Charles University

Faculty of Social Sciences
Institute of Economic Studies

MASTER'S THESIS

Public Procurement and Budgeting of Municipalities

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Declaration of Authorship

The author hereby declares that she compiled this thesis independently; using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

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Prague, December 9, 2023 Kristýna Šafářová

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Abstract

This thesis analyzes the spending behavior of municipalities regarding public contracts, mainly the relationship between municipal public procurement spending and fixed capital formation, using a unique panel dataset containing data on 3,404 Czech municipalities for the years 2011–2022 made specifically for this purpose. The relationship was found significant and positive regardless of other municipalities' characteristics: size, regional affiliation, and political affiliation. Although the distribution of spending on public procurement during municipal election terms pointed to a certain degree of opportunistic spending in the years of elections, no definitive conclusion could be made for the subset of parties present both in the municipal and national government at the same time. It was also found that in most cases, the established national political parties ruling in municipalities are more likely to invest in all three main contract types (construction works, services, supplies) as opposed to having no contract when compared to independent candidates. A prediction of future short-term gross fixed capital formation was ruled out as unreliable using the dataset in question.

JEL Classification	C55, C81, H57, H72
Keywords	public procurement, budgeting of municipalities, municipal capital expenditure, fixed capital formation, municipal political affiliation
Title	Public Procurement and Budgeting of Municipalities

Abstrakt

Tato práce analyzuje výdajové chování obcí v oblasti veřejných zakázek, především vztah mezi obecními výdaji na veřejné zakázky a tvorbou fixního kapitálu, s využitím unikátního panelového souboru dat obsahujícího údaje o 3 404 českých obcích za roky 2011–2022, který byl vytvořen speciálně pro tento účel. Tento vztah byl shledán významným a pozitivním bez ohledu na další charakteristiky obcí: velikost, regionální příslušnost a politickou příslušnost. Přestože rozložení výdajů na veřejné zakázky během volebních období v obcích ukazovalo na určitou míru oportunistického utrácení v letech voleb, nebylo možné učinit jednoznačný závěr pro strany, které byly současně přítomny v obecní i celostátní vládě. Bylo také zjištěno, že ve srovnání s nezávislými kandidáty investují ve většině případů národní zavedené politické strany vládnoucí v obcích častěji do všech tří hlavních typů zakázek (stavební práce, služby, dodávky) než do žádných zakázek. Předpověď budoucí krátkodobé tvorby hrubého fixního kapitálu s využitím daného souboru dat byla vyloučena jako nespolehlivá.

Klasifikace	C55, C81, H57, H72
Klíčová slova	veřejné zakázky, hospodaření obcí, kapitálové výdaje obcí, tvorba fixního kapitálu, politická příslušnost obcí
Název práce	Veřejné zakázky a hospodaření obcí

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Acronyms

ADF Augmented Dickey-Fuller

CPV Common Procurement Vocabulary

EC European Commission

EEA European Economic Area

EU European Union

GLS Generalized Least Squares

ISVZ Information System on Public Procurement (“Informační systém o veřejných zakázkách” in Czech)

Master's Thesis Proposal

Author:	Bc. Kristýna Šafářová
Supervisor:	Mgr. Roman Kalabiška
Defense Planned:	June 2023

Proposed Topic:
Public Procurement and Budgeting of Municipalities

Motivation:
According to the report published by the Czech Ministry of Regional Development (2021), the share of public procurement market on GDP was 12.65 % in 2020 and had been gradually increasing in the previous years. Public procurement is thus a crucial component of a nation's economy. However, this subject has not been explored in sufficient depth in the case of the Czech Republic. In particular, the relationship between the award of public contract and the expenditure on fixed capital at the municipal level in our country has not been under scrutiny by researchers, although it plays a key role in the municipal investment activities and local policymakers' decisions.

Public procurement on the national and local level has been studied from various perspectives in different countries. Flynn (2018) uses data collected by the European Commission, analysing the gaps in the procurement performance among the EEA countries. The management and structure of local public purchasing activities was studied for example by Glock and Broens (2013), focusing on German municipalities, or Patrucco (2020), studying the case of municipalities in Italy and the USA. Gori et al. (2017) assess the factors behind the long duration of public works in municipalities in an Italian region, highlighting the lack of expertise and experience. Another stream of interest in the public spending literature concerns the political budget cycles, i.e., the relationship between elections and government spending. The primary question here is whether the fiscal policy of incumbent governments' changes significantly prior to the elections in order to increase the chances of reelection. The presence of these cycles, as well as the conditions under which they occur the most frequently, have been studied on both the national and subnational level with data from various countries - e.g., by Castro and Martins (2017) or Veiga and Veiga (2007).

Regarding the research on public procurement in the Czech Republic, the behavior of the contracting authorities and its consequences was analysed by Nikolovova et al. (2012). Sedmihradska et al. (2011) focus on the political business cycle at the municipal level. Chvalkovska and Skuhrovec (2010), using the Czech Public e-Procurement System, construct a unique Transparency Index, rating the public contractors. However, to the best of my knowledge, no past research examined the municipalities' public procurement and its relationship with the fixed capital investment.

Moreover, this relationship studied on micro-level data might have other interesting implications. For example, the Ministry of Finance of the Czech Republic publishes quarterly Macroeconomic Forecast which includes the investment indicator for the Czech Republic (gross fixed capital formation), relying mostly on

macro-level data. It usually includes predictions for 4 consecutive years, which tend to be highly volatile and could be imprecise in certain parts of the economic cycle. When used as an alternative to these official numbers, the investment predictions based on micro-level public procurement data could lead to more accurate, even if only short-term, estimates.

Hypotheses:

1. Hypothesis #1: The distribution of the aggregate values of the public procurement indicates an uneven municipalities' spending during the election terms (more spending close to the end of election term).
2. Hypothesis #2: The municipal authorities' affiliation to political parties determines the type of public procurement contracts which they choose to invest in.
3. Hypothesis #3: The relationship between the aggregate value of municipalities' public procurement and their investment (fixed capital formation) is not homogeneous – it is influenced by other municipalities' characteristics, such as their size, regional affiliation, distribution of their public procurement spending, or political affiliation.
4. Hypothesis #4: There is a positive correlation between the aggregate value of municipalities' public procurement and their investment (fixed capital formation).
5. Hypothesis #5: Based on these findings, the prediction of future investment (gross fixed capital formation) is possible.

Methodology:

The data I will be using come from two main sources: First, the aggregate values of the municipalities' public procurement activities will be taken from the Information system on public procurement managed by the Ministry of Regional Development of the Czech Republic. Second, the data on municipalities' investments (fixed capital formation) will be taken from Treasury Monitor, an application of the Ministry of Finance of the Czech Republic, containing Czech public finance data. I will analyse the period between 2010-2022 (the latest available data), altogether consisting of four election terms. These two sources will also be accompanied by data on political affiliation of the contracting authorities in individual municipalities, obtained as a combination of two sources – website volby.cz, run by the Czech Statistical Office, and open data provided by the Ministry of the Interior of the Czech Republic.

The first step of my analysis will consist of the assessment of the distribution of public procurement values for each election term separately, indicating whether there is any sign of increased spending near the end of the term. Secondly, I will divide the municipalities' procurement contracts based on their type and match individual municipalities with the political affiliation of their leaders. For those affiliated with established political parties, I will determine whether it is the case that certain parties tend to prioritize certain types of public procurement contracts.

A fixed-effects regression will follow, where the dependent variable will be the municipalities‘ investments and the independent variable will be the delayed value of municipalities‘ public procurement activities (delayed in terms of the length of the contract), supplemented by other municipalities' characteristics – namely their size, regional affiliation, distribution of their public procurement spending, and political affiliation. Finally, based on these findings, the relationship between the municipalities' fixed capital investment and public procurement will be assessed, and potentially used to make a prediction of the gross fixed capital formation in the short-term future (ca. 1 year).

Expected Contribution:
I will conduct an analysis of the municipal fixed capital investment in a form which has not been previously employed in the case of the Czech Republic. Moreover, the analysis will rely on an extensive micro-level dataset, put together for the purpose of this study, which could be further used for answering other research questions regarding municipalities' public procurement. The most important contribution will lie in the micro-data-based prediction of municipalities' investment, which might serve as an enhancement of the macroeconomic predictions made by the Ministry of Finance, possibly leading to a more precise short-term estimate. The findings might as well provide answers to other questions regarding managing local procurement in the Czech Republic, specifically, whether mayors from one political party prefer certain types of local investments, compared to mayors from other parties, and serve as a foundation for further in-depth research on the topic, contributing to the debate on well-functioning municipal budgeting.

Outline:
1. Introduction
2. Theory – I will briefly describe the Act on Public Procurement of the Czech Republic, and how the contracts work.
3. Literature review – I will introduce the topics regarding public procurement and municipalities' investments in the existing literature.
4. Data and methodology – I will outline the process of gathering the panel data and the regressions used.
5. Results – I will describe my findings.
    i) Distribution of the public procurement contracts within the election terms
    ii) Determination of where the individual political parties tend to invest the most
    iii) Relationship between the municipal investment and public procurement, as well as other municipalities' characteristics
    iv) Prediction of short-term future gross investment, using the results based on micro data
6. Conclusion – I will summarize the implications and suggest possible paths for further research.

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1 Introduction

According to the report published by the Ministry of Regional Development of the Czech Republic (2021), containing indicators and statistics regarding the public procurement market in the Czech Republic and the Czech Public e-Procurement Information System, the share of public procurement market on GDP was 12.65 % in 2020 and had been gradually increasing in the previous years. Public procurement is thus a crucial component of a nation's economy. However, although it plays a key role in municipal investment activities and local policymakers' decisions, this subject has not been explored in sufficient depth in the case of the Czech Republic.

The main objective of this thesis was to study the relationship between public procurement spending and fixed capital formation at the municipal level, taking into account other characteristics of the municipalities. This relationship has not been studied either in the Czech Republic or abroad. Moreover, I analyzed the role that local election terms might play in local procurement spending, and potential ties between political affiliation and different types of public procurement contracts in which the municipalities invest. I tested the hypotheses using a unique dataset which I put together from various sources, containing information for the highest number of municipalities possible.

During the period studied in this thesis (2011–2022), the public procurement contracts were first regulated by Act No. 137/2006 Coll., which was replaced in 2016 by Act No. 134/2016 Coll. (on Public Procurement), further referred to as "the Act". It is important to mention and explain several terms from the Act that were crucial to my analysis: the sole focus was kept on municipalities as the *contracting authorities*; thus, the *economic operators* (suppliers) and their characteristics did not enter my analysis directly. Moreover, the three main types of public contracts were crucial, as distinguished by Section 14 of the Act:

(1) *Public supply contract*, referred to as "supplies" later in the thesis, "having as its object the acquisition of things, animals, or controllable forces of nature, other than those that are part of public works contracts under subsection (3). The acquisition includes but is not limited to purchase, lease, and usufructuary lease",

(2) *Public service contract*, referred to as "services" later in the thesis, "having as its object the provision of services other than those referred to in subsection (3)",

(3) *Public works contract*, referred to as "construction works" later in the thesis, "having as its object a) the provision of the service defined in division 45 of the main vocabulary of the single classification system of the European Union [CPV – common procurement vocabulary], b) the execution of a [construction] work, or c) the provision of related design works provided that they are awarded jointly with works referred to in paragraphs a) or b)".

Additionally, the public contracts are assigned *CPV codes* (based on Common Procurement Vocabulary) standardized by the EU authorities to further specify the object of the contract and to simplify and streamline the process. The objective is also to improve the accuracy and completeness of the data on public procurement. There exist 9,454 distinct types of CPV codes, and they are formatted as unique 8-digit numbers with additional descriptions (e.g., *71000000 – Architectural, construction, engineering, and inspection services*, *45112710 – Landscaping work for green areas*, etc.). More information on CPV codes and their full list can be found at https://cpvcodes.eu/en/.

Another term of interest was the *estimated value of procurement*, which is filled in by the contracting authorities in some cases. I used the estimated value whenever the actual value was not available in the data. This value, as described in Section 16 of the Act, should be estimated by the contracting authority based on available data and information on similar contracts, and if not available, based on market research, preliminary consultations, or similar means. It should be determined before the launch of the procurement procedure or the award of the public contract itself, in terms of money that the authority is expected to pay, including the total value of the performance as arising from the contract, the value of estimated reserved supplements to the contract, and any other payments and remuneration provided to the economic operators for their participation. In line with the mentioned provisions, I also used the values provided in the data to calculate some of the missing contract values. I describe the exact process of the imputation in more detail in Chapter 3 (Section 3.1).

The thesis is structured as follows: Chapter 2 presents existing literature on public procurement in the Czech Republic and abroad, Chapter 3 describes the data gathered and used to create a new dataset, and the variables chosen for the analysis. Chapter 4 describes the methodology I used to test the hypotheses and Chapter 5

presents the results. Finally, Chapter 6 summarizes my findings and conclusions and suggests possibilities for further enhancement of the thesis.

2 Literature Review

This chapter introduces the topics concerning public procurement and municipalities' investments discussed in the existing literature. It also discusses the most important findings that my thesis intends to supplement.

The literature on municipalities' budgeting and public procurement can be divided into multiple streams. However, to the best of my knowledge, no previous research has focused solely on the relationship between public procurement and fixed capital formation or the impacts of other characteristics of the contracting authorities on this relationship. Nevertheless, existing studies on municipalities' spending are presented to better understand the behavior of local governments concerning their investment activities and political decisions, both in the Czech Republic and abroad.

2.1 International studies on public procurement and public spending

The European Commission (EC) regularly publishes data regarding its member states' public procurement. According to the latest numbers reported by the European Commission for the year 2021 (European Commission, 2021a), public procurement in the European Union accounts for 14% of its GDP, highlighting the importance of focusing on how national and local authorities spend their money on public contracts, and leaving space for further assessment of the data gathered and possible recommendations stemming from the results.

The Commission's data and its measurement system were examined for example by Flynn (2018), presenting a set of policy actions recommended for the EC and EEA countries to further boost the effectiveness of their public procurement and value for money. These actions emphasize the role of oversight of proper implementation and compliance with the regulations at the national level, together with continuous monitoring of procurement performance across the EEA countries. Moreover, ensuring that public buyers in all countries possess the skills and knowledge needed to engage in contracts in an efficient and legally acceptable manner is seen as crucial.

Fazekas & Skuhrovec (2016) notice a sizable gap between the EU countries' overall trade openness and public procurement trade openness, estimating that 17% of

public procurement spending is subject to particularistic protectionism, where the public bodies tend to bend the rules of open and fair access to public contracts to favor domestic firms, both in high- and low-integrity countries. The authors suggest that following the lead of the EU institutions which do not tend to favor domestic firms in the member states of their location, international trade in public contracts could be increased up to 10 times to achieve greater fairness and openness.

Further, the researchers have also studied the efficiency of municipal public procurement and the purchasing behavior of contracting authorities. The most frequently analyzed factors in the public procurement area are the municipalities' size, the duration of public works, composition and organization of the municipal governments, digitalization of the procurement processes, environmental responsibility, and spillover effects.

In Germany, large municipalities are characterized by higher levels of decentralization which reduces complexity but also introduces less consolidated requirements resulting in higher prices (Glock & Broens 2013). However, Patrucco et al. (2021), studying Italian and American municipalities, observe that decentralized management might still be able to reduce the trade-off between utility and efficiency by investing more in the use of technology.

According to Gori et al. (2017), focusing on the time-to-completion escalations in Italian municipalities, the delays in awarded public works and their longer durations are frequently associated with the lack of adequate specialization and experience on the contracting authorities' side. Glock & Broens (2013) also recommend that the municipalities increase the level of specialization in purchasing different products and services, which might lead to greater efficiency and lower prices.

Patrucco et al. (2021) distinguish between two models for the public procurement structure: cost-oriented (focused on savings) and user-oriented (focused on quality), arguing that configuring the public procurement practice in either of the two ways should improve the performance of the public institutions. Moreover, the digitalization of public contracts and the introduction of an e-procurement system also have a positive impact on procurement efficiency (Patrucco et al., 2021, Glock & Broens, 2013).

Focusing on the case of Portuguese municipalities, Costa et al. (2015) demonstrate the interaction effects that local governments experience in their spending—mimicking and spillovers occur mainly concerning "expenditures on constructions that require coordination among neighboring municipalities", which is

illustrated by the discovered increase of 4.8% in a municipality's expenditures caused by a 10% increase in expenditures of a nearby municipality.

Additionally, the environmental factor is becoming more important in the municipal procurement conduct: namely emphasizing knowledge sharing, learning, and collaboration with other municipalities (Kristensen et al., 2021), evidence-based and more dynamic approach to the legislation development resulting in less ambiguity in the sustainable criteria (Vluggen et al., 2019), and the need to simultaneously adopt strategic guidelines and include green criteria in specific tenders for a well-functioning green public procurement practice (Bryngemark et al., 2023).

Finally, properly functioning legislation plays a key role as well. The over-flux of regulations complicates local decision-making, calling for a better incentive system for the employees of the organizations to replace the complex legislation system (Glock & Broens, 2013). Moreover, competence pooling via inter-municipal exchange of experiences and assistance of regional and national authorities is recommended to achieve a greater specialization and to spread the know-how needed by local governments (Gori et al., 2017).

As can be seen from the summary above, most studies provide an in-depth dive into the more specific fields, rather than analyzing the public procurement spending broadly and for all the available municipalities, which was the goal of my thesis. It is therefore challenging to compare it to the existing international literature one-to-one.

Generally, besides the unique focus of my research questions, the main contribution of my thesis to the literature is in the usage of data. While the data used in most of the above-mentioned studies are largely selected subsets of municipalities—mostly either the largest ones within a country (Glock & Broens, 2013, Patrucco et al., 2021), a specific region (Gori et al., 2017), the proactive ones (Kristensen et al., 2021, Bryngemark et al., 2023) or the ones chosen based on other specific criteria (Vluggen et al., 2019)—my data consists of the maximum number of Czech municipalities possible, across all sizes and regions, which I put together uniquely for the analysis. Unlike other studies, I also use panel data spanning multiple election terms, allowing for the examination of the municipalities' behavior not only across years but also across political cycles.

2.2 Czech studies on public procurement and municipalities' spending

According to the report published by the Czech Ministry of Regional Development (2021), the share of the public procurement market on GDP was 12.65 % in 2020 and had been gradually increasing in the previous years. As shown by the European Commission's public procurement indicators (European Commission, 2021b), Czechia scored "average" in its 2020 performance, compared to other European countries. In addition to the EC measure, a *Transparency Index* (a weighted sum of 10 separate indicators), rating the contracting authorities within the Czech Republic, has been constructed by Chvalkovska & Skuhrovec (2010). In the example of the Czech Public e-Procurement Information System, they demonstrate the importance of enabling easier access to data on public procurement and thus allowing for better public control over government procurement spending.

Later, Skuhrovec & Soudek (2016) also introduced a *zIndex*, indirectly measuring the efficiency and corruption potential of Czech municipalities in public procurement via the deviations from the best practice, covering areas of transparency, openness, and competition. They found that good practice as indicated by the index is significantly correlated with both savings and legal misconduct: "best-performing cities save on average 5% of relative price and face 30% lower chance of legal misconduct than the worst ones".

Finally, Pocarovsky (2014) analyzed firms' political connections (e.g., past employment of a politically active person) and donations to political parties and how they impact public procurement contracts, discovering that medium-sized firms that make donations or are otherwise connected to a political party are on average awarded with more and larger contracts and depend on their public procurement revenues to a larger extent. Further, the author found that when a donating or politically connected company participates in a tender (and wins), there are generally fewer bidding companies, implying that they are aware of the presence of the connected company and are discouraged from participation, which affects the price and overshadows the efficient allocation of public funds. My thesis partly builds on these findings, as I am interested in the types of public contracts that different political leaderships of municipalities tend to invest in (although without the connection to specific firms).

Again, compared to the Czech literature on the topic of municipal procurement spending, my thesis is unique in the employment of a new dataset that was never used before in the Czech context and the introduction of new research questions. Namely, I

study the relationship between fixed capital formation and public procurement spending on the municipal level together with other municipalities' characteristics, which was not yet examined using data on Czech municipalities.

2.3 Briefly on political budget cycles

Another increasingly popular topic in the public spending literature is the occurrence of political budget cycles (sometimes also referred to as political business cycles), i.e., the influence an approaching election has on government spending. The primary question here is whether the fiscal policy of incumbent governments changes significantly before the elections to increase the chances of reelection. The focus on Portugal and its national or local governments is particularly prominent.

For example, Castro & Martins (2019) observe the political manipulation in the national government's expenditures over the years, arguing that "Portuguese governments act opportunistically when they need to and behave in a partisan manner when they can". Acting opportunistically means that before the elections, the governments were found to favor more visible spending and policies maximizing their support, followed by contractionary measures after the elections to reverse this disbalance, whereas partisan behavior describes the behavior of politicians after the elections according to their position in the political spectrum (and thus their objectives), with the implication that the right-wing governments tend to reduce their post-elections expenditures more than their left-wing counterparts.

Alternatively, Veiga & Veiga (2007), studying Portuguese municipalities, conclude that the left-wing incumbents tend to behave more opportunistically than the right-wing ones, whereas also observing increased spending on items highly visible to the voters before the elections (such as overpassing, streets, rural roads, etc.) compared to those which are less visible (such as machinery and transportation material), leading to significant inefficiencies in the allocation of resources. Moreover, the term-limited mayors were found to demonstrate lower efforts than reelection-eligible mayors, resulting in lower expenditures and revenues for their respective municipalities (Veiga & Veiga, 2019).

Foucault et al. (2008) also found strong evidence for the opportunistic behavior of local governments in France, which tend to increase their spending in pre-electoral periods. Moreover, they suggest that there exist some spending interactions (positive influence of one municipality's spending on another municipality's spending) between the local governments of neighboring municipalities and municipalities with the same

political affiliation, which might be caused by “the fear of driving away taxpayers or attracting recipients from other states if their social benefits are too generous”.

Further research on the topic has led to conclusions that certain types of political and institutional circumstances are more likely to induce the political budget cycles—for example, Veiga et al. (2019) mention “predetermined elections, close (disputed) elections, majoritarian electoral rules, larger private benefits from holding office, weak constraints on executives, a high proportion of uninformed voters, and new democracies”. Moreover, media freedom, as mentioned by Veiga et al. (2017), can be added to the list of factors that tend to influence the budget cycles occurrence, as low media freedom generates politically oblivious citizens, reducing electoral accountability and rendering it easier for the governments to manipulate fiscal policies, mainly through the immediately visible current spending.

Additionally, political business cycles were analyzed also at the Czech municipal level, mainly by Sedmihradska et al. (2011). They found an opportunistic behavior of the local incumbent politicians, but in contrast to the majority of Portuguese-focused studies emphasizing the current expenditures, the increase in spending in the election years was driven mainly by capital spending. Nevertheless, the study concludes that Czech incumbents exhibit irrational behavior, as it did not significantly raise the politicians’ chances of being reelected, supposedly because of a high degree of perceived corruption among the public.

Even though my thesis does not directly contribute to the literature on political budget cycles, I incorporated various elements of the stream in the thesis. Namely, the importance of political affiliation and election cycles to the budgeting decisions of local governments did not go unnoticed: among other things, I use my data to examine the distribution of public procurement spending during the election terms and the possible connection between political party in power and types of public contracts which it tends to invest in. To the best of my knowledge, a similar connection has not yet been studied for the case of Czech municipalities.

3 Data

This chapter describes the dataset used and how I put it together from the data I gathered from various sources. The core dataset consists of panel data on the total value of public procurement spending of Czech municipalities in each year over the period 2011–2022 (using the latest available data for the year 2022), combined with the municipalities' total fixed capital formation (capital expenditures and investment purchases) in the same period. According to the latest data from the Czech Statistical Office (2022), in total, there are 6,258 municipalities in the Czech Republic, including 6,254 municipalities and 4 military areas ("vojenský újezd" in Czech). Nevertheless, I only used 3,404 of the municipalities (excluding the military areas) in the analysis as the maximum possible number that could be covered. It was mostly a result of the lack of information or insufficient data entries on public procurement in the Czech Republic which could not be manually retrieved. Therefore, I discarded 2,854 municipalities from the dataset for various reasons, explained in detail later in this chapter.

I identified and categorized the municipalities by their name, unique 5-digit municipality code, Company identification number (ICO) assigned to each Czech economic entity, and district to which they affiliate. The analyzed period 2011–2022 consists of three election terms (2010–2014, 2014–2018, 2018–2022), further modified for the analysis to three periods with non-overlapping years, where each 4-year term starts in the year succeeding the election year: 2011–2014, 2015–2018, and 2019–2022. The main reason behind this modification was that municipal elections generally take place in the fall, and it takes time before the original municipal council is replaced by the succeeding one. This division into election terms was useful for analyzing the distribution of public procurement spending of individual local governments.

The uniqueness of the used dataset lies in its extent, as it covers all three main components of the public contracts (supplies, services, and construction works) for the largest number of Czech municipalities possible in the given period, as opposed to the subsamples of municipalities or sectors predominantly studied in previous research. It becomes especially important in the public procurement domain, where the data is largely unreliable or unavailable (Skuhrovec & Soudek, 2016).

