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The Types of Authorities performing Green Public Procurement within Europe

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Abstract

MSc Sustainable Business and Innovation

The Types of Authorities performing Green Public Procurement within Europe

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Green Public Procurement has gained interest over the last decades as an important tool for policy makers in reaching their environmental targets. However, the uptake of Green Public Procurement remains limited and there is still a lot of misunderstanding regarding the subject. This study contributes to the literature by assessing what type of contracting authorities are performing Green Public Procurement. Additionally, other factors that influence the uptake of Green Public Procurement such as the procurement procedure, business sector, the type of contract, joint procurement and the size of the tender are explored. The TED database of the European Commission is used to assess tenders from nine European countries over a time span of six years. By scanning the award criteria of each tender for environmental key words an indication was made whether a procurement could be considered as green. With this information a regression analysis was carried out to see what factors impact the probability of a procurement being green. The findings suggests that ministries and federal authorities and water, energy and transport authorities are positively correlated to the probability of a procurement being green. On the other hand, regional or local authorities correlate negatively to Green Public Procurement. Furthermore, supplies contracts, open procedures and procedures with competitive dialogue impact positively on the probability, just as the presence of joint procurement. The construction, business services and architectural services sectors are less likely to procure green compared to the food and environmental services sectors. The results of this study are useful for policy makers to construct more direct policies for contracting authorities in sectors where the uptake is limited.

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Chapter 1

Introduction

1.1 History of public procurement

In recent years, public procurement has increasingly gained interest as an important tool to foster policy objectives of the public sector. Public procurement is defined as the acquisition of goods and services by government or public sector institutions (Uyarra and Flanagan, 2010). Although public procurement as a policy tool has been acknowledged for some time, the focus of the demand side approach of procuring has only received more attention in recent studies (Rolfstam, 2012). While first public procurement was used solely for satisfying the basic needs and demands of the public sector, now, public procurement is considered as a tool help reach policies such as sustainable or green targets of authorities (Chiappinelli, Gruner, and Weber, 2019). Public procurement can be a facilitator to solve important societal problems identified in the academic world by pushing the market towards finding solutions (Tukker et al., 2008). Since in the European Union public procurement accounts for 13.3 percent of the GDP in 2017 (EC, 2017), ability of public procurement to influence the public organizations, citizens and the economy cannot be underestimated (Grandia, 2018). The range of products, services and goods procured is extremely broad, from schoolbooks to fighter planes. Therefore, it is logical that the European Commission has identified the enormous purchasing power of public procurement goals as a tool to help reach climate goals via Green Public Procurement (Kunzlik, 2013). The demand side approach of public procurement is not a new concept. In the 1970s the US and Japan were front runners when it comes to building a more systemic approach to procuring for innovation and this helped significantly in closing budget gaps for R&D. In Europe, Rothwell (1984) found that procurement

of the public sector triggered more innovation than subsidies for R&D. Additionally, Geroski (1990) discovered that public procurement is a far more efficient tool to reach heightened level of innovation than solely R&D. In the last two decades interest in public procurement has risen, both in academic as the public sector. In 2006, the EU presented its broad innovation strategy which incorporated public procurement as a key tool of governments to foster policy goals (Blind, 2009).

1.2   The rise of Green Public Procurement

In 2015, with the signing of the Paris agreement, it has become evident that to keep the global temperature rise under 1.5 degrees significant action needs to be undertaken by governments. Public procurement is a tool of government that typically balances between these three areas of society. It induces innovation in the private sector that is necessary to construct sustainable solutions for products or services that cannot be innovated by solely the governments themselves. Several authors have concluded that innovation is one of the engines behind constructing a more sustainable future (Nash, 2009, Souchkov, 2010). Therefore, public procurement has a great ability to carry out the sustainable policies of public authorities (Nissinen, Parikka-Alhola, and Rita, 2009). However, within the European Commission as well as in the academic literature, there is a lack of up-to-date data on the uptake of sustainable or green policies in procurement. Up to now, the literature of public procurement in combination with sustainability has only received limited attention compared to procurement or purchasing in the private sector. The research consists mainly of case studies and has dominantly focused on agencies in the private sector, while it also of great importance for the public sector (Walker et al., 2012). Within the literature, there are a plethora of definitions associated with the concept. A term used often when these practices are incorporated is Sustainable Procurement (SP), identified by Lindgreen et al. (2009) as "procurement that is consistent with the principles of sustainable development, such as ensuring a strong, healthy and just society, living within environmental limits, and promoting good governance" (p. 128).

Green Public Procurement, or GPP, is a subsumed part of Sustainable Procurement with a specific focus on the environmental aspects of public procurement. There is no clear definition of what Green Public Procurement is

in the literature. Rainville (2017) defined it as 'purchasing which reduces environmental impacts across product or service life cycles'. Most definitions stress the importance of replacing standard products with environmentally friendly products. Green Public Procurement is embedded in the procurement policy of the European Union by Directive 2014/24/EU (EC, 2014a) and Directive 2014/25/EU (EC, 2014b). The difficulty of this and other definitions is the way in which they are transferred to variables for analysis, since they remain vague and ambiguous. In recent years, the so-called MEAT (Most Economically Advantageous Tender) methods have gained traction in public procurements. With this assessment method, contracting authorities can use other indicators than price to elect the best bidder for the public procurement. Environmental and sustainable criteria are among the indicators often used when the MEAT method is applied. In order for a procurement to be called green it is required to use of environmental criteria. These criteria can include eco-labels, emissions maximums, or certification systems. Until today, these criteria are still all voluntary and there is still little standardization by the European Commission. The uptake of Green Public Procurement has been limited up to now due to the insufficient or incomplete information surrounding the criteria that have to be used (Renda et al., 2012). There have been efforts of both national as supranational organizations to promote Green Public Procurement. A first intention to standardize the criteria of Green Public Procurement was made by the European Commission in 2008 with the publication of GPP criteria for different business sectors (EC, 2008a). More recently, the European Commission has started promoting the use of Green Public Procurement in 2016 with the publication of a handbook (EC, 2016). With the creation of GPP criteria for 21 different sectors, the formation of a help desk and several publications on by the European Commission on this topic, Green Public Procurement is promoted across all Member States of the European Union.

Green Public Procurement can have direct impact through improved environmental performance of goods, services and works bought. Additionally, Green Public Procurement can have indirect impact through using this market leverage to encourage companies to invest in cleaner products and services. However, studies on the characteristics of sustainable procurement and the authorities mainly performing it are limited.

1.3   Problem statement

Public procurement is complex and can take many forms, depending on what type of procurement is performed and what authority executes the process. It is of great importance for policy makers to have knowledge of what authorities are already procuring green, in what sectors they may be mostly present and what kind of procedures increase the possibility of a procurement incorporating environmental criteria in the awarding procedure. Since these aspects are different for every authority it is important to analyse the differences based on databases and quantitative methods. With this knowledge, policy makers can promote Green Public Procurement more directed at the authorities and sectors where this is still lagging. Unfortunately, currently the practices of public procurement are not consistently available, are not well rooted in overall governance and do not address the whole procurement process or the broader cultural problem. Furthermore, budget cuts have halted progress on public procurement (Nikolaou and Loizou, 2015). More specific policy recommendations based on the group where the authority is in can be designed. An insight into the diffusion of these practices within the public procurement authorities will open doors to the development of specific policies, strategies or mechanisms for each group of authorities.

Up to date, analyses of public procurement that include variables related to sustainability are not widely available in the academic literature, especially considering its apparent significance given the scale of environmental footprint that can be cut when Green Public Procurement is taken up widely (Lundberg and Marklund, 2018). Additionally, no peer-reviewed studies have been published that use quantitative methods to study exactly the correlations between the variables that determine Green Public Procurement on cross-country scale (Amann et al., 2014).

The aim of this study is to identify which type of authorities carry out Green Public Procurement in Europe. This will be done with the help of the Tenders Electronic Daily (TED) database, which records all procurements in the European Union and categorizes them with the help of a large set of categories such as country, type of authority or type of procedure. This study will look into the characteristics of the Green Public Procurements based on the variables availabe in the data. Additionally, a regression analysis is carried out to calculate the probability and odds of a procurement being green based on

a set of independent variables present in the TED database. of Consequently, the following research question is constructed;

- What types of contracting authorities within Europe are performing sustainable procurement?

This question will be answered by assessing the award criteria variable used in the public procurement. This study will perform a quantitative regression analysis on public procurement cases within the database of Tenders Electronic Daily (TED), testing a typology of a number of variables such as described in (Rainville, 2016). The results will identify which authorities currently perform more Green Public Procurement. Other variables such as the type of contract or type of awarding procedure will be taken into account in the analysis. Additionally, other factors will that influence the probability of a procurment being green will be assessed. These variables include the country, the business sector, the type of contract, the type of procedure, the involvement of joint procurement and the size of the procurement. With this complete analysis, a more comprehensive overview of what factors impact the uptake of Green Public Procurement like nowadays in Europe.

1.4   Scientific and social relevance

Due to its enormous purchasing power, Green Public Procurement has increasingly been an important topic on the environmental agenda of public authorities. Using this power can increase sustainable innovation and thus foster the power of innovation in the environmental sector and stimulate companies to become active in this sector. This will result in more sustainable products and services for the consumer. With the results of this study, it can be identified what areas or regions of the public sector are currently lagging on the topic of Green Public Procurement, which will help policymakers to see in what area an increase in awareness of the importance sustainable procurement is necessary. The public sector will be enabled to specifically analyse which products are generally procured more sustainably, which type of authorities, what countries or what business sectors are more likely to perform Green Public Procurement. This will help increase the number of procurements with sustainability in mind because a more targeted approach in promoting Green Public Procurement is possible, improving the overall quality of the tenders. A more thought-out policy of public procurement

that leads to the incorporation of more sustainability characteristics will help reach the goals set by the European Commission on sustainability.

1.5   Overview of this thesis

In this thesis, Chapter 2 will discuss the theoretical framework of Green Public Procurement based on the literature in the academic world and publications by relevant organisations involved in the public procurement area. Thereafter, in Chapter 3, the methodology of this thesis is explained in three steps which will result in the creation of a final sample of Green Public Procurement. The method used to create the regression formulas will also be described in this chapter. In Chapter 4, the data of the analysis will be demonstrated in and the characteristics will of Green Public Procurements will be visualized in tables and figures. In Chapter 6 the final formula for the regression analysis is constructed. Thereafter, the results of the regression analysis will be demonstrated. Subsequently, the results from the analysis will be discussed in Chapter 6, where after conclusions will be presented in Chapter 7.

Chapter 2

Theory

2.1 General context for Green Public Procurement

2.1.1 A short history of Green Public Procurement

Policies surrounding Green Public Procurement have developed over the last three to four decades. It was mentioned firstly at the International Conference on Environment and Development at Rio de Janeiro in 1992. Since then, the awareness that Green Public Procurement can play a key role in supporting sustainable consumption has grown significantly. In 1994, Denmark was the first country to actively promote Green Public Procurement by implementing a National Action Plan (Charter, 2001). The aim was to integrate the so-called Integrated Product Policy (IPP) concept, setting out a set of targets of Green Public Procurement. At the European level, the Green Book of Integrated Products Policy was the first step towards promoting Green Public Procurement for the Member States. The 2004 directive issued by the European Commission gave the real start sign to taking Green Public Procurement seriously by "the coordination of Procedures for the award of public works contracts, public supply contracts and public service contracts, which has changed the legal framework on public procurement at the EU level" (EC, 2014a). A next step was taken in 2008, when the European Commission published guidance on how to use public procurement as a tool to reduce the impacts on the environment caused by the public sector (EC, 2008a). The latest step has been taken in 2016, when the European Commission developed the *Buying Green! A handbook to Green Public Procurement* manual (EC, 2016). In this handbook, environmental GPP criteria are described per business sector, making it easier for institutions to carry out Green Public Procurement and for companies to deal with the awarding process of Green

Public Procurement. The business sector are defined by the types of products associated with them. Nowadays, it is expected and acknowledged by major organizations such as the EU, the OECD and the UN that Green Public Procurement will be an important tool for authorities to strategically decarbonize sectors in order to reach the targets of the Paris agreement (Chiappinelli, Gruner, and Weber, 2019).

Although the fact that a significant uptake of Green Public Procurement can help governments cut carbon, water and material footprints, the research on it has been limited (Chiappinelli, Gruner, and Weber, 2019; Testa et al., 2012). The majority of the literature has focused more on development in the private sector, where purchasing is the preferred term. In the public sector, the link between policies set out by authorities and public procurement strategy remains weak, not only for Green Public Procurement, but for the whole area (Lember, Kattel, and Kalvet, 2015).

2.1.2   A framework for Green Public Procurement

Green Public Procurement is often seen as a part of sustainable procurement. The range of definitions in the literature of sustainable procurement is broad and often research on Green Public Procurement is conducted under the umbrella of sustainable procurement. Therefore, in this next section both research on Green Public Procurement will be taken into account. Among pioneers in the area is the previously mentioned study of Brammer and Walker (2011), who studied and defined sustainable procurement. The European Commission defines sustainable public procurement as 'a process by which public authorities seek to achieve the appropriate balance between the three pillars of sustainable development - economic, social and environmental - when procuring goods, services or works at all stages of the project (EC, 2014a), which largely corresponds with what is present in the literature. For example, in Walker et al. (2012) the framework is also based on the triple bottom line of sustainability (Elkington, 1998), with on the other axis the level of research focuses from individual to market level. In recent years, when looking at the number of publications in relevant journals, sustainable procurement has gained interest (Walker et al., 2012). Nevertheless, the differences in the amount of research among countries are large as well as how countries perform on sustainable procurement (Brammer and Walker, 2011). The main difference of sustainable procurement with Green Public Procurement is that

sustainable procurement generally solely focuses on the environmental aspects of sustainability instead of the three pillars of sustainability (People, Planet, Profit) (Koch, 2020).

As of today, studies on Green Public Procurement have mainly focused on what kind of practices are associated with Green Public Procurement and what considerations need to be taken into account. However, not a lot of research has yet been conducted on which types of organizations or authorities are more likely to perform Green Public Procurement. In the analysis performed in Rainville (2016), different forms of public procurement are clustered in order to find heterogeneity amongst contracting authorities. A great number of variables were used such as size of the procurement, frequency and content, as well as knowledge sourcing practices. Knowledge sourcing refers to the interactions between users and producers to embed innovation procurement into the organization, to foster organizational learning and to evolve products and services (Edler and Yeow, 2016). Despite the value that these studies have given to the literature on public procurement, it has become evident that a lot of focus is directed at the innovative character that public procurement can have and not on the direct impacts of public procurement on the environment.

The work that has been done on solely the characteristics of Green Public Procurement is often based on surveys or interviews and have been accused of social desirability bias and low response rates (Renda et al., 2012). Of the 67 relevant studies on Green Public Procurement found in a literature review study between 2000 and 2016 it was concluded that no researches used large data-sets to analyse the characteristics or uptake of Green Public Procurement (Cheng et al., 2018). Research conducted on identifying specific characteristics of specific groups in contracting authorities has been focused on one component, such as costs or the presence of a change agent (Grandia, 2018). Grandia and Kruyen (2020) did use text mining techniques on a database of Belgian procurements to identify in which groups sustainable procurement techniques are most used. They found that in more than 70% of the notices performed sustainable public procurement in Belgium between 2011 and 2016, significantly more than the 40-60% reported by the European Commission (Renda et al., 2012). The European Commission researches several topics around Public Procurement, including Green Public Procurement. However, the majority are carried out with qualitative methods such as interviews and/or questionnaires.

Since this study looks at the characteristics of Green Public Procurement based on a set of variables, it is important to investigate is already research on these variables. A report requested by the European Parliament assessed the impact of public procurement based on the TED database (EC, 2019a). The data was cleaned and thereafter analysed based on country, participation of Small & Medium Enterprises (SMEs), the Type of Contract and the size of the procurement. Regarding the analysis into SMEs, the Types of Authorities were also taken into consideration. These reports show the importance of databases which can be analysed in a good manner to provide useful results for policy-makers to structure policies around important variables such as the ones mentioned above for Green Public Procurement.

2.2   Identifying a Green Public Procurement

2.2.1   Problems with identifying Green Public Procurement

Identifying and classifying public procurements as sustainable or green remains a difficult issue for researchers and policy-makers. The studies based on qualitative data remain vague and often subjective to the response rate of the questionnaire or the answers given during the interviews. Within the documents of the handbook of the European Commission, it is clearly addressed that the use of green and sustainable award criteria is a key issue of procuring green (EC, 2016). Among the possibilities discussed are the use of Life Cycle Costing (LCC), eco-labels and standards. A major distinction can be made between the use of standards. Firstly, the contracting authority can set obligatory requirements for the bidder based on a set of standards. The second option is that the contracting authority gives a certain value to the set of standards set, and chooses the bidder who performs the best on these standards. The latest research available is a 2015 study by the European Commission and carried out by the consultancy agency PWC (EC, 2017). This study looked into the TED database of 2013 and drafted recommendations on how the European Union could procure more strategically. Green Public Procurement (GPP) and Socially Responsible Public Procurement (SRPP) are researched separately based on key words found in the procuring documents to determine whether a tender is a Green Public Procurement or Socially Responsible Procurement. With this information data could be visualized to assess the characteristics within Europe of these types of procuring.

2.2.2 The use of Sustainable Award Criteria

In the process of awarding a public procurement to a certain bidder, there are two ways to evaluate the bidder; price only or the Most Economically Advantageous Tender (MEAT). In the former, price is taken as the sole indicator. Thus, the eventual tender procedure is generally speaking cheaper and more straightforward to conduct. In the latter, price is not the only indicator and more aspects are assessed. The MEAT assessment method was introduced by the European Commission in 2014. According to the EC Directive of 2004 (EC, 2004) a MEAT assessment can include the following indicators:

- Quality

- Price

- Technical merit

- Aesthetic and functional characteristics

- Environmental characteristics

- Running costs

- Cost-effectiveness

- After-sales service and technical assistance

- Delivery date

- Delivery period or period of completion

If a public purchaser uses the MEAT criteria for awarding the contract to the bidder, the purchaser must specify the respective weighting which it gives to each criteria. This can be done either in the contract notice or in the contract documents or, in the case of a competitive dialogue awarding procedure, in the descriptive document.

In the majority of the public procurements, the contracting authority sets out a list of requirements with the weighting per requirement already established. After receiving the different bids of the bidders, the contracting authority awards points per criterion, and the bidder with the most award points wins the contract. When weighting is not possible for some reason, the authority should indicate the importance per criteria by ordering them by importance. Next to this, the contracting authority can set minimal environmental requirements as a prequalification to the bidders such as the use of specific material or chemicals. However, these environmental requirements

TABLE 2.1: Differences between technical qualifications and award criteria. Based on the *GPP Training Toolkit* (EC, 2019b).

Technical Specifications	Award Criteria
Functional or based on standards	Can address wide range of environmental factors
Cannot be waived unless variants permitted: Pass or fail.	Assign marks for better performance: Score
Best for ensuring that all bids will meet minimum environmental standards	Best for stimulating the market to provide more sustainable solutions

cannot be discriminatory to a bidder. For example, a certain eco-label that is barely used in a certain area cannot be used a technical specification. For the sake of clarity, this does not mean that the contracting authority cannot use the requirements of the eco-label, only that requiring the use of the eco-label itself is not possible. Technical specifications and award criteria are often combined when discussing on who should be awarded the contract. The most important differences between technical specifications and award criteria are demonstrated in Table 2.1.

The European Commission uses 21 categories of Green Public Procurement, with every category assigned to a specific business sector based on the product this sector produce, which can either be supplies, works or services (EC, 2019b). These criteria, ranging from Green Public Procurement criteria on cleaning products and services to requirements for the construction of complete data-centres, were designed to help Member States in performing Green Public Procurement by providing them with lists suggestions for award criteria for the awarding procedure. All of these criteria are constantly updated by the European Commission by the publication of reports per sector. Furthermore, supranational, national or regional bodies can develop other criteria for Green Public Procurements that sometimes cover a wider range of products or services. With the earlier mentioned publication of ***Buying Green! A Handbook to Green Public Procurement*** in 2016 (EC, 2016) the first real framework was laid out. It was designed to help Member States carry out Green Public Procurement and explains the possibilities offered by the European Union in this area on a practical level. The Green Public Procurement criteria are distinguished into two separate groups.

- The **core criteria** focus on the environmental performance in the key area of the product or service to be procured. This allows procuring authorities to minimize the administration costs and still perform Green Public Procurement.

- The **comprehensive criteria** go further that the core criteria, in the sense that more and higher level of environmental performances of the product or service to be procured. These criteria recommended for authorities that want to go further in supporting environmental or innovation goals.

For all of the 21 sectors the European Commission publishes a technical report in which the core and comprehensive criteria are outlined. The frequency of these reports depends on the sector. Other than the criteria the report contains lists of and links to technical specifications for specific segments of sectors. For example, in the food sector, a list is published on the types of fish in the catering procurement for a tender to be green.

An important factor in the award criteria of Green Public Procurement is the use of Life Cycle Costing (LCC) (EC, 2016). Using LCC in public procurement extends to assessing the whole life cycle of a certain product instead of solely focusing on the greenness of end-product or service. The European Commission supports the use of MEAT because it encourages companies to innovate on environmental or social aspects, so that business do not only compete on price and margins. This way the European Commission encourages the market to find solutions for the long term. In the contract notice, the award criteria used must be clearly defined and weighted.

Within the literature, a few studies have been undertaken an analysis of the use of environmental criteria in public procurement. In a 2010 study on the four Scandinavian countries the conclusion was reached that old practices in the awarding procedure such as choosing the lowest price are still favoured by a majority of the contracting agencies (Palmujoki, Parikka-Alhola, and Ekroos, 2010). A recent study that did assess the environmental criteria in a large database, showed that for certain variables there is a positive correlation. These variables include the contract value GPA, the involvement of joint procurement, the procedures competitive dialogue, negotiation with competition, and the transport equipment and food sector (Yu, Morotomi, and Yu, 2020). Since environmental criteria and consciousness around sustainability has become more important over the last decade the need for more of these kinds of studies are evident.

Chapter 3

Methodology

3.1 Research Design

The methodology of this study is developed based on the available sources of information of public procurements within the European Union. A methodological design was constructed of how the data available was collected, prepared and analysed. The goal of this study is to identify Green Public Procurements in the European Union and to assess which authorities are procuring green, based on a number of important variables which will be discussed later in this chapter. The research design developed to reach this goal is demonstrated in Figure 3.1, where the different steps are chronically visualized. In order to determine what authorities mainly perform sustainable procurement and what characteristics are associated with them, this study made use of quantitative methods. These quantitative methods are chosen to differentiate from the research already conducted in this area of study. The use of a large number of public procurements has a significant advantage over the use of qualitative methods as it takes away biases in answers. Although the data still has to be submitted by the procurers, with the documents that have be filled in the possibilities for biases reduces.

As shown, three main steps were undertaken to reach conclusions on the characteristics of Green Public Procurement. First, an appropriate database was selected. This database had to meet requirements, which will be explained later on, so that a valid regression analysis could be carried out later in the process. The database was then prepared by eliminating cancelled and duplicated contracts. Outliers that could cause problems later on were removed. Details on the methods for this preparation will be explained later on.

Secondly, the geographical and temporal scope were selected based on the academic literature and the nature of the database. Then, the keyword lists in different languages that served as basis for the selection of the Green Public Procurements used for the analysis were formed based on the GPP criteria of the European Commission and a thorough literature study (EC, 2016). These key word lists were based on the vocabulary used in the chosen database combined with experiences from earlier research and studies of third groups or organisations. Three different samples were created. A first sample was used to give some general context of the tenders in the database. A second sample was created to perform the regression analysis. For this sample, a new dependent variable is created to indicate whether a tender is green or not and independent variables are selected to carry out the final regression analysis. The third sample consisted of all the Green Public Procurements was created to analyse the characteristics of Green Public Procurements in the database.

Thirdly and lastly, the two different analyses were carried out. The three samples were analysed based on the distribution per variable. After that, the appropriate software for the analysis was selected and the regression analysis was carried out. The software was chosen based on the nature of the eventual samples, looking at size, the amount and characteristics of these variables. With the software the final sample was analysed and among other results. Finally, to test the validity of these results they were compared with already existent literature. The next sections will go deeper into the details of the different steps of the research design.

3.2 Data selection

3.2.1 Requirements of the database

Since the number of different authorities performing Green Public Procurement is extensive, a large data set was necessary to get valid results. The requirements for this data set were that (a) from the information it was possible to determine whether a tender was sustainable or not, and (b) that it contained enough other variables to perform a regression analysis. The database chosen that met these requirements was the Tenders Electronic Daily (TED) of the European Commission, which specifics will be discussed in more detail in the data collection section of this chapter. To determine whether a tender
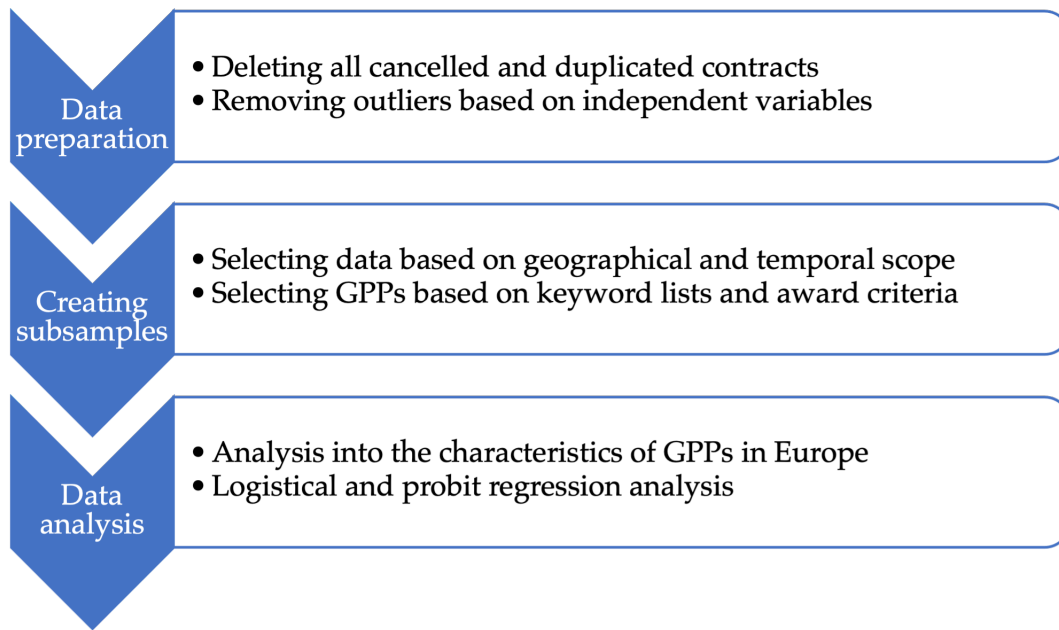
FIGURE 3.1: The three steps of the Methodology.

was green or not, it was chosen to look at the used award criteria in the procurement information. This was done in two simple steps. First, the presence of MEAT criteria must be included in the tender. Secondly, the use of specific key words, that resemble a good indication of a Green Public Procurement, in the award criteria segments of the data.

A database that met the requirements set in the previous section is the Tenders Electronic Daily database. This database is a supplement to the Official Journal of the EU and is publicly available online. The database contains Contract Notices providing information on calls for tenders, as well as all the winning bids of previous tenders, so-called Contract Award Notices. The TED database is often used by researchers because of its EU wide perspective and uniform template. DG GROW of the European Commission, the department responsible for the internal market and industry, uses the database for their yearly reports on the public procurement indicators. The data is collected by the European Commission via standard forms that are to be filled out by the procuring agency and is thereafter submitted into the database. A major advantage of a large database is the possibility to examine categorical variables in which some variables only contain a very small percentage of the total sample. Because of the large data set, the total amount of observations for this category will still be sufficient to analysis.

3.2.2   Temporal and geographical Scope

Because the new directive of the European Commission on public procurement started in 2014, this study analysed all contract award notices of public procurements from 2014 until 2019. Due to availability of the creation of key word lists in different languages, only tenders from the following eight Member States were included in the final Sample and are demonstrated in Figure 3.2 with the colour green.

- Austria (AT)

- Belgium (BE)

- Germany (DE)

- Ireland (IE)

- Italy (IT)

- The Netherlands (NL)

- Spain (ES)

- The United Kingdom (UK)

The data within the TED database is open and publicly accessible, therefore no permission is necessary when the data is downloaded. First, the data is cleaned by eliminating those procurements that have been cancelled. Additionally, when one or more of the necessary (described below) variables has not been filled in correctly, the public procurement is eliminated from the sample.

3.2.3   Determination of Green Public Procurement

To determine which specific groups of authorities perform Green Public Procurement procurement in the European Union, it was first necessary to identify when a certain tender can be called green. The focus of this research was based on the award criteria. In the process of awarding a tender, sustainable characteristics are included in determining the Most Economically Advantageous Tender (MEAT), as explained above. In both Green Public Procurement as in Sustainable Procurement the importance of including sustainable characteristics in the award criteria of the public procurement is necessary in order to be classified as sustainable or green. The MEAT principle was used to improve the price-quality ratios for the procuring agencies, enabling
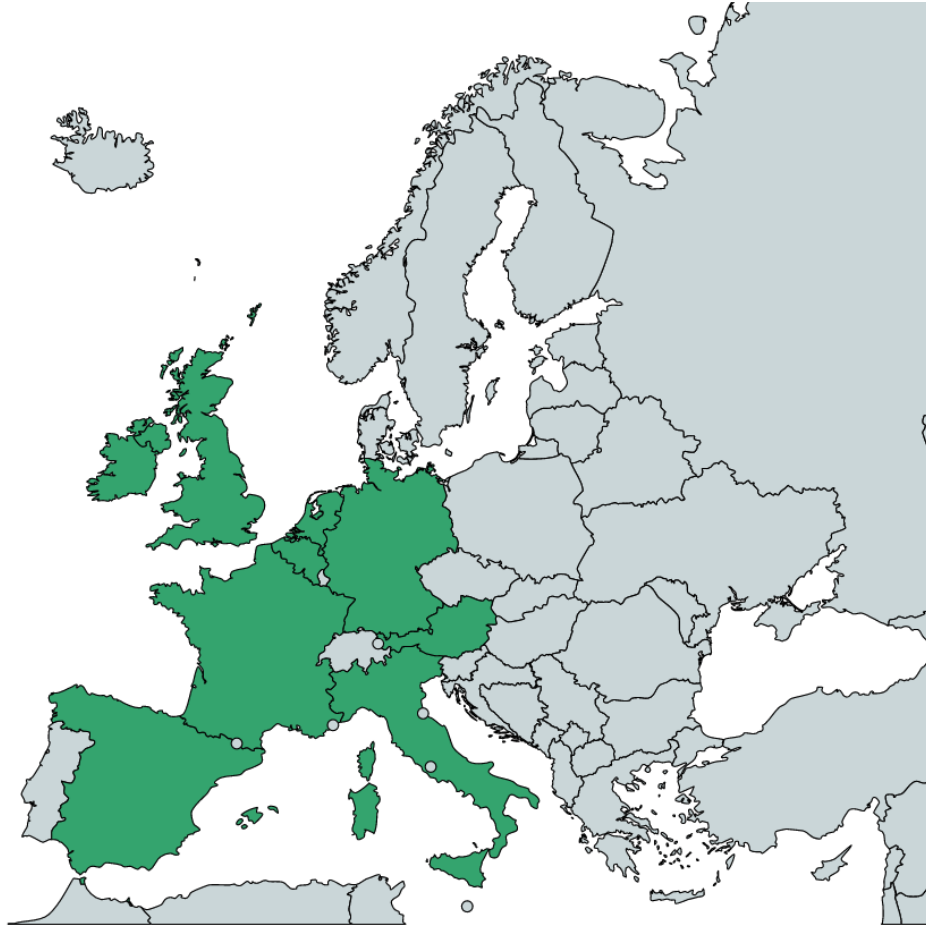
FIGURE 3.2: The geographical scope.

possibilities to make better informed decisions rather than based solely on lowest-cost. When sustainable variables are included in the public procurement, they are identified via the award criteria. Thereafter, a selection was made of all the tenders that fulfil these requirements, the different variables of these tenders were analysed. On the basis of these results conclusions can be drawn on the characteristics of agencies that perform sustainable procurement.

The TED database uses a wide range of variables. To indicate whether or not a procurement is sustainable or not, the variable award criteria is assessed. Within this variable, the agency needs to indicate whether only the price is used as a criteria, or if the previously mentioned Most Economic Advantageous Tender (MEAT) is used. In the documents attached to the specific procurement it must be indicated what indicators are used and how they are weighted. A close look is taken into the use of environmental or sustainable aspects in the contract notice of the procurement by the procuring agency.

This will be done with the help of specific key words. These key words are identified based on desk research, with a specific focus on the 19 Green Public Procurement criteria described by the European Union (EC, 2016). When key words are mentioned by the contracting agency in the procuring documents, the public procurement is identified as a Green Public Procurement.

To select only the the public procurements that take sustainability or Green Public Procurement into account, the column *Award Criteria* was searched for words that give a good indication of sustainable or green practices. The key word lists were constructed based on previous research of the commission and the academic literature on the topic of sustainability (Yu, Morotomi, and Yu, 2020; Zipperer, 2019). The European Commission has stated different criteria that need to be adhered to for a tender to be called a Green Public Procurement. These EU GPP criteria are categorised into several groups (EC, 2019b). The different categories were scanned and specific keywords were selected and included in the keyword lists used for this analysis. Additionally, the studies that used a similar method of key word lists were assessed and useful words were admitted into the list used for this study (EC, 2017; Yu, Morotomi, and Yu, 2020). Since the descriptions in the Award Criteria variable of the database are usually published in the language of the Member State, it was necessary to translate the key words into the different languages used. The different lists used for different countries do not always match perfectly. A specific word in one language can require the addition of several words in another. The final keyword list is demonstrated in Table 3.1, separated into five different categories for the sake of clarity. The original list is was constructed in English and is therefore shown in English in Table 3.1.

With these keyword lists the sample was assessed and the dependent variable were created. All tenders in the sample were given either a 0 (False) or 1 (True) based on whether words relating to Green Public Procurements were used in the Award Criteria.

3.2.4   Variable selection

The information available in the TED database is extensive and includes information not relevant for this study. Per tender, 64 different variables are available. Only the most relevant independent variables were useful for the analysis of the final sample. Thereafter, the seven most important independent variables were selected, which are explained below. These are chosen so

TABLE 3.1: Keyword lists.

Category	Key words
Environmental	CO2, CO-2, carbondioxide, carbon, environment, environmental, GWP, Global Warming Potential
Sustainability	Life Cycle Costs, LCC, lifecycle, lifetime, life-cycle, durability, renewable, recycling, recycle, remake, re-use, water-efficient, waterefficient
Ecology	ecology, ecological, organic, organically, pollution, toxic, greening, eco-driving, biodiversity, biodegredable, soil pollution, noise pollution
Energy	renewable energy, solar energy, wind energy, green eletricity, zero emission electricity, fossil fuel, low-emission, low emission, energy balance, energy saving
Standards	ISO 20400, ISO 50000, ISO 14001, eco-label

that analysis conducted can be compared well to the existing body of literature. Some of the variables are numeric and some are described in words, or so-called strings. For the further analysis, the variables described with words had to be translated into categorical, so they would be eligible. Not all the variables were used for every analysis in the results, which will be elaborated upon in the next section.

- For the dependent variable the text in the *Award Criteria* of the tenders in the TED database were assessed. The tenders that contained one of the key words of Table 3.1 are selected out and given an indication of TRUE in the newly created GPP (Green Public Procurement) variable in the final sample.

- The *Type of Contracting Authority* indicates what organization or what authority performs the public procurement and is the main focus of this study. This variable will help draft policies that reach the buyer targeted by the specific policy. The term contracting authority was defined in Directive 2004/24/EC (EC, 2004). Tenders Electronic Daily distinguishes six different categories and designates all authorities that do not fall within one of these categories under *Other*. The six categories are: ministry or any other national or federal authority including their regional of local subdivisions; regional or local authority; water, energy, transport and telecommunications sectors; European Union institution/agency; other international organisations; body governed by

public law. Furthermore, TED distinguishes between national or federal agencies, regional or local agencies or tenders where this is not specified. All categories except one are considered public authorities under the articles of the Directive. Only bodies governed by public law is not. Bodies governed by public law does not have a simple definition. An authority is considered as such as when three conditions are met: (1) established for purpose of the general interest and does not have a commercial intention, and (2) has legal personality, and (3) is financed by the state, or regional or local authorities.

- The *Type of Contract* refers to whether the public procurement relates to either works, supplies or a service. A work contract refers to building, construction and engineering related works. Work contracts have the aim to design and execute specific works such as building roads or sewage plants. Supplies refer to contracts on goods, either purchased or hired. These contracts have the aim to purchase, lease or hire either with or without the option to buy. Finally, services contracts that services that are provided by an external service provider. These contracts are described as when a procurement that does not include works or supplies, but the provision of a service such as training or consultancy. The large differences between these three types make them of great importance when advice is given on how to define the award criteria for the specific procurement.

- The *Type of Procedure* is the way in which the tender is awarded to the bidder. It is the preparatory stage of any procurement. When a procedure is chosen, it is important that it is considered where criteria will be applied. Six types of procedures are distinguished in the data. The negotiated and competitive dialogue procedures are applied by public authorities only at special circumstances. These procedures may offer are preferred in the context of GPP, because they are more flexible compared to the open and restricted procedures. When a procedure is open all bidder are aloud to submit a tender. If the tender meets the pass/fail conditions specified it is eligible to to be taken into consideration. When a procedure is restricted the technical capacities are determined in a prior stage and the number of operators invited is limited.

- The *Country* refers to where the procurement took place, due to language restrictions the following member states of the European Union countries were included in the analysis. Knowing differences within

the procurement culture of countries is of importance because of the need for different approaches. The advancement on sustainable procuring practices can differ greatly among Member States.

- The *Size of Procurement* refers to the contract value of the public procurement. For this analysis there are no limits on the value of the procurement. This variable is of importance to see whether sustainable procurement align with the size of the procuring agency, for example if a large governing body is only procuring sustainable when the value is low or vice versa.

- The *Business Sector* refers to the first two numbers of the CPV (Common Procurement Vocabulary) code. The CPV code is an 8-digit classification system with the goal to standardize the references used by the contracting agencies. The CPV refers to the product procured by the contracting authority, which is the main difference with the *Main Activity* variable. Based on the latest data available, the CPV vocabulary consists of 9454 terms, including supplies, works and services contracts (EC, 2008b). The most recent guide was published in 2008 and can be accessed via the SIMAP channels of the European Commission. Within the TED database, it is possible to assign multiple CPV codes to a procurement. However, for this analysis only the main code is taken into consideration. For this study, only the first two numbers of the code are assessed, so that 45 different CPV codes that indicate the sector of the procuremenent remain.

- The *Main Activity* refers to the more general area of the market in which the procuring authority is active. The TED database distinguishes eleven different categories: general public services, defence, public order and safety, environment, economic and financial affairs, health, housing and community amenities, social protection, recreation, culture and religion, education, and other activities. This and the type of procurement variable will help establish for what sectors more specific policies are necessary. Since the main activity is described in words in the TED database, a enormous amount of unique values are present in the database. Therefore, it was not possible to analyse the sample with all tenders based on the main activity of the procuring authority. However, in the final sample of only Green Public Procurements the different main activities were categorised in the eleven different categories listed in Table 3.2.

- The *Joint Procurement* refers to whether or not the procurement involves multiple countries or contracting authorities, or a central purchasing body performs the public procurement. Joint procurement can be done with different contracting agencies from the same country, as well as cross-border authorities. This type of procurement may be particularly valuable in relation to GPP, where environmental skills and knowledge of the market for green products and services may be limited. Joint procurement can be put in place, for example, by central purchasing bodies at the regional or national level to carry out procurement on behalf of public authorities.

The variables discussed in this section are also demonstrated in Table 3.2. The second column refers to the code given to the variable in the TED database. For the sake of consistency, These codes will also be used in the tables and figures of the results and discussion, Chapter 5 and Chapter 6 respectively. In the third column the information on the different possibilities of every variable. This information is directly available at the TED database (EC, 2021).

TABLE 3.2: All the dependent and independent variables used in the analysis.

Variable	Code in TED database	Specifications
Dependent Variable		
Green Public Procurement	AWARD_CRITERIA	• 0: False • 1: True
Independent Variables		
Type of buyer	CAE_TYPE	• 1: Ministry or any other national or federal authority, including their regional of local subdivisions • 3: Regional or local authority • 4: Water, energy, transport and telecommunications sectors • 5: European Union institution/agency • 5A: Other international organisation • 6: Body governed by public law • 8: Other • N: National or federal Agency/Office • R: Regional or local Agency/Office • Z: Not specified
Year	YEAR	• 2014 - 2019
Size of procurement	AWARD_VALUE_EURO	• Value in Euro (€)
Criteria code	CRIT_CODE	• Lowest price (L) • Most Economically Advantageous Tender (M)

Table 3.2 – continued from previous page

Variable	Code in TED database	Specifications
Joint Procurement	B_INVOLVES _JOINT_ PROCUREMENT	• Yes • No
Type of contract	TYPE_OF_CONTRACT	• Works (W) • Supplies (U) • Services (S)
Country	ISO_COUNTRY_CODE	• Austria (AT) • Belgium (BE) • Germany (DE) • Ireland (IE) • Italy (IT) • The Netherlands (NL) • Spain (ES) • The United Kingdom (UK)
Business Sector	CPV	• The main Common Procurement Vocabulary code of the main object of the contract. 45 categories (listed in Appendix A.
Type of procedure	TOP_TYPE	• AWP (award without prior publication of a contract notice) • COD (competitive dialogue) • NOP or NOC (negotiated without a call for competition) • NIP or NIP (negotiated with a call for competition) • OPE (open) • RES (restricted)

Table 3.2 – continued from previous page

Variable	Code in TED database	Specifications
Main Activity	MAIN_ACTIVITY	• General public services • Defense • Public order and safety • Environment • Economic and financial affairs • Health • Housing and community amenities • Social protection • Recreation, culture and religion • Education • Other activities

3.3 Data analysis

3.3.1 The three subsamples

For the sake of the clarity, in the results section the different samples have been assigned a letter. Thereafter it is indicated what variables are analysed for each sample in the first part of the results section.

- **Sample A:** Sample of all public procurements between 2014 and 2019 of all Member States. Used for general context of the tenders in the database. **Variables analysed**: Award Criteria and Year.

- **Sample B:** Sample of all public procurements between 2014 and 2019 of the selected Member States (Figure 3.2). Used for analysis on the tenders in the database and the logistical and probit regression analysis. **Variables analysed:** Green Public Procurement, Type of Buyer, Year, Size of Procurement, Type of Contract, Country, Type of procurement, Joint Procurement.

- **Sample C:** Sample of Green Public Procurements between 2014 and 2019 of selected Member States (Figure 3.2). Used for analysis of the

characteristics of Green Public Procurements in the database and creating the Green Public Procurement variable in Sample B. **Variables analysed:** Type of Buyer, year, Type of Contract, Country, Type of Procurement, Main Activity.

The Type of Procurement variable or CPV code variable contains 45 categories, which are all taken into account for the first part of the analysis (4). However, for the regression analysis (5), to fall within the scope of this research, only the eight most important industry sectors, based on the literature and the size of the sectors, are used. The Business Sectors taken into account are listed below with a shorter name to make the interpretation of the results easier. Also, only the first two numbers of the full CPV code are given based on the documentation of the European Commission (EC, 2008b). The full names as mentioned in the CPV database can be found in Appendix A.

- Food (CPV code 15)

- Medical equipment (CPV code 33)

- Transport (CPV code 34)

- Furniture (CPV code 39)

- Construction (CPV code 45)

- Architectural services (CPV code 71)

- Business services (CPV code 79)

- Environmental Services (CPV code 90)

3.3.2   Analysis of the characteristics of the sample

To get a good overview of what kind of authorities are procuring green in the selected Member States, the data of Sample A, B & C are analysed. Sample A is used for context on the distribution of the samples per year and the percentage of tenders using the MEAT criteria. Sample B & C are analysed for the bulk of the variables. With these samples a good indication can be given on the differences between the overall distribution of the values in the variables in the data set. The data is analysed with the help of the RStudio software, which resulted in different figures and tables visualizing the data to support the results, discussion and conclusion of this study.

3.3.3 Regression analysis

To analyse the the different variables and their affect on a procurement being green or not, a binary logistic regression was performed. Several steps were undertaken to complete the logistic regression and to test and validate the results. Logistic regression analysis are good methods to predict the outcome of a binary dependent variable based on a set of independent variables. It is a statistical model that uses a logistically distributed random variable to calculate the conditional probability, also referred to as log-odds (the logarithm of odds). Formula 3.1 shows the mathematical explanation of a logistic regression model,

$$p(Y = \frac{1}{x_1, x_2, ..., x_k}) = F(\alpha + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_k x_k) \qquad (3.1)$$

in which $Y)$ serves as the depending variable and p the probability. F is the standard logistically distributed random variable. In the parentheses, the regression equation is showed for the independent variables, in which α represents the intercept or constant of the equation, b the coefficient or slope of the predictor or independent variables, and x the value of the independent variables. The independent variables can both be numeric as categorical. When a variable is numeric the an increase by 1 of x means an increase in the unit of the variable. When a variable is categorical and non-ordinal, dummy variables are created so the value of the variable can only either be 0 or 1.

Additionally, a probit regression model was created. A probit model uses similar techniques as the logistic regression analysis. However, in probit regression the cumulative standard normal distribution (CDF) function is used instead of the logistically distributed random variable. To explain how the cumulative standard normal distribution function works lies outside the scope of this study. The probit regression formula looks very similar to the logistic regression formula;

$$p(Y = \frac{1}{x_1, x_2, ..., x_k}) = \phi(\alpha + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_k x_k) \qquad (3.2)$$

in which ϕ represents the cumulative standard normal distribution. The outcomes of both models are quite similar, the main difference between logit and probit models is way in which the models assume the distribution of errors.

Logit has standard logistic distribution of errors, while probit has normal distribution of errors.

For the analysis, the dependent and independent variables are established. The binary dependent variable is indicated as Green Public Procurement in Table 3.2. A multicollinearity test is used to identify whether two independent variables are correlated. Multicollinearity is the presence of high inter-correlations between the independent variables which can lead to skewed or misleading results. This test shows the Variance Inflation Factor (VIF) per independent variable. With the multicollinearity test the the VIF value is calculated for each individual independent variable. A VIF value of over 5.00 is considered to show evidence of multicollinearity (Rogerson, 2001). The variables that have a VIF value of over 5.00 are eliminated for the final analysis in order to provide valid outcomes of the regression analysis.

Next, for all the categorical variables a reference group is chosen. The reference group is the category to which the other categories in the model are compared. For the results, it does not matter which reference group is chosen. However, it can make interpreting the result easier when one reference group is chosen over the other. This reference group per variable is chosen based on a couple of considerations. Firstly, the reference group had to account for a significant part of both Sample B and Sample C, so that there would not be very large or very small outcomes in probability or odds. Secondly, the share of the category in Sample B and Sample C had to remain reasonably constant as this is best for interpreting the results of a regression analysis. This was another reason for analysing the characteristics of the samples in the first part of the Results section. This way, it was easier to choose the best reference group per categorical variable as will be done in the second part of the results section.

To assess the fit of the models, the Akaike Information Criterion or AIC is assessed. The AIC estimates the prediction error and thus the relative quality of regression models. With the addition or subtraction of cases or independent variables the AIC changes. It is calculated from the number of independent variables and the maximum likelihood estimate of the model. AIC penalizes the use of too many independent variables. The formula for the AIC is;

$$AIC = 2K - 2ln(L) \tag{3.3}$$

in which K is the number of independent variables and L is the log-likelihood

(the likelihood that the model could have produced your observed y-values). The lower the value of AIC, the better fit the model has. Of the models tested in this study, the ones with the lowest AIC scores and thus the best fit ar chosen and the results from these model are visualized.

The logistical and probit regression analysis are carried with the software of RStudio, which is an open source programming language for statistical computing and graphics. The results are visualized with the RStudio package 'stargazer' (Hlavac, 2018).

Chapter 4

Data

The results section is split into two separate chapters. These two different chapter are necessary since not all the variables as discussed in the Methodology are eligible for the second part of the analysis, the regression analysis. However, they are still interesting to look at for the overall characteristics of the samples that solely contain Green Public Procurements.

In the first part, this Chapter, the different samples that were used for the logistical and probit regression analysis are presented. The characteristics of this sample are already of value for the discussion of the results, since it gives insights into outcomes and context on the data analysis of the second section. This part will first go into the main question of this research, what types of authorities are procuring green. In the following subsections, the other variables are assessed for both Sample B as Sample C. The bars in the graphs represent the different unique values of the variables and are filled with the distribution per type of contracting authority as indicated with the numbers in Table 3.2 in Chapter 3, since this is the main point of research in this study.

In Chapter 6 second section demonstrates the results of the logistical and probit regression models, giving insights into what types of authorities mainly procure green in comparison to the reference group. First, the construction of the formulas for the analysis will be explained. Thereafter, the results will be summarized in two different tables. Additionally, it shows the influence of other variables on the probability of a procurement being green.

4.1 Characteristics of the different samples

4.1.1 Characteristics of all Public Procurements in all Member States

TABLE 4.1: Observations per Sample.

Sample	Observations
Sample A	3.935.603
Sample B	1.133.056
Sample C	36.144

The total number of tenders when all the data (without the cancelled contracts) from 2014 to 2019 from all EU Member States were bonded into Sample A covered 3.935.603 tenders, as is shown in Table 4.1. Sample B consisted of 1.133.056 tenders, meaning that this number of procurements was used initially for the regression analysis. Finally, 36.144 tenders were observed that are considered green according to the methodology of this study.

In Table 4.2 the number of tenders per year is shown. Over the six year analysed, a general positive trend is seen in the number of tenders registered in the TED database. Forty-seven percent (1.833.911) of the tenders used the MEAT assessment to award the contract, while 43% used the lowest price method, as shown in Figure 4.3. As demonstrated in Table 4.2, the first three years from 2014 to 2016 cover around 14% of the tenders per year in Sample A, while the last three years average around 20% per year. In Figure 4.1 the tenders of Sample A are plotted over the years in three different bar charts indicating the method of awarding assessment. Since 2014 until 2018 there has been a gradual rise in the number of MEAT assessed tenders. Only in 2019 a significant drop was noticed. The number of tenders assessed with the Lowest Price method declines from 2014 to 2016, but increases again over the next three years.

4.1.2 Types of Procuring Authorities

This next section will describe the characteristics of Sample B and Sample C, covering all tenders in the eight selected Member States (Sample B) and all the Green Public Procurement (Sample C), as indicated in Figure 3.2 in Chapter 3. Sample B consists 1.133.056 tenders in total, 29% of the tenders in Sample A. Sample C consisted of 60.118 tenders that could be characterised
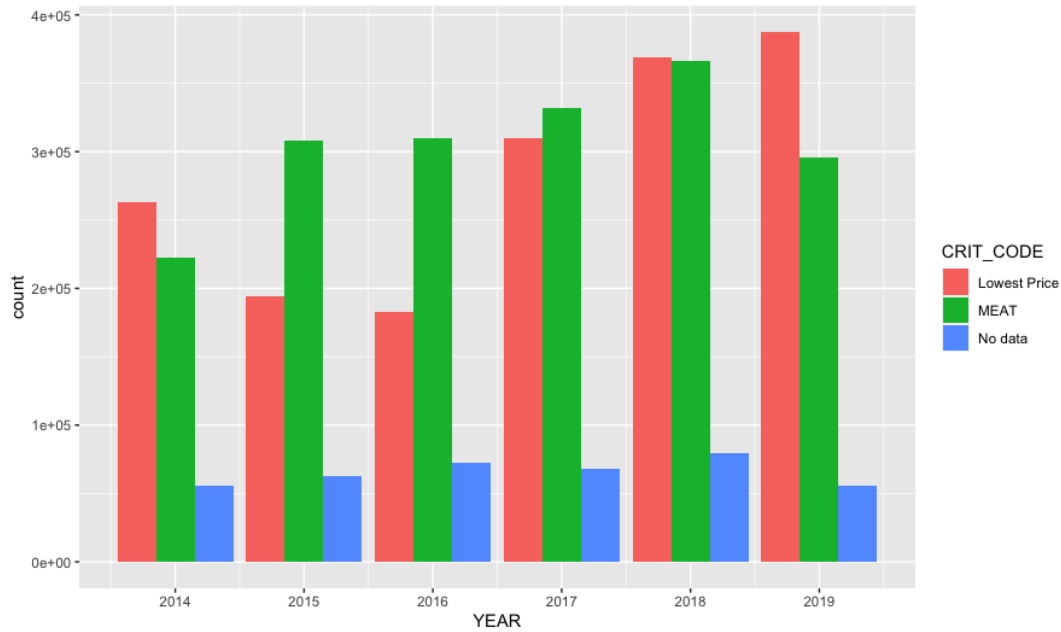
FIGURE 4.1: Distribution of total number of tenders per year and code of awarding method.

TABLE 4.2: Distribution per year of tenders in Sample A.

Year	Number	Percentage
2014	541534	13.76%
2015	565163	14.36%
2016	564997	14.36%
2017	709990	18.04%
2018	815012	20.71%
2019	738907	18.77%

as a Green Public Procurement. In Figure 4.3 the most important variable for this study, distribution per Type of Authority procuring, is demonstrated. It can be clearly noticed that regional or local authorities, bodies governed by public law and organisations not defined in the specifications are responsible for the vast majority of the Sample B. Regional or local agencies take up more of the tenders in Sample B than national or federal agencies.

In Figure 4.2 the percentage of Green Public Procurements over the temporal scope is demonstrated. The percentage of the total GPPs remains overall constant at around 3% of the total number of tenders over the years. However, this number should be regarded with suspicion, since the this number is affected heavily by the number of detail in the TED database. Over the years, a gradual rise in Green Public Procurement is noticed, due to mainly more

tenders procured by authorities in the category *Other*. This increase over the years is larger than the increase in the total number of tenders in Sample B, indicating that a larger percentage of the tenders in the selected Member States can be categorised as a Green Public Procurements. The number of GPPs thus coincides with the total number of tenders per year as shown in Figure 4.2. In Figure 4.4 a bar chart is projected of the distribution of the tenders in Sample C per type of procuring authorities. Just like in Sample C, regional authorities, bodies governed and other institutions represent the vast majority of the tenders. Almost no tenders of international organisations or the EU are observed. When compared to Figure 4.3, the graphs look overwhelmingly similar. However, some small differences can be noticed, such as a larger difference between regional/local tenders and national tenders and a relative decrease of tenders contracted by water, energy, transport and telecommunications sectors. In the regression results a more precise indication of what these differences mean and how they should be interpreted will be explained.
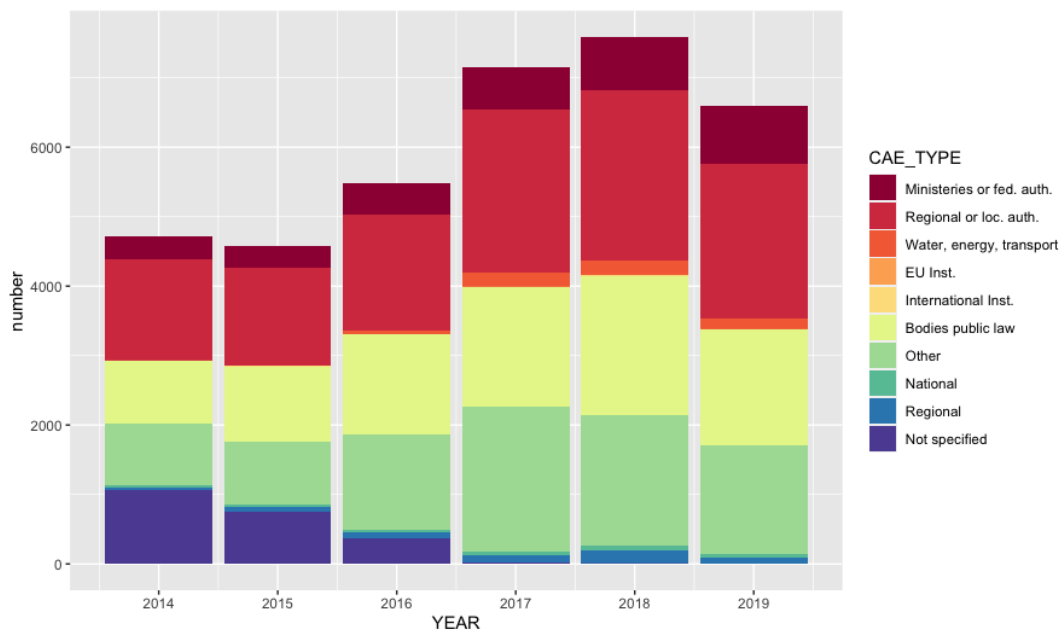
FIGURE 4.2: Distribution of Green Public Procurements over the temporal scope.
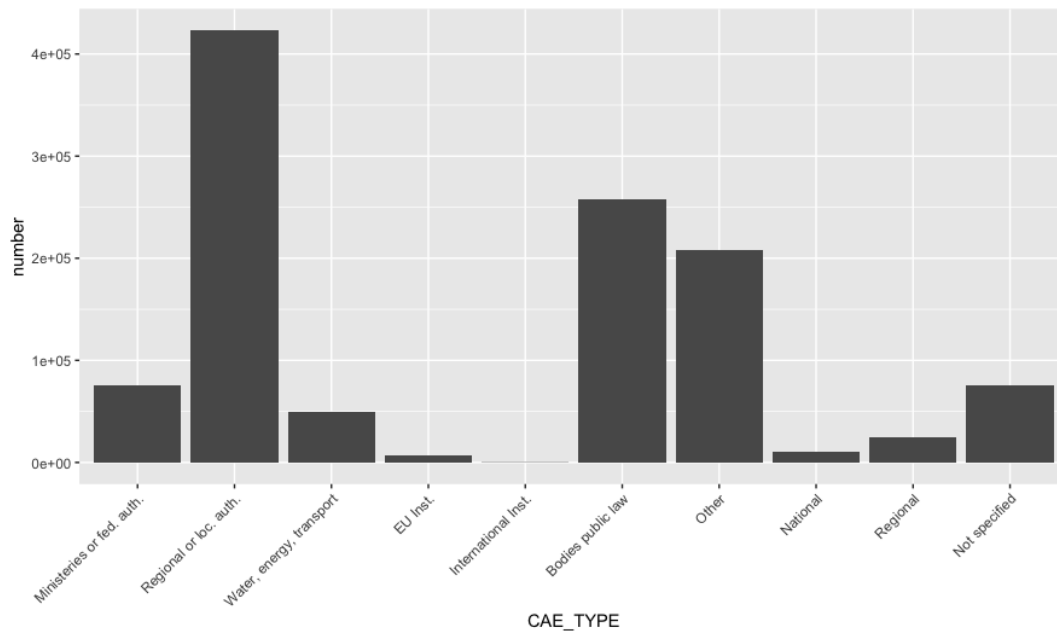
FIGURE 4.3: Distribution of tenders per tType of Authority in Sample B.
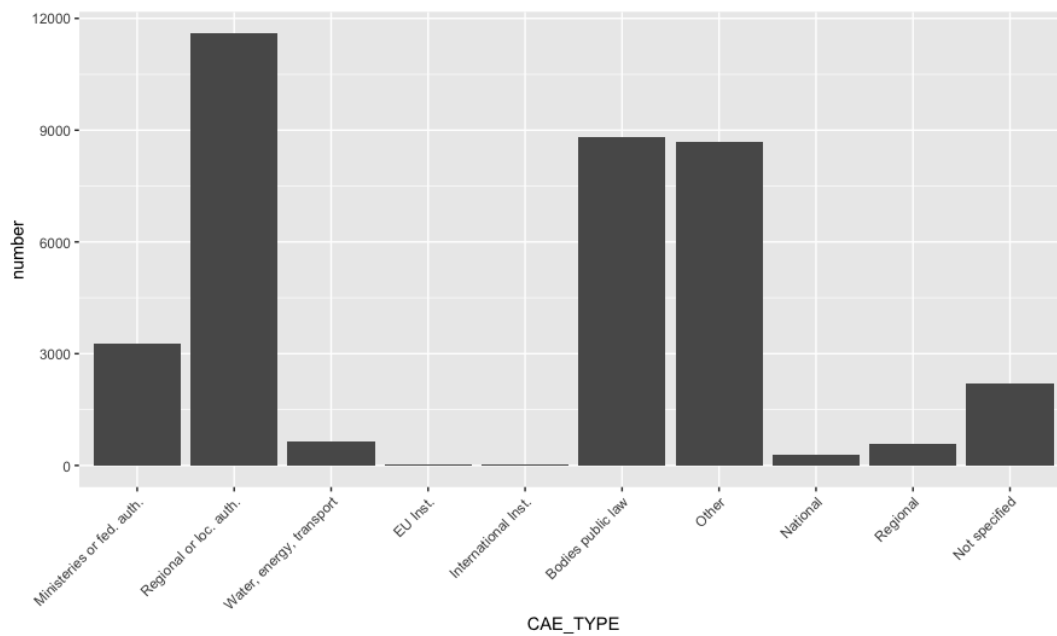
FIGURE 4.4: Distribution of tenders per Type of Authority in Sample C.

4.1.3   Member States

In Table 4.3 the distribution of per Member State are demonstrated. The percentage columns (third and fifth column) refer to the percentage of the specific Member State for the total sample. In both Sample B as Sample C, French tenders take up about half of the total number of procurements. The United Kingdom, Germany and Spain are also responsible for a good percentage of the tenders, while Austria and Ireland only take up about 1%. This is in line with expectation when the size of the countries is considered. It is therefore more interesting to look at the differences between the percentage of Sample B and Sample C. The largest differences can be found between France (+6.41%) and The Netherlands (+5.78%). The Member States with the largest percentage decrease between the samples are the United Kingdom (-6.34%) and Italy (-4.05%). The percentages of the remaining countries remain quite even between Sample B and Sample C, indicating a relatively stable percentage of Green Public Procurements compared to the mean percentage of Green Public Procurements over all the countries.

In Figure 4.5 the distribution of the Green Public Procurements of Sample C are shown, to assess what the distribution of the different types of procuring authorities looks like. Overall, the bar charts are quite similar, with *Regional or local authorities* and *Bodies governed by public law* taking up the majority of the green tenders. Some interesting results occur in Spain and France, where the *Other* category takes up a larger percentage compared to the mean. Although no definitive conclusions can be drawn from looking just at the results from this specific part of the sample, it is necessary when the results of the regression analysis are discussed.

TABLE 4.3: Distribution per Member State of Sample B & Sample C.

Member State	Sample B		Sample C	
	Number	Percentage	Number	Percentage
Austria	13282	1.17%	711	1.18%
Belgium	32823	2.90%	1563	2.60%
Germany	112560	9.93%	6119	10.18%
Spain	99541	8.79%	4802	7.99%
France	556202	49.09%	33364	55.50%
Ireland	14460	1.28%	188	0.31%
Italy	65721	5.80%	1053	1.75%
The Netherlands	43262	3.82%	5774	9.60%
United Kingdom	195205	17.23%	6544	10.89%
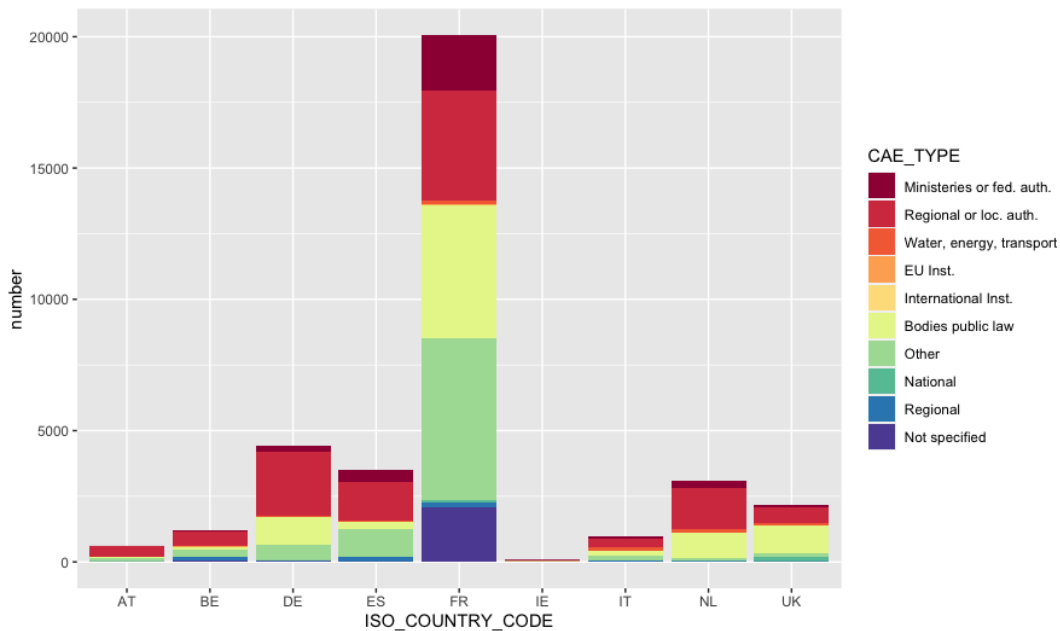
FIGURE 4.5: Distribution per Member State of tenders in Sample C.
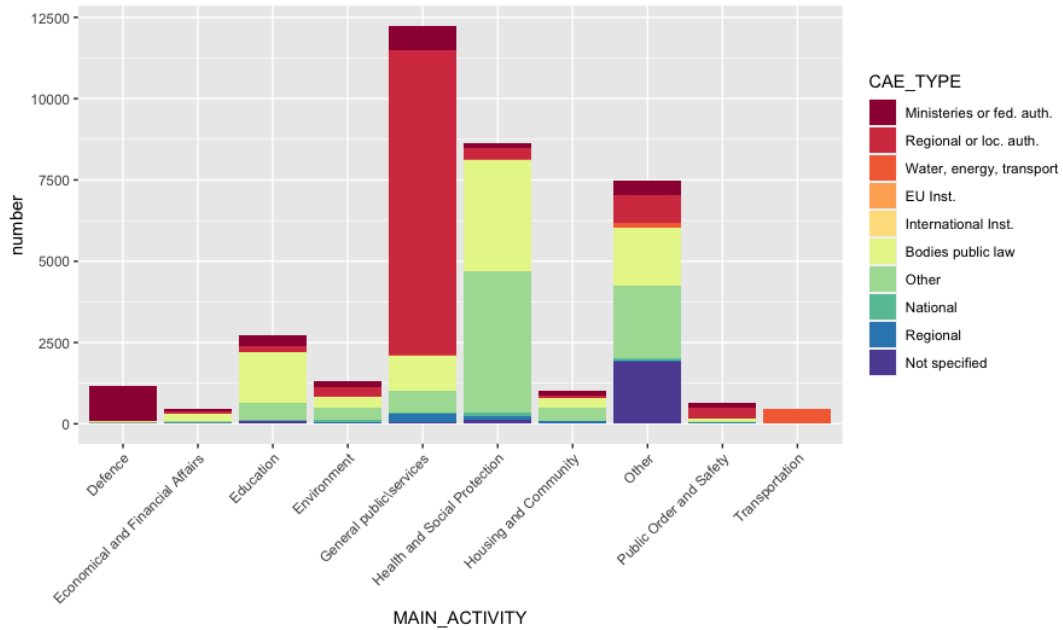
FIGURE 4.6: Distribution per year of Sample C. **S:** Services. **U:**
Supplies. **W:** Works.

4.1.4 Main Activity

For Sample C it was possible to analyse the variable Main Activity, as shown
in Figure 4.6. The *Main Activity* refers to the activities of the procuring au-
thority. However, it was necessary to categorize the different options that
were possible for tenders in the database. Because it was possible to enter
multiple Main Activity options when the tender was registered in the TED
database, for tenders with multiple Main Activities the most relevant was
chosen and the tender was put in that category. When it was not clear what
Main Activity was most relevant, the tender was put in the category *Other*.
Three values, *General Public services*, *Health and Social Protection* and *Other*,
account for the vast majority of the tenders in Sample C. Education, environ-
ment and defence also account for a good number of the sample. The other
Main Activities account for significantly less of the total tenders in Sample
C. The distribution of the different types of authorities procuring shows no
relevant differences compared to the overall distribution of this variable in
Figure 4.4.

TABLE 4.4: Distribution of the different Types of Procedures of
Sample B & Sample C.

Type of Procedure	Sample B		Sample C	
	Number	Percentage	Number	Percentage
Award Without Publication	37128	3.28%	730	2.02%
Competitive Dialogue	2671	0.24%	152	0.42%
Innovation Partnership	119	0.01%	5	0.01%
Negotiated without competition	73126	6.46%	1159	3.21%
Negotiated without competition	10100	0.89%	185	0.51%
Negotiated with competition	1836	0.16%	7	0.02%
Open	934997	82.59%	32351	89.58%
Restricted	72116	6.37%	1504	4.16%

4.1.5 Type of Procedure

Table 4.4 represents the different Types of Procedures in the first column,
the number and percentage per type of procedure of Sample B and Sample
C in the columns to the right. As shown, open procedures account for the
overwhelming majority of the sample and gains about seven percent when
comparing Sample C with Sample B. The percentages of the restricted pro-
cedures goes down by two percent, while for the other types of procedures
only small changes can be noted. The significance of these results are bet-
ter to interpret in the results of the regression analysis when a statistically
more advanced analysis is carried out. However, the table is included in the
results because it is of importance for justifying the choose of the reference
group. Additionally, the table can give context to the results of the regression
analysis. For example, it can explain that a certain category is not significant
because the number of observations is relatively low compared to the other
variables.

4.1.6 Type of Contract

Figure 4.8 demonstrates the distributions per Type of Contract of the tenders
in Sample C. The Supplies contracts account for the majority of the tenders
in Sample C, followed by services contract and works contracts. Only a very
small number of the tender contracts is works related. The figure shows sig-
nificant differences with the figure of the tenders in Sample B (Figure 4.7),
where services account for the majority of the tenders and where works con-
tracts contribute significantly more. Based on these results, it could be said

that tenders with Services contracts are less likely to procure green than tenders with Supplies or Work contracts. These results are very interesting for to analyse in the regression analysis, since Works and Services are more present in Sample C compared to Sample B. In the following chapter and in the discussion section of this study more details will be given on regarding this topic. The distribution of the type of contracting authority remains overwhelmingly similar for both figures.
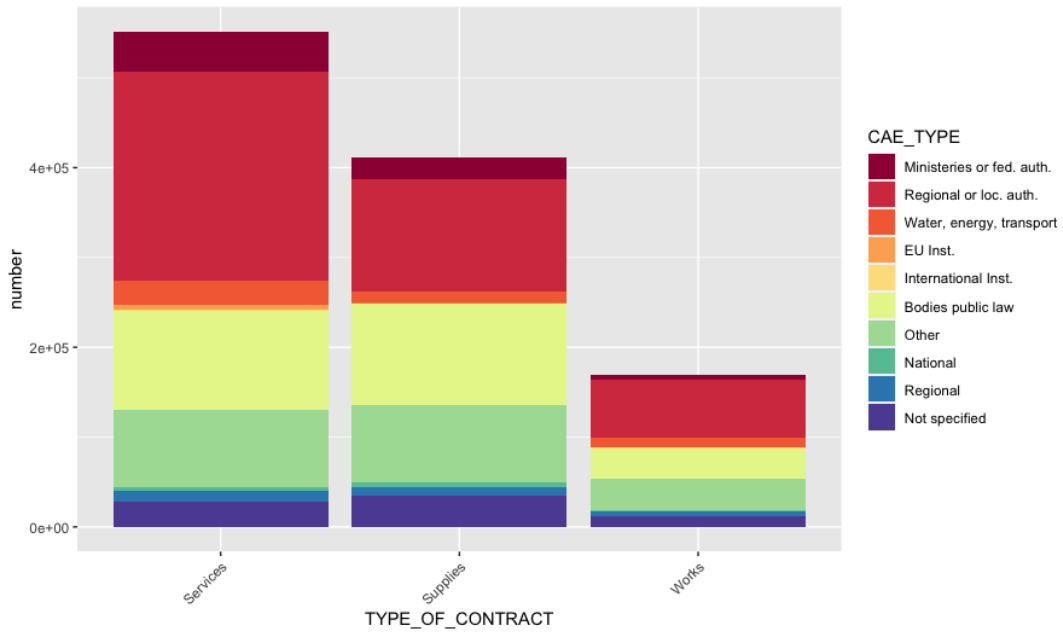
FIGURE 4.7: Distribution per Type of Contract of tenders in Sample C.
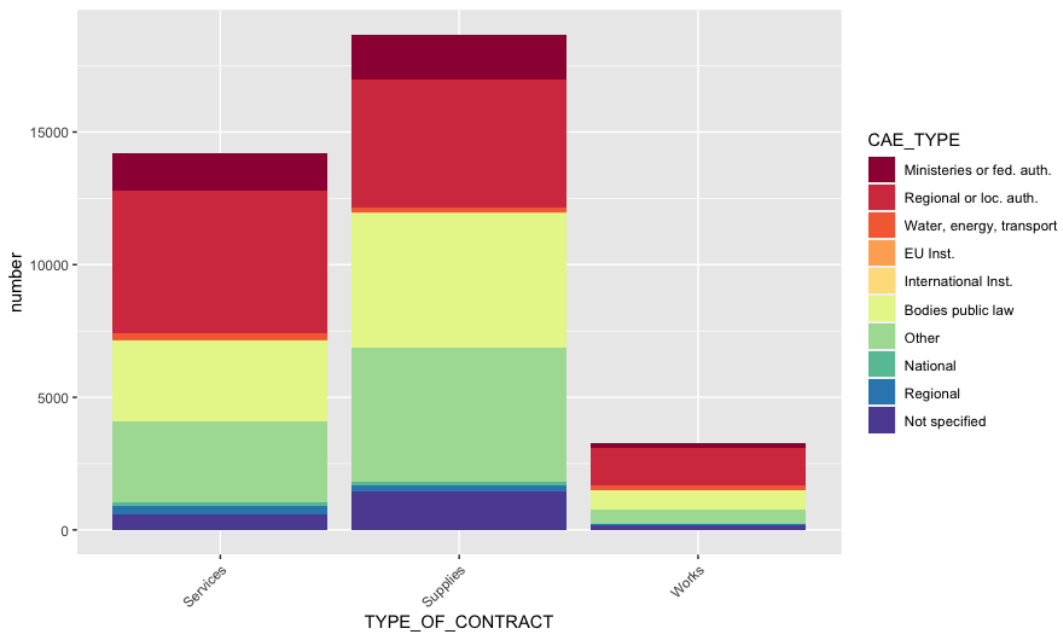
FIGURE 4.8: Distribution per Type of Contract of tenders in Sample C.

4.1.7 Business Sectors

In Table 4.5 the distribution per Business Sector is demonstrated for both Sample B and Sample C. In Appendix A a full list of the explanation per code is available. The business sectors are determined by the first two numbers of the CPV code, as explained in the methodology in Chapter 3. In Sample C sectors 15 (Food, beverages, tobacco and related products), 33 (Medical equipment, pharmaceuticals and personal care products) and 90 (Sewage, refuse, cleaning and environmental services) account for more than 10% of Sample C. In bold, the sectors are demonstrated as discussed in the methodology. These sectors will be taken into account for the logistical and probit regression analysis. They are based on their size, their relevance to GPP based on the literature and the difference in percentage between Sample B and Sample C. For example, sector 39 (Furniture (incl. oce furniture), furnishings, domestic appliances and cleaning products) does not represent a large percentage in Sample B but the percentage almost doubles in Sample C, which makes it an interesting sector to analyse in the regression analysis. On the other side, for sector 71 (Architectural, construction, engineering and inspection services) the percentage almost halves from Sample B to Sample C and is therefore also of interest to analyse in the regression analysis.

TABLE 4.5: Distribution of the different sectors of Sample B & Sample C.

Distribution of the different sectors of Sample B & Sample C. Rows in bold represent the sectors analysed in the logistic regression analysis.

CPV		Sample B		Sample C	
		Number	%	Number	%
14	Mining	1958	0.17%	77	0.21%
15	**Food**	**41661**	**3.68%**	**3937**	**10.90%**
16	Agricultural machinery	2349	0.21%	87	0.24%
18	Clothing	11029	0.97%	572	1.58%
19	Leather and textile fabrics	1954	0.17%	251	0.70%
22	Printed matter	9807	0.87%	365	1.01%
24	Chemical products	7605	0.67%	451	1.25%
30	Computing machinery	23755	2.10%	1763	4.88%
31	Electrical machinery	12558	1.11%	312	0.86%
32	Communication	10799	0.95%	423	1.17%
33	**Medical equipment**	**150426**	**13.28%**	**4150**	**11.49%**
34	**Transport**	**48343**	**4.27%**	**2317**	**6.42%**
35	Security	5895	0.52%	168	0.47%
37	Music, sports and games	3924	0.35%	164	0.45%
38	Laboratory equipment	13446	1.19%	580	1.61%
39	**Furniture**	**31991**	**2.82%**	**1951**	**5.40%**
41	Water	235	0.02%	2	0.01%
42	Industrial machinery	9379	0.83%	376	1.04%
43	Machinery for mining	3476	0.31%	83	0.23%
44	Construction	22224	1.96%	616	1.71%
45	**Construction work**	**154196**	**13.61%**	**2984**	**8.26%**
48	Software package	9553	0.84%	173	0.48%
50	Repair and maintenance	49180	4.34%	1513	4.19%
51	Installation services	1253	0.11%	41	0.11%
55	Hotels and Restaurants	11475	1.01%	638	1.77%
60	Transport services	52096	4.60%	1385	3.84%
63	Supporting transport	4039	0.36%	84	0.23%
64	Postal	10722	0.95%	411	1.14%
65	Public utilities	2251	0.20%	60	0.17%
66	Financial services	38643	3.41%	356	0.99%
70	Real estate services	3225	0.28%	40	0.11%
71	**Architectural**	**77586**	**6.85%**	**1368**	**3.79%**
72	IT services	26815	2.37%	380	1.05%
73	R and D	5367	0.47%	45	0.12%
75	Architectural	5892	0.52%	72	0.20%
76	Oil and gas	251	0.02%	3	0.01%
77	Agricultural	16519	1.46%	913	2.53%
79	**Business services**	**69651**	**6.15%**	**1125**	**3.12%**
80	Education	26561	2.34%	248	0.69%
85	Health	57608	5.08%	323	0.89%
90	**Environmental**	**69600**	**6.14%**	**4277**	**11.84%**
92	Recreational	7721	0.68%	157	0.43%
98	Community services	7864	0.69%	426	1.18%

Chapter 5

Results

5.1 The regression analysis

The second part of the results section describes the outcomes of the regression models. With these outcomes a more complete overview of the information in the data can be visualized and discussed. First, this Chapter will show how the final formula was constructed and what variables were included. Thereafter, the different results of the models are visualized and the most important results are summarized.

5.1.1 Construction of the logistical and probit regression formula

For the regression analysis, a formula was created based on the dependent variable, the GPP variable, and a range of independent variables as demonstrated in Table 3.2. After performing the multicollinearity test as described in Chapter 3, the independent variables as shown in Table 3.2 were chosen as predictor variables in the regression analysis. The table shows the descriptive statistics of the different variables. For every categorical variable, a reference group was chosen that was most representative for the data-set so that the final results could be read most easily.

The regression models were run with the categorical variables Type of Procuring Authority, Type of Procedure, Country, the Business Sectors and Joint Procurement. The size of the procurement is a numeric variable in the model. For the size of procurement the log value is chosen to make the interpretation of the results easier. Unfortunately, the Type of Contract variable had a too high VIF value based on the multicollinearity test and was therefore

not included in the model. When the dummy variables were created the total variable count resulted in 30 dummy variables and one numeric variable. The model formula is demonstrated below;

$$GPP = \alpha + \beta_1 CAE + \beta_2 TOP + \beta_3 CON + \beta_4 CPV + \beta_4 JP + \beta_5 VAL \quad (5.1)$$

in which Y is the dependent variable GPP, α is the constant, CAE is the Type of Procuring Authority, TOP is the Type of Procedure, CON is the Country, CPV is the Business Sector, JP is the Joint Procurement and VAL is the size of the procurement. Formula 5.1 is inserted in the logistical regression formula 3.1 and the probit regression formula 3.2 to get to the mathematical equation that demonstrate the results. For every categorical variable a reference group had to be chosen based on the considerations outlined in the methodology. In Table 5.1 the reference group of every categorical variable is displayed.

It was not possible to include the Type of Contract variable in the model since it would cause multicollinearity. However, since it is logical that different types of procurement subject posses different features it was decided to create three subsamples for services, products and work contracts. These three subsamples were analysed with the exact same logistic and probit regression model as the first analysis and are included in the results.

5.1.2 Results of the regression analysis

The results from the logistical and probit regression analysis are shown in Table 5.2. In the first column the different dummy and numeric variables are displayed. For most of the variables a shorter name is displayed than the actual name in the database so that the results could be more easily interpreted. The full names can be found in Table 3.2 in Methodology of Chapter

TABLE 5.1: Reference groups for the categorical variables used in the regression analysis.

Categorical Variable	Code in Database	Reference group
Type of Procuring Authority	CAE_TYPE	8: Other
Type of Procedure	TOP_TYPE	AWP
Country	ISO_COUNTRY_CODE	France (FR)
Business Sector	CPV	Medical Equipment

3). In the second and third column the coefficients of respectively the logistic and probit regression analysis are demonstrated, with in parenthesis the standard deviation error or p-value. For every new categorical variable the reference group is written in the parenthesis. It is imprtance to take into account the fact that only tenders from nine of the forty-five available business sectors were included in the analysis. Furthermore, only tenders were included that had values for all the variables in the final model. Consequently, in the final regression analysis there were 280,490 observations of tenders, meaning 280,490 had values for all the variables included in the regression model. The intercept or constant α was calculated at -3.283 for the logistic regression and -1.788 for the probit regression with both three star significance levels. Per variable, different levels of significance are given by assessing the p-value, which is calculated automatically by the software with the Pearson Chi-square test. The probit model is considered the better model in this study since the AIC value is ten points lower than the logistic model. It is demonstrated in Chapter 4 that the total amount of Green Public Procurements is constant around 3% in Sample B of this study. Therefore, it makes sense that the constants of both the logistic as the probit model are negative values. The table should be interpreted as follows. For every variable as described in Formula 5.1 one of the values in table are chosen. The reference group, a tender from the reference group, which has all the values as described in 5.1 with no Joint Procurement and no value for the Award Value, will have a GPP value of the constant α. The values shown in Table 5.2 could then be inserted for the β values in Formula 5.1 to get the probability or odds value for GPP in the model.

The values for the different dummy and numeric variables give insights into how this variable changes the probability or odds of a tender being green compared to the reference group, either negatively or positively. In the following bullet points the main results of the different variables are summarized:

- Regarding the types of authorities procuring that have significant coefficients the *Ministry or federal authorities* and *National* groups have positive values compared to the reference group. Additionally, *Water, energy, transport*, which cannot be considered regional or national, are positively correlated to a procurement being green. *Regional or local authorities*, *European Institutions* and *Bodies governed by public law* have

negative coefficients. *International organisations* did not have a significant effect in the models. In general, it can be concluded that national or federal authorities are relatively more likely to perform Green Public Procurement than regional or local authorities based on the results from the regression analysis.

- For the types of procedures, *Competitive Dialogue or COD, Open, and Restricted* (only in the logistic regression analysis) procedures all had positive values compared to the reference group. However, Competitive dialogue had a significantly higher value than the other groups. Both the procedures with negotiated procedures had negative values. Innovation Partnership was not considered significant in the models, due to the very low number of observations as shown in Table 4.4. When these numbers are compared with the total observations as demonstrated in Table 4.4, the results align. However, it must be noted that *Open* takes account for the overwhelming majority in the samples while *Competitive dialogue* procedures only accounts for a small share.

- Regarding the differences per country, *Germany* and *The Netherlands* had positive values compared to the reference country *France*, while the other countries had negative values. However, for the probit regression, the coefficients of *Belgium* and *Spain* were not considered significant. However, when considering these results it is necessary to take into consideration the fact that the reference country, France, had a rise in percentage between Sample B and Sample C (Table 4.3). Therefore, France can also be considered one of the countries that have a positive correlation of Green Public Procurement, although this is not technically correct on the basis of solely the regression analysis.

- Regarding the Business Sectors, the *Food, Furniture and Environmental services sectors* had positive values compared to the reference group. Especially the *Food* sector had a very highly positive correlation in both models of this study compared to the other business sectors. The *Transport, Construction, Architectural services and Business services* sectors had negative values compared to the reference group.

- The Involvement of *Joint Procurement* had a significant positive influence on the odds and probability of a procurement being green for both the logistical and probit regression models. Although the presence of Joint Procurement in the different samples analysed is still low, it is interesting that three star significance levels are reached for this variable.

- The same can be said for the of the size of the procurement, of which the natural logarithm is taken. When the size of the procurement in award value increases, the odds and probability, for respectively the logistic and probit analysis, of the model of the procurement being green increases as well.

Most of the coefficients of the variables had three star significance levels, the highest possible level. The main results will be further discussed and put into context in Chapter 6.

TABLE 5.2: Results from the logistical and probit regression analysis.

	Dependent variable: GPP	
	logistic	*probit*
Type of Procuring Authority (ref: Other)		
Ministry or federal authority	0.251*** (0.030)	0.125*** (0.015)
Regional or local authority	−0.499*** (0.022)	−0.244*** (0.011)
Water, energy, transport	0.599*** (0.071)	0.299*** (0.035)
European Institutions	−2.650*** (0.448)	−1.135*** (0.162)
International Organisations	0.531 (0.326)	0.253 (0.172)
Body governed by public law	−0.381*** (0.023)	−0.182*** (0.011)
National	0.713*** (0.082)	0.341*** (0.043)
Regional	−0.816*** (0.068)	−0.380*** (0.030)
Type of Procedure (ref: AWP)		
Competitive Dialogue	1.390*** (0.174)	0.646*** (0.084)
Innovation partnership	0.742 (0.614)	0.248 (0.308)
Negotiated with competition	−0.140 (0.111)	−0.105** (0.046)
Negotiated without competition	−0.417** (0.182)	−0.235*** (0.078)
Open	0.720*** (0.096)	0.296*** (0.039)
Restricted	0.292*** (0.110)	0.074 (0.046)
Country (ref: France)		
Austria	0.094 (0.065)	0.083*** (0.031)
Belgium	−0.119** (0.052)	−0.023 (0.025)
Germany	0.606*** (0.028)	0.312*** (0.014)
Spain	−0.063** (0.031)	−0.004 (0.015)
Ireland	−1.393*** (0.120)	−0.636*** (0.051)
Italy	−1.452*** (0.066)	−0.622*** (0.027)
The Netherlands	0.925*** (0.040)	0.484*** (0.020)
United Kingdom	−0.244*** (0.038)	−0.101*** (0.018)
Business Sector (ref: Medical equipment)		
Food	0.911*** (0.028)	0.488*** (0.015)
Transport	−0.055 (0.034)	−0.017 (0.017)
Furniture	0.347*** (0.035)	0.193*** (0.018)
Construction	−0.842*** (0.031)	−0.379*** (0.015)
Architectural services	−1.264*** (0.044)	−0.560*** (0.019)
Business services	−1.209*** (0.043)	−0.534*** (0.019)
Environmental services	0.062** (0.029)	0.053*** (0.014)
Joint Procurement	0.186*** (0.034)	0.103*** (0.017)
log(Award Value in €)	0.029*** (0.002)	0.015*** (0.001)
Constant	−3.283*** (0.100)	−1.788*** (0.042)
Observations	280,490	280,490
Log Likelihood	−58,780.290	−58,770.000
Akaike Inf. Crit.	117,626.600	117,606.000

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

5.1.3 Results from the Types of Contract subsamples

The results of the three sub-samples that were created per Type of Contract are demonstrated in Table 5.3. The table only displays the dummy variables of the Type of Authority, but the analyses is carried out on all the variables as demonstrated in Formula 5.1. The Tables of the full results per Type of Authority can be found in three different tables in Appendix B.

The second and third column of Table 5.3 show respectively the logistic and probit regression analysis of the sample with solely the tenders with services contracts. The constant for this sample are -2.709 and -1.578, which are higher values than the constant values in the first regression analysis of Table 5.2. In Figures 4.7 and 4.8 it was shown that the services contracts bar is lower in Sample C than in Sample B, which would mean that the probability or odds of the final formula will be lower. However, these values have no significant meaning unless they are calculated along with the other variables of the formula. Regarding the results per contracting authority, only the *National* authorities are significantly positively related to the probability of a contract being green compared to the reference group. For the probit regression, also the *Water, energy and transport* authorities are positively related.

The fourth and fifth column display the coefficients of the sample with solely the works contracts. As was shown in Figure 4.8, this sample was the smallest of the three. This has an negative effect on the significance level of the regression analysis, with less of the results per contracting authority being significant. The constant for this sample are -3.148 and -1.560, which are relatively similar values to the constants of the first analysis. In the results, only the *Water, energy, transport authorities* is significantly positively correlated to a procurement being green compared to the reference category.

The sixth and seventh column demonstrate the results of the sample with solely supplies contracts. The constant for this sample are -3.148 and -1.560, which are lower values than the first analysis. However, it was indicated in Figures 4.7 and 4.8 that the bar chart of supