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Public Procurement As A Policy Tool For Growth

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Dissertation presented as partial requirement for obtaining the Master Degree Program in
Data Science and Advanced Analytics

NOVA Information Management School

Instituto Superior de Estatística e Gestão de Informação

Universidade Nova de Lisboa

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Pulic Procurement as a policy tool

by

Andreia Filipa Dias Taboleiros

Dissertation report presented as partial requirement for obtaining the Master's
degree in Advanced Analytics, with a Specialization in Business Analytics

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February 2023

STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledge the Rules of Conduct and Code of Honor from the NOVA Information Management School.

Andreia Taboleiros

Cascais, 28/02/2023

Acknowledgements

During my two years at this university, I felt great support from the faculty team, and I thank all the staff for helping me in accomplishing another goal in my life.

On a personal level, I have no words on how to thank my family for supporting me and for pushing me to be a better version of myself. Without them I could have not finish this and be where I am today.

Abstract

As we know Public Procurement is when there is the spending of public money to deliver services, goods and works to the population. So, how can the State use it as a tool of economic growth? And is it in fact an effective measure for both sides (public and private sector)? We may think in fact that it is a useful tool for a country as public procurement has a big share of OECD countries expenditures.

Besides, how can we analyze it in quantitatively methods? To do our analyze we are not going to scale the data as the companies are not all equal and use Difference-in-Differences as to conclude regarding our previous questions. This is an analytical technique that helps to draw causal conclusions even when we cannot randomize the process. To do that we have to have the control group that refers to companies that are not involved in contracts with the State and we also have the treatment group which are the companies involved in contracts with the State. With this method we can compare companies that are different and have more than two periods. By doing this, we get an objective characterization of how public procurement impacts the companies and if it is beneficial for the private sector to enroll in such contracts.

To do this analysis we will use data that was extracted from the Portuguese Database regarding Public Contracts and data from Orbis database to have more information regarding the Portuguese companies. To compute it graphically we will resort to the event-study design.

Moreover, we can say that Public Procurement can be used as a policy for economic growth, but we cannot state it with precision. There is the need to have more information to obtain a better confidence interval on the results and to be able to truly trust them.

Keywords: Public Procurement, Economic Growth, Event-Study Design, Difference in Difference

Resumo

Contratação Pública é uma forma de gasto público para possibilitar o acesso e a entrega de serviços e outros meios necessários à população para ter o mínimo de conforto. Então como é que o Estado pode usar a Contratação Pública como uma ferramenta para o crescimento económico? Se pensarmos bem será que é uma medida eficiente para o setor público e para o setor privado? Como é uma parte significativa dos gastos dos países da OECD pode-se pensar que seja uma ferramenta útil para um país.

No entanto como é que é possível analisar o proposto em cima de forma quantitativa? Na nossa análise não iremos normalizar a data já que as empresas têm estruturas muito diferentes umas das outras. Para a análise iremos usar a técnica Difference-in-Difference para conseguirmos obter alguma resposta às questões anteriormente feitas. Isto é uma técnica analítica que ajuda na obtenção de conclusões causais, mesmo quando não conseguimos ter um processo aleatório. Para criarmos esta operação é necessário ter o grupo de controlo que se refere as empresas que não fazem contratos com o Estado e o grupo de tratamento que se refere as empresas que estão envolvidas em contratos com o Estado. Usando este método podemos comparar empresas que são diferentes na sua estrutura orgânica e podemos fazer a análise para mais do que dois períodos. Com isto é possível obter informação mais objetiva em como é que a Contratação Pública interfere com as empresas privadas e se, isto é, de facto benéfico ou não para o setor privado.

Para esta análise vamos usar dada extraída da base de dados Portuguesa relativa à Contratação Pública e da base da Orbis que contém a informação relativa as empresas portuguesas.

Alem disso, podemos afirmar que a Contratação Pública pode ser usada como uma política para fomentar o crescimento económico para se atingir um maior bem-estar geral. Contudo não se pode afirmar com precisão tal suposição devido à falta de significado estatístico nos dados. É necessário o acesso a mais informação para se obter resultados mais concretos e mais fiáveis.

Palavras-Chave: Contratação Pública, Crescimento Económico, Event-Study Design, Difference in Difference

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1 Introduction

Public Procurement is defined as the acquisition of goods, services and works for the population [[Siyal & Xin, 2019](#)]. The Government opts for this via as he cannot alone produce the necessary goods and platforms to fulfill the citizen's needs. Nowadays, it is not just the straightforward way of the State to get commodities for the population, but it started to be a way of the State to change the long-term unemployment, the sustainability levels and so on. It is a form to change the core function of the country [[Arrowsmith & Kunzlik, 2009](#)].

Public Procurement weighs 29% of Government expense and 14% of OECD country's gross domestic product (GDP) [[Comission, n.d.](#)]. With the increase of its importance there is the need to regulate the mechanisms used for Public Procurement. What we want is to have a transparent, effective and objective process when looking at Public Procurement. The European Commission has created a framework for Europe to assure it. Moreover, this framework also aims at creating an equal process for Public Procurement for the European countries [[Public procurement - Management of public funding](#)].

To have an equal process, the stages and the mechanisms need to be similar and for that they need to be digitalized. E-Procurement is the way to do that. It is a valuable tool for the OECD as it helps to reduce fraud and corruption. It makes it easier to access the information and for the countries to have similar processes.

Nonetheless, there is still lack of information when it comes to Public Procurement [[Lehmann et al., 2022](#)].

This work will go through the information available on Public Procurement and the problematic of only having biased studies. Most reports comes within the organization and have a general analysis [[Wachs et al., 2021](#)].

It will focus on how in Portugal Public Procurement can be used as a tool for economic growth by recurring to the method Difference-in-Difference. What this method gives is the differences between the variables that suffered a treatment to the ones that did not yet suffered it [[Schwerdt & Woessmann, 2020](#)]. These differences show the impact of having a treatment or not. It will show if that treatment has a positive, neutral or negative effect on our outcome.

The next chapter will explain more in depth what Public Procurement is and the methods and models that will be used to answer our question: can Public Procurement be used as a tool for promoting economic growth?

In addition, the following chapter explains more in depth the method that will be used to answer our question and how we have dealt with the data available and the transformations done to get to the final dataset.

Then, we will have an explanation of the results obtained and how we got them. Moreover, we will reflect on the limitations that we have encountered while doing this project.

2 Literature Review

2.1 An introduction to Public Procurement

Firstly, we need to define what Public Procurement is. It is said to be the acquisition of goods, services and works from a private source to help the population [[Lloyd & McCue, 2004](#)]. It is used to acquire the tools that are necessary for the welfare of the country that the State cannot produce by itself. For example, whenever a public-school needs material the State hires a company to provide them as the State does not produce those types of goods.