I used two main sources to gather the data: first, I obtained the data on public contracts awarded by individual municipalities from the Information System on Public Procurement managed by the Ministry of Regional Development of the Czech

Republic and transformed it into the aggregate values for each municipality and each year of interest. Second, I used data on municipalities' fixed capital formation (capital expenditures and investment purchases) from the Monitor, an application of the Ministry of Finance of the Czech Republic which contains Czech public finance data.

I accompanied these two sources with data on political affiliation of the contracting authorities in individual municipalities, obtained from the website *volby.cz* provided by the Czech Statistical Office and the Ministry of the Interior of the Czech Republic. I also added the size and regional affiliation provided by the Czech Statistical Office for each municipality, as well as the type of public contract that was predominant for each municipality in each year available. I describe the process of obtaining each part of the dataset below in the individual sections.

3.1 Aggregate values of public procurement spending

I computed the aggregate spending of each municipality on all its public contracts during each year using the individual values of the municipality's public contracts, provided by the Czech Information System on Public Procurement (ISVZ). I distributed the values in time based on the starting date of the contracts and the average durations of the types of contracts.

For this part of data preparation only, the year 2010 was also included, as many contracts tend to span multiple years, and omitting the year 2010 would probably result in missing aggregate values of contracts for the year 2011. Nevertheless, the year 2010 was not included in the final dataset, as it did not contain enough observations itself, missing contracts from the previous year (as can be seen for example from Table 3.3 which will be explained subsequently). Moreover, it did not fit into my division of the analyzed period into election terms because it would belong to the election term preceding my chosen period (i.e., 2007–2010), as explained above.

The three crucial components needed for the data transformation were the following variables (all available in the Information System): 1) CPV code, specifying the type of the contract (1,673 unique types occurring in the initial data downloaded from ISVZ), which makes its use more suitable as it is more specific compared to only the three main types of contracts: supplies, services, and construction works), 2) starting date of the awarded contract, 3) monetary value of the contract (final or, if not available, estimated value).

Initially, the data on all public contracts awarded by municipalities between 2010 and 2022 contained 101,902 rows (= public contracts) in total. Given the large number

of missing information crucial for the analysis, two essential modifications were necessary: First, I imputed the final monetary values for as many contracts with missing values as possible because the large number of missing values would result in a significant loss of data. Second, as there was only the start date of the contracts provided and the end date of the contracts was missing altogether in the currently available database, I assigned the average duration to each contract based on its type, assuming that similar types of public contracts tend to last similarly long, using an auxiliary non-public dataset of a similar extent from the Czech Information System on Public Procurement.

The first modification, leading to the final monetary values of the contracts, consisted of three steps. The main attempt here was to impute all the missing monetary values based on the CPV types using all the non-missing values, resulting in as few losses in data entries as possible. Therefore, in the first two steps of this part, I disregarded the starting date of the contract and whether it was missing or not.

First, I reviewed the initial data on the monetary values of the contracts, grouped by the years of their award, as shown in Table 3.1. Second, I examined extremely small (< CZK 1000) and large (outliers from the plots in Figure A.1 in Appendix A) values of the contracts, marking some of the values as missing or discarding them altogether, resulting in new statistics for the values, as shown in Table 3.2. It can be seen from the plots in Figure A.2 in Appendix A that the extremely large outliers remained in the data even after my examination. The main reason was that, after I examined all the outliers in the data manually with their respective additional information, I did not suspect any misreporting in the data and assumed the contracts in question were simply more expensive. I am aware of the drawbacks of keeping extreme outliers in the data but as these values were not the final ones to be used in regression and they needed to be further modified for the purposes of my analysis, I decided to keep the values and not to use a technique such as trimming or winsorization used for example by Palanský (2020). Third, I imputed some of the missing monetary values based on a criterion chosen given the nature of the data: I imputed the missing monetary values where, for their given CPV type, there were at least 30 non-missing values, while the missing values accounted for up to 30% of the non-missing values, and if less than 30 non-missing values, the missing values accounted for up to 10% of the non-missing values, using median of the corresponding non-missing values (as compared to mean, median performs better when facing outliers in the data). This way, 12,900 missing monetary values of the contracts were imputed (based on 193 CPV types). As a result, the rest of the rows (public contracts) with missing monetary values, starting dates, or CPV codes could be discarded, leading to 41,343 contracts left. The statistics after the final step

are shown in Table 3.3. The plots of the monetary values of the contracts grouped by the year of award for all three steps separately can be seen in Appendix A (Figures A.1, A.2, and A.3).

The second modification consisted of assigning average duration to the contracts based on their CPV type, where possible, and thus inferring their ending date to determine the exact amount of money spent on a given contract each calendar year. I used auxiliary data gathered for municipal public contracts awarded between the years 2006 and 2021, consisting of 51,492 entries and containing both the starting and ending dates. Again, I used the average duration (in days) of the contracts with the same CPV type and matched it with my data. The chosen criterion for whether the average duration would be assigned or not was at least 15 occurrences of the particular CPV code among the auxiliary data (assuming that the more occurrences, the more precise result), while for 5–14 occurrences, the average was computed only when the difference between the highest and the lowest duration divided by the number of occurrences was less than or equal to 60 (a number determined after examining the nature of the data, as a value higher than 60 indicated that the difference between the highest and lowest duration was too large and/or the number of occurrences was too small). After calculating the average durations from the auxiliary data (in total for 561 CPV types), assigning them to my data, and deleting the rows with no ending date (where the criterion could not be met), the final number of public contracts in the dataset was 33,881, containing complete data for 3,796 municipalities. The plots of the final monetary values of the contracts after the two modifications grouped by the year of award can also be seen in Appendix A (Figure A.4).

Thus, for a given municipality and a given contract, I determined the starting date of the contract and its monetary value, together with its expected duration in days based on the contract type (CPV). Then it was possible to distribute the price over the expected period of duration of the contract from its starting date and, since the contracts are usually spread over multiple years, calculate the share of value spent on each contract each year based on the number of days the contract was ongoing that year. I did the same with all contracts for a given municipality and summarized the individual values, resulting in final aggregate values spent by each municipality on all its contracts each year (over the period 2010–2022, i.e., 13 separate years).

I am aware of the limitations of the chosen approach to data modification. The decision to impute some missing values rather than discard them altogether points to

Table 3.1: Monetary values of contracts, number of initial non-missing values, and number of initial missing values (no modifications).

Step 1			
year	non-missing	missing	**Row Sum**
2010	2534	114	**2648**
2011	2236	146	**2382**
2012	2599	185	**2784**
2013	4173	396	**4569**
2014	3699	386	**4085**
2015	3091	344	**3435**
2016	2102	521	**2623**
2017	2868	1045	**3913**
2018	3602	1336	**4938**
2019	3245	1367	**4612**
2020	3515	1392	**4907**
2021	3672	1259	**4931**
2022	3558	542	**4100**
Col Sum	**40894**	**9033**	**49927**

Units: number of occurrences. Source: ISVZ, Author.

Table 3.2: Monetary values of contracts, number of non-missing values, and number of missing values, with extremely small/large values modified (where necessary).

Step 2			
year	non-missing	missing	**Row Sum**
2010	2533	114	**2647**
2011	2233	148	**2381**
2012	2597	185	**2782**
2013	4167	399	**4566**
2014	3690	394	**4084**
2015	3087	346	**3433**
2016	2099	523	**2622**
2017	2864	1049	**3913**
2018	3595	1343	**4938**
2019	3236	1376	**4612**
2020	3513	1394	**4907**
2021	3670	1261	**4931**
2022	3548	552	**4100**
Col Sum	**40832**	**9084**	**49916**

Units: number of occurrences. Source: ISVZ, Author

Table 3.3: Final monetary values of contracts, number of non-missing values, and number of imputed values, with the missing values discarded.

Step 3			
year	non-missing	imputed	**Row Sum**
2010	205	4	**209**
2011	2232	74	**2306**
2012	2597	108	**2705**
2013	4167	162	**4329**
2014	3690	195	**3885**
2015	3087	164	**3251**
2016	2099	231	**2330**
2017	2864	333	**3197**
2018	3595	341	**3936**
2019	3236	397	**3633**
2020	3513	311	**3842**
2021	3670	330	**4000**
2022	3548	190	**3738**
Col Sum	**38503**	**2840**	**41343**

Units: number of occurrences. Source: ISVZ, Author

the trade-off between the loss of data entries and their accuracy. Specifically, the imputation of median or mean value based on arbitrary criteria can result in imprecise results and conclusions. Moreover, each municipality can have a different strategy for the process, for example, for the division of the contracts into types based on CPV codes, an issue that is difficult to account for but may arise. As for assigning the average duration of the contracts based on their type using a different dataset, it introduces possible errors that may result in biases or loss of information, leading to inaccurate estimations. Moreover, the size of municipalities whose contracts fall under the same CPV code is also important: for example, when a CPV code contains mainly less expensive contracts of smaller municipalities and then one or two high-priced contracts of the city of Prague, it shifts the average duration significantly.

On the other hand, the loss of data entries following the decision not to impute some of the missing values would likely lead to a dead end. For example, for small municipalities with only a few contracts over the years, I would likely lose a significant part of the value of the resulting explanatory variable which would prevent me from continuing with the research.

Thus, the obtained final aggregate values of municipalities' spending used in the analysis should be viewed as approximate rather than precise, similar to the estimated values of the contracts filled in the database by municipal authorities (they are usually very different from the final values). Nevertheless, I believe that the data are as representative of the real situation as possible given the information available and that the analysis of the data can lead to valuable conclusions.

3.2 Fixed capital formation

The second part of the dataset consists of data on fixed capital formation (represented either by capital expenditures or investment purchases) for each municipality in each year. The difference between capital expenditures and investment purchases is in the items involved in the calculation, as incorporated in 412/2021 Coll. Decree on budgetary composition. While capital expenditures contain several whole groupings of items, investment purchases are one particular group falling under capital expenditures which includes only "expenditures on the acquisition of fixed assets and their technical improvement", with several subgroupings. The division of both capital expenditures and investment purchases into groups and subgroups, respectively, is presented in Table 3.4.

Table 3.4: The components of capital expenditures and investment purchases.

Capital expenditures (groups)	Investment purchases (subgroups of (61))
(61) Investment purchases and related expenditures	(611) Acquisition of intangible fixed assets
(62) Purchase of property shares and entitlements and contributions to foundations and institutes	(612) Acquisition of tangible fixed assets
(63) Investment transfers	(613) Land
(64) Investment borrowed funds	(614) Overlimit easements and construction rights
(67) Investment transfers to the National Fund	
(69) Other investment expenditures	

Source: 412/2021 Coll. Decree on budgetary composition

The Monitor provides three different values for both capital expenditures and investment purchases: 1) approved budget (authorized by the Ministry of Finance by April 30th of each year), 2) amended budget (updated by the municipalities during the year based on their expenditures, revenues, etc.), and 3) resulting budget since the beginning of the year (the final value spent). I gathered all the values of interest, i.e., Capital Expenditures – resulting budget, Capital Expenditures – approved budget, Investment Purchases – resulting budget, and Investment Purchases – approved budget, resulting in four distinct variables providing a larger variety to examine and choose from for the analysis.

3.3 Political affiliation

According to Glock & Broens (2013), adding a variable on political culture might enhance the results of public procurement analyses, as a purely economic perspective is often not the primary source of municipal governments' decisions. Therefore, I assigned each municipality a political affiliation of its mayor for a given year. In the years of municipal elections resulting in changes in the composition of local governments, the political party which was in power for most of the year was prioritized. For example, in the election year 2018, the assigned party was the one in power since the last election (2014), as it held the mandates for a longer part of the year 2018, given that the elections usually take place in the fall and the succeeding party replaces the one in power only for a small fraction of the year 2018. The succeeding party would then be assigned to the municipality for the year 2019 and the three subsequent years till the next elections (until 2022).

I was mainly interested in the municipal governments affiliated with established political parties, allowing for answering the question of whether it is the case that certain parties tend to prioritize certain types of public procurement contracts. Moreover, political affiliation was used in the equation as one of the factors potentially influencing the relationship between municipalities' public procurement spending and fixed capital formation.

For the purposes of my analysis, I assigned each municipality in each election term one of the following eight most dominant Czech political parties, based on the party to which the respective mayor belonged: ANO, CSSD, KDU-CSL, KSCM, ODS, Pirati, STAN, TOP 09. I marked the rest as either *independent* (the candidate did not belong to any party) or *other* (the candidate belonged to a smaller than the listed eight parties or a local party), resulting in a factor variable with ten levels, one for each category of municipalities' political representation. The data on political affiliation was only available for the latest two election terms, i.e., 2015–2018, and 2019–2022. Therefore, this variable could only be used for the years 2015–2022, rendering it necessary to use the data in two parts (years 2011–2022 excluding political affiliation, and years 2015–2022 including political affiliation).

3.4 Predominant type of contract

I further used the types of public contracts to distinguish whether certain municipalities and their political leaders preferred awarding certain types of contracts during the election terms—i.e., whether some contract types were associated with certain political parties during the years of interest. I matched each municipality with the type of public contract on which it spent the largest amount of money in a given year, using the division into the three main contract types: construction works, supplies, and services. Where there were no predominant types of contracts (a municipality did not award any contract during a specific year), I marked it as *no contract*. I used the resulting factor variable with four levels, including "no contract", with the previously mentioned political affiliation to determine possible preferences in spending on particular public contract types across the political spectrum.

3.5 Size

Further, I assigned the population size obtained from the Czech Statistical Office website to each municipality for each year during the period of interest. I used the resulting numerical variable for the assessment of whether the municipalities' size

influences the relationship between municipalities' public procurement spending and their fixed capital formation.

3.6 Regional affiliation

Finally, based on data from the Czech Statistical Office, I added the municipalities' affiliation to one of the 14 regions:

1) Prague
2) Central Bohemian Region
3) South Bohemian Region
4) Pilsen Region
5) Karlovy Vary Region
6) Usti and Labem Region
7) Liberec Region
8) Hradec Kralove Region
9) Pardubice Region
10) Vysocina Region
11) South Moravian Region
12) Olomouc Region
13) Zlin Region
14) Moravian-Silesian Region

I obtained a factor variable with fourteen levels assigning each municipality the region it belongs in. Again, I hypothesized that regional affiliation would influence the relationship between municipalities' public procurement spending and their fixed capital formation.

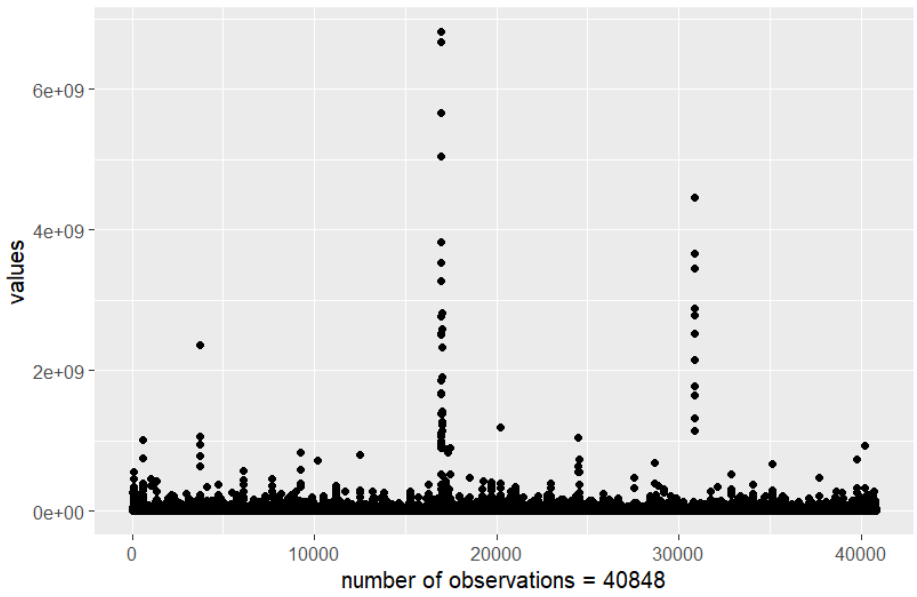
3.7 Variable selection, modification, and summary statistics

First, I would like to comment on the existence of outliers among the numeric variables, specifically, the aggregate values of public procurement spending described in Section 3.1 and the four variables on fixed capital formation (Capital Expenditures – resulting budget, Capital Expenditures – approved budget, Investment Purchases – resulting budget, and Investment Purchases – approved budget) described in Section 3.2. It is clear from Figure 3.1 below that some outlier values remained in the aggregate values of public procurement spending even after the series of modifications introduced in

Section 3.1. One might argue that the extremely large outliers should have been dropped to avoid biases in the models' outputs.

On the other hand, when inspecting Figures 3.2 to 3.5, the values taken from Monitor for the four variables representing the fixed capital formation of the municipalities also contain outliers in the budget values. In line with intuition, Figures 3.2 to 3.5 look identical, as they represent similar values (the resulting budget and approved budget should follow the same distribution, whereas investment purchases are in essence a subset of capital expenditures, as explained in Section 3.2). Given the inspection, I concluded that outliers in municipalities' spending and budgets are inevitable, as the values are largely dependent on the circumstances such as local needs for new investments and capital, and, of course, the municipalities' size.

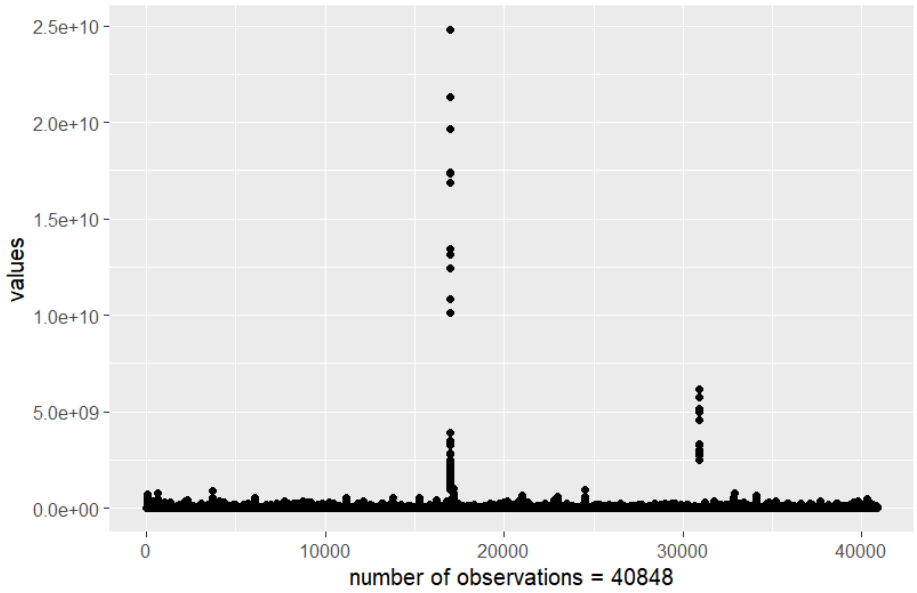
Figure 3.1: Aggregate values of public procurement spending.



Source: ISVZ, Author

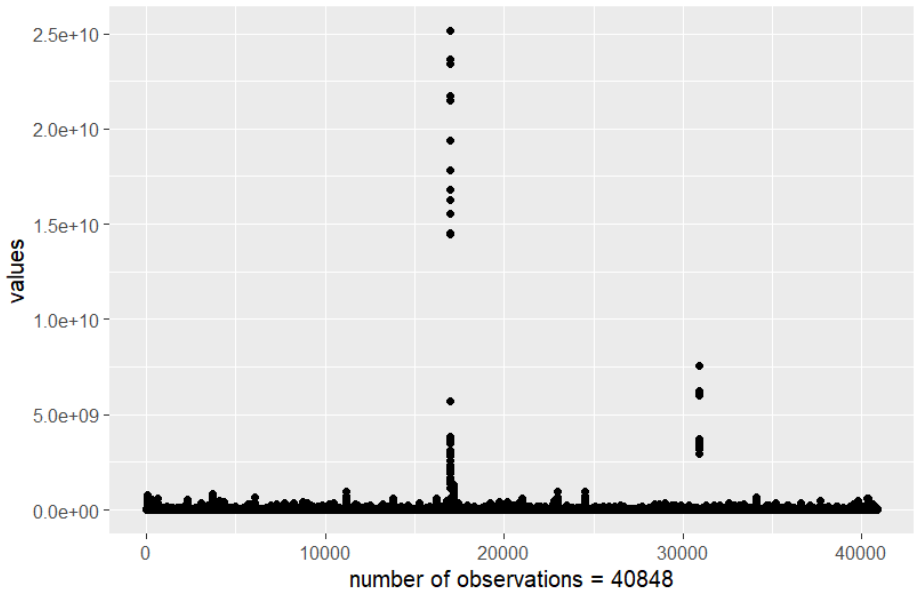
Moreover, Table 3.5 shows that the correlations between the variables Capital Expenditure – result, Capital Expenditure – approved, Investment Purchases – result, and Investment Purchases – approved are high. Based on the correlations, combined with figures 3.2 to 3.5 which show that the variables have very similar distributions, and the fact that the investment purchases are a subset of capital expenditures, I concluded that it is safe to choose only one of the variables representing fixed capital expenditures for the analysis. Therefore, I chose the *Capital Expenditure – resulting budget* to be subsequently used in the models.

Figure 3.2: Values for the variable Capital Expenditures – resulting budget.



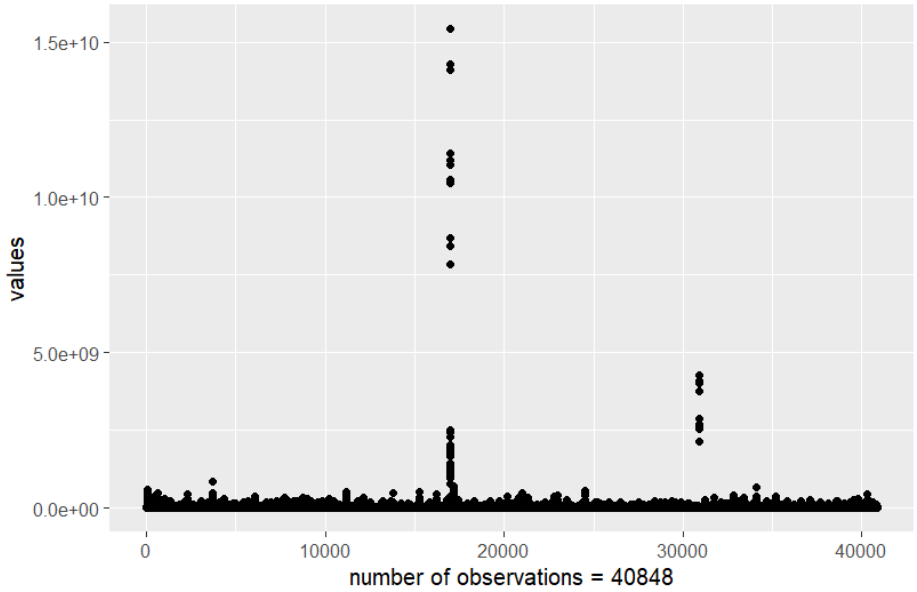
Source: Monitor, Author

Figure 3.3: Values for the variable Capital Expenditures – approved budget.



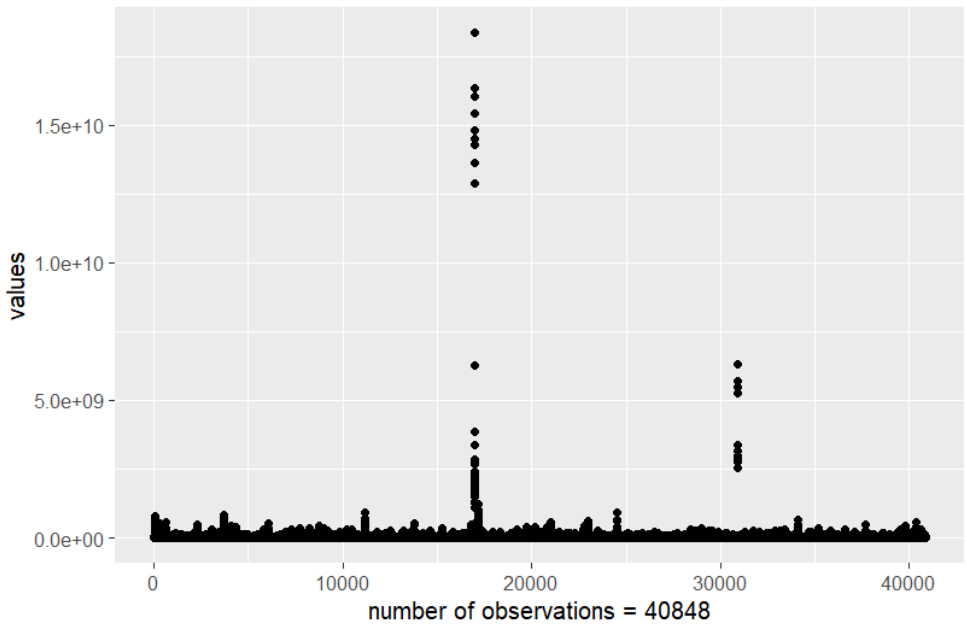
Source: Monitor, Author

Figure 3.4: Values for the variable Investment Purchases – resulting budget.



Source: Monitor, Author

Figure 3.5: Values for the variable Investment Purchases – approved budget.



