits around 200 thousand CZK (limitE) then they have a higher probability of re-election by about 8.5% (0.01318*6.4605 = 0.0851) and by about 15.3% (0.00329*46.5059 = 0.153) respectively (again we use the median values for these variables from table 4.6). The reason could be that the spending in the smaller limit can tend to be seen in public (sidewalk repair and similar minor works). On the other hand, the spending on the higher price limit can include higher investments (repair of the municipality square and similar works). Thus these procurements could be seen as the spending to persuade the swing voters (undecided voters). We have proved similar results, as paper Dias *et al.* (2018), that *"local leaders tend to realize more "visible" investments,*

Table 4.4: Regression results OLS 4

	Estimate	Std. Error	t value	Pr(>|t|)	significance
(Intercept)	0.3190	0.1248	2.56	0.0136	*
limitA_2017	-3.9303	3.7774	-1.04	0.3030	
limitA_2018	7.3801	2.8181	2.62	0.0116	*
limitE_2017	-57.4614	20.3769	-2.82	0.0068	**
limitE_2018	47.1703	19.7385	2.39	0.0206	*
limitF_2017	17.6707	11.9587	1.48	0.1457	
limitF_2018	-17.3197	16.5895	-1.04	0.3014	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.4512 on 51 degrees of freedom
Multiple R-squared: 0.2518, Adjusted R-squared: 0.1638
F-statistic: 2.861 on 6 and 51 DF, p-value: 0.01767

such as investments in streets, schools, hospitals, etc." All these investments (or part of them) could be around our price limits. Similar results are presented in Drazen & Eslava (2010) where authors argue that "*rational voters may support an incumbent who targets them with spending before the election even though such spending may be due to opportunistic manipulation.*" We have proved that higher spending in price limits around 6 million CZK and 200 thousand CZK increase the mayors' probability of re-election.

Table 4.5: Regression results - Probit model

	Estimate	Std. Error	z value	Pr(>|z|)	significance
(Intercept)	0.2916	0.6481	0.45	0.6528	
dodatky_2017	0.6559	1.4417	0.45	0.6491	
dodatky_2018	-3.7934	1.6639	-2.28	0.0226	*
soft_2017	62.6145	27.5583	2.27	0.0231	*
soft_2018	22.3692	23.3531	0.96	0.3381	
limitA_2017	-66.7123	27.7912	-2.40	0.0164	*
limitA_2018	38.9646	13.1441	2.96	0.0030	**
limitE_2017	-458.7195	155.9965	-2.94	0.0033	**
limitE_2018	332.4765	111.9662	2.97	0.0030	**
limitF_2017	109.5958	46.1537	2.37	0.0176	*
limitF_2018	-119.6710	65.0146	-1.84	0.0657	.

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
(Dispersion parameter for binomial family taken to be 1)
Null deviance: 77.904 on 57 degrees of freedom
Residual deviance: 46.024 on 47 degrees of freedom
AIC: 68.024, Number of Fisher Scoring iterations: 8
change in deviance: 31.88011, change in degrees of freedom: 10
chi square test p-value: 0.0004192793

Table 4.6: Reduced summary statistics

variable	Minimum	Median	Mean	Maximum	observations
dodatky_2017	0.00000	0.23188	0.26940	0.79426	58
dodatky_2018	0.00055	0.23753	0.28746	0.82913	58
limitA_2017	0.00000	0.00556	0.01135	0.09323	58
limitA_2018	0.00000	0.01318	0.01872	0.10246	58
limitE_2017	0.00000	0.00295	0.00466	0.02859	58
limitE_2018	0.00000	0.00329	0.00483	0.02455	58
limitF_2017	0.00025	0.00394	0.00603	0.03444	58
limitF_2018	0.00064	0.00344	0.00476	0.02324	58
soft_2017	0.00000	0.00381	0.00696	0.05450	58
soft_2018	0.00020	0.00426	0.00952	0.08935	58