Legally, Public Contract's definition according to professor Pedro Costa Gonçalves, faculty member of Coimbra's University refers that *Public Contract it's a contract, which means that is an agreement formed by two or more formal contracts that are in the form of producing some legal effects* [[Gonçalves, 2015](#)]. In addition, this contract must be formed by a public party and a private one. The public party can be the Government, local/regional public authorities and parties that have authority, or any organism related to Public Law [[Gonçalves, 2015](#)]. Furthermore, we can align the Portuguese law to the OECD has we need to follow their standards. OECD when referring to Public Procurement always had in the basis of it the transparency of the contract and the fairness of the process [[Co-operation & Development, 2009](#)]. One important document to support this thesis is the directives issued in 2014/18/CE and 2004/17/CE that aims to adjust and create a more similar process when it comes to Public Procurement across the nations. It also implements E-Procurement that was not being used by many at that time. E-Procurement refers to Electronic Procurement. It is the online/electronic process of purchasing goods, works and services to the private sector. It is a way to make the process more transparent and easier for the suppliers to go the online auction [[Piera et al., 2014](#)].

Nonetheless, all contracts above 6,242,000 euros that are related to public works contracts and 249,000 euros that refer to public supplies and services contracts [[Lambeva, 2017](#)] need to be published in the Official European Journal and can be accessed through <https://ted.europa.eu>. Though, these values have been decreased to increase the number of contracts published in the Official European Journal. This measure can be understood as a way for the OECD to promote more transparency on the Public Contracts and equal treatment to them [[Arrowsmith & Kunzlik, 2009](#)].

More than 250,000 Public Institutions spend more than 14% of their GDP on the acquisition of goods, services and works [[Grandia & Kruyen, 2020](#)]. From what we have already learnt we know that most of these acquisitions at the beginning were just to fulfill a specific need or gap. However, nowadays Public Procurement is being used for a set of different goals. These varies from trying to add value to the environment in question to improving working conditions. This transformation makes Public Procurement not only

a mean to fulfill a need but also a tool to achieve a better society [[Grandia & Meehan, 2017](#)].

Public Procurement has been a tool to improve the country's welfare [[Martins & Damásio, 2020](#)]. It affects not only the population but all the businesses that act in the field of the contract [[McCrudden, 2004](#)]. It is an issue that is in the central focus of Developed countries such as the US, China, Brazil and Europe [[Lember et al., 2015](#)]. Nonetheless, there is still not alignment and a defined strategy between Public Procurement and policy applications [[Rolfstam, 2015](#)].

But why use Public Procurement as a tool to economic growth? We have seen that it is used to change the welfare in a positive manner. Nonetheless, there is the need to define value for money in the purchase of procuring goods. This is important as the private sector is not the same as the State. It seeks to satisfy its own needs and its employer needs whereas the State wants to fulfill the population needs [[Woldesenbet & Worthington, 2019](#)]. To create value for the company and value for the State the latter needs to create strategies that will attract the private sector and that will also go along the State desire. For example, the increase of the use of renewable energy in Sweden is fomented by the State and it uses Public Procurement to increase the private companies that use it. They have a strong green Public Procurement program [[Lindfors & Ammenberg, 2021](#)].

Moreover, to use Public Procurement as policy tool the contracts need to be appellative to both sides. In addition, when the process of public contracts is more transparent and simpler more companies will want to join it. There is a long way to go but knowing more and more about the topic helps to be closer to the goal [[Edquist & Zabala-Iturriagoitia, 2020](#)].

2.2 Public Procurement in Sweden and in the US

Sweden is one of the most transparent countries in the OECD when it comes to Public Procurement [[Fazekas, 2017](#)]. It has an effective system to control corruption and includes the areas that the European Union defends for progress: innovation, green and social [[Broms et al., 2019](#)]. What they aim at is to have a sustainable development and a policy making. To do so, they use an approach called *market environmentalism* [[Beymer-Farris & Bassett, 2012](#)]. *It sets the stage for an institutional arrangement dominated by market logics as the main tool for formulating and realizing policies for sustainability* [[Olsson & Öjehag-Pettersson, 2020](#)]. Nonetheless, critics have been pointed out to the limitations of sustainability. If we think about unsustainability, we can conclude that it can be a market failure and it can be a problem to progress [[Brunori & Di Iacovo, 2014](#)].

To solve that issue Kirsi and Halonen pointed out that to use Public Procurement as a tool for sustainability we need to focus on the Green Public Procurement. To do that we cannot generalize the tools for sustainability for every industry. There must be an approach for each sector to encourage the companies to search for sustainable solutions [Halonen, 2021].

In addition, the United States spends a considerable amount of money in the defense areas [Defense, 2022]. This is regulated at the federal level. In the US we do not have only one agency supervising every single area, which can be viewed to promote transparency as there are more means available to control corruption. In addition to this area, the US also uses information technology procurement to promote the economy [Yukins, 2022]. This is a case that it is important to us as we want to see if Portugal can use Public Procurement as a tool for economic growth.

Another relevant aspect is that in 2014 the US approved the Digital Accountability and Transparency Act which aims for more transparency and effectiveness of the contracts. The data can be accessed at www.usaspending.gov.

As we can see, Public Procurement is evolving to promote a more green and sustainable economy. Moreover, E-Procurement comes to facilitate the access to the data to the common population, but the data available is still very small and does not represent the Public Procurement market.

Moreover, as we have previously mentioned that there is lack of data available and from our research, we can see that most of the data comes from the countries data agency or from the companies in charge of the platforms [Thai, 2001]. This shows that we must try to study Public Procurement outside this bubble to see if the data shown is as realistic as we want. Also, having studies from the enterprises that control the Public Procurement data platforms is a problem as they are the ones that choose what should and not should be study.

Furthermore, the analysis done on the data is done in a narrower way than the ones we see in other fields. Most articles, books and studies are regarding Public Procurement laws or how local governments deal with Public Procurement.

2.3 Impact Evaluation

To understand the effect of a policy, we need to understand the impact that it has on the variables that are being studied . [Reed Johnson et al., 2013] So, Why do we evaluate impacts? Before answering this question, we need to understand a broader concept that is evidence-based making.

Evidence-based making decision is a method that collects data to be used in experimental evidence to make a choice [[Baba & HakemZadeh, 2012](#)]. Experimental evidence is used to provide a set of tools to verify and improve the effectiveness of the policies at the various stages of implementation [[Deller Jr & Hansen, 2004](#)].

Now we can answer the previous question. We evaluate impacts to assess the changes in our model and to what problem they can be attributed, because at the end what we want to answer questions that are related to the design or results [[Gertler et al., 2016](#)].

In our case what we want is to study cause-and-effect questions. This focus on how different interventions affect the outcomes.

2.4 Causal Inference

Cause-and-effect questions come from the core of causal inference. Causal inference is the study and deep knowledge of our problem in order to be able to estimate the effect of events on a given interest outcome [[Cunningham, 2021](#)].

This method is based on statistical models and refers that using data that we observed and that shows a correlation can incur in a logical fallacy. If we say that something happened because of a previous event we are saying that there is a correlation, though, this cannot be true.

To avoid this, we are not going to focus on observational data (non-experimental data), but on experimental data. What we want is to have a research question that can be answered through causal inference [[Huntington-Klein, 2021](#)].

To create a research question that is good it needs two things: to be answerable and needs to tell something about the world. In our case we are going to add information to the planet by looking for the causal effects of our question. We want to know the unobserved process that creates the correlation.

2.5 Difference-in-Difference Method

Conventional regression-based estimators have a problem as they fail to give unbiased estimates of relevant estimates when we do not have homogeneity [[Damásio & Nicolau, 2014](#)]. Use Difference-in-Difference to solve this issue. It is a method that is used to estimate causal effects. It is used mostly to analyze economic cases [[Lechner, 2011](#)]. It computes the effect of a treatment on a certain outcome by comparing the average change over time on the outcome result. The treatment effect is the independent variable. We call a variable independent when it refers to the variable, we can control or

vary on an experimental study to explore the effects. It is not controlled by other variables [Flannelly et al., 2014]. The outcome can be referred as the response variable or the dependent variable. It is the variable that changes when other factors change in our problem.

The design used for DID is usually done by comparing two different groups and in two periods, which is the canonical approach. The groups we are referring to are the treatment group and the control group. The first one is related to, in our case, the companies that suffered a treatment (the companies that did contracts with the State). The second one refers to the companies that did not yet suffer any treatment.

Moreover, another important factor about DID are the assumptions that make it possible to use this method [Fredriksson & Oliveira, 2019]:

- MLRM (Multi-Linear Regression Model) assumptions apply to DID
- Trends must be parallel
- Composition of the groups is assumed to be unchanged over time
- No anticipation

The first assumption refers to three key assumptions. The first one is related to the assumption of linearity. We need to fit a linear model to a data that is linear for the model to be corrected and therefore reliable. We cannot fit data that is not linearly-correlated. Then we also need to mention the assumption of homoscedasticity. There is the need for the variances to be similar in the different groups that are being compared. It is an important assumption because statistical tests are sensitive to any dissimilarities. The third assumption is related to the normality of errors. If the errors are not normalized; the standard errors won't be reliable.

DID procedures rely on the parallel trend assumption. This assumption states that in the absence of the treatment the control group and the one that was supposed to be treated are constant overtime. What we want to measure is the difference after the existence of a treatment on the trends.

The third assumption mention above refers to when we have a unit being treated or a cluster being treated. The number of units in that cluster or that unit cannot be changed overtime. They will remain the same until the end of the program.

The no-anticipation assumption imposes that if a unit is not treated in period t , the outcome will not depend on what time period they will be treated in the future.

In addition, we can also consider five auxiliar assumptions to our DID [Athey & Imbens, 2022]:

- Constant treatment effect over units
- Constant treatment effect overtime
- Binary Treatment and constant treatment effects

- Random Sampling
- Additivity

We want the treatment to be constant on similar units' overtime to specifically understand the impact of the treatment on them. Additionally, binary treatment refers to when we have a dummy variable to represent the treated units, it will equal one, and the not yet treated units, that will be equal to zero. Random sampling is important for our model as it reduces variability and potential confounding which results in a better estimation of the treatment effects. The additivity assumption is important. It refers to the effect of changes in a predictor on a response is independent of the effect of changes in another predictor. The assumptions above help to better understand the model and what will be done further ahead.

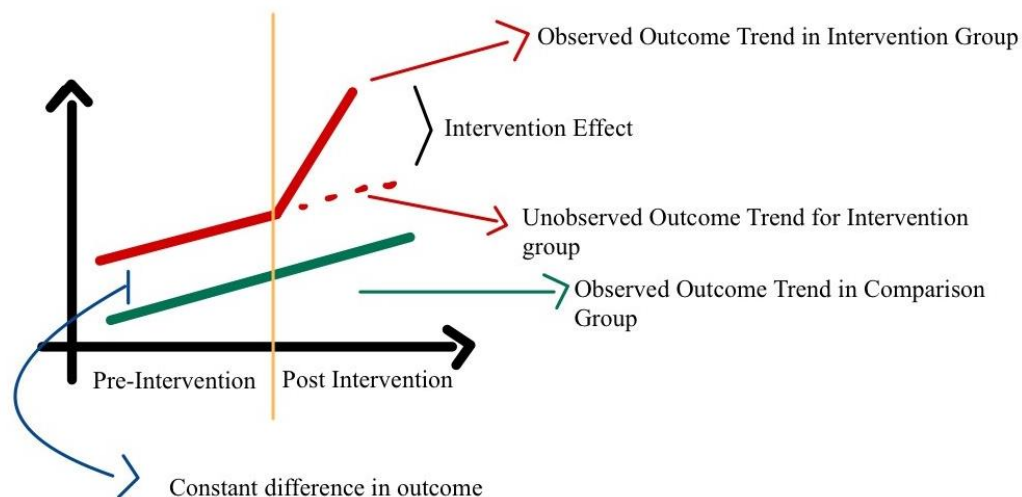


Figure 2.5-1 Graphic Explanation of DID Process

Figure 2.5-1 shows a simple version of the DID method. The periods will be 0 and 1 and will be defined by t . When we have $t=0$ we are referring to the period before the treatment whereas $t=1$ is the time after the treatment [Wing et al., 2018].

This is an implementation of event studies via two-way fixed regression (TWFE) [Wooldridge, 2021].

TWFE is good to use when we have several treatment variables. The coefficient on each treatment identifies a weighted sum of that treatment's effects.

Nonetheless, the implicit conflation on TWFE, the act or process of combining two or more elements into one whole, on different assumptions leads to biases.

To solve this, we need to look at the assumptions described before and see if the policy influences the outcome before it occurs. This is called Pre-Trend [Roth et al., 2022]

Then, to plot the event study there are two major ways. The first one depicts cumulative estimated effects of the policy and plot cumulative estimated effects of the policy in areas outside the permitted perimeter where the policy is thought to affect the outcome [[Simon et al., 2022](#)].

2.6 Event Study Design

The event study framework is a difference-in-difference design, where we are assessing the effects of a policy before and after its introduction [[Borusyak et al., 2021](#)]. It is an estimate of the impact of a quasi-experimental policy [[Clarke & Tapia-Schyte, 2021](#)]. The latter refers to the identification of a comparison group that is alike to the treatment group in terms of the pre-treatment period [[Reichardt, 2011](#)].

Event study design allows the use of dynamic leads and lags. Leads and lags are used to move a variable in terms of time to ensure that the movements of two variables are closer if there is a time lag between a change of one variable and the impact on the other [[Burns & Mitchell, 1946](#)].

In graphical terms, an event study will represent one or more time series before and after the event [[Johnson, 1998](#)].

3 Methodology

3.1 Difference-in-Differences

In the last chapter we made an introduction to Difference-in-Differences. We use this method as firms are different from one another and using DID we can compare how the groups change overtime. Comparing them between themselves eliminates group differences and then makes the comparison between the control group and the treatment group.

Difference-in-Differences is a commonly used and oldest quasi-experimental design in its two-time period form and with the assumptions we have already learnt. Trends need to be parallel and treatments effects are constant overtime [[Goodman-Bacon, 2021](#)].

Using TWFE a regression with one treatment identifies a weighted sum of the treatment effects of the treated.

Andrew Bacon states we can get a positive or a negative weight. When we get the positive one it states that the treatment effects do not change overtime whereas we will get a negative weight when effects vary overtime. This helps to see the different effects and not only one [[Goodman-Bacon, 2019](#)].

We will consider the weight to be 0 as we consider the treatment effect to be homogeneous.

What we want to use is multiple time periods and a variation of the treatment timing [[Callaway & Sant'Anna, 2021](#)].

A common model to represent this situation is to adopt staggered. It is a linear panel model with dynamic effects.

$$y_{it} = \alpha_i + \gamma_t + q'_{it}\varphi + \sum_{m=G}^M \beta_{mzi,t-m} + C_{it} + \varepsilon_{it}$$

What we are interested in doing is learning the effect of a scalar policy q'_{it} on the outcome y_{it} in multiple periods $t \in \{1, \dots, T\}$. α_i is the unit fixed effect, γ_t refers to the time fixed effect and q'_{it} is the vector of controls with comfortable coefficients φ . $\sum_{m=G}^M \beta_{mzi,t-m}$ this term reflects the dynamic effects on the policy. Then, C is the confounder that be correlated with the policy and ε_{it} represents the unobserved shock that is not correlated with the policy.

In our study we will consider the time effect, the value of the contracts and the companies to see how these variables impact the revenue of the companies that do contracts with the State .

The outcome at time t can only be directly affected by the value of the policy at most $M \geq 0$ periods before t and at most $G \geq 0$ after t . G and M are mostly defined by the researcher [[Simon et al., 2022](#)].

As we want to show cumulative effects, we need to replace the levels of the policy with first differences. $\Delta z_{it}: [z_{i,t} - z_{i,t-1}]$

For our hypothesis we will say that for each unit i , z_{it} starts at 0 and switches to 1 at time t^* (i).

The outcome at time t can only be directly affected by the value of the policy at most $M \geq 0$ periods before t and at most $G \geq 0$ after t .

Moreover, $(\beta)_{m=-G}^M$ will summarize the magnitude of the dynamic effect and it will be summarized in an event study plot [[Clarke & Tapia-Schyte, 2021](#)].

3.2 Public Procurement Terminology

There are three types of contracts defined when talking about Public Procurement that one needs to understand. As we are analyzing it through sectors, we need to know in which type of public activity we are talking about.

Three types of contracts [[Bosio et al., 2022](#)]:

Table 3-1 Description of the type of Public Procurement Contracts

Work	Refers to the execution or/and design of works. For example, it resorts to the construction of roads or Hospitals
Services	Refers to the acquisition of services that varies from training to accounting
Goods	Refers to the lease, rental or purchase, with the option to buy, of products such as vehicles, furniture and medical suppliance

This follows the standard classification from the European Commission [[Commission, 2015](#)]. Moreover, we need to understand the Portuguese Law of Public Procurement which follows the European Union guideline [[Kersyte, 2018](#)].

When looking at the State data regarding Public Procurement we see that many contracts did not go forward under the Portuguese Law of Public Procurement, and we need to take them out of our analysis. Nonetheless, we need to know why we are not considering them. We exclude them due to Artigo 20.º, n.º 1, alínea a) do Código de Contratos Públicos.

3.3 Data

Public Procurement data in Portugal is overseen by Instituto dos Mercados Públicos e da Construção (IPMC) and the data is available online on <https://www.base.gov.pt/>. This data is available following the Open Contracting Data Standard also available online on <https://www.open-contracting.org/data-standard/>.

The dataset is built in two parts. Most of the data is manually extracted from the Government database. The rest of the data has some bugs and has been taking by performing some programming techniques. To do the second one we use the json library [[Pezoa et al., 2016](#)]. This helps to extract data through an API and then store the data in a data frame. To do so, we copy the URL that we need and then see each section to see which requests the session was asking for. While doing this extraction the code needed to be improved and, in the future, it might need to suffer some changes as the website permissions change overtime. After doing this, the database needs to be cleaned and formatted to be equal to the one we collected manually to later join them.

Subsequentially, the pre-processing steps of the final State data were the following:

Table 3-2 Data Transformation Steps

Checking for duplicates and later removing them
Creating the VAT column by extracting the value from the company's column
Discard all the columns that will not be used in the rest of the process
Creating a column with just the year of the contract
Discard contracts that were not finalized [dos Contratos Públicos, 2008]
Renaming the columns to be written in English

After all these computations we ended up with the following variables:

Table 3-3 Public Contracts Dataset

Contract Object	Refers to the type of contract the State was doing with the private companies
Contract Type	Refers to the type of contract done
Contract Place	Refers to the place where the contract was performed
PC Law	Refers to the Portuguese Law under which Public Contracts are regulated
Total Price	Refers to the final cost of the contract
VAT	Refers to the company's VAT number
Contract Year	Refers to when the contract was signed

With this information it was possible to extract the following information to better understand our data.

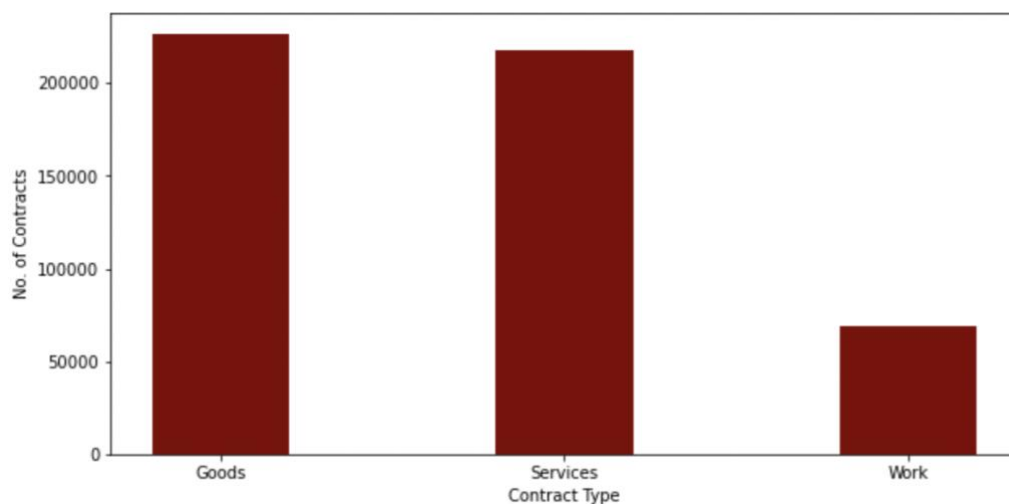


Figure 3.3-1 Public Procurement Contract Type

Figure 3.3-1 refers to the number of Procurement issued between 2010 and 2019 by the Portuguese Government. The total number of contracts is taken from the Total Price column. In goods we have a total of 226524 contracts, then in services we have 217630 contracts and in work part we have 69134 contracts.

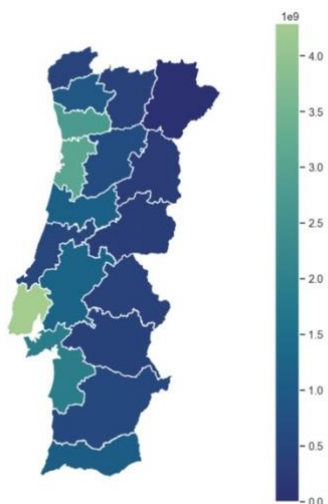


Figure 3.3-2 Contracts value in Portugal area

Figure 3.3-2 refers to the density of contracts issued between 2010 and 2019 by the Portuguese Government. Denser areas reflect areas where more contracts were issued in terms of monetary value, not necessarily the ones that were officially celebrated [Curado et al., 2021].

The data referring to the private companies is provided through Orbis database. The data can be accessed through <https://www.bvdinfo.com/>. Orbis is a company information company that collects data from various companies across the globe and it is known to be one of the most completed databases regarding private and listed companies.

All the information that is not relevant to our analysis is deleted. We ended up with the following columns and missing values:

Take into account that at this time we have 13500 companies.

Table 3-4 Missing Values value per Variable

Variable	Definition	Years	Number of missing values	Percentage
Vat Tax Number	Serves to identify the company in fiscal terms	-	0	-
Company Name	The legal name given to the organization	-	0	-
NACE Rev	Company Sector	-	0	-
Operating Revenue Turnover	Number of times businesses make assets or burn through them	2019	4731	35,04%
		2018	4234	31,36%
		2017	4337	32,13%
		2016	4581	33,93%
		2015	4914	36,40%
		2014	5183	38,39%
		2013	5459	40,44%
		2012	5763	42,69%
Cash Flow EUR	Movement of money in and out of a company	2019	4762	35,27%
		2018	4214	31,21%
		2017	4259	31,55%
		2016	4510	33,41%
		2015	4834	35,81%
		2014	5126	37,97%
		2013	5373	39,80%
		2012	5684	42,10%
Total Assets EUR		2019	4731	35,04%

		2018	4158	30,80%
		2017	4190	31%
		2016	4484	33,21%
	Sum of the book values of all assets owned a company	2015	4756	35,23%
		2014	5039	37,33%
		2013	5290	39,19%
		2012	5622	41,64%
		2011	5820	43,11%
		2019	4767	35,31%
		2018	4364	32,33%
		2017	4492	33,27%
		2016	4761	35,27%
		2015	5115	37,89%
		2014	5424	40,18%
		2013	5677	42,05%
		2012	5992	44,39%
		2011	6166	45,67%
	The difference between the total cost to run your business and the total revenue it brings in	2019	4767	35,31%
		2018	4364	32,33%
		2017	4492	33,27%
		2016	4761	35,27%
		2015	5115	37,89%
		2014	5424	40,18%
		2013	5677	42,05%
		2012	5992	44,39%
		2011	6166	45,67%
		2019	4861	36,01%
		2018	4352	32,24%
		2017	4369	32,36%
		2016	4631	34,30%
		2015	4980	36,89%
		2014	5259	38,96%
		2013	5485	40,63%
		2012	5802	42,98%
		2011	5953	44,10%
		2019	5170	38,30%
		2018	4685	34,70%
		2017	4796	35,53%
		2016	5055	37,44%
		2015	5347	36,61%
		2014	5629	41,70%
		2013	5893	43,65%
		2012	6146	45,53%
		2011	6306	46,71%
		2019	5444	40,33%
		2018	5103	37,80%
		2017	5152	38,16%
		2016	5478	40,58%
		2015	5844	43,29%
		2019	5444	40,33%
		2018	5103	37,80%
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		2017	5152	38,16%
		2016	5478	40,58%
		2015	5844	43,29%
		2019	5444	40,33%
		2018	5103	37,80%
		2017	5152	38,16%

		2014	6197	45,90%
		2013	6403	47,43%
		2012	6709	49,70%
		2011	6733	48,87%

As so we need to perform some pre-processing steps also:

1. Discard all the variables that will not be needed for the DID [[Athey & Imbens, 2022](#)]
2. Filling some missing values:
 - a. To fill the missing values, we had to choose a method that would compromise our data to the least.
 - b. We decided to fill in with the mean of the previous value and the following value. Rows that had a lot of missing values were not filled to not compromise the company data.
 - c. The values to fill and to be filled were from the company itself and not from similar companies to no compromise the data.

As there is still a lot of information missing from the companies, to surpass this we will eliminate the variables that have more or equal than 40% missing values. With this we end up with 7377 companies.

After all these computations we have merged both datasets and we have the following dataset for analysis:

Table 3-5 Final Dataset

VAT	Serves to identify the company in fiscal terms
Year	Refers to the year of when there was a contract with the State
PBT	Profit before taxes
PBT Rel 2011	Profit Before Taxes relative to the year 2011
Assets	Resource owned by a company
Assets Rel 2011	Assets relative to the year 2011
ROPP	Return on Public Procurement
Public Contracts	Contracts done with the State
Revenue	Money generated from day-to-day operations
Contract Type	Refers to the type of contract done

The column Year is imputed in this dataset for us to create the timeslots regarding the period a company has done a contract with the State. It is important to have this column to use it in the computations that will result in the information that will be seen in the next section. Plus, some variables were created along the way but will not be used for the results. In the next section we will explain why. Nonetheless, there is the need to explain what they are.

Profit before taxes refers to the company's profits before paying its corporate income tax. It is mostly used to see how much a company owes in taxes and can be used to compare companies [Eng & Vichitsarawong, 2022]. However, this can be misleading as we do not know the taxes the multiple companies pay. It is used more as a calculation method than a performance measure.

PBT Rel 2011 refers to the Profit Before Taxes relative to the year 2011. By putting a year as the base year, we can better analyze the changes throughout the years.

The Assets variable the Total Assets. It has the liabilities on it. It can suffer from inflation by the loans. Nonetheless, is one of the most complete variables and that shows the money available in the company to be invested in various works.

Assets Rel 2011 refers to the Assets relative to the year 2011. By putting a year as the base year, we can better analyze the changes throughout the years.

As we know ROCE which is Return on Capital Employed is a financial ratio. It assesses the company's efficiency to generate profits from its capital. To compute this, we must divide the Profit Before Taxes by Total Equity minus Liabilities [[Bishop, 1969](#)]. From this ratio we have created a new one: ROPP which stands for Return on Public Procurement. It was created by dividing the contracts with the State with the Total Equity minus the Liabilities.

Revenue as it refers to the money generated from nominal business operations [[Nobes, 2012](#)]

To do the event study plot event study design we will make some assumptions that will be explained in the next section.

4 Results and Discussion

The measure to compare the companies that we ended up choosing was the Revenue. Moreover, the VAT of the companies is used to see how many companies that have done contracts with the State.

We ended up with the following results:

Table 4-1 Comparison between total companies and companies that have contracts with the State

Total Companies	Companies with State Contracts
7377	1647

Moreover, the results from the table above come from the process used to fill in and discard the missing values that was explained in the previous chapter.

However, how did we ended up by choosing the Revenue. A good strategy to choose which variables to use is through correlation. It shows if there are any dependencies on the variables or not.

	PBT	PBT Rel 2011	Assets	Assets Rel 2011	ROPP	Public Contracts	Revenue
PBT	1.000000	0.002302	-0.113827	-0.002601	-0.005171	0.002475	0.279206
PBT Rel 2011	0.002302	1.000000	0.005514	-0.056321	0.007581	-0.000373	-0.005855
Assets	-0.113827	0.005514	1.000000	-0.011131	-0.010576	0.012733	0.280419
Assets Rel 2011	-0.002601	-0.056321	-0.011131	1.000000	-0.004179	0.004822	-0.008217
ROPP	-0.005171	0.007581	-0.010576	-0.004179	1.000000	0.157063	-0.018408
Public Contracts	0.002475	-0.000373	0.012733	0.004822	0.157063	1.000000	0.138755
Revenue	0.279206	-0.005855	0.280419	-0.008217	-0.018408	0.138755	1.000000

Figure 4-1 Correlation between variables

Figure 4-1 shows the correlation between the variables and from that we understand that the best variable to use is the Revenue. As there are far too many companies having the Revenue missing for several years there is the need to make some assumptions.