Source: Monitor, Author

Table 3.5: Correlation matrix of the numeric variables representing municipal procurement spending and fixed capital formation.

	Procurement Spending	Capital Expenditure – result	Capital Expenditure – approved	Investment Purchases – result	Investment Purchases – approved
Procurement Spending	1	0.844	0.843	0.838	0.805
Capital Expenditure – result	0.844	1	0.962	0.984	0.940
Capital Expenditure – approved	0.843	0.962	1	0.965	0.960
Investment Purchases – result	0.838	0.984	0.965	1	0.951
Investment Purchases – approved	0.805	0.940	0.960	0.951	1

The summary statistics of all the variables to be used in regressions can be found in Tables 3.6 to 3.9. Table 3.6 summarizes the numerical variables and Table 3.7 summarizes the number of occurrences for each level of the factor variables in the full dataset for the whole period 2011–2022, including the missing values for the political affiliation variable (*Party*) during the first election term (2011–2014), marked as "na", thus consisting of 40,848 observations of 3,404 municipalities over 12 years. Table 3.8 summarizes the numerical variables and Table 3.9 summarizes the number of occurrences for each level of the factor variables in the dataset without the first term,

Table 3.6: Summary statistics for the numerical variables in the dataset for the period 2011–2022.

Statistic	N	Mean	St. Dev.	Min	Max
Procurement Spending	40848	10924449	97416488	0	6810019381
Capital Expenditure – resulting budget	40848	22895429	302155564	-31439	24794988593
Capital Expenditure – resulting budget (nonnegative)	40848	22895429	302155564	0	24794988593
Population	40848	2830.84	24325.62	54	1335084

Note: Negative capital expenditure may arise in some cases due to prepayments for the contracts. In this case, only one negative value is present in the data, indicating no positive expenditure for the combination of municipality and year. After rewriting the one negative value to 0 for the purpose of logarithmic transformation of the Capital Expenditure variable described below, the summary statistics did not change except for the minimum value, as can be seen in the row representing nonnegative Capital Expenditure.

i.e., only for the period 2015–2022, with no "na" values for the *Party* variable, thus consisting of 27,232 observations of 3,404 municipalities over 8 years. The second dataset (with only two election terms) was used mainly to examine the relationship between the political affiliation of a municipality's mayor and its predominant type of contract, together with the assessment of what effect might the political affiliation have on the relationship between municipalities' public procurement spending and their fixed capital formation.

Table 3.7: Number of observations for each level of factor variables in the dataset for the period 2011–2022 (with the Party variable having some "na" observations).

Party	N	Contract Type	N	Region	N
ANO	448	construction works	9576	Central Bohemian	7956
CSSD	1252	services	675	Hradec Kralove	2796
KDU-CSL	1588	supplies	1562	Karlovy Vary	852
KSCM	380	no contract	29035	Liberec	1392
ODS	1248	-	-	Moravian-Silesian	2856
Pirati	16	-	-	Olomouc	3096
STAN	1196	-	-	Pardubice	2616
TOP 09	248	-	-	Pilsen	2748
other	2604	-	-	Prague	12
independent	18252	-	-	South Bohemian	3612
na	13616	-	-	South Moravian	4980
-	-	-	-	Usti nad Labem	2376
-	-	-	-	Vysocina	3168
-	-	-	-	Zlin	2388
Total	**40848**		**40848**		**40848**

Note: The number of observations (N) for each factor variable is the total number of observations in my panel dataset, i.e., with 12 observations for each municipality—one for each year over the period 2011–2022. For the number of municipalities falling into a specific category, it is necessary to divide the numbers by 12.

Table 3.8: Summary statistics for the numerical variables in the dataset for the period 2015–2022.

Statistic	N	Mean	St. Dev.	Min	Max
Procurement Spending	27232	12291929	103755064	0	6810019381
Capital Expenditure – resulting budget	27232	24192338	291595027	0	24794988593
Population	27232	2838.30	24573.42	54	1335084

To properly use the three factor variables (*Party*, *Contract Type*, and *Region*) in the subsequent models, I modified them into separate dummy variables, each representing a specific level of the factor and being equal to 1 for a municipality belonging to the respective level in a given year, and 0 otherwise. Therefore, *Party* resulted in a total of ten dummy variables (but was only used when working with the 2015–2022 data), *Contract Type* resulted in four dummy variables, and *Region* resulted in fourteen dummy variables.

Table 3.9: Number of observations for each category of the factor variables in the dataset for the period 2015–2022 (with the Party variable having no "na" observations).

Party	N	Contract Type	N	Region	N
ANO	448	construction works	6658	Central Bohemian	5304
CSSD	1252	services	447	Hradec Kralove	1864
KDU-CSL	1588	supplies	929	Karlovy Vary	568
KSCM	380	no contract	19198	Liberec	928
ODS	1248	-	-	Moravian-Silesian	1904
Pirati	16	-	-	Olomouc	2064
STAN	1196	-	-	Pardubice	1744
TOP 09	248	-	-	Pilsen	1832
other	2604	-	-	Prague	8
independent	18252	-	-	South Bohemian	2408
-	-	-	-	South Moravian	3320
-	-	-	-	Usti nad Labem	1584
-	-	-	-	Vysocina	2112
-	-	-	-	Zlin	1592
Total	**27232**		**27232**		**27232**

Note: The number of observations (N) for each factor variable is the total number of observations in my panel dataset, i.e., with 8 observations for each municipality—one for each year over the period 2015–2022. For the number of municipalities falling into a specific category, it is necessary to divide the numbers by 8.

Further, to reduce the impact of outliers present in the data (as discussed above) and to combat the presence of homoscedasticity and autocorrelation in the subsequently described models, I faced the need to transform the numeric variables. Specifically, I used a combination of two transformation approaches for the public procurement spending and fixed capital formation variables in both datasets: logarithmic transformation and first difference. As the 2015–2022 dataset is essentially a subset of the 2011–2022 dataset, I describe transformation only for the larger 2011–2022 dataset. The following standard logarithmic transformation adding 1 to each

value was necessary due to the values of 0 occurring in the dataset (for the cases where a municipality did not spend any money on public procurement in a given year):

$$logvariable_{it} = log(variable_{it} + 1),$$

(Equation 3.1)

where $i = 1, \dots, 3404$ and $t = 1, \dots, 12$. (In the one case of negative value of capital expenditure which itself indicates no positive expenditure and would render the logarithmic transformation impossible, I rewrote the value to 0, as described in the Note in Table 3.6.)

Further, I applied the following difference transformation to the logarithms of the two variables:

$$difflogvariable_{i,t+1} = logvariable_{i,t+1} - logvariable_{i,t},$$

(Equation 3.2)

where $i = 1, \dots, 3404$ and $t = 1, \dots, 11$, leading to a loss of data for the year 2011, as the values for this year could not be subtracted from any previous value.

Moreover, as mentioned earlier, I used lagged values of procurement spending in the models. The average duration of public procurement contracts in my data was 326 days, i.e., approximately one year, hence I lagged the values in the data by one year. The logic behind it is the following: the contracts usually take some time X to be completed, and only after that is the contracts' value included in the municipal capital expenditure. Thus, it would not be accurate to compare the municipal capital expenditure and procurement spending both at time T, but rather, capital expenditure at time T and procurement spending at time T+X should be compared. In my case, X is equal to 1. The lagging modification resulted in a further reduction of the data dimension, dropping also the 2012 data, because, as a result of the difference operation, for the year 2011 there was no value that could be shifted to the following year. Therefore, the resulting two datasets to be used in the regressions consisted of 1) years 2013–2022 not including the political affiliation, and 2) years 2015–2022 including the political affiliation.

4 Hypotheses and Methodology

The following chapter describes my hypotheses and the methodological tools used to test all of them. Each of the five hypotheses is presented in a separate section.

4.1 Hypothesis #1

My first hypothesis inspects whether *the distribution of the aggregate values of municipal public procurement spending indicates uneven spending during the election terms (more spending close to the end of the election term).* I tested it first by examining the distribution of the aggregate values of municipalities' spending on public procurement contracts (absolute values without the transformations described in Section 3.7 in the previous chapter) in the three election terms of interest (2011–2014, 2015–2018, 2019–2022). Second, I also examined the distribution of spending on public procurement contracts for a subset of municipalities led by political parties which were at the same time also part of the national government, using only the two latest election terms (2015–2018, 2019–2022) for which the data on political affiliation were available. The municipal election terms do not match the national government elections, thus, each of the two municipal election terms consisted of two sets of national governments and I assigned a political party separately to each year of interest according to the election results, as shown in Table 4.1.

Table 4.1: Political parties in government assigned to the municipal election years.

Year	Municipal election terms	National government election terms	Political parties in the national government
2015	2015–2018	2015–2017	ANO, CSSD, KDU-CSL
2016			
2017			
2018		2018–2021	ANO, CSSD
2019	2019–2022		
2020			
2021			
2022		2022	KDU-CSL, ODS, Pirati, STAN, TOP 09

Source: Author

The underlying assumption is that graphs showing greater expenditures during the last (election) years in each term (i.e., 2014, 2018, 2022) serve as an indication of uneven spending by the local authorities which could point to opportunistic spending in the months before elections, both in aggregate terms and for the subset of parties present in the national government (although the described result would not point to a significant presence of political budget cycles itself). I present my findings regarding Hypothesis #1 in Chapter 5 (Results), Section 5.1.

4.2 Hypothesis #2

Second, I hypothesized that *the relationship between the aggregate value of municipalities' public procurement spending and their fixed capital formation is not homogeneous—it is influenced by other municipalities' characteristics: population size, regional affiliation, and political affiliation.* I used the two sets of panel data to test it, one for the period 2013–2022 where political affiliation could not be included, and one for the period 2015–2022 including political affiliation.

After examining the correlations among the variables to be used in the regressions for both datasets, which can be seen in Figure 4.1 and Figure 4.2, I concluded that certain variables cannot be used together as regressors, as they are highly correlated—namely, I excluded the dummy variable for Prague Region (*RPrague*) which was correlated with the population size (*Population*), both in the case of the 2013–2022 dataset with fewer variables (where the correlation coefficient between the two variables was equal to 0.899) and the 2015–2022 dataset with more variables (where the correlation coefficient between the two variables was equal to 0.900).

Further, for both datasets, I chose the dummy variable *RCentralBohemian* (indicating affiliation to the Central Bohemian Region) to be excluded from the models as the baseline for regional affiliation to be contained in the intercept since the variable is essentially a linear combination of the rest of the region dummies and keeping all of them in a model would result in singular fit, model misspecification and errors in computations. Similarly, I excluded the dummy variable *PartyIndependent* (indicating political affiliation not belonging to any political party) from the model.

I also show the results of the Augmented Dickey-Fuller (ADF) Test to examine the presence of stationarity among the variables chosen for the regressions in Table 4.2. When the data are stationary, they exhibit no trend over time, have constant variance over time, and have a consistent autocorrelation structure across time. As can be seen, it is the case for all the variables to be used in the regressions: in all cases, the

Figure 4.1: Correlations of the independent variables to be used in regressions, using the 2013–2022 data (without political representation).

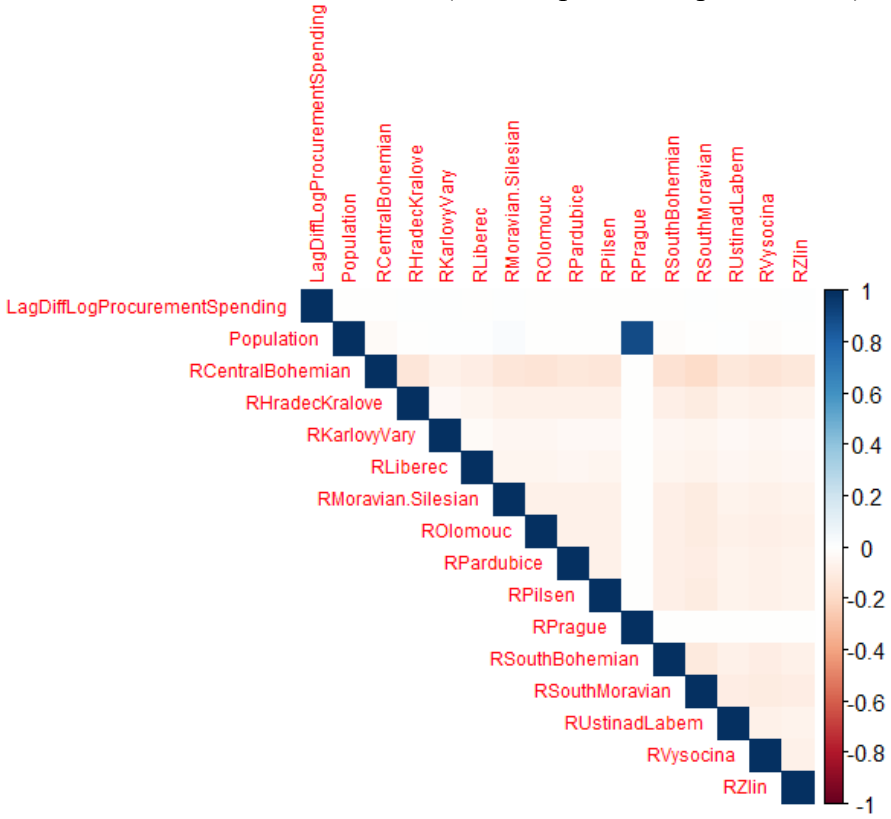
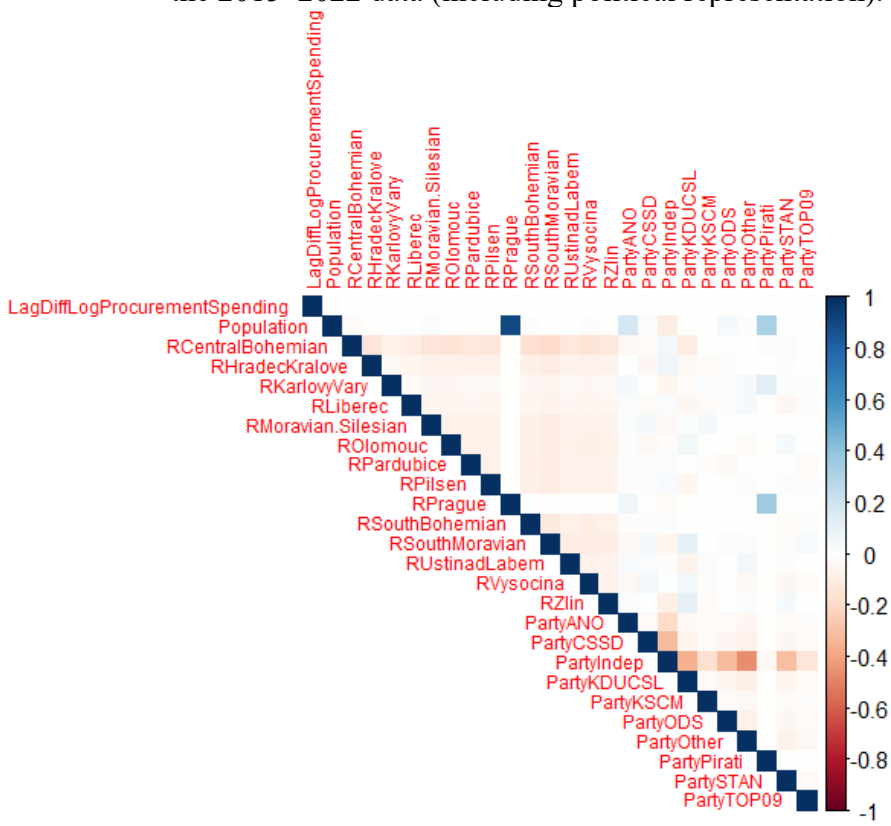


Figure 4.2: Correlations of the independent variables to be used in regressions, using the 2015–2022 data (including political representation).



p-value is smaller than 0.05 and thus the null hypothesis of the ADF test can be rejected, indicating that the variables are stationary, exhibiting stable long-term behavior.

Table 4.2: ADF test results for the variables to be used in the regressions.

Variable	Dickey-Fuller	Lag order	p-value
Procurement spending	-34.36	32	0.01
Capital Expenditure – resulting budget	-34.12	32	0.01
Population	-21.54	32	0.01
Region Hradec Kralove*	-7.21	32	0.01
Region Karlovy Vary*	-13.31	32	0.01
Region Liberec*	-8.22	32	0.01
Region Moravian-Silesian*	-10.59	32	0.01
Region Olomouc*	-10.69	32	0.01
Region Pardubice*	-7.37	32	0.01
Region Pilsen*	-8.91	32	0.01
Region South Bohemian*	-11.08	32	0.01
Region South Moravian*	-5.18	32	0.01
Region Usti and Labem*	-8.07	32	0.01
Region Vysocina*	-8.46	32	0.01
Region Zlin*	-8.31	32	0.01
Party ANO**	-27.09	30	0.01
Party CSSD**	-27.14	30	0.01
Party KDUCSL**	-24.60	30	0.01
Party KSCM**	-28.16	30	0.01
Party ODS**	-27.78	30	0.01
Party Other**	-26.27	30	0.01
Party Pirati**	-21.79	30	0.01
Party STAN**	-27.03	30	0.01
Party TOP09**	-28.61	30	0.01

* *Region dummies*
** *Political affiliation dummies*
Note: Procurement spending values are lagged and transformed using logarithms and first difference, Capital Expenditure – resulting budget values are transformed using logarithms and first difference. The Procurement spending, Capital Expenditure, Population, and region dummy variables are taken from the 2013–2022 data, the political dummies are taken from the 2015–2022 data.

To test the hypothesis on the 2013–2022 data, I added the variable on municipalities' size (*Population*) and the dummy variables for regional affiliation (except for *RPrague* and *RCentralBohemian*) as regressors to the model with fixed capital formation (*Capital Expenditures – resulting budget*, or *DiffLogCapitalExp_res*) as the dependent variable, and lagged procurement spending (*LagDiffLogProcurementSpending*) as the independent variable. Therefore, I used the following equation for the regression:

$$DiffLogCapitalExp\_res_{it} = \beta_0 + \beta_1 LagDiffLogProcurementSpending_{it} + \beta_2 Population_{it} + \beta_3 RHradecKralove_{it} + \beta_4 RKarlovyVary_{it} + \beta_5 RLiberec_{it} + \beta_6 RMoravianSilesian_{it} + \beta_7 ROlomouc_{it} + \beta_8 RPardubice_{it} + \beta_9 RPilsen_{it} + \beta_{10} RSouthBohemian_{it} + \beta_{11} RSouthMoravian_{it} + \beta_{12} RUstinadLabem_{it} + \beta_{13} RVysocina_{it} + \beta_{14} RZlin_{it} + u_{it},$$

(Equation 4.1)

where $i = 1, \dots, 3404$, and $t = 1, \dots, 10$.

Further, I also added dummy variables for political affiliation (except for *PartyIndependent*) to the equation as independent variables, and applied it to the dataset restricted to the period 2015–2022:

$$DiffLogCapitalExp\_res_{it} = \beta_0 + \beta_1 LagDiffLogProcurementSpending_{it} + \beta_2 Population_{it} + \beta_3 RHradecKralove_{it} + \beta_4 RKarlovyVary_{it} + \beta_5 RLiberec_{it} + \beta_6 RMoravianSilesian_{it} + \beta_7 ROlomouc_{it} + \beta_8 RPardubice_{it} + \beta_9 RPilsen_{it} + \beta_{10} RSouthBohemian_{it} + \beta_{11} RSouthMoravian_{it} + \beta_{12} RUstinadLabem_{it} + \beta_{13} RVysocina_{it} + \beta_{14} RZlin_{it} + \beta_{15} PartyANO_{it} + \beta_{16} PartyCSSD_{it} + \beta_{17} PartyKDUCSL_{it} + \beta_{18} PartyKSCM_{it} + \beta_{19} PartyODS_{it} + \beta_{20} PartyOther_{it} + \beta_{21} PartyPirati_{it} + \beta_{22} PartySTAN_{it} + \beta_{23} PartyTOP09_{it} + u_{it},$$

(Equation 4.2)

where $i = 1, \dots, 3404$, and $t = 1, \dots, 8$.

In both cases, the added regressors were expected to influence the relationship between public procurement and fixed capital formation of the municipalities. The results of the regressions are presented in Chapter 5 (Results), Section 5.2.

The chosen estimation method was GLS (generalized least squares), which violated the required assumptions of homoscedasticity and no autocorrelation to the

minimum possible extent. The results of the tests for both assumptions are presented in Section 5.2 as well.

4.3 Hypothesis #3

My third hypothesis is linked to the second one: *there exists a positive correlation between the aggregate value of municipalities' public procurement spending and fixed capital formation.* Testing the third hypothesis consisted of examining the results of the regressions employed in the previous section (4.2). I expected the regression coefficient to be positive regardless of the variables added or the dataset used. The findings are also presented in Section 5.2 of the next chapter, together with the results of testing Hypothesis #2.

4.4 Hypothesis #4

For the fourth hypothesis, I tested whether *the political affiliation of municipal authorities determines the type of public procurement contracts which they choose to invest in.* I used a regression model to determine whether there is a correlation between the political affiliation of the municipalities and the predominant type of public contract (the type in which a municipality invested the most in a given year). The model was applied to the dataset consisting of years 2015–2022 (two election terms) only, given the data availability discussed in the previous chapter.

In this case, the dependent variable (*ContractType*), is a factor variable with four levels: "no contract", "construction works", "services", and "supplies". Therefore, I used a multinomial logistic regression, and I chose the "no contract" level (indicating that a municipality did not spend any money on public contracts in a given year) to be the reference category for the variable—the one to be compared with the other levels when interpreting the results.

Given that I preferred to assess the correlation for each political party separately, I used nine dummy variables (eight representing one of the major political parties in Czechia and one for the rest of the smaller parties) in the regression as ten independent variables. As in the case of the model described in the previous section, I excluded the dummy for independent candidates from the model specification, to be used as a baseline. The resulting equation was the following:

$$ContractType_{it} = \beta_0 + \beta_1 PartyANO_{it} + \beta_2 PartyCSSD_{it} + \beta_3 PartyKDUCSL_{it} + \beta_4 PartyKSCM_{it} + \beta_5 PartyODS_{it} + \beta_6 PartyPirati_{it} + \beta_7 PartySTAN_{it} + \beta_8 PartyTop09_{it} + \beta_9 PartyOther_{it} + u_{it},$$

(Equation 4.3)

where $i = 1, \dots, 3404$ and $t = 1, \dots, 8$.

Further, I also complemented the model with other municipalities' characteristics as independent variables to mitigate the omitted variable bias. Namely, I included population size and lagged procurement spending used in the previous hypotheses (only the continuous variables were included since a second set of dummy variables for the regional affiliation would render the interpretation unintuitive), resulting in the following equation:

$$ContractType_{it} = \beta_0 + \beta_1 PartyANO_{it} + \beta_2 PartyCSSD_{it} + \beta_3 PartyKDUCSL_{it} + \beta_4 PartyKSCM_{it} + \beta_5 PartyODS_{it} + \beta_6 PartyPirati_{it} + \beta_7 PartySTAN_{it} + \beta_8 PartyTop09_{it} + \beta_9 PartyOther_{it} + \beta_{10} Population_{it} + \beta_{11} LagDiffLogProcurementSpending_{it} + u_{it},$$

(Equation 4.4)

where $i = 1, \dots, 3404$ and $t = 1, \dots, 8$.

I comment on the regression outputs and the difference between the two models in Chapter 5 (Results), Section 5.3.

4.5 Hypothesis #5

My fifth and last hypothesis is that *based on the previous findings, the prediction of future gross fixed capital formation is possible.* The intention here was to attempt to predict the future short-term gross fixed capital formation using the microdata on municipal fixed capital formation and procurement spending, which could serve as an addition or improvement of the annual predictions of gross fixed capital formation prepared by the Czech Ministry of Finance with the use of macro indicators.

Forecasting using panel data is generally more demanding than with time series, especially when the future values of the independent variables are not available (at the time of writing this thesis, I could not obtain the final 2023 values of the independent variables used in the model described by Equation 4.2). I considered two options for

predicting the value of municipal fixed capital investment for the year 2023: time series aggregation and imputation.

First, using the 2013–2022 data, I aggregated the relevant variables by year: population, fixed capital expenditure, and lagged procurement spending transformed with logs and first difference (as in the previous hypotheses), using mean as the aggregation operation. The dummies for the region and political affiliation could not be used as their mean resulted in the same values for all or some of the years leading to a rank-deficient matrix. I then applied the ARIMA forecasting model to the aggregated time series.

Second, using the 2015–2022 data, I proceeded with the imputation technique to obtain the 2023 values based on historical patterns and trends in the variables in the following three steps: 1) I aggregated the variables (including the region and party dummies) for each municipality, using three different operations: mean, sum, and median as a robustness check, 2) I used my GLS model to predict the values for each municipality in the year 2023 based on the aggregated data, 3) I aggregated the predicted values for each municipality to determine the overall trend for the gross fixed capital expenditure in 2023 across all municipalities.

I discuss the results of both methods in Chapter 5 (Results), Section 5.4.

5 Results

In this chapter, I describe my findings and the implications they have. As Hypotheses #3 and #4 involve the same model and require to be discussed together, I merged their results into one section (5.2).