Source: Author’s calculation

Chapter 5

Conclusion

The present thesis is devoted to public procurements. It is a field of interest where billions of Czech Crowns are spent each year. We focus on spending on public expenditures in the municipalities in the Czech Republic. Our sample consists of 58 largest municipalities in the Czech Republic which have 20 000 inhabitants or more and we focus on the time period 2017-2018. We use several data sources. The first data source is the election results from years 2014 and 2018 and the data are harvested manually. The second data source is the Bulletin of Public Procurements which is the Information System on Public Contracts. The last data source is the Registry of contracts. It is the legislation which states that every state and public institutions, municipalities, state enterprises and other legal entities with a majority ownership interest, and other public institutions are obliged to publish new contracts with a value over 50 000 CZK without the value-added tax.

First, we focus on different researches on the political business cycle, spending behavior, and re-election probability of elected representatives. The researches cover different kinds of states (developed and developing countries - Belgium/Colombia) or the researches are even made across states (OECD economies/US states). One paper even focuses on groups like developed and less developed countries, new and old democracies, and various levels of democracy.

Then we present our different data sets and show how we clean them. The process of cleaning is described in detail. We very broadly describe which procurements we delete and why to show that they are not necessary for our data set. Then we show how these clean data sets are used for the creation of our testing data set. We mention different methods of creation of our variables and explain why we use specifically this method. Also, we describe our types of variables in detail in order to understand which procurements they should cover.

The next step is our empirical analysis. The primary aim of this thesis is to figure out whether higher expenses in different types of public procurements (e.g. small-

scale contracts in different price limits) lead to a higher or lower probability of mayors' re-election. The criteria are examined by the ordinary least squares (OLS) method. First, we describe our hypotheses and explain the ideas behind them. Then we show several methods we try to use to improve our data set (work with outliers, winsorizing technique, grouping price limit variables, grouping variables for soft services, and red flag companies). Based on this information we create our regression equation.

Finally, we discuss our results. We describe several models and show why we used the reduced model. Also, with the reduced model, our hypotheses for testing have also reduced and we show which of them we test. Then we interpret our results. All the hypotheses are related to the variables from the year 2018. The hypotheses about the soft services, amendments, and small-scale contracts around 100 000 CZK limits are not proved. The variables are seen as insignificant based on their t-tests. The only hypotheses we prove are about the small-scale contracts in price limits 6.0 million CZK (limitA_2018) and 200 000 CZK (limitE_2018). These price limits lead to a higher probability of mayors' re-election. Whether mayors spend more through these procurements in these price limits in election year then they have a higher probability that they are going to be re-elected. The results about these hypotheses corroborate the results in other papers like Dias *et al.* (2018) or Drazen & Eslava (2010). It is that local leaders realize a more visible investment in the election period, like the investment in streets, hospitals, cities' squares, etc. to persuade the swing/undecided voters.

The present thesis shows that the Registry of contracts is a useful data source. We have a chance to prove the hypotheses about the price limits which probably would not have been proved without this data source (only a limited number of these procurements is available in the Bulletin of Public Procurements). The legislation about the Registry of contracts is efficient for a short period of time but we still are able to get at least some information from that. As the contracts in this system will be rising then the analyses could be done not only for a short period of time as we do but also for longer time periods in panel data as other papers.

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Appendix A

Appendix

Table A.1: Deleting variables limitC

	Estimate	Std. Error	t value	Pr(>|t|)	significance
(Intercept)	0.2272	0.3485	0.65	0.5184	
dodatky_2017	0.0598	0.4286	0.14	0.8898	
dodatky_2018	-0.5965	0.3839	-1.55	0.1287	
soft_2017	9.2294	7.5639	1.22	0.2301	
soft_2018	4.8034	4.2869	1.12	0.2697	
limitA_2017	-5.2332	4.7553	-1.10	0.2782	
limitA_2018	7.6708	3.3688	2.28	0.0287	*
limitB_2017	0.2862	6.9754	0.04	0.9675	
limitB_2018	-5.3331	7.4977	-0.71	0.4814	
limitD_2017	-19.0640	18.4911	-1.03	0.3092	
limitD_2018	-2.8260	15.6018	-0.18	0.8573	
limitE_2017	-56.4535	28.3220	-1.99	0.0536	.
limitE_2018	41.5226	24.1696	1.72	0.0942	.
limitF_2017	30.3661	15.3909	1.97	0.0560	.
limitF_2018	-5.8397	22.8308	-0.26	0.7995	
red_flags_2017	0.1198	0.4841	0.25	0.8060	
red_flags_2018	0.0304	0.6119	0.05	0.9607	
bidder_2017	0.1021	0.4600	0.22	0.8256	
bidder_2018	0.2499	0.3952	0.63	0.5310	
price_2017	0.1072	0.3224	0.33	0.7415	
price_2018	0.0987	0.3929	0.25	0.8031	

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
Residual standard error: 0.4774 on 37 degrees of freedom
Multiple R-squared: 0.3924, Adjusted R-squared: 0.06395
F-statistic: 1.195 on 20 and 37 DF, p-value: 0.3113

Table A.2: Deleting variables red flags

	Estimate	Std. Error	t value	Pr(>|t|)	significance
(Intercept)	0.2499	0.3201	0.78	0.4398	
dodatky_2017	0.0582	0.4176	0.14	0.8899	
dodatky_2018	-0.5888	0.3712	-1.59	0.1208	
soft_2017	9.3942	7.1522	1.31	0.1967	
soft_2018	4.5164	4.0536	1.11	0.2720	
limitA_2017	-5.2601	4.6330	-1.14	0.2632	
limitA_2018	7.7169	3.2710	2.36	0.0234	*
limitB_2017	0.1522	6.7487	0.02	0.9821	
limitB_2018	-5.0057	7.2023	-0.70	0.4912	
limitD_2017	-19.9610	17.5161	-1.14	0.2614	
limitD_2018	-1.7292	14.7047	-0.12	0.9070	
limitE_2017	-53.5686	25.5393	-2.10	0.0425	*
limitE_2018	39.7445	22.6866	1.75	0.0877	.
limitF_2017	30.1811	14.8784	2.03	0.0494	*
limitF_2018	-6.5223	22.1195	-0.29	0.7697	
bidder_2017	0.0940	0.4475	0.21	0.8348	
bidder_2018	0.2718	0.3715	0.73	0.4688	
price_2017	0.1166	0.2972	0.39	0.6970	
price_2018	0.0730	0.3714	0.20	0.8452	

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
Residual standard error: 0.4655 on 39 degrees of freedom
Multiple R-squared: 0.3911, Adjusted R-squared: 0.1101
F-statistic: 1.392 on 18 and 39 DF, p-value: 0.19

Table A.3: Deleting variables price

	Estimate	Std. Error	t value	Pr(>|t|)	significance
(Intercept)	0.3791	0.2336	1.62	0.1123	
dodatky_2017	0.0535	0.4081	0.13	0.8964	
dodatky_2018	-0.5821	0.3497	-1.66	0.1036	
soft_2017	8.6883	6.9015	1.26	0.2152	
soft_2018	4.3324	3.8744	1.12	0.2700	
limitA_2017	-4.9810	4.3053	-1.16	0.2540	
limitA_2018	7.9782	3.1483	2.53	0.0152	*
limitB_2017	-0.1839	6.5723	-0.03	0.9778	
limitB_2018	-4.9774	6.9928	-0.71	0.4806	
limitD_2017	-16.3785	16.1408	-1.01	0.3162	
limitD_2018	-1.1695	14.2938	-0.08	0.9352	
limitE_2017	-53.3076	24.9299	-2.14	0.0385	*
limitE_2018	40.0945	22.1207	1.81	0.0772	.
limitF_2017	29.5843	14.5454	2.03	0.0485	*
limitF_2018	-7.7829	20.4767	-0.38	0.7058	
bidder_2017	0.1141	0.4260	0.27	0.7901	
bidder_2018	0.2475	0.3247	0.76	0.4503	

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
Residual standard error: 0.4561 on 41 degrees of freedom
Multiple R-squared: 0.3854, Adjusted R-squared: 0.1456
F-statistic: 1.607 on 16 and 41 DF, p-value: 0.1105

Table A.4: Deleting variables limitB

	Estimate	Std. Error	t value	Pr(>|t|)	significance
(Intercept)	0.3498	0.2260	1.55	0.1290	
dodatky_2017	0.0570	0.4006	0.14	0.8875	
dodatky_2018	-0.6076	0.3418	-1.78	0.0825	.
soft_2017	9.1864	6.7124	1.37	0.1782	
soft_2018	4.5773	3.7804	1.21	0.2326	
limitA_2017	-4.9164	4.0972	-1.20	0.2367	
limitA_2018	7.5115	2.9817	2.52	0.0156	*
limitD_2017	-16.1953	15.8181	-1.02	0.3116	
limitD_2018	-1.2738	13.7424	-0.09	0.9266	
limitE_2017	-53.4287	24.1064	-2.22	0.0320	*
limitE_2018	39.3590	21.4433	1.84	0.0734	.
limitF_2017	30.4888	14.0149	2.18	0.0351	*
limitF_2018	-9.9031	19.8814	-0.50	0.6209	
bidder_2017	0.1319	0.4174	0.32	0.7535	
bidder_2018	0.2512	0.3190	0.79	0.4355	

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
Residual standard error: 0.4482 on 43 degrees of freedom
Multiple R-squared: 0.3777, Adjusted R-squared: 0.1751
F-statistic: 1.864 on 14 and 43 DF, p-value: 0.05941

Table A.5: Deleting variables price

	Estimate	Std. Error	t value	Pr(>|t|)	significance
(Intercept)	0.4640	0.1668	2.78	0.0079	**
dodatky_2017	0.0292	0.3919	0.07	0.9409	
dodatky_2018	-0.5910	0.3347	-1.77	0.0842	.
soft_2017	8.8824	6.6020	1.35	0.1852	
soft_2018	4.5926	3.6881	1.25	0.2195	
limitA_2017	-5.2470	3.8979	-1.35	0.1850	
limitA_2018	7.2066	2.9045	2.48	0.0169	*
limitD_2017	-13.6597	15.0359	-0.91	0.3685	
limitD_2018	-3.0731	13.3606	-0.23	0.8191	
limitE_2017	-58.5263	22.6874	-2.58	0.0132	*
limitE_2018	42.7160	20.7313	2.06	0.0452	*
limitF_2017	27.1659	13.2049	2.06	0.0455	*
limitF_2018	-10.6449	19.5238	-0.55	0.5883	

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
Residual standard error: 0.4415 on 45 degrees of freedom
Multiple R-squared: 0.3681, Adjusted R-squared: 0.1995
F-statistic: 2.184 on 12 and 45 DF, p-value: 0.02942