We will consider the companies that have not done yet a contract with the State the non-treated companies. The other companies to be considered for the study need to meet the following requirements:

1. Years of treatment > 0 ;
2. Sum of the Revenue must be higher than 0;
3. We will consider that the treatment will be looked into the times it has occurred.

The first requirement needs to be met as we want to study the effect of the treatment on the variables, so our year of treatment cannot be zero.

The second requirement imposed in this study is to eliminate any company that still has no value regarding the Revenue. Without this value the company has no meaning for our study.

The third one is related to the way our data is displayed. Most of the companies do not do a contract with the State every year and the Revenue that comes from those contracts is not all received in the year of the celebration of the contract. As we cannot precise how it is received, we will assume that once the contract is celebrated the value will be felt after a few years of the celebration of the contract [[Damásio et al., 2018](#)]. We could have done by dividing the value into the years of treatment and that treatment will continue until the end of the period being study. Nonetheless, we would create an artificiality as the last year would accumulate all the values from all the contracts. Several companies do more than one contract with the State in the period that is being studied.

Note that the variables are not normalized as it will incur in misleading information. Doing the normalization having in reference the Revenue it would give us incorrect information as we have companies with different values. The method used will be normalized in accordance with the years of treatment.

Moreover, we also need to consider some considerations on the regression to better understand the outcome:

- The point of the regression is to show that the coefficients on the periods where no treatment occurred yet have no statistical significance [[Clarke & Tapia-Schythe, 2021](#)];
- If the control and treatment groups are statistically the same before the treatment does not prove the parallel trends assumption [[Rambachan & Roth, 2019](#)].

From the requirements above we consider the following companies for the study:

Table 4-2 Companies to be included in the Study

	Treated	Untreated/Control
Good Companies	1212	56

For the event study plot design, we also considered the time effects. This event-study plot graph is used to depict if there is an existence of a difference between the treatment and control at different times points before and after the event [[Paredes et al., 2022](#)].

It is a good technique to be used as we do not have the treatment happening at a single point in time.

Before building the graph, we need to drop one of the times periods to avoid perfect multicollinearity. In most studies, the -1 time lag is used as a dropped [[Kranse et al., 1995](#)].

Multicollinearity refers to when an independent variable is highly correlated with one or more of the other independent variables. This results in a problem as it makes the statistical inferences not so much reliable [[Vatcheva et al., 2016](#)].

To build the graph we need to create lags and leads. Lead-lag effect summarizes the situation in where the leading variable is cross-correlated with the values of the lagging variable at later times [[Li et al., 2022](#)].

These leads and lags are created upon the policy variable and then the outcome is regressed on the leads and lags and then we plot these coefficients along with the associated confidence intervals.

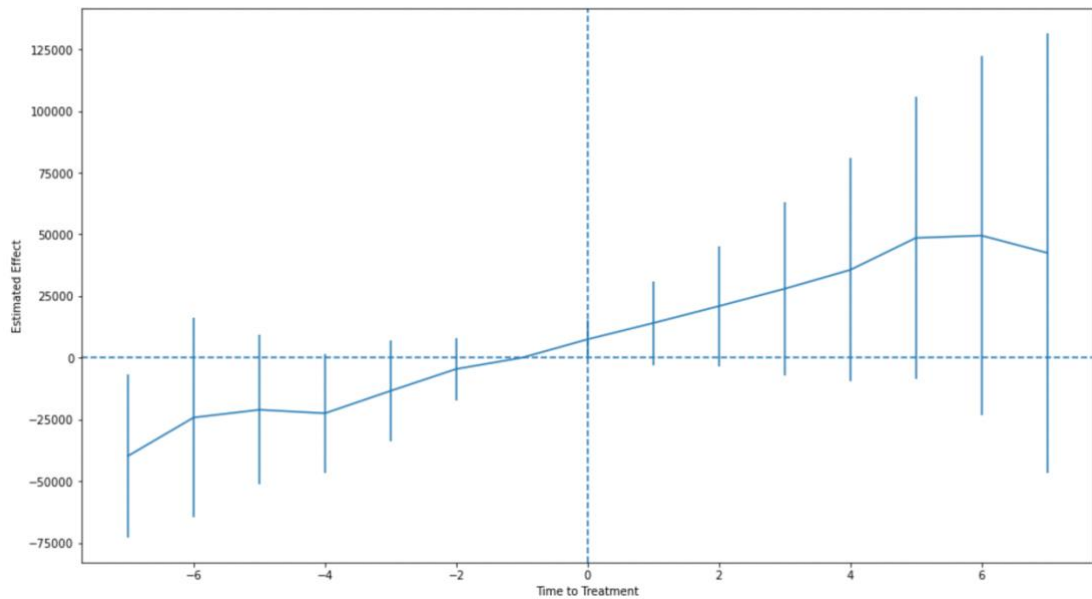


Figure 4-2 Simple Event-Study Plot Design

Figure 4-2 illustrates the cumulative effect of the policy on the final outcome. From this graph we can see that doing contracts with the State has a positive impact on the revenue of the companies. The graph also points out that this positive effect is more significant between period 0 and period 5. Nonetheless, what we want to see is the pre-treatment to be closer to zero, which does not happen. This can be due to the short temporal period we are studying (2011-2019) and that we assume that before 2011 there are no contracts with the State. Another thing that pops out is that when we start to be further from Lag-0 the error gets bigger. This happens because we have less points being treated. Let's look at Lag-7. When we have this lag it means that the treatment was initiated seven years ago and we have few points in those conditions. This just increases the uncertainty on the estimation of that point. This outcome has a P-value of 0.68. From the standard value, we can state that this is statistically insignificant.

The first study here represented is only related to the time of treatment and how it affects the Revenue. The second study will have all the variables that were mentioned previously to do the study: year of treatment, value of public contracts and the type of contracts. The way to do this next analysis is exactly as the way we did the other. The only difference is that it has more variables in the study.

Using the same requirements from above we consider the following companies for the study:

Table 4-3 Companies to be used on the second Study

	Treated	Untreated/Control
Good Companies	1249	56

Note that in here we also consider the value of the contracts with the State and the Contract Type which may change the outcome.

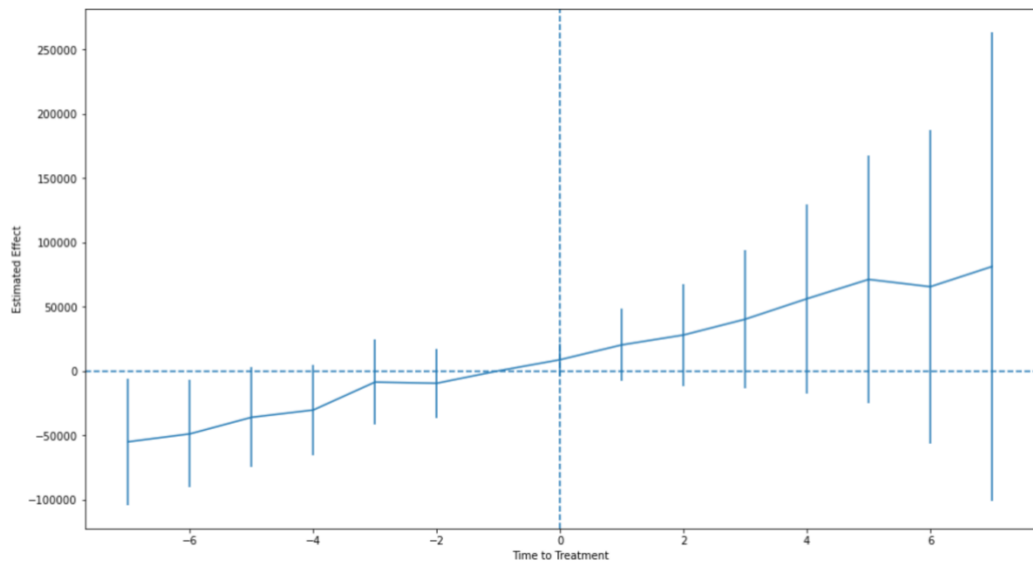


Figure 4-3 Event Study Design with all the variables

Figure 4-4 illustrates the cumulative effect of the policy on the result. From this graph we can see that doing contracts with the State has a positive impact on the revenue of the companies. The graph also points out that this positive effect is significant after period 0. Between period 5 and 6 there is a slight decrease. Again, we start to be further from Lag-0 the error gets bigger. This happens because we have less points being treated. Let's look at Lag-7. When we have this lag it means that the treatment was initiated seven years ago and we have few points in those conditions. This just increases the uncertainty on the estimation of that point. This outcome has a P-value of 0.69. From the standard value, we can state that this is statistically insignificant.

On these graphs we are computing the average β . We understand from it that the $\beta_t < \beta_{t+1}$ generally. Which makes sense as we have a delay in time related to when the companies receive the actual value of the treatment. The treatment that happens in a certain year will only be felt after some years [Biaett & Richards, 2020].

Another analysis that we can do is focusing on the type of contracts. Again, the computation will be like the ones done previously. Nonetheless, for computations simplification we will use the value of Nan to define the companies that do not have any contract and we will not restrain just for the value of the revenue to be different than 0.

We will start with the Services contracts. We will have the following companies for the study:

Table 4-4 Companies related to the Services Contracts

	Treated	Untreated/Control
Good Companies	587	56

From this table we can understand that from our timeframe we have a total of 587 contracts valid to our study related to Services.

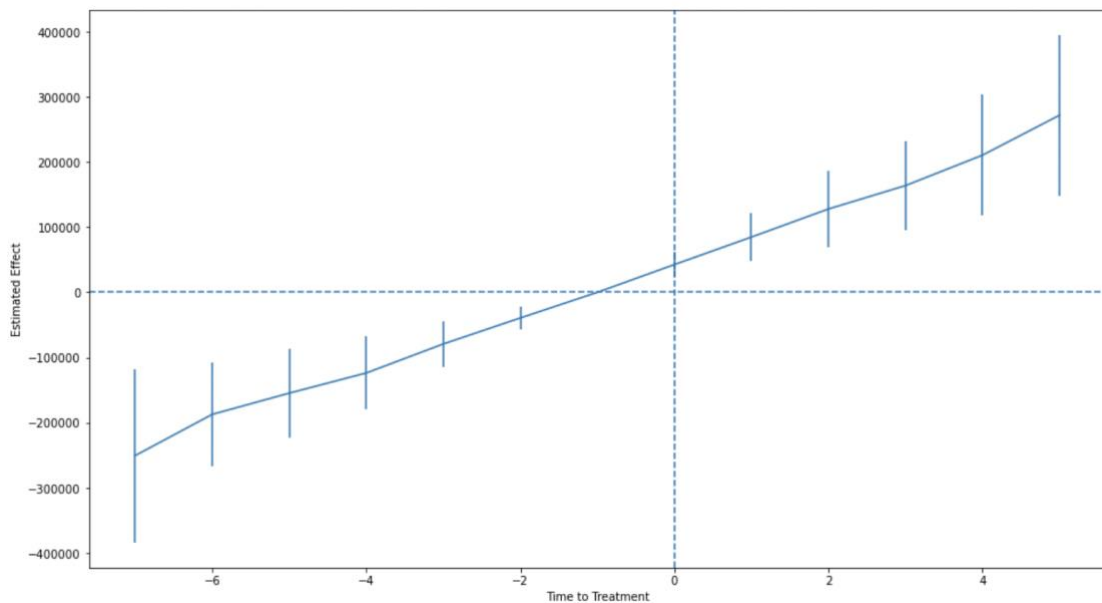


Figure 4-4 Event Study Design related to the Services Contracts

Figure 4-5 illustrates the cumulative effect of the policy on the final result. From this graph we can see that doing contracts with the State has a positive impact on the revenue of the companies by looking at the slope after period 0. The graph also points out that this

positive effect is significant and rapid after period 0. This has a P-value of 0.67. Moreover, the lack of data on the companies makes the results to be dubious and not precise.

Now let’s look into the Goods Contracts. We will have the following companies for the study:

Table 4-5 Companies related to Goods Contracts

	Treated	Untreated/Control
Good Companies	784	56

From this table we can understand that from our timeframe we have a total of 784 contracts valid to our study related to Goods. We have more contracts for analysis in here.

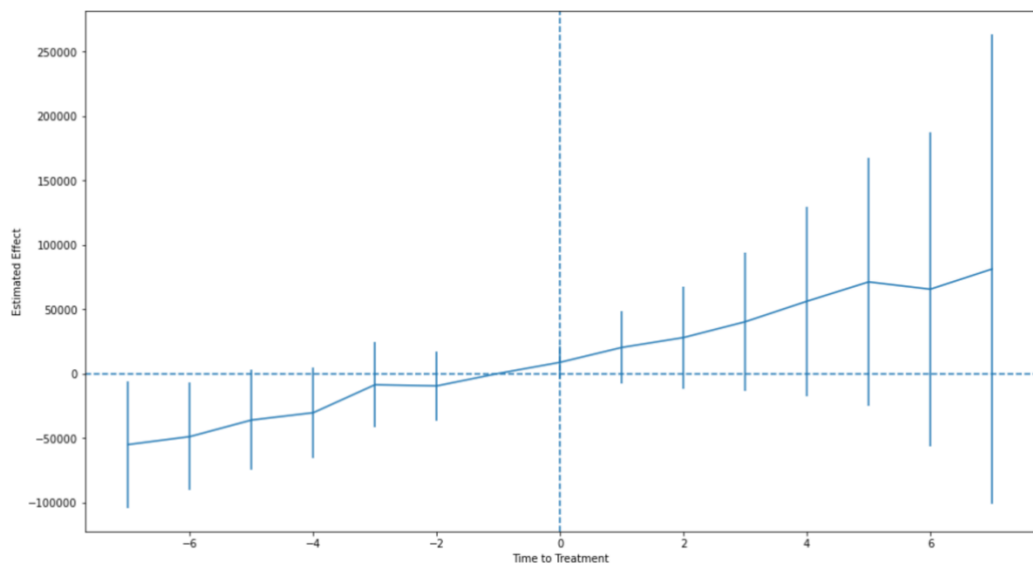


Figure 4-5 Event Study Design related to Goods Contracts

Figure 4-6 illustrates the cumulative effect of the policy on the final result. From this graph we can see that doing contracts with the State has a positive impact on the revenue of the companies. The graph also points out that this positive effect is significant after period 0 until period 5, just by looking at the slope. Again, we have a decrease between period 5 and 6. This has a P-value of 0.87. This confidence level can reflect on the variables that might have been absorbed and shows that having more companies on the study does not mean that the outcome will be better than the one from the Services Contract Type. Moreover, it can reflect the possibility of the existence of confounding

variables [Damásio & Mendonça, 2019]. Again, at Lag-7, we know that the treatment was initiated seven years ago and we have few points in those conditions. This just increases the uncertainty on the estimation of that point.

Now let's investigate the last type of contracts: Work Contracts. We will have the following companies for the study:

Table 4-6 Companies related to Goods Contracts

	Treated	Untreated/Control
Good Companies	186	68

From this table we can understand that from our timeframe we have a total of 186 contracts valid to our study related to Goods. It is the one with fewer contracts to analyze.

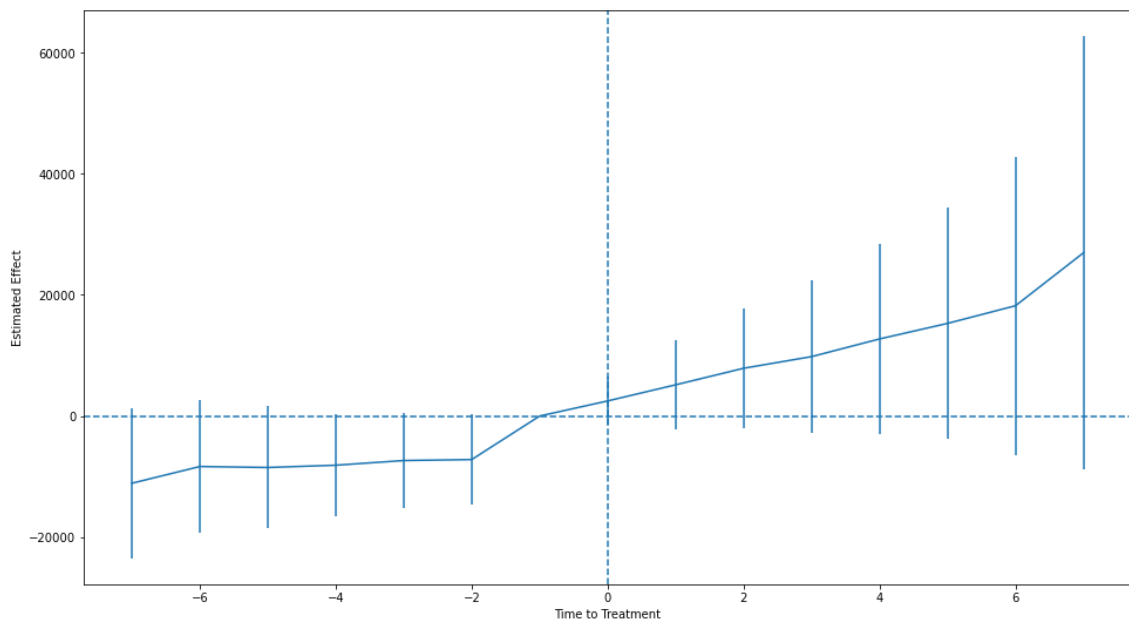


Figure 4-6 Event Study Desing for Work Contracts

Figure 4-7 illustrates the cumulative effect of the policy on the final result. From this graph we can see that doing contracts with the State has a positive impact on the revenue of the companies. The graph also points out that has a positive effect after period 0 if we just look at the slope. This has a P-value of 0.04. This confidence level shows that this test has statistically significance. As we have less companies, we have a lower probability in incurring in errors. Nonetheless, the pre-treatment is constant but not close to 0.

5 Conclusion

To create a model adapted to the reality of our database tends to be challenging as data is not always perfect. In our case it is far from it. The Government database is not up to date as there are contracts from previous years that have been already finished but were not yet published. Moreover, the Orbis database has a lot of missing values and we cannot fully fulfil them without incurring in misleading information. This creates an augmentation on the error as the years go by as we have less points that have a bigger treatment dataframe [[Damásio & Mendonça, 2022](#)].

Furthermore, we came up with a model that tries to surpass these difficulties and see if Public Contracts can be used as a policy tool.

In addition, we were able to show the effects using multiple treatments on our outcome. Our outcome is the effect the treatment has on the Revenue of the company. However, as it is not possible to precise when the payments of the contracts were done that creates a temporal delay and can show a misleading outcome.

Temporal delay means that the effect is not immediate. The effect will only be felt later. This is a limitation to the work as it can create a slight confusion on our treated variables as the treatment happens in one year but will only be seen years later.

Nonetheless, from this study we can say, in overall, that Public Procurement can be used as a tool to foment economic growth if we look at the slopes of the graphics. Statistically speaking there is lack of robustness. To use Public Procurement as a metric and a measure there is the need as already stated to have more information and transparency on the process of Public Procurement to better make the assumptions and for them to be closer to the reality. There is also the need to implement tools to use this to promote the increase of welfare as Sweden and the US are doing. To do so there is the need to focus in a more green and transparent economy [[Lyra et al., 2021](#)].

6 Limitations and recommendations for future works

A key factor for this work to be done is the quality of the data and the access to it. Taking the data from the Government base takes time and there are still public contracts that have already ended but have not been posted on the website. It is something that makes it harder to have the most accurate projection. In addition, Orbis database has a lot of information regarding the companies but the one we had access did not have the balance sheets of the companies. Balance sheets are more accurate and give more information which can help to make a more objective analysis and create a more powerful DID.

DID is also a recent tool and so there is still the need to study it in depth and to create versions of DID's that can foresee situations where the study is not linear as the one we have. As we know one of DID assumptions is that the trends need to be equal and that we create the artificial control. Nonetheless, when dealing with companies we are not dealing with static variables and variables that are to look alike. Companies can be from the same sector but have different dimensions that affect the outcome in a very different way.

Moreover, if the State improves the E-Procurement platform for better extraction of the data it can also make available information regarding the whole process. Having information since the beginning and until the end helps to make better assumptions to create the DID and agglomerate the companies and if that information was available, it would be possible to do the DID by the type and volume of the contracts instead of the other way.

Then, it is necessary to have a powerful machine to run so many data and so we needed to choose some sectors to analyze. In the future, if possible, it would be good to do the analysis to every single sector to see the real global impact.

Regarding Orbis database, by being paid limits the access to it and makes it difficult to extract the data and check for more data.

In addition, by comparing the studies and the references mentioned in the Literature Review regarding Sweden and the US we still have a long way to do in order to have more transparency on our data and we need to focus more on the contracts to be a way of economic growth for the country to improve the overall welfare of the country [[Lyra et al., 2022](#)].

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