5.1 Distribution of public procurement spending within the election terms

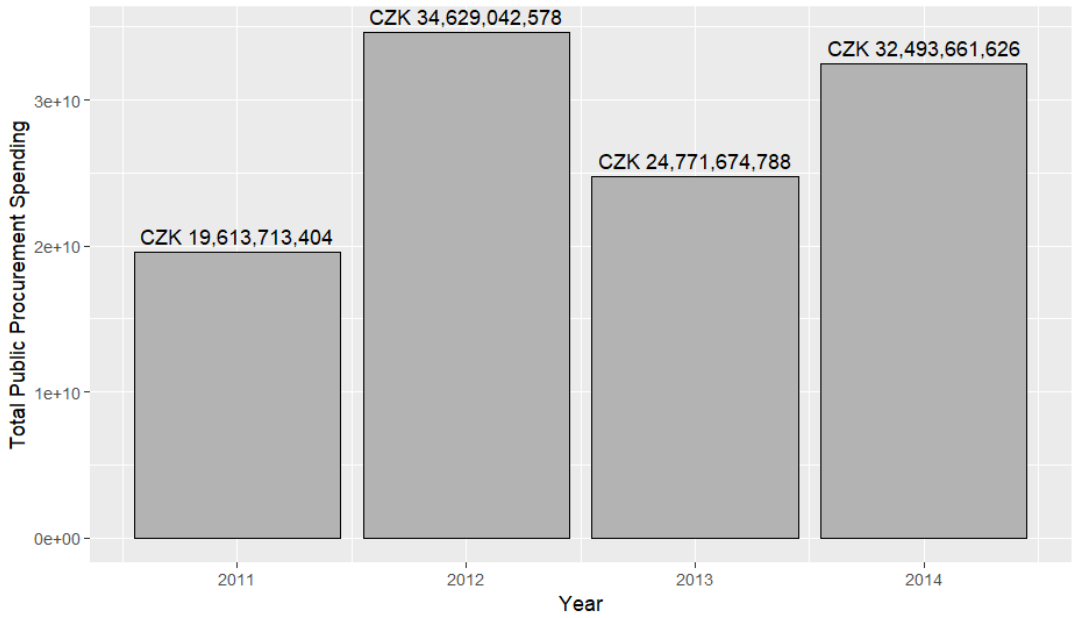
The distributions of municipalities' public procurement contracts and spending for each of the analyzed election terms, 2011–2014, 2015–2018, and 2019–2022, can be found in Figure 5.1, Figure 5.2, and Figure 5.3, respectively. Each bar is labeled with the total volume of all spending (in CZK) made by all municipalities in the respective year.

As can be seen from figures 5.1 to 5.3, municipal spending on public procurement contracts varies not only across the election terms but also across the years. A significant drop in spending occurs especially in the year 2016. One of the reasons behind this could be the introduction of the new Act on Public Procurement in 2016, which identified new standards and rules that could to some extent cause a delay in awarding new public contracts.

Figure 5.1 does not indicate that municipalities would increase their spending in the final year of the first studied term, i.e., before the elections of 2014. On the other hand, both Figure 5.2 and Figure 5.3 suggest the opposite: the overall public procurement spending is the largest in the final year of the second and third studied election terms, i.e., in the election years 2018 and 2022, which is in line with the findings of Sedmihradska et al. (2011) describing an opportunistic behavior of the local incumbent politicians. Although a certain conclusion about the presence of political budget cycles cannot be made solely based on the distributions, they indicate a certain unevenness and opportunism in public procurement spending on the municipal level and a tendency to spend more money during the election years.

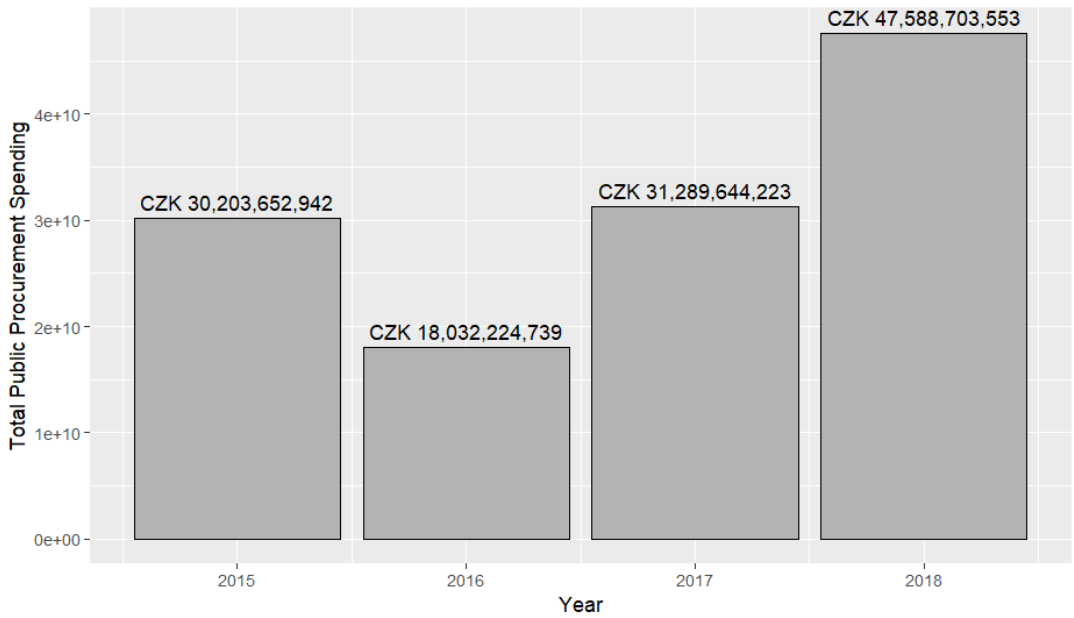
Figures 5.4 and 5.5, describing only the municipalities led by parties that were also part of the national government at the same time, show that the highest spending also tends to occur during the years of the elections, i.e., 2018 and 2022. However, especially in the case of the last election term (2019–2022), the results might be biased,

Figure 5.1: Distribution of total public procurement spending in the first election term (2011–2014) by year.



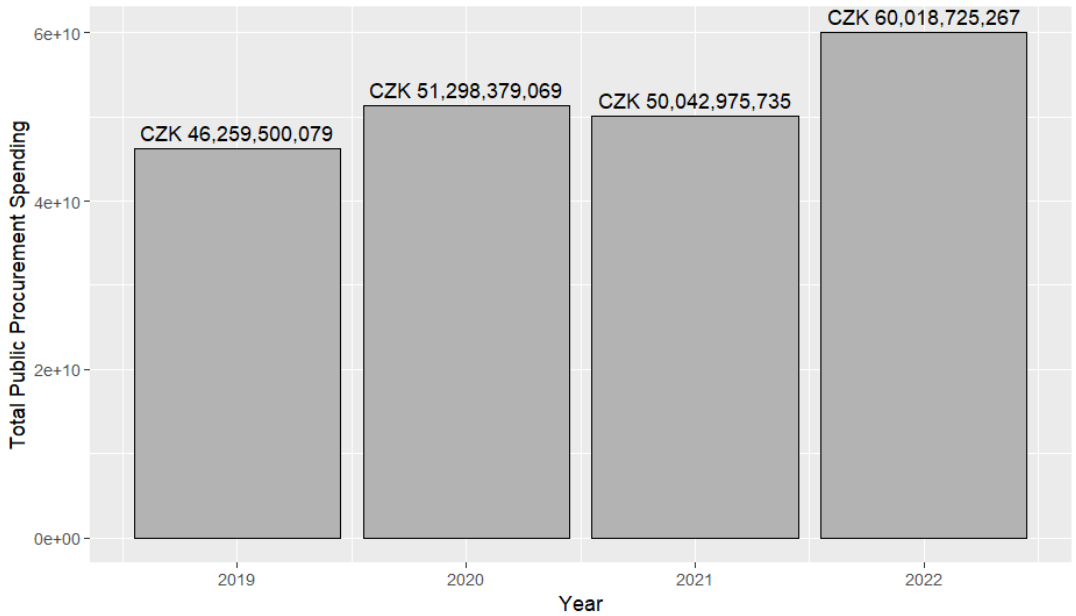
Source: Author, ISVZ

Figure 5.2: Distribution of total public procurement spending in the second election term (2015–2018) by year.



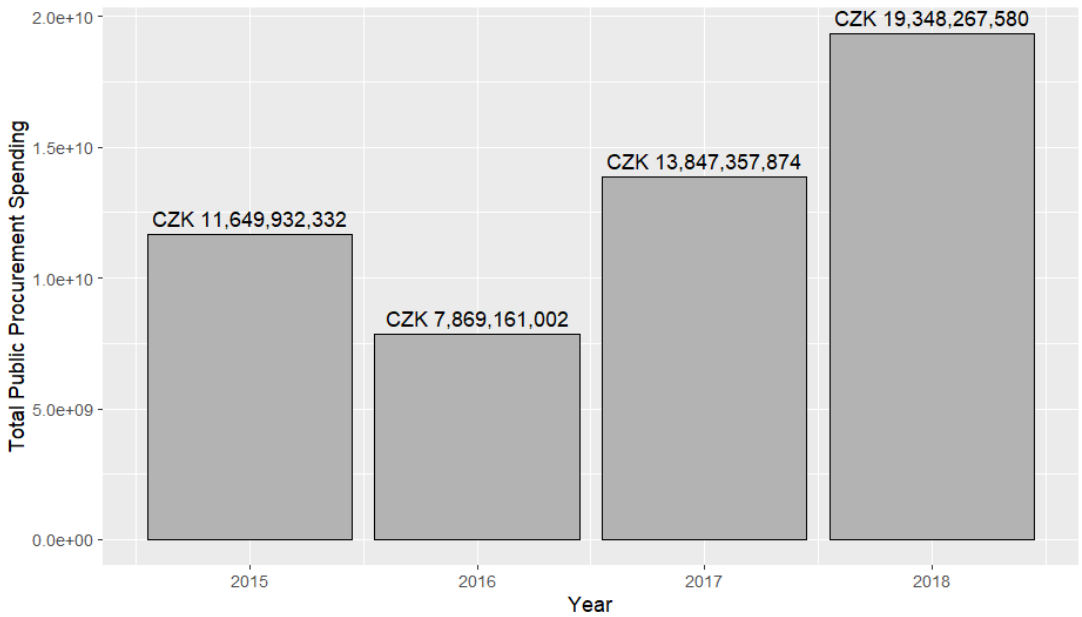
Source: Author, ISVZ

Figure 5.3: Distribution of total public procurement spending in the third election term (2019–2022) by year.



Source: Author, ISVZ

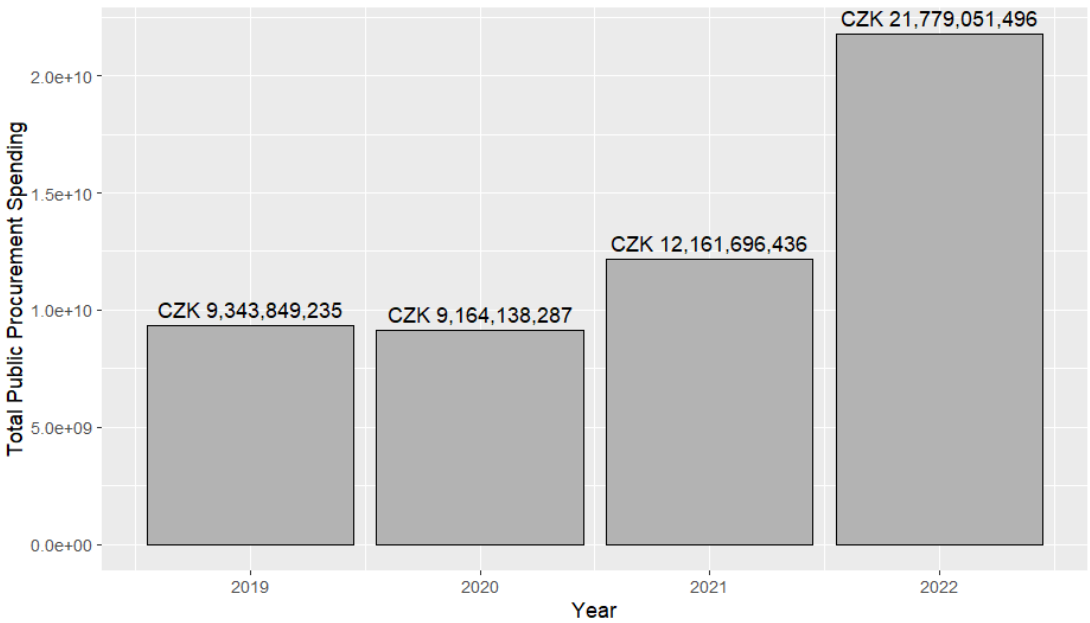
Figure 5.4: Distribution of total public procurement spending of the municipalities led by government parties in the second election term (2015–2018) by year.



Source: Author, ISVZ

because following the change in national government for the last year of the period, more parties were suddenly included in the subset data (till 2021, the government parties were ANO and CSSD, while from 2022 on, the parties forming a national government are KDU-CSL, ODS, Pirati, STAN, and TOP 09). The results are therefore inconclusive.

Figure 5.5: Distribution of total public procurement spending of the municipalities led by government parties in the third election term (2019–2022) by year.



Source: Author, ISVZ

5.2 Relationship between municipal fixed capital formation and public procurement spending

I present the results of testing both Hypothesis #2 and #3 here. The regression results using the specification determined by Equation 4.1 on the 2013–2022 data are summarized in Table 5.1.

The variable of most interest, lagged procurement spending, is the only statistically significant one and it behaves as expected: holding all other variables constant, a 1% change in spending on public procurement is associated with a 0.012% increase in capital expenditures (i.e., fixed capital formation). This is in line with intuition, as public procurement spending should be a part of the overall expenditure

Table 5.1: Regression results for the 2013–2022 data, with size and regional affiliation omitted.

	Dependent variable:
	DiffLogCapitalExp_res
LagDiffLogProcurementSpending	0.012***
	(0.001)
Population	-0.00000
	(0.00000)
RHradecKralove	0.008
	(0.046)
RKarlovyVary	-0.059
	(0.075)
RLiberec	-0.049
	(0.061)
RMoravian.Silesian	-0.009
	(0.046)
ROlomouc	0.012
	(0.044)
RPardubice	0.011
	(0.047)
RPilsen	-0.008
	(0.046)
RSouthBohemian	-0.004
	(0.042)
RSouthMoravian	-0.005
	(0.038)
RUstinadLabem	-0.004
	(0.049)
RVysocina	-0.011
	(0.044)
RZlin	-0.010
	(0.049)
Constant	0.103***
	(0.023)
Observations	34,040
Log Likelihood	-70,349.960
Akaike Inf. Crit.	140,731.900
Bayesian Inf. Crit.	140,866.900
Note:	*p<0.1; **p<0.05; ***p<0.01

on fixed capital. Therefore, there is a positive correlation between the municipalities' public procurement spending and fixed capital formation.

As for the effect of municipalities' population size and regional affiliation, the correlation coefficients are statistically insignificant. The most important question here is whether the inclusion of population and region dummies somehow impacts the main relationship in question (between the municipalities' public procurement spending and fixed capital expenditures). When running the regression without the population and region variables, the results do not change, as can be seen in Table 5.2. Again, a 1% change in procurement spending is associated with a 0.012% increase in fixed capital formation. Thus, I concluded that the relationship between municipal procurement spending and fixed capital formation is not influenced by other municipalities' characteristics.

Table 5.2: Regression results for the 2013–2022 data, with size and regional affiliation omitted.

	Dependent variable:
	DiffLogCapitalExp_res
LagDiffLogProcurementSpending	0.012***
	(0.001)
Constant	0.098***
	(0.010)
Observations	34,040
Log Likelihood	-70,310.800
Akaike Inf. Crit.	140,627.600
Bayesian Inf. Crit.	140,652.900
Note:	*p<0.1; **p<0.05; ***p<0.01

As for the regression on the 2015–2022 data specified by Equation 4.2, the results summarized in Table 5.3 are similar to the larger dataset. In this case, I could also add the third municipality characteristic: dummies for political representation. Again, all the correlation coefficients are insignificant except for the lagged procurement spending which has a similar effect on capital expenditures: a 1% increase in the public procurement spending is associated with a 0.011% increase in capital expenditures (i.e., fixed capital formation), all other variables held constant.

When I excluded the variables describing municipalities' characteristics from the regression, I obtained the results summarized in Table 5.4. As before, the exclusion

resulted in no change in the coefficient size: a 1% increase in public procurement spending is associated with a 0.011% increase in capital expenditures.

Table 5.3: Regression results for the 2015–2022 data (political affiliation included).

	Dependent variable:
	DiffLogCapitalExp_res
LagDiffLogProcurementSpending	0.011*** (0.002)
Population	-0.00000 (0.00000)
RHradecKralove	0.017 (0.049)
RKarlovyVary	-0.097 (0.081)
RLiberec	-0.066 (0.065)
RMoravian.Silesian	-0.005 (0.049)
ROlomouc	-0.021 (0.047)
RPardubice	0.022 (0.050)
RPilsen	0.032 (0.049)
RSouthBohemian	0.014 (0.045)
RSouthMoravian	-0.032 (0.041)
RUstinadLabem	0.013 (0.052)
RVysocina	-0.0002 (0.047)
RZlin	-0.012 (0.052)
PartyANO	0.026 (0.089)
PartyCSSD	-0.017 (0.053)
PartyKDUCSL	-0.012 (0.049)
PartyKSCM	-0.004 (0.094)
PartyODS	-0.038 (0.053)
PartyOther	-0.013 (0.038)
PartyPirati	0.067 (0.485)
PartySTAN	-0.029 (0.054)
PartyTOP09	-0.026 (0.116)
Constant	0.076*** (0.026)
Observations	27,232
Log Likelihood	-54,866.650
Akaike Inf. Crit.	109,783.300
Bayesian Inf. Crit.	109,988.600
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 5.4: Regression results for the 2015–2022 data, with size, regional affiliation, and political affiliation omitted.

	Dependent variable:
	DiffLogCapitalExp_res
LagDiffLogProcurementSpending	0.011***
	(0.002)
Constant	0.066***
	(0.011)
Observations	27,232
Log Likelihood	-54,816.140
Akaike Inf. Crit.	109,638.300
Bayesian Inf. Crit.	109,662.900
Note:	*p<0.1; **p<0.05; ***p<0.01

Further, I would like to comment on the results of testing the regression models summarized in Table 5.1 and Table 5.3 for heteroscedasticity and autocorrelation. The results of the tests are presented in Table 5.5 and Table 5.6, respectively. In the case of the first model (applied to the 2013–2022 data), the heteroscedasticity test shows a p-value greater than 0.05, which means that the null hypothesis assuming no heteroscedasticity cannot be rejected. On the other hand, the p-value for the autocorrelation test is less than 0.05. Thus, we can reject the null hypothesis assuming no autocorrelation, and conclude that the residuals exhibit autocorrelation. I reached the same conclusions for the second model (applied to the 2013–2022 data).

To remedy the presence of autocorrelation, I tried to add the correlation structure class *CorAR1* (the autoregressive process of order 1) as a correlation argument to the specification of the GLS model. However, due to the extent of the dataset and the subsequent memory intensity, I could not find a device to run the regression for the whole dataset. I managed to obtain results after running the regression with added correlation structure on a subset of the data (years 2021 and 2022). The results of the subsequent heteroscedasticity and autocorrelation test presented in Table 5.7 indicate that the *CorAR1* structure is a solution for the presence of autocorrelation: although the p-value is still not greater than 0.05, it is much closer to 0.05 than for the previous models where the correlation structure could not be specified due to capacity reasons. Therefore, there is a reason to believe that the specification of correlation structure would have a similarly beneficial impact on the model run for the whole dataset.

Table 5.5: The results of testing the first model for heteroscedasticity and autocorrelation (2013–2022 data, without political affiliation).

Studentized Breusch-Pagan test (heteroscedasticity)

BP	*df*	*p-value*
1.4411	1	0.23

Breusch-Godfrey test (autocorrelation)

BG	*df*	*p-value*
595.03	1	< 2.2e-16

Table 5.6: The results of testing the second model for heteroscedasticity and autocorrelation (2015–2022 data, with political affiliation).

Studentized Breusch-Pagan test (heteroscedasticity)

BP	*df*	*p-value*
0.034372	1	0.8529

Breusch-Godfrey test (autocorrelation)

BG	*df*	*p-value*
287.47	1	< 2.2e-16

Table 5.7: The results of testing the model for heteroscedasticity and autocorrelation with CorAR1 correlation structure on a subset of data (years 2021 and 2022, with political affiliation).

studentized Breusch-Pagan test (heteroscedasticity)

BP test statistic	*df*	*p-value*
0.59806	1	0.4393

Breusch-Godfrey test (autocorrelation)

BG test statistic	*df*	*p-value*
4.8355	1	0.02788

5.3 Determination of predominant types of public investments for established political parties

The results of the first multinomial logistic regression (based on Equation 4.3) are presented in Table 5.8 and the results of the second multinomial logistic regression (based on Equation 4.4) are presented in Table 5.9. To choose whether the first (null) model or the second (full) model fits the data better, I performed a likelihood ratio test. The results of the test are summarized in Table 5.10. The very small p-value (< 2.2e-

16) provides strong evidence to reject the null hypothesis and conclude that the full model, which includes the additional variables, provides a significantly better fit to the data compared to the null model, which includes only the political party dummies. I will therefore interpret the results of the full model (Table 5.9).

The sets of coefficients for each dummy variable represent the log-odds ratios of investing in the respective contract type relative to the reference category ("no contract" in my case) when being associated with the respective political party compared to the baseline (*PartyIndependent*, or an independent candidate, in my case), while holding all other variables constant. Therefore, for each combination of coefficient and variable (party):

Table 5.8: Multinomial logistic regression results, only political party dummies as independent variables (null model).

	Dependent variable:		
	construction works	services	supplies
	(1)	(2)	(3)
PartyANO	2.030***	2.658***	1.497***
	(0.108)	(0.219)	(0.234)
PartyCSSD	0.851***	1.255***	0.802***
	(0.063)	(0.183)	(0.143)
PartyKDUCSL	0.255***	0.447**	0.141
	(0.062)	(0.211)	(0.154)
PartyKSCM	0.284**	0.734**	0.731***
	(0.124)	(0.366)	(0.236)
PartyODS	1.139***	1.360***	1.119***
	(0.062)	(0.185)	(0.133)
PartyPirati	2.856***	4.224***	3.709***
	(0.782)	(1.002)	(0.914)
PartySTAN	0.509***	0.539**	0.206
	(0.067)	(0.237)	(0.176)
PartyTOP09	1.352***	1.912***	1.301***
	(0.136)	(0.324)	(0.279)
PartyOther	0.872***	1.245***	0.970***
	(0.046)	(0.138)	(0.098)
Constant	-1.352***	-4.224***	-3.304***
	(0.019)	(0.071)	(0.045)
Akaike Inf. Crit.	40,887.100	40,887.100	40,887.100

Note: *p<0.1; **p<0.05; ***p<0.01

Table 5.9: Multinomial logistic regression results, independent variables include political party dummies, municipalities' population size, and lagged procurement spending (full model).

	Dependent variable:		
	construction works	services	supplies
	(1)	(2)	(3)
PartyANO	0.074***	0.685***	-0.536***
	(0.00000)	(0.000)	(0.00000)
PartyCSSD	-0.033***	0.369***	-0.091***
	(0.00000)	(0.00000)	(0.00000)
PartyKDUCSL	-0.063***	0.129***	-0.179***
	(0.00000)	(0.00000)	(0.00000)
PartyKSCM	0.038***	0.489***	0.486***
	(0.000)	(0.000)	(0.00000)
PartyODS	0.115***	0.331***	0.082***
	(0.00000)	(0.00000)	(0.00000)
PartyPirati	0.073***	1.336***	0.345***
	(0.000)	(0.000)	(0.000)
PartySTAN	0.187***	0.216***	-0.118***
	(0.00000)	(0.00000)	(0.00000)
PartyTOP09	0.432***	0.991***	0.380***
	(0.00000)	(0.00000)	(0.00000)
PartyOther	0.106***	0.478***	0.199***
	(0.00000)	(0.00000)	(0.00000)
Population	0.001***	0.001***	0.001***
	(0.00001)	(0.00001)	(0.00001)
LagDiffLogProcurementSpending	0.003	0.002***	0.012***
	(0.002)	(0.0001)	(0.0001)
Constant	-1.955***	-4.828***	-3.913***
	(0.00001)	(0.00000)	(0.00000)
Akaike Inf. Crit.	36,480.260	36,480.260	36,480.260
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 5.10: Likelihood ratio test to choose between the null and the full model.

Likelihood ratio test

LR test statistic	*df*	*p-value*
4418.835	6	< 2.2e-16

(i) If the coefficient for the party is positive and statistically significant, it suggests that the log odds of investing in the respective contract type versus having no contract increase when switching from an independent candidate to the respective political party.

(ii) If the coefficient for the party is negative and statistically significant, it suggests that the log odds of investing in the respective contract type versus having no contract decrease when switching from an independent candidate to the respective political party.

*(iii)*If the coefficient for the party is not statistically significant, it suggests that the log odds of investing in the respective contract type versus having no contract do not change significantly when switching from an independent candidate to the respective political party.

When examining the coefficients of the full model (Table 5.9), I interpreted the results for each of the established political parties as follows: When switching from an independent candidate to *ANO*, the log odds of investing in construction works versus having no contract will increase by 0.074, the log odds of investing in services versus having no contract will increase by 0.685, and the log odds of investing in supplies versus having no contract will decrease by 0.536. When switching from an independent candidate to *CSSD*, the log odds of investing in construction works versus having no contract will decrease by 0.033, the log odds of investing in services versus having no contract will increase by 0.369, and the log odds of investing in supplies versus having no contract will decrease by 0.091. When switching from an independent candidate to *KDUCSL*, the log odds of investing in construction works versus having no contract will decrease by 0.063, the log odds of investing in services versus having no contract will increase by 0.129, and the log odds of investing in supplies versus having no contract will decrease by 0.179. When switching from an independent candidate to *KSCM*, the log odds of investing in construction works versus having no contract will increase by 0.038, the log odds of investing in services versus having no contract will increase by 0.489, and the log odds of investing in supplies versus having no contract will increase by 0.486. When switching from an independent candidate to *ODS*, the log odds of investing in construction works versus having no contract will increase by 0.115, the log odds of investing in services versus having no contract will increase by 0.331, and the log odds of investing in supplies versus having no contract will increase by 0.082. When switching from an independent candidate to *Pirati*, the log odds of investing in construction works versus having no contract will increase by 0.073, the log odds of investing in services versus having no contract will increase by 1.336, and

the log odds of investing in supplies versus having no contract will increase by 0.345. When switching from an independent candidate to *STAN*, the log odds of investing in construction works versus having no contract will increase by 0.187, the log odds of investing in services versus having no contract will increase by 0.216, and the log odds of investing in supplies versus having no contract will decrease by 0.118. When switching from an independent candidate to *TOP09*, the log odds of investing in construction works versus having no contract will increase by 0.432, the log odds of investing in services versus having no contract will increase by 0.991, and the log odds of investing in supplies versus having no contract will increase by 0.380.

The results suggest that most of the established political parties are associated with an increased likelihood of investing in contracts compared to the independent candidates (with the exceptions of the combinations of *ANO*–supplies, *CSSD*–construction works, *CSSD*–supplies, *KDUCSL*–construction works, *KDUCSL*–supplies, and *STAN*–supplies, which had negative coefficients and therefore decreased likelihoods). Although there is no direct research to compare the results with, they might indicate a certain level of opportunism in spending, as described e. g. by Castro & Martins (2019), Veiga & Veiga (2007) or Foucault et al. (2008), only regardless of the election terms and narrowed specifically to the established political parties.

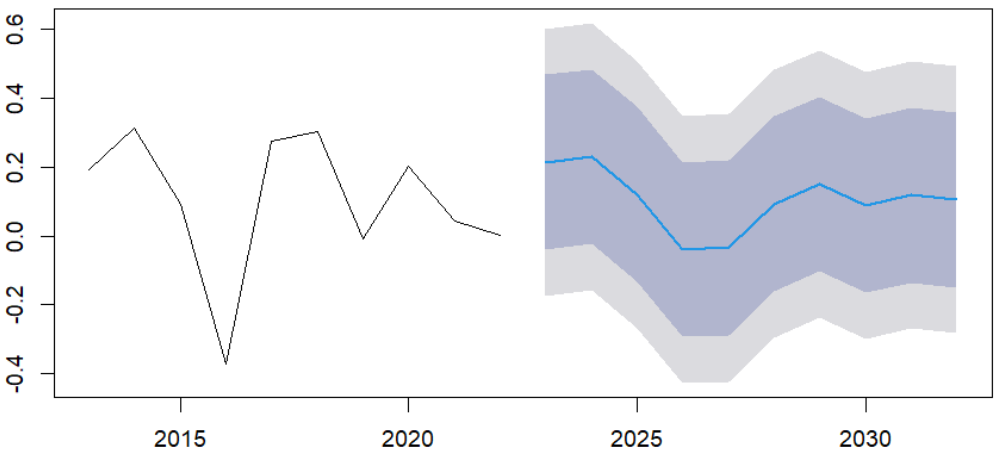
5.4 Prediction of future short-term gross fixed capital formation based on microdata

The first method used to test the hypothesis, applying the forecasting ARIMA method on the relevant variables aggregated into time series, led to the prediction plotted in Figure 5.6. The prediction for the next ten years (up to 2032) shows a pattern similar to the historical data (ten past years, 2013–2022) and so the value of fixed capital expenditures for the year 2023 is predicted to rise approximately to the level of 2013, a result which is highly questionable. It is possibly caused by the fact that despite having many observations for municipalities, the historical values span only ten years and so they form a time series that is too short to obtain a reliable forecast.

The second approach, imputation based on the historical data, led to predicted values of fixed capital expenditures for the year 2023 for each municipality, which I aggregated in Table 5.11. For each type of operation used (mean/sum/median), it shows the number of municipalities that are predicted to increase fixed capital expenditures in 2023 (“up”), the number of municipalities that are predicted to decrease fixed capital expenditures in 2023 (“down”), and the number of municipalities that are predicted to maintain the same level of fixed capital expenditures (“no change”) compared to 2022.

As can be seen, the results are essentially identical regardless of the operation used, and all three are rather inconclusive: although the number of municipalities predicted to decrease expenditures on fixed capital in 2023 is slightly higher, the difference between the two groups is marginal. Therefore, it is not possible to draw a definitive conclusion regarding the direction of future short-term gross fixed capital formation.

Figure 5.6: Forecasted capital expenditures.



Source: Author

Table 5.11: The direction of fixed capital expenditures for all municipalities in 2023 obtained by imputation using different operations.

	trend	count
using mean	up	1698
	down	1706
	no change	0
using sum	up	1613
	down	1791
	no change	0
using median	up	1698
	down	1706
	no change	0

Source: Author

Although the trends provide an overall sense of the direction in which the fixed capital expenditures might move in 2023 for individual municipalities, the imputation suffers from the same limitations as the first approach. Given the limited number of

observations for each municipality (spanning only eight years), the presented predictions exhibit significant uncertainty and should be interpreted and further built upon with caution.

A comparison of the results to the latest macroeconomic forecast of the Ministry of Finance of the Czech Republic for the year 2023 (from November 2023) is in place: "Gross fixed capital formation is expected to slow down in 2023 due to economic problems in euro area countries. … In contrast, investment activity will be positively affected by government spending co-financed by EU funds from the previous financial perspective. For next year, thanks to the expected economic growth in the euro area, we expect a recovery in private investment, but this will be hampered by the impact of restrictive monetary and fiscal policy stance. The transition to the new financial perspective of EU funds will lead to a decline in investment by the general government sector. Thus, gross fixed capital formation may increase by 2.2% (vs. 0.8%) in 2023 …" (Ministry of Finance of the Czech Republic, 2023). Given that I was not able to obtain similarly reliable results, I concluded that the prediction of future short-term gross fixed capital formation using my microdata on municipalities' spending behavior is not possible.

6 Conclusion

This thesis studied the public procurement spending and budgeting of 3,404 Czech municipalities (the highest number of municipalities for which relevant data were available, which is 54% of all the municipalities in the Czech Republic) during the years 2011–2022. For this purpose, I put together a unique panel dataset consisting of municipal procurement spending values, fixed capital formation values, political affiliation based on the mayor ruling in a given election term, type of contract the municipality invested the most in, population size, and regional affiliation, all assigned to each municipality for each given year of interest (except for the political affiliation, which could be assigned only for years 2015–2022).

I tested five different hypotheses. First, I studied the distributions of municipal spending on public procurement during the municipal election terms (2011–2014, 2015–2018, 2019–2022), using both all available municipalities and a subset of municipalities led by political parties which were for a given year also present in the national government. The results for all municipalities pointed to opportunistic spending towards the end of the election terms (higher amounts were spent during the years of elections), whereas the results for the subset of municipalities were inconclusive. Second, using a GLS model, I found that the relationship between municipal fixed capital formation and procurement spending is not influenced by other municipalities' characteristics (population size, regional affiliation, and political affiliation): the coefficient remained significant and positive regardless of whether the characteristics were present in the regression or not. Third, the results of a multinomial logistic regression suggested that in most cases, the established political parties are associated with an increased likelihood of investing in all three contract types (construction works, services, supplies) as opposed to having no contract when compared to the independent candidates. Finally, I concluded that the prediction of future short-term gross fixed capital formation using my microdata on municipalities' spending behavior is not possible using standard procedures. The main reason behind this is that the historical values start in the year 2013 at the earliest, resulting in a time series too short for a reliable prediction.

The main contribution of my thesis to the existing literature lies mainly in the research questions which have not yet been studied in the Czech context. Moreover, I created a new extensive dataset for my thesis: I gathered data from various sources

(Czech Information System on Public Procurement, Monitor containing public finance data, Czech Statistical Office, and Ministry of the Interior of the Czech Republic) and attempted to include the highest possible number of all municipalities by imputing missing values where possible. As similar data are neither available in any public source nor previously computed by another researcher, the newly created dataset opens more possibilities for further research on municipal procurement spending.

There is also room for extension of the thesis. First of all, the values for the political affiliation variable should be completed for the first election term (2011–2014) so it can be used for the whole dataset and not only a subset of it. Further research could also take into account other municipal characteristics, such as variables regarding the municipal environmental responsibility, the economic operators (suppliers) themselves, or possibly add more historical values to the dataset (starting with earlier years) to obtain a longer trend for predicting the future values, which was all beyond the scope of this thesis. In general, researchers focusing on the topic would benefit from better availability of data in public databases, especially the data on public procurement. Careful revision of the information on public contracts (such as values spent) and complementing the data with an end date for each completed contract would result in fewer biases and limitations caused by imputations of missing values. Moreover, it might also allow us to work with a larger fraction of municipalities (or perhaps all of them). When having data for more municipalities, my hypothesis regarding the association between political representation and types of contracts that municipalities invest in could implement a broader variety of types of contracts using CPV codes, not only the three main contract types, an improvement which could lead to more specific results.

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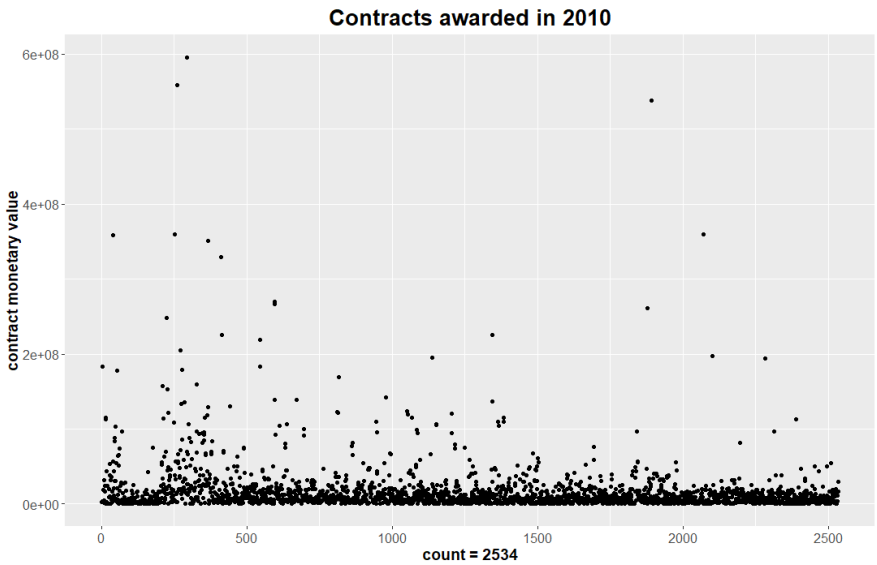
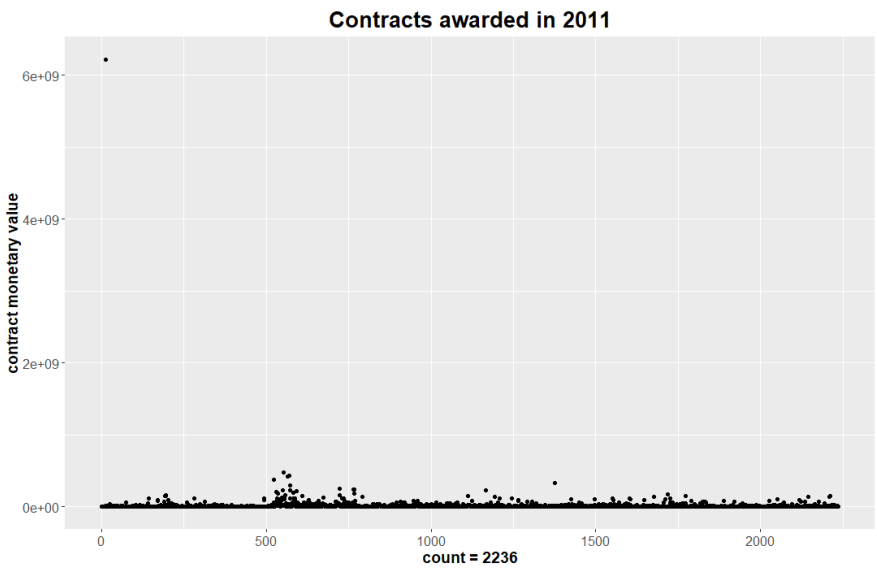
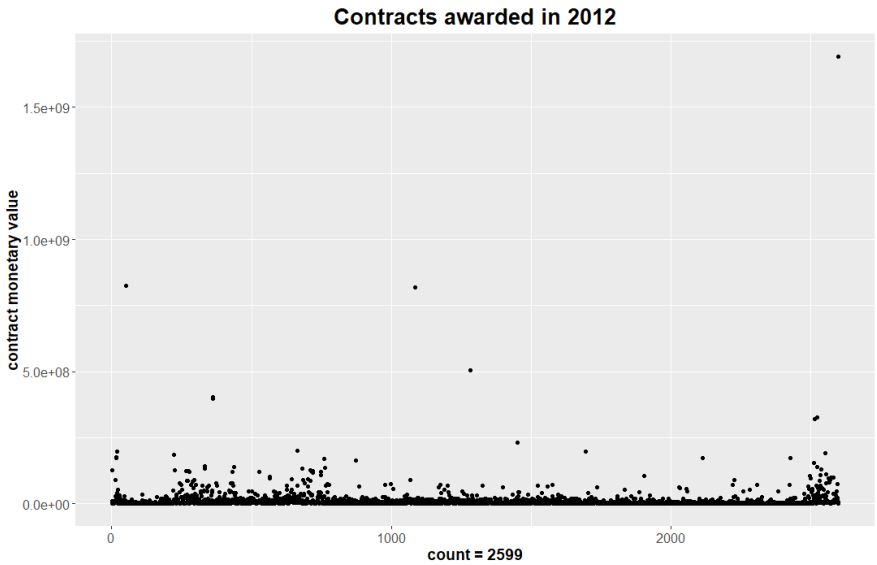
Appendix A: Data Modifications

Figure A.1: Plots of all initially available monetary values of the contracts with no modifications, including the values only used for imputing the missing values but then deleted because they were missing a starting date and/or CPV type.



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contract monetary value
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5.0e+08
0.0e+00
0
1000
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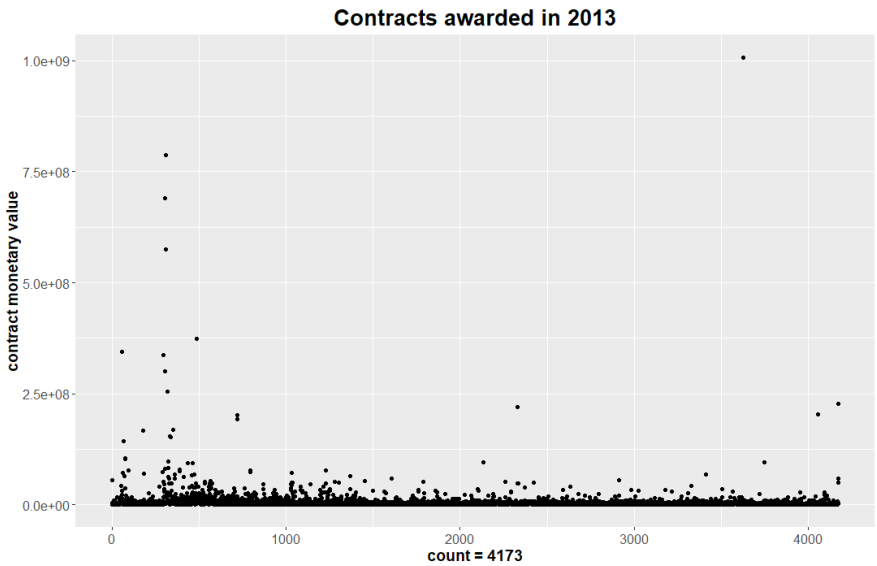
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contract monetary value
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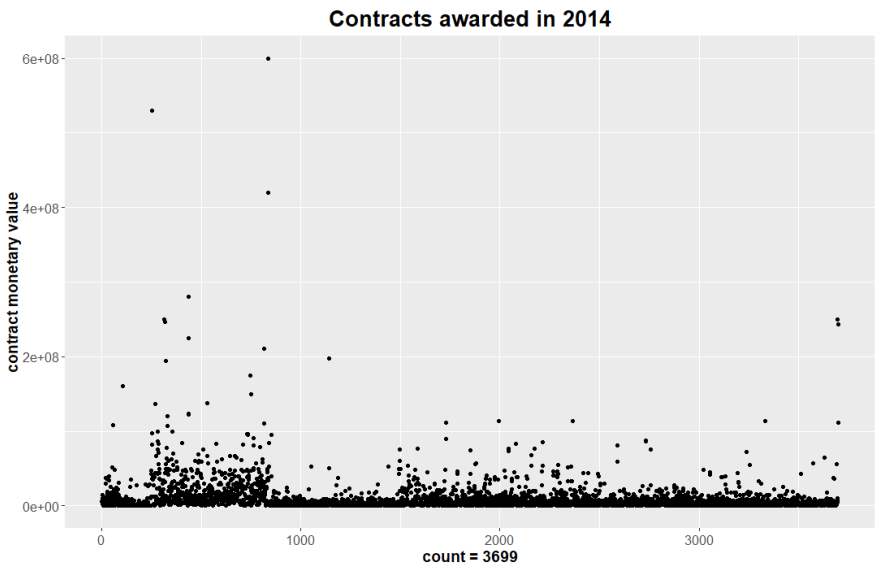
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contract monetary value
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0e+00
0
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3000
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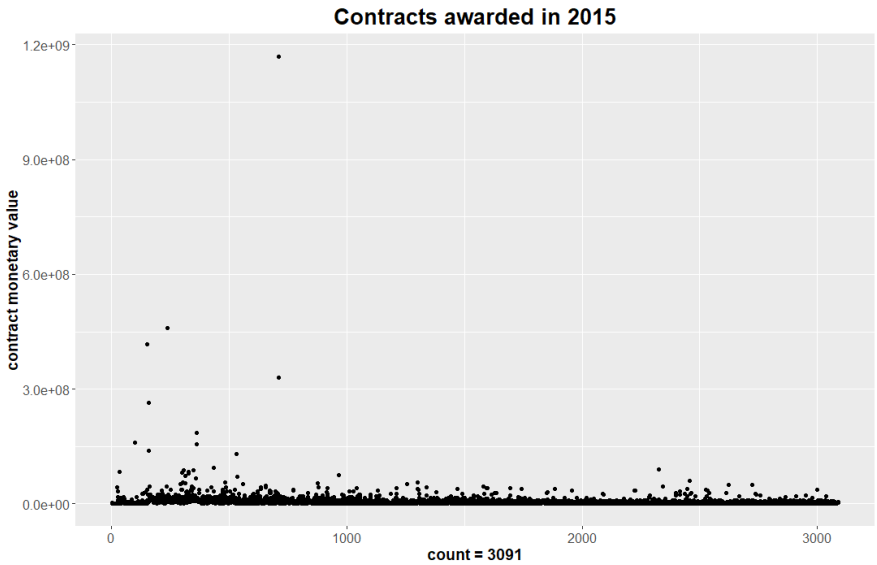
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6.0e+08
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0.0e+00
0
1000
2000
3000
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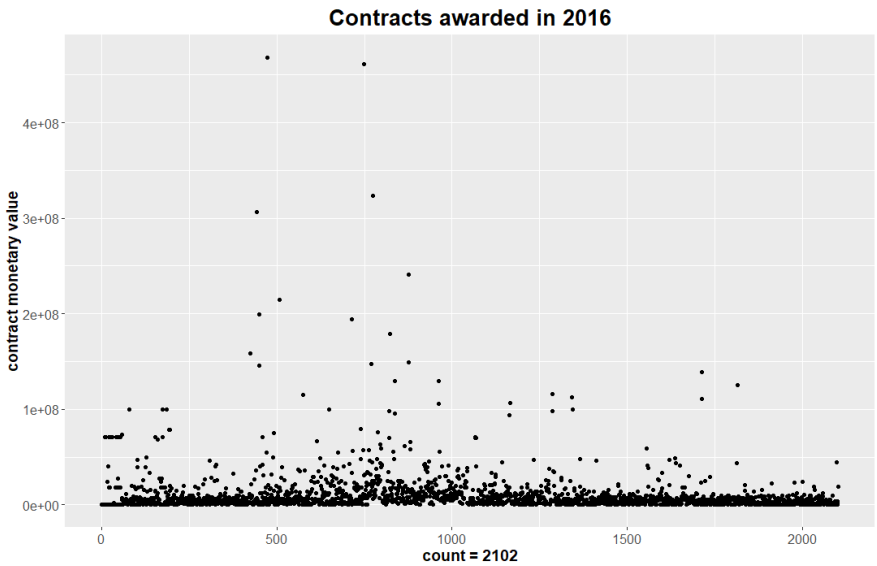
Contracts awarded in 2016
contract monetary value
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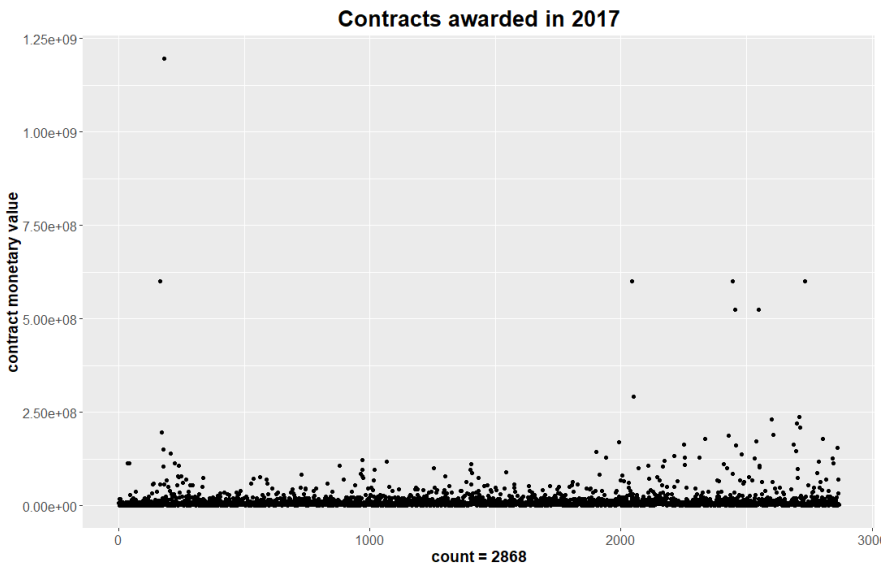
3e+08
2e+08
1e+08
0e+00
0
500
1000
1500
2000
count = 2102


Contracts awarded in 2017
contract monetary value
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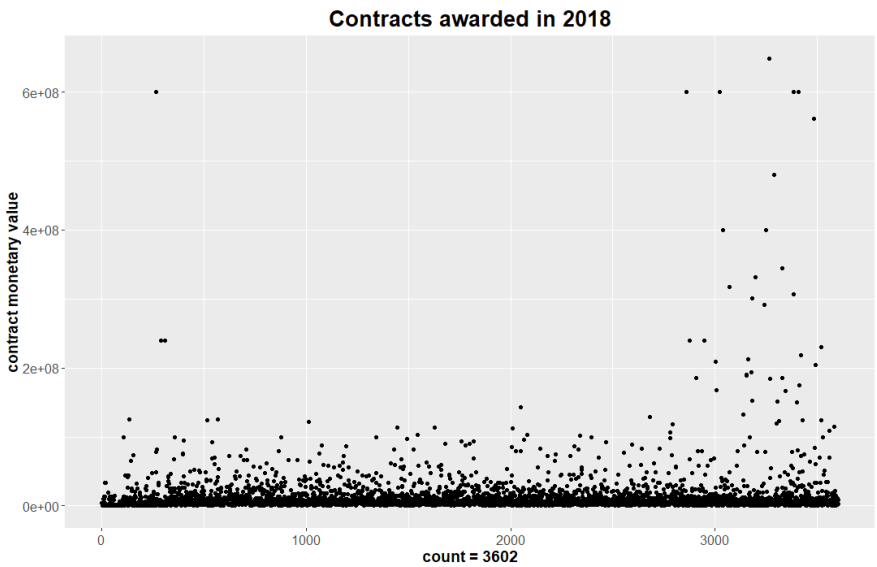
7.50e+08
5.00e+08
2.50e+08
0.00e+00
0
1000
2000
count = 2868


Contracts awarded in 2018
contract monetary value
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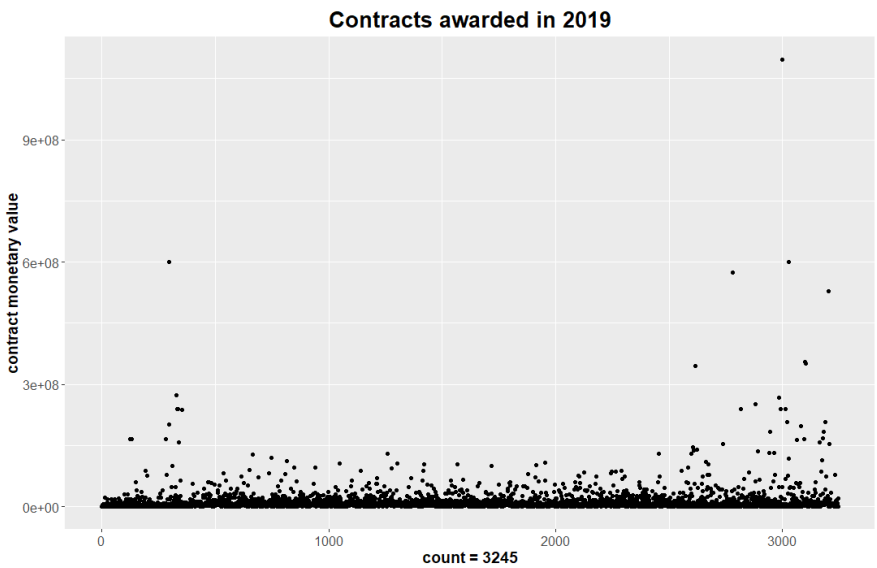
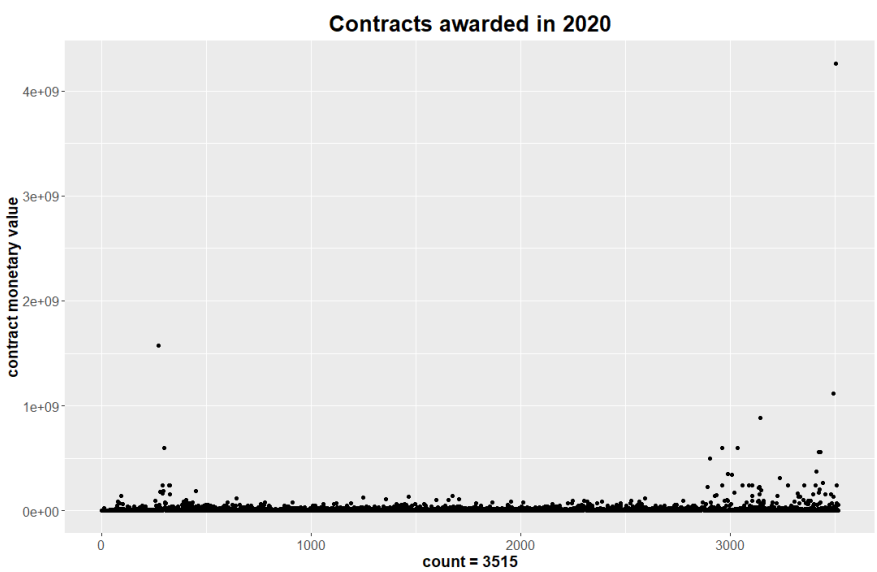
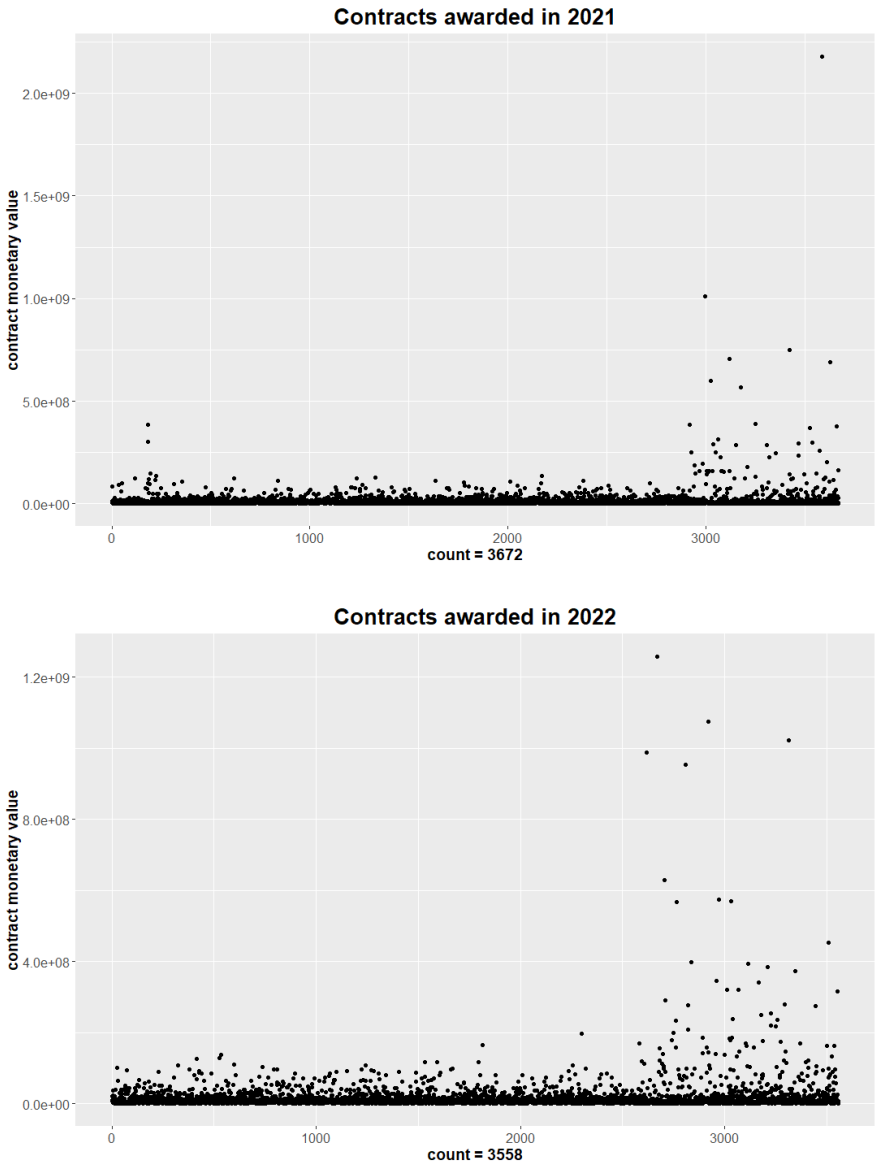
4e+08
2e+08
0e+00
0
1000
2000
3000
count = 3602

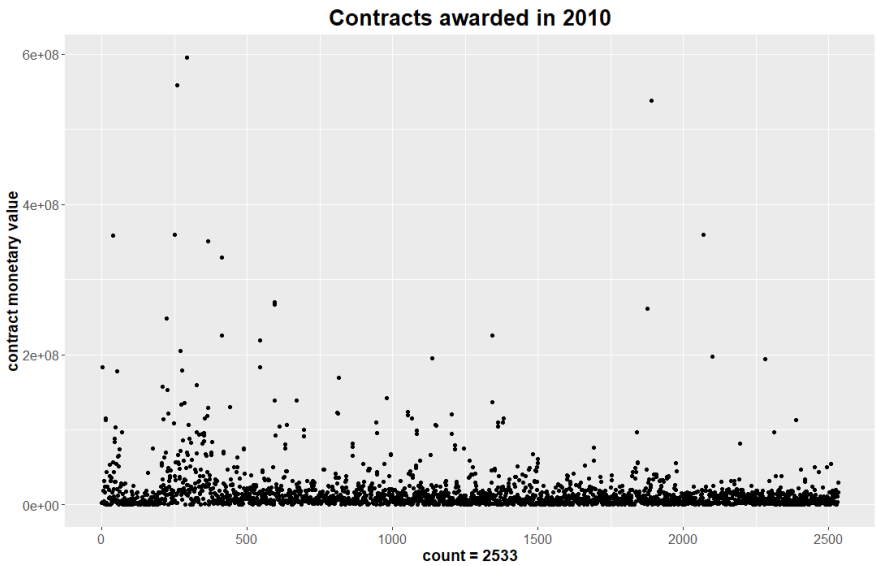

Contracts awarded in 2019
contract monetary value
9e+08
6e+08
3e+08
0e+00
0
1000
2000
3000
count = 3245

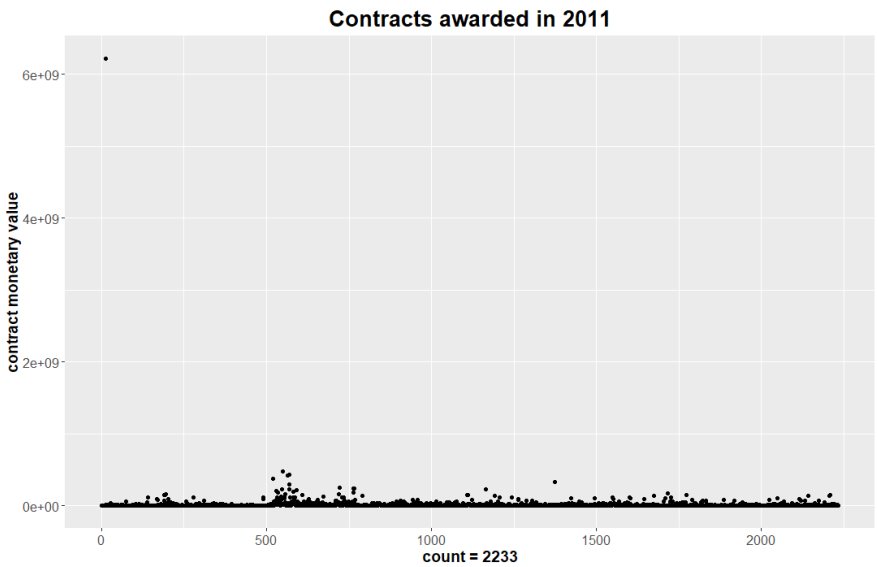

Contracts awarded in 2020
contract monetary value
4e+09
3e+09
2e+09
1e+09
0e+00
0
1000
2000
3000
count = 3515

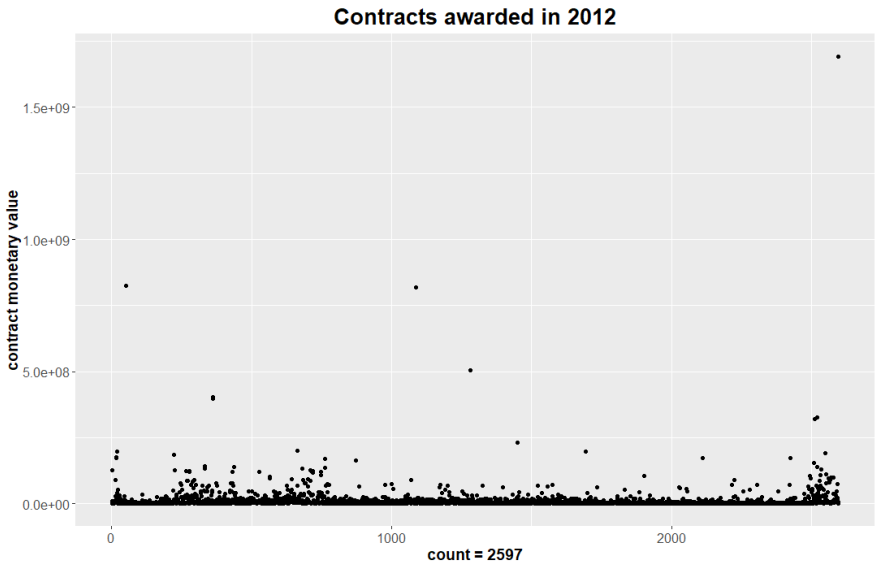


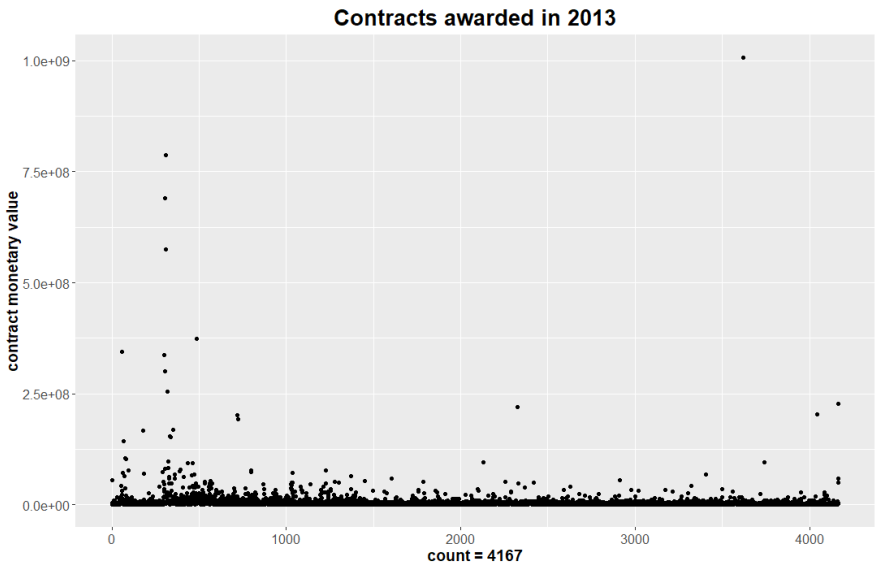
Source: ISVZ, Author

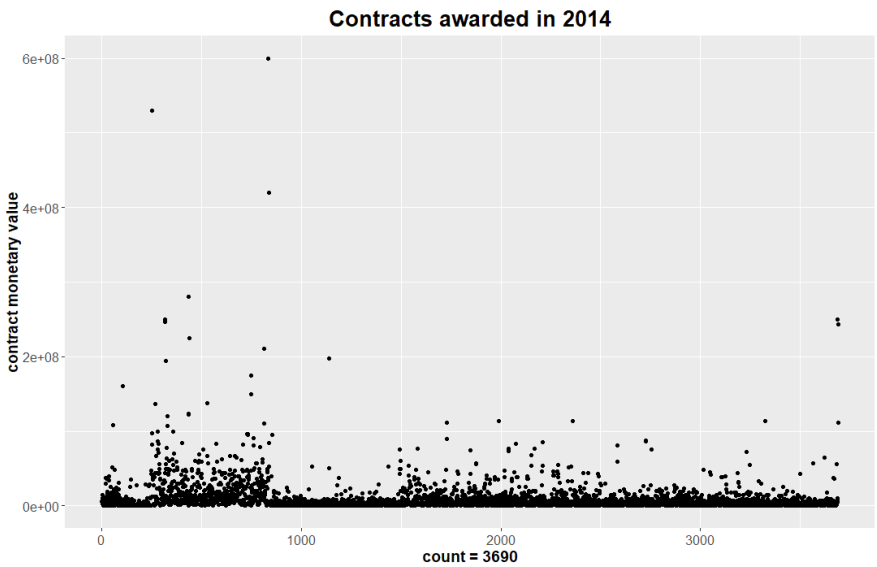
Figure A.2: Plots of monetary values of the contracts where extremely small (< CZK 1000) / large (outliers from the previous plots) values were examined and, if needed, modified or marked as missing.

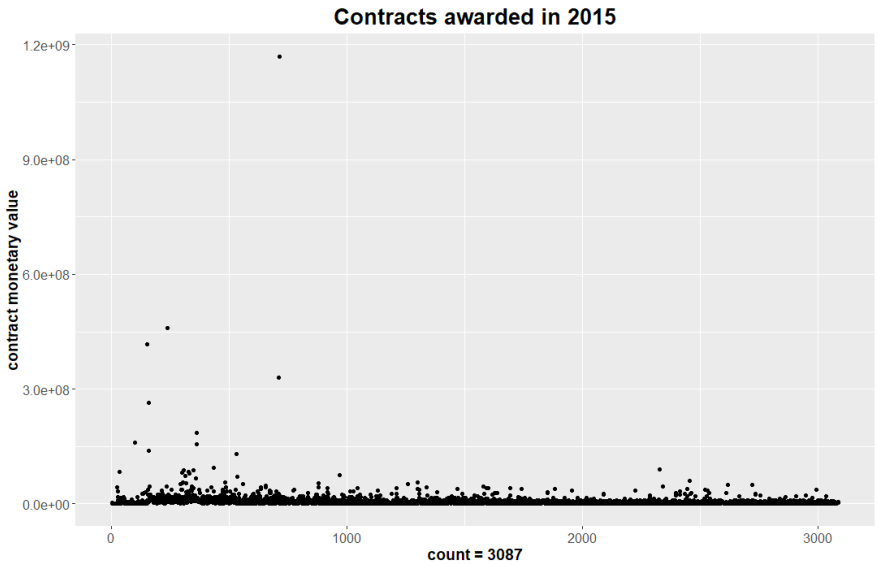


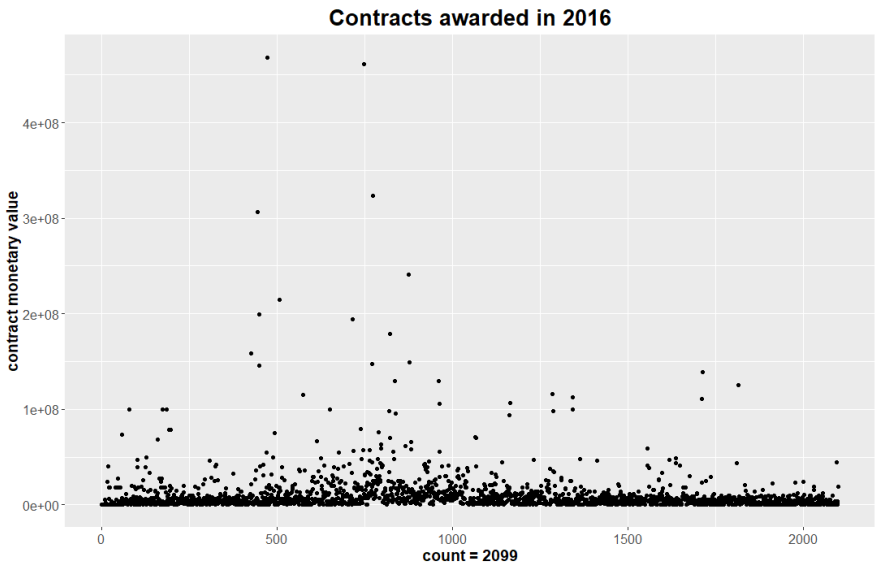


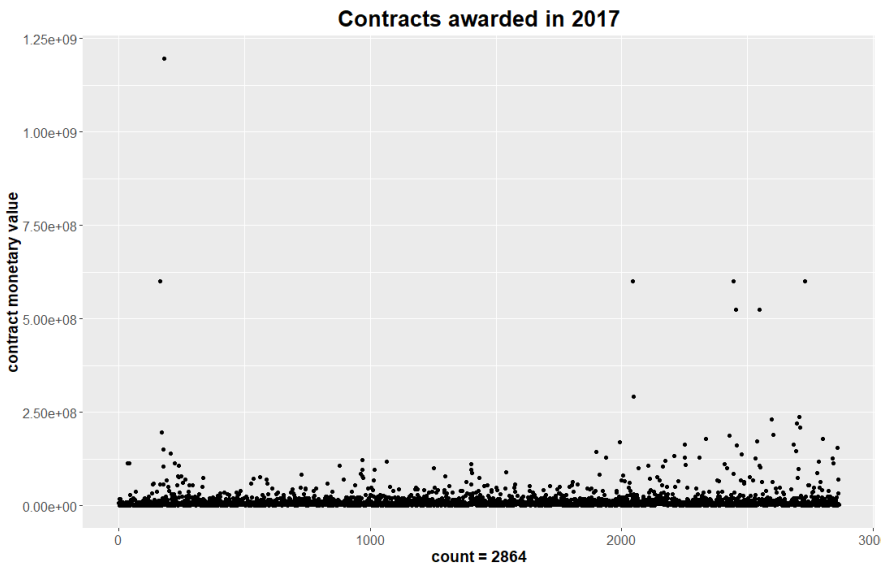

Contracts awarded in 2012
contract monetary value
1.5e+09
1.0e+09
5.0e+08
0.0e+00
0
1000
2000
count = 2597

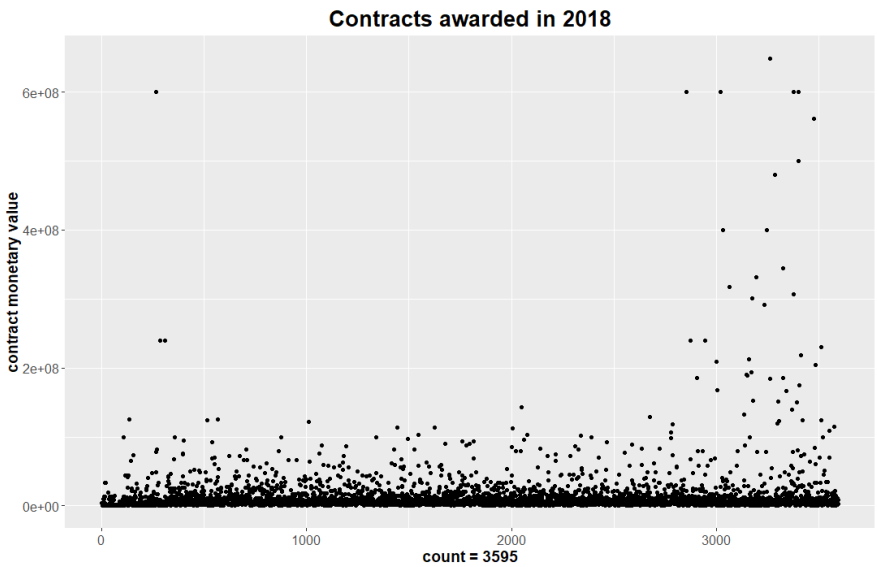

Contracts awarded in 2013
contract monetary value
1.0e+09
7.5e+08
5.0e+08
2.5e+08
0.0e+00
0
1000
2000
3000
4000
count = 4167

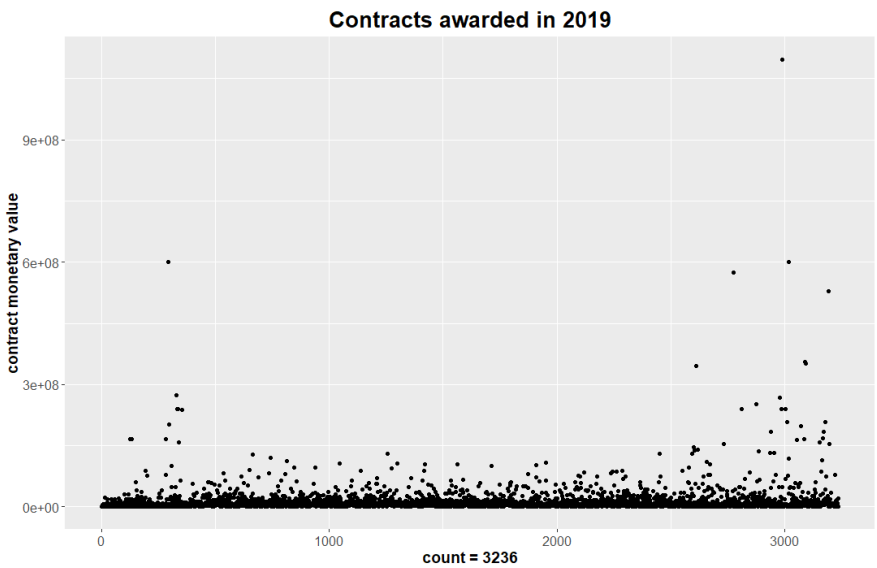

Contracts awarded in 2014
contract monetary value
6e+08
4e+08
2e+08
0e+00
0
1000
2000
3000
count = 3690

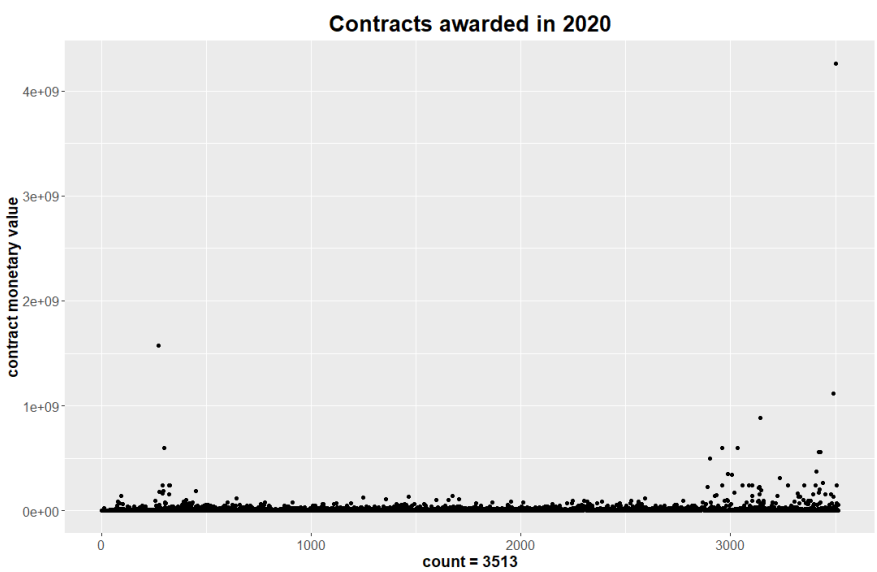

Contracts awarded in 2015
contract monetary value
1.2e+09
9.0e+08
6.0e+08
3.0e+08
0.0e+00
0
1000
2000
3000
count = 3087

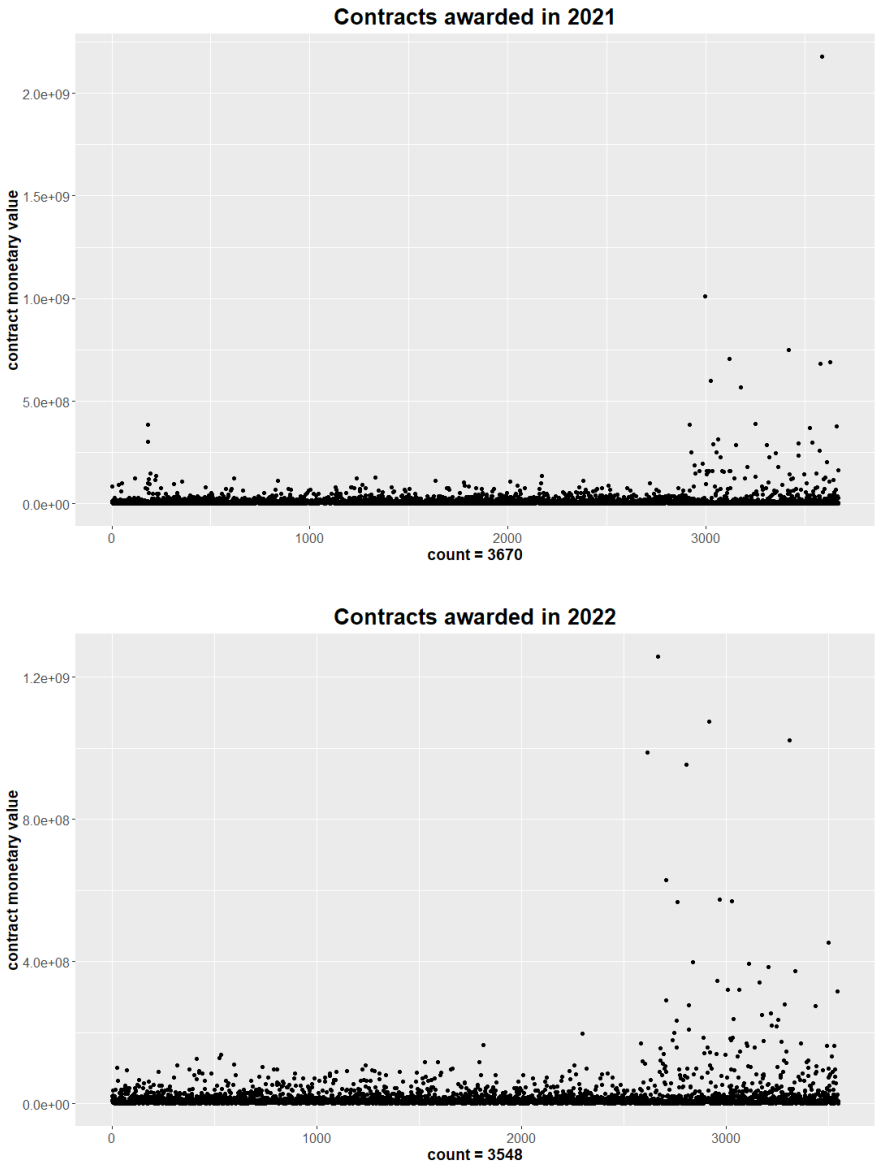

Contracts awarded in 2016
contract monetary value
4e+08
3e+08
2e+08
1e+08
0e+00
0
500
1000
1500
2000
count = 2099


Contracts awarded in 2017
contract monetary value
1.25e+09
1.00e+09
7.50e+08
5.00e+08
2.50e+08
0.00e+00
0
1000
2000
300
count = 2864


Contracts awarded in 2018
contract monetary value
6e+08
4e+08
2e+08
0e+00
0
1000
2000
3000
count = 3595

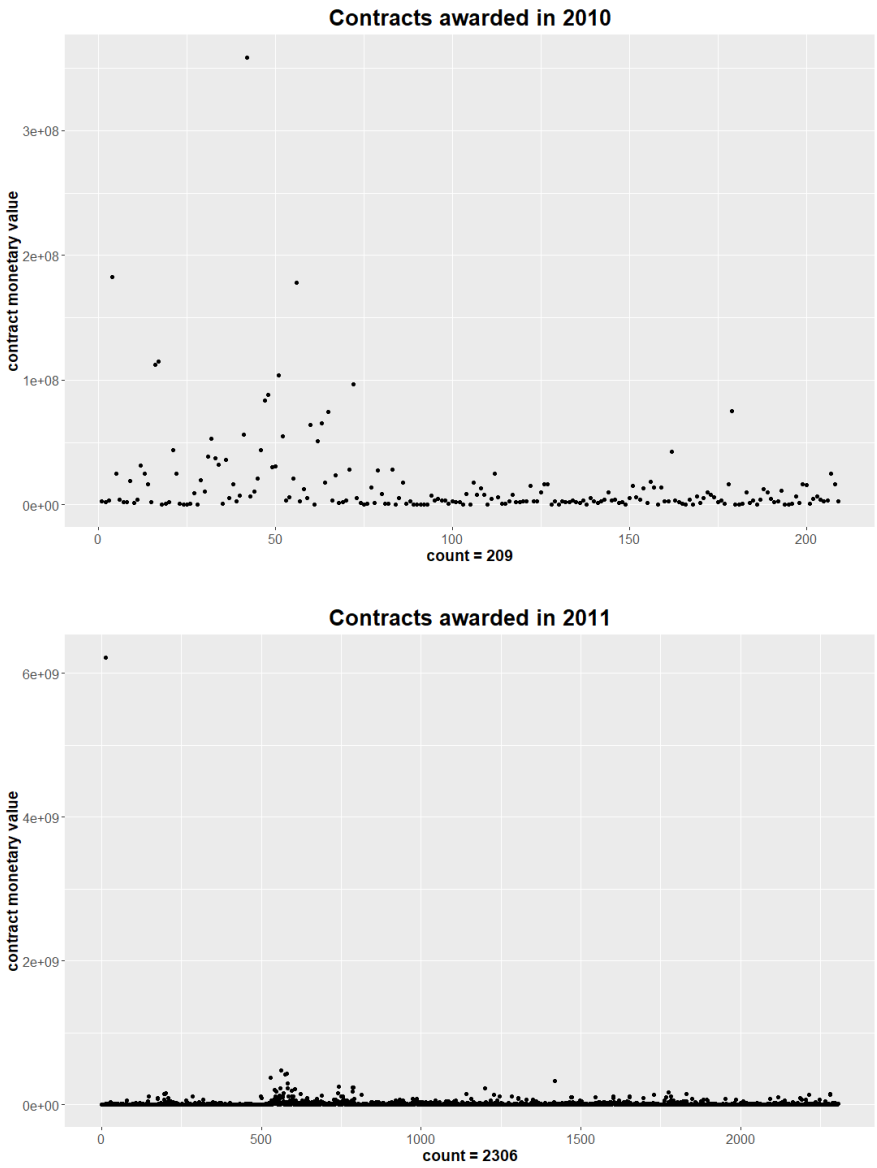

Contracts awarded in 2019
contract monetary value
9e+08
6e+08
3e+08
0e+00
0
1000
2000
3000
count = 3236

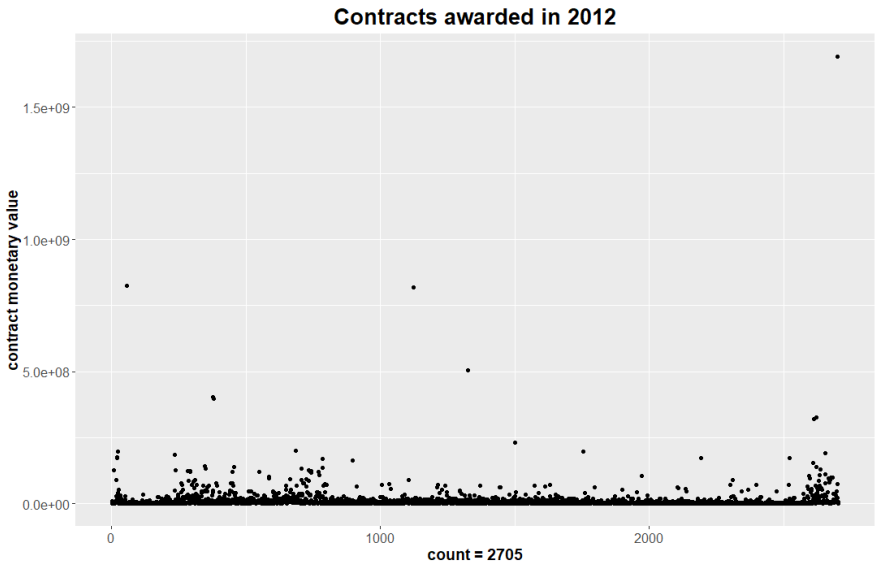

Contracts awarded in 2020
contract monetary value
4e+09
3e+09
2e+09
1e+09
0e+00
0
1000
2000
3000
count = 3513

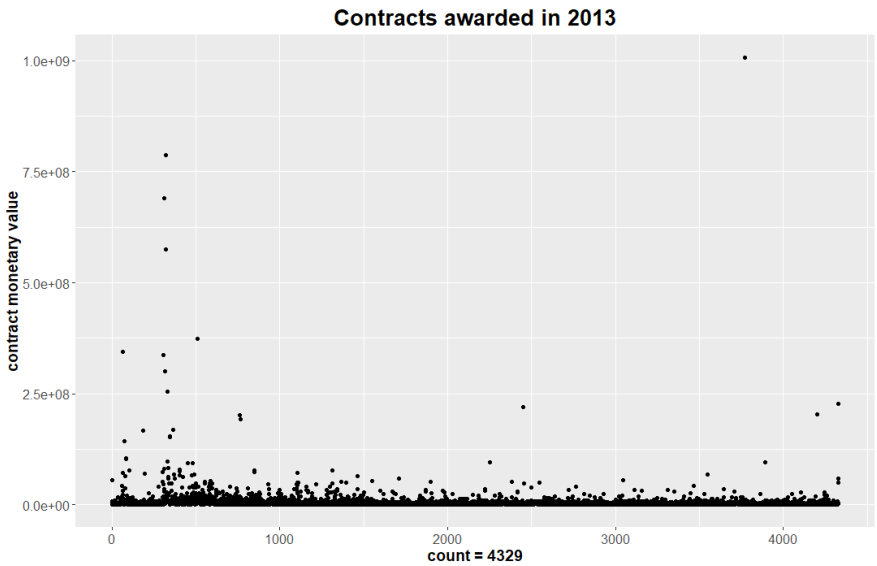


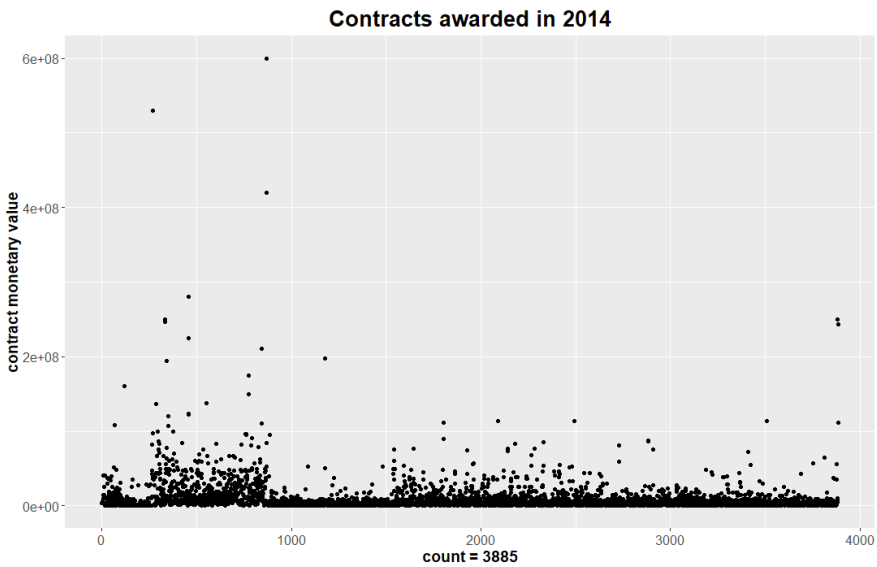
Source: ISVZ, Author

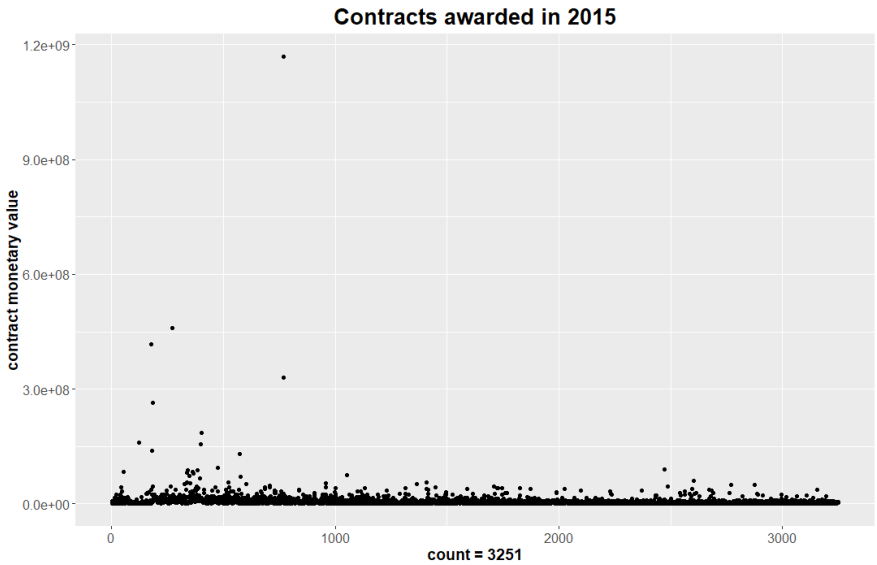
Figure A.3: Plots of monetary values of the contracts with the imputed missing values (where possible) and discarded rows where either the starting date, CPV type, or the monetary value was missing.

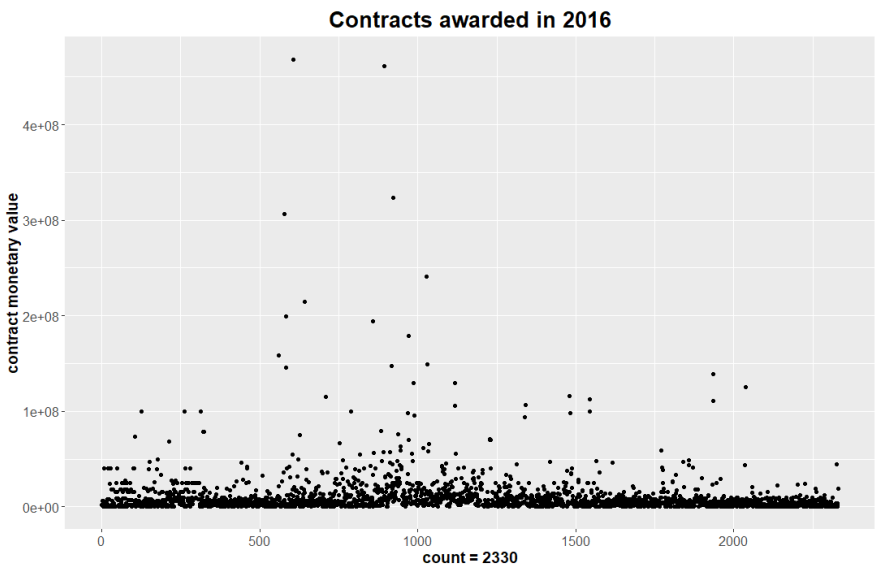


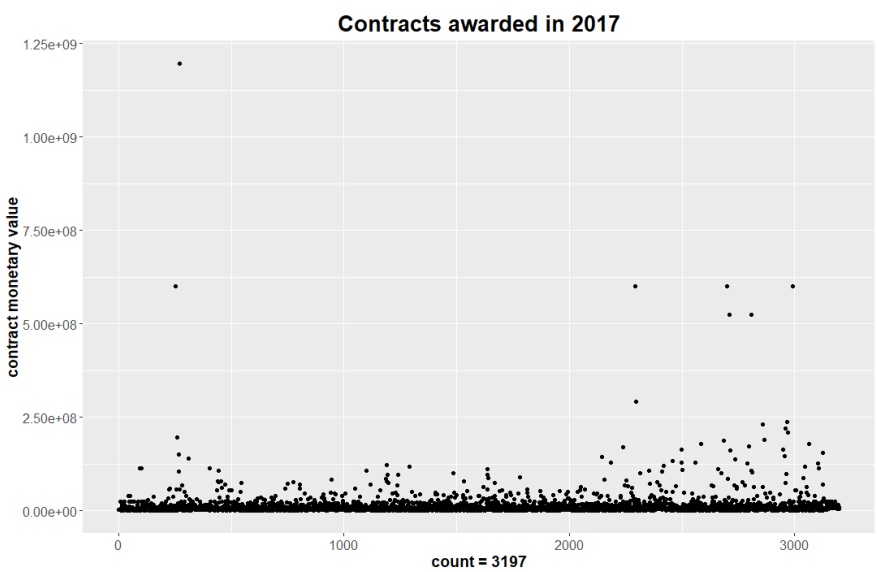

Contracts awarded in 2012
contract monetary value
1.5e+09
1.0e+09
5.0e+08
0.0e+00
0
1000
2000
count = 2705

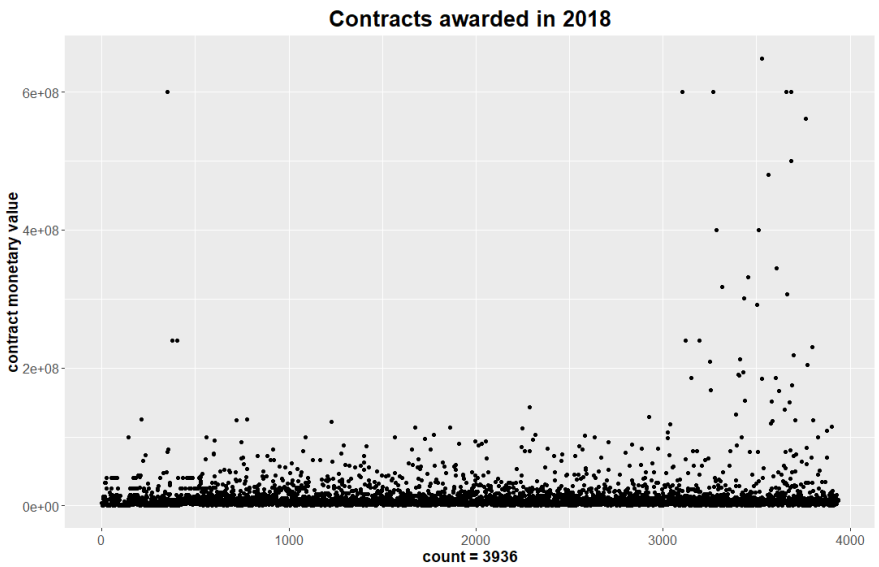

Contracts awarded in 2013
contract monetary value
1.0e+09
7.5e+08
5.0e+08
2.5e+08
0.0e+00
0
1000
2000
3000
4000
count = 4329

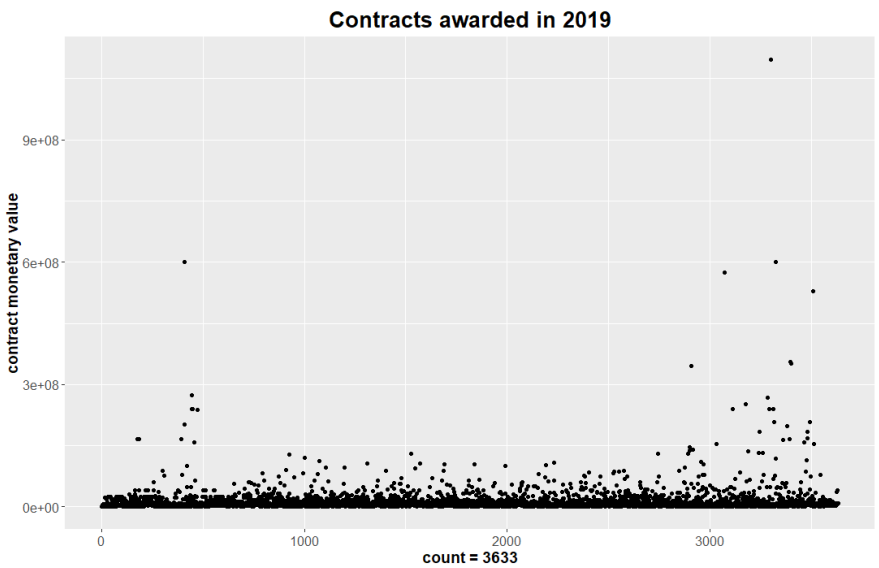

Contracts awarded in 2014
contract monetary value
6e+08
4e+08
2e+08
0e+00
0
1000
2000
3000
4000
count = 3885

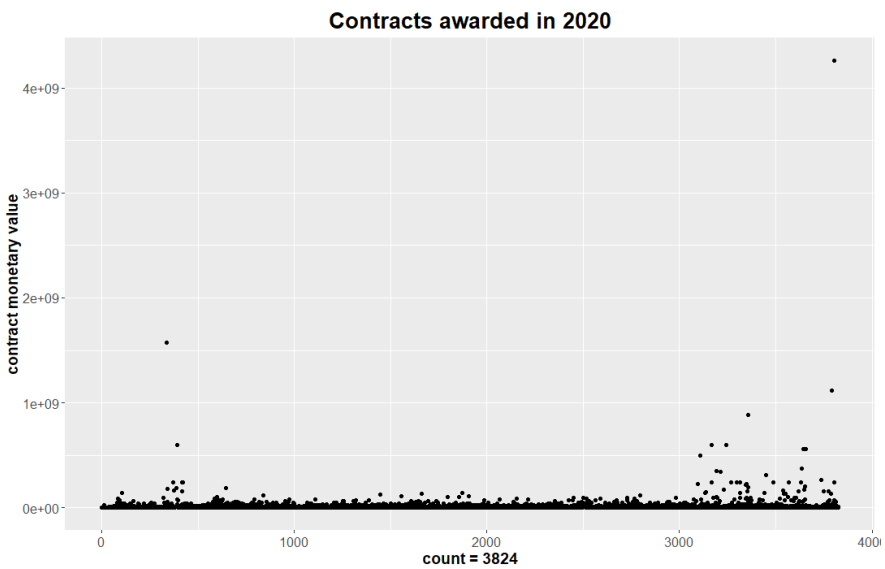

Contracts awarded in 2015
contract monetary value
1.2e+09
9.0e+08
6.0e+08
3.0e+08
0.0e+00
0
1000
2000
3000
count = 3251

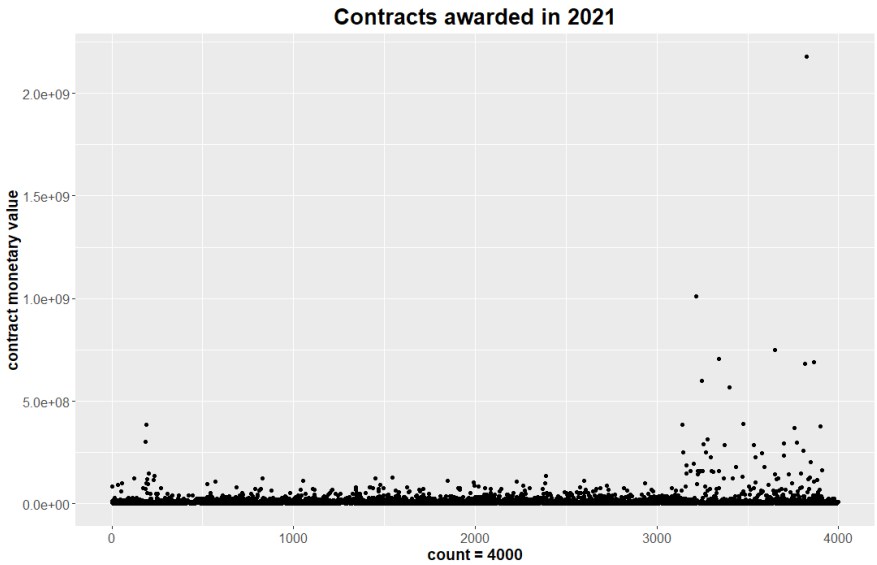

Contracts awarded in 2016
contract monetary value
4e+08
3e+08
2e+08
1e+08
0e+00
0
500
1000
1500
2000
count = 2330

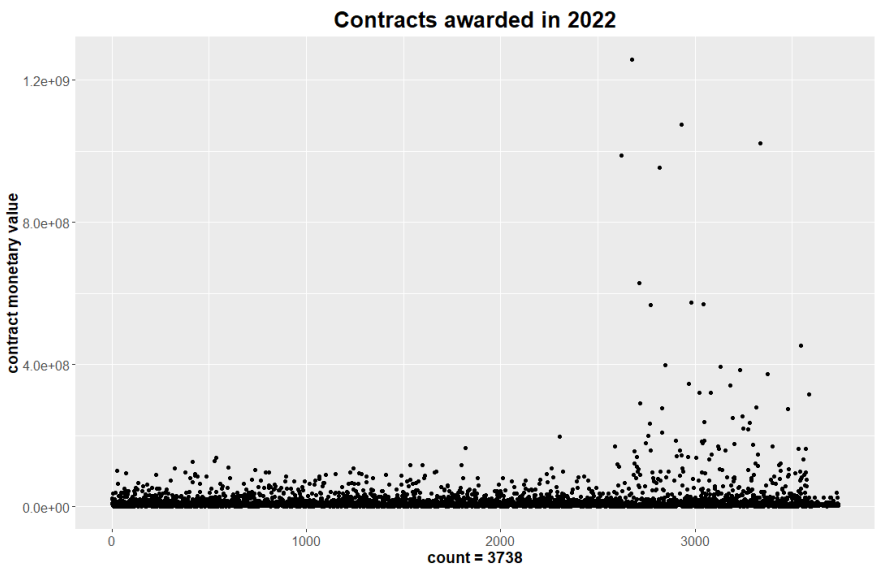

Contracts awarded in 2017
contract monetary value
1.25e+09
1.00e+09
7.50e+08
5.00e+08
2.50e+08
0.00e+00
0
1000
2000
3000
count = 3197


Contracts awarded in 2018
contract monetary value
6e+08
4e+08
2e+08
0e+00
0
1000
2000
3000
4000
count = 3936


Contracts awarded in 2019
contract monetary value
9e+08
6e+08
3e+08
0e+00
0
1000
2000
3000
count = 3633

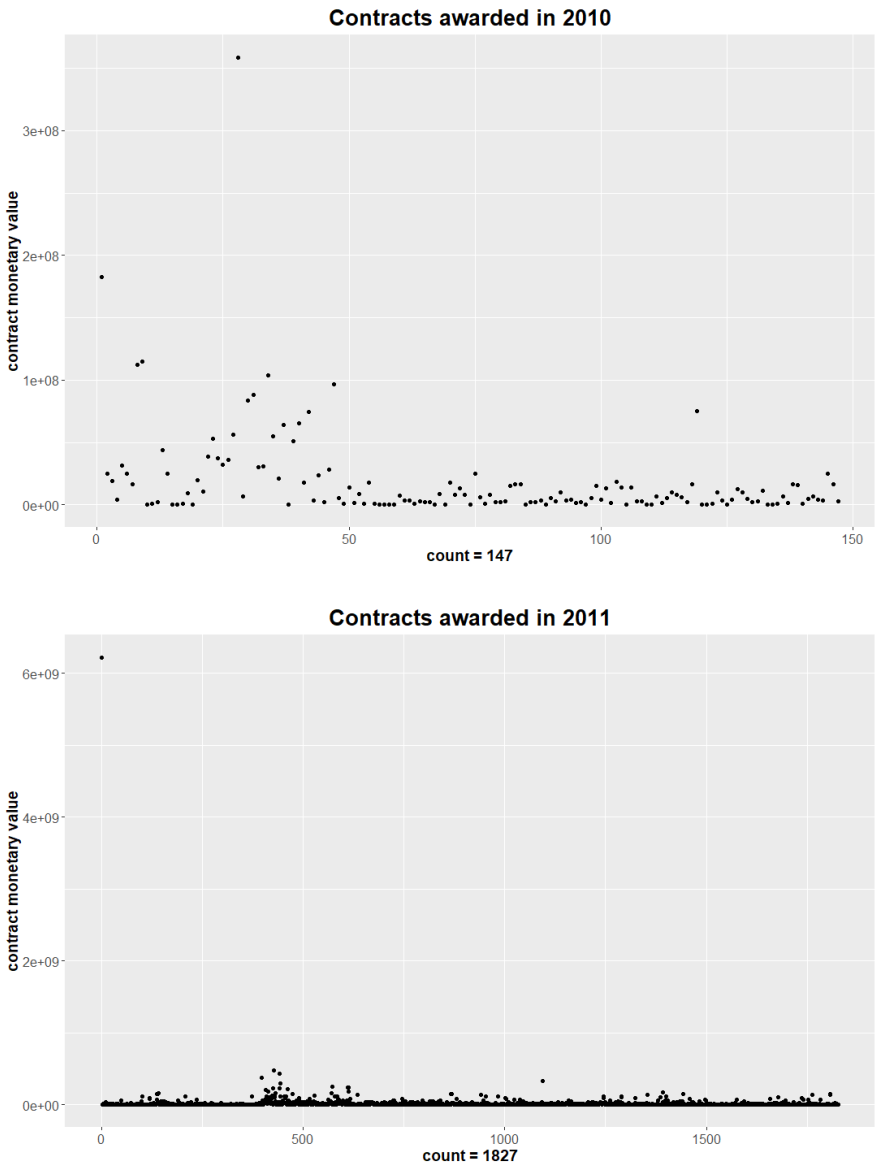

Contracts awarded in 2020
contract monetary value
4e+09
3e+09
2e+09
1e+09
0e+00
0
1000
2000
3000
count = 3824

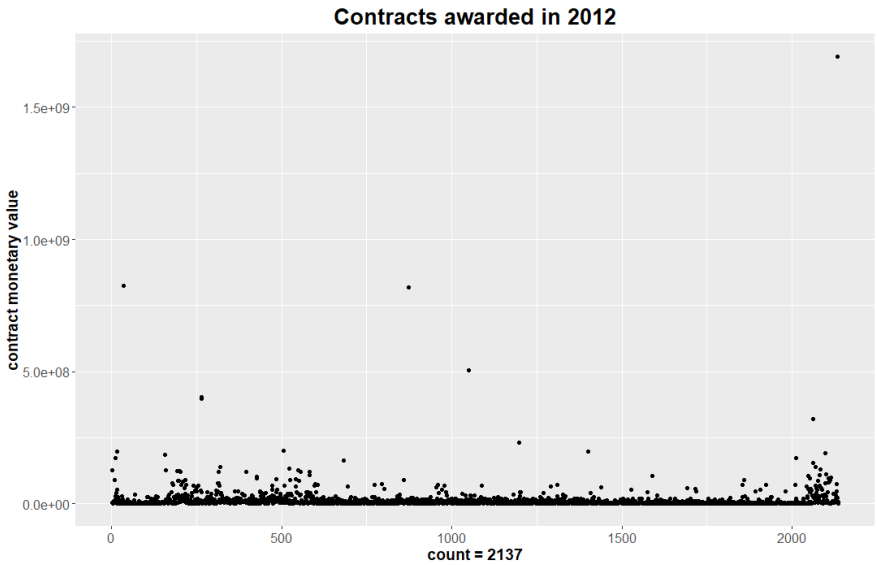


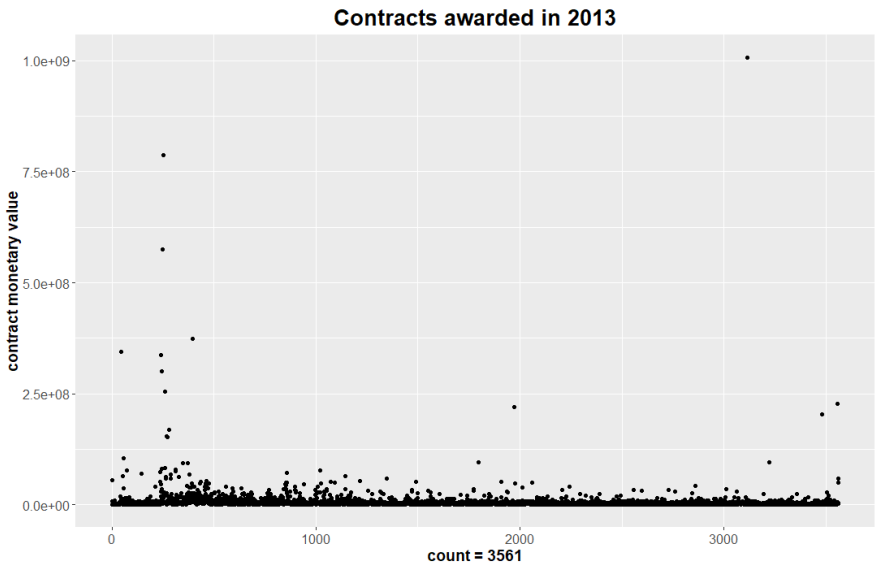


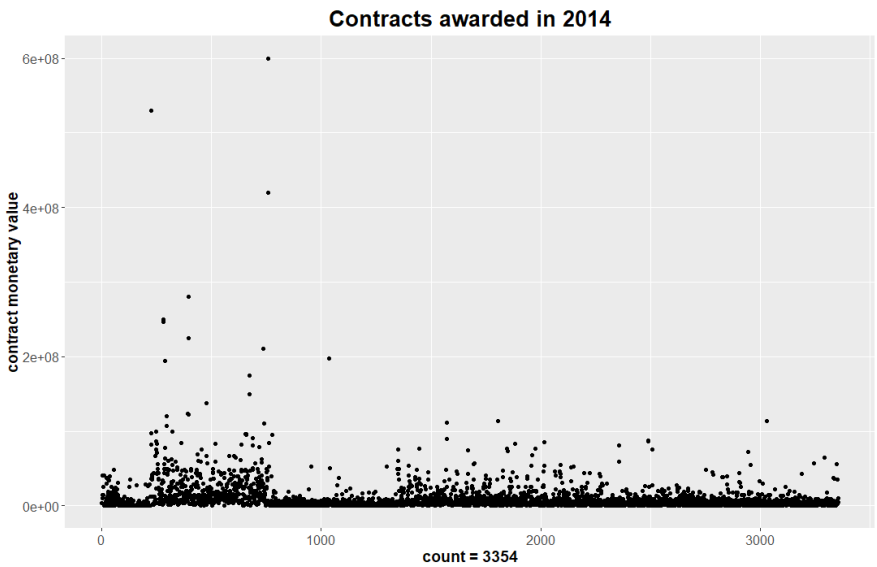
Source: ISVZ, Author

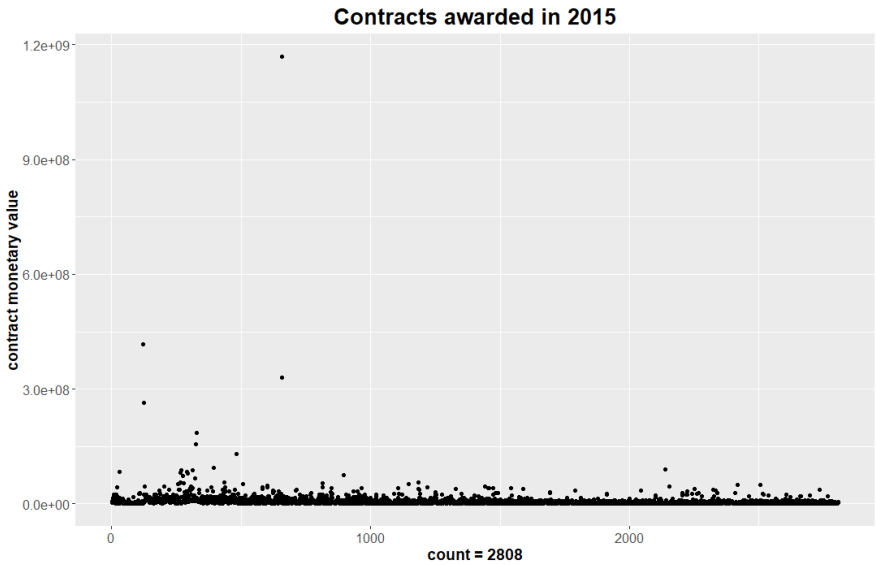
Figure A.4: Plots of final monetary values of the contracts after the ending dates were added to the data (where possible), where the values of the contracts for which the ending date couldn't have been calculated were discarded.

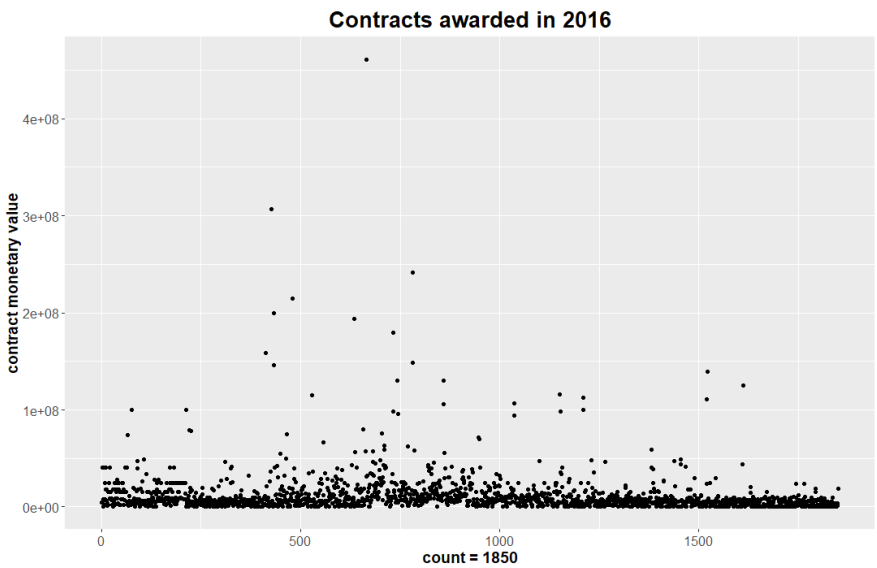


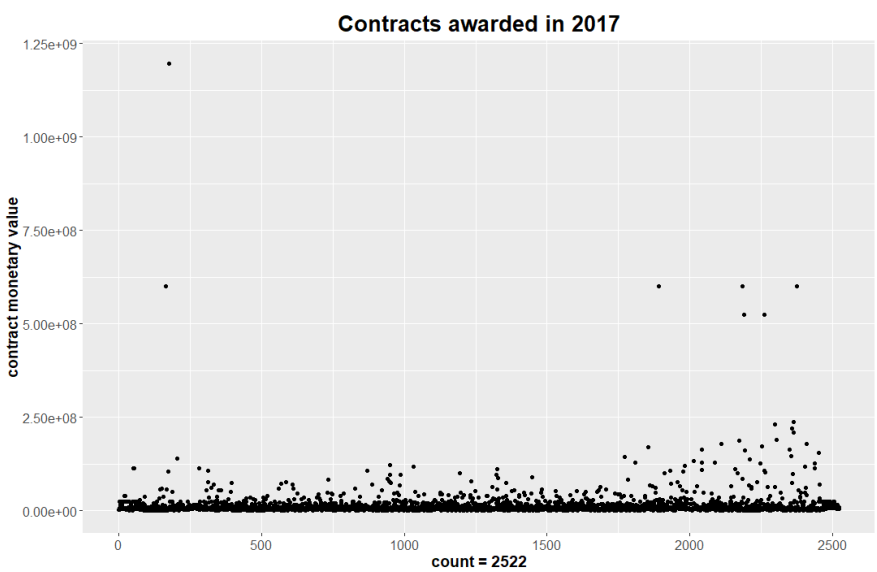

Contracts awarded in 2012
contract monetary value
1.5e+09
1.0e+09
5.0e+08
0.0e+00
0
500
1000
1500
2000
count = 2137

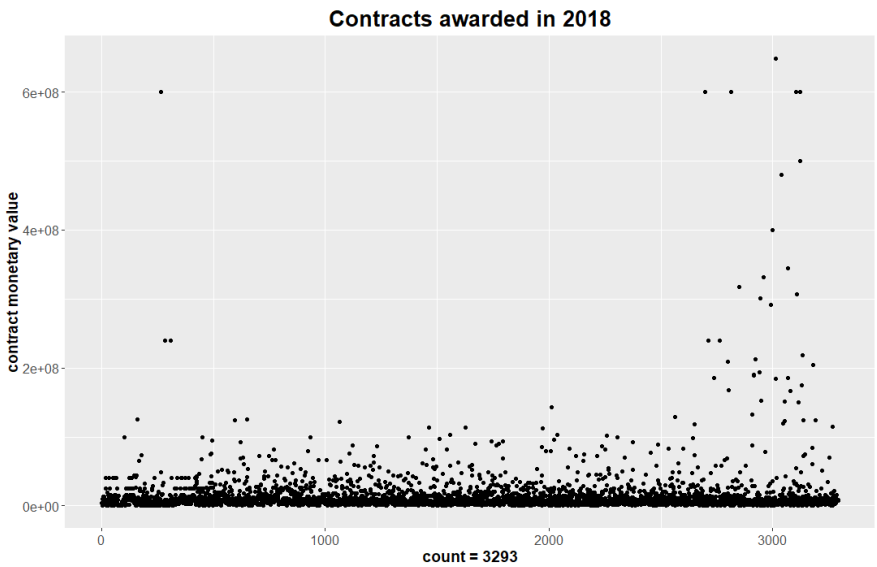

Contracts awarded in 2013
contract monetary value
1.0e+09
7.5e+08
5.0e+08
2.5e+08
0.0e+00
0
1000
2000
3000
count = 3561

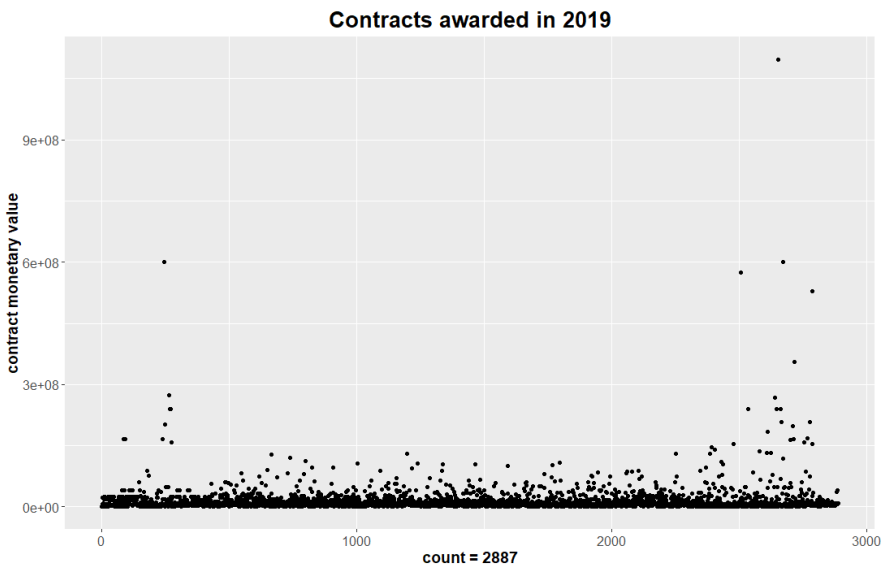

Contracts awarded in 2014
contract monetary value
6e+08
4e+08
2e+08
0e+00
0
1000
2000
3000
count = 3354

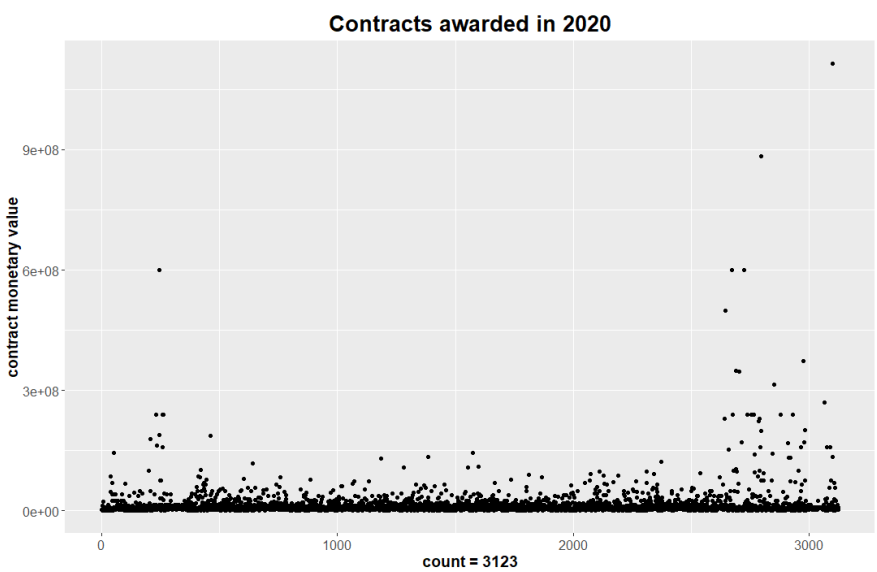

Contracts awarded in 2015
contract monetary value
1.2e+09
9.0e+08
6.0e+08
3.0e+08
0.0e+00
0
1000
2000
count = 2808

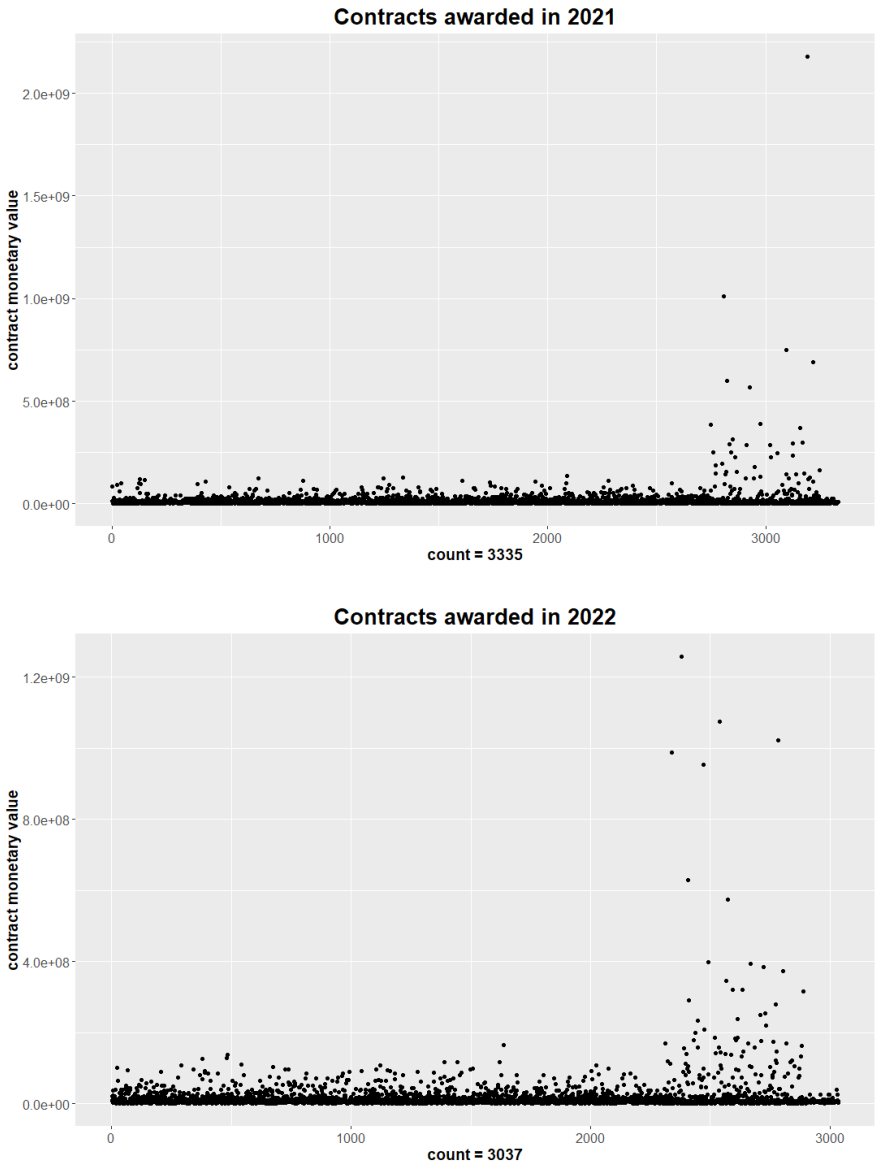

Contracts awarded in 2016
contract monetary value
4e+08
3e+08
2e+08
1e+08
0e+00
0
500
1000
1500
count = 1850


Contracts awarded in 2017
contract monetary value
1.25e+09
1.00e+09
7.50e+08
5.00e+08
2.50e+08
0.00e+00
0
500
1000
1500
2000
2500
count = 2522


Contracts awarded in 2018
contract monetary value
6e+08
4e+08
2e+08
0e+00
0
1000
2000
3000
count = 3293


Contracts awarded in 2019
contract monetary value
9e+08
6e+08
3e+08
0e+00
0
1000
2000
3000
count = 2887


Contracts awarded in 2020
contract monetary value
9e+08
6e+08
3e+08
0e+00
0
1000
2000
3000
count = 3123



Source: ISVZ, Author