Figure A.1: OLS assumption 1

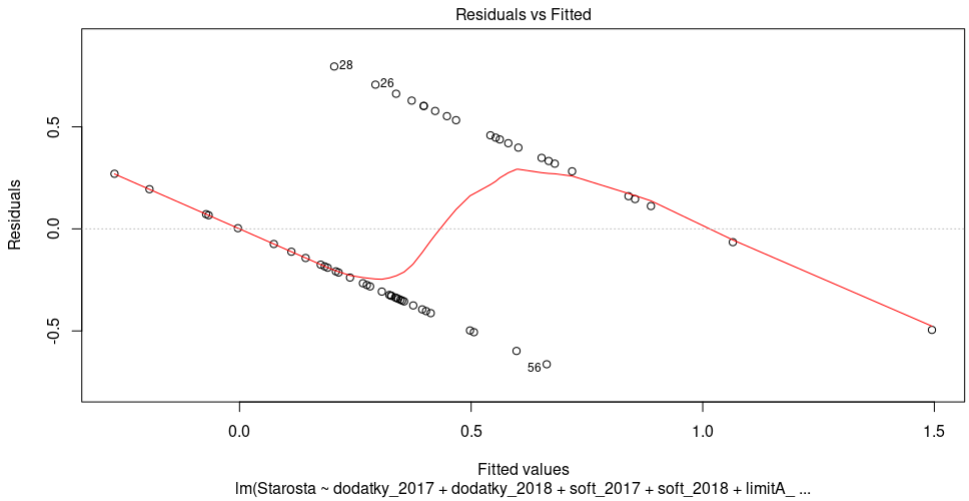

Figure A.2: OLS assumption 2

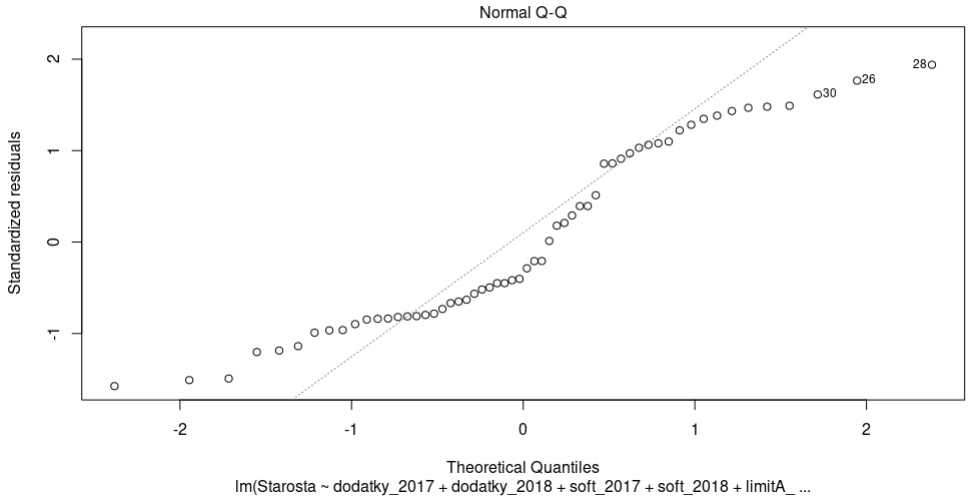

Figure A.3: OLS assumption 3

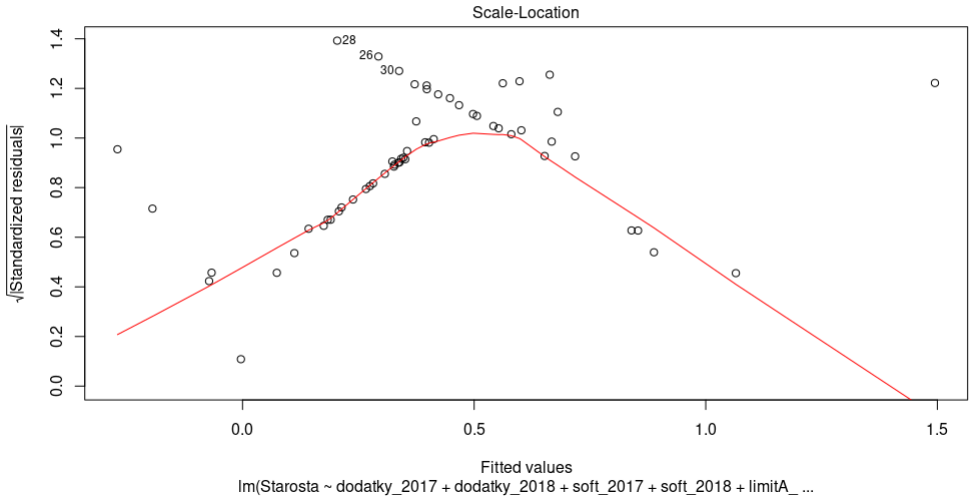

Figure A.4: OLS assumption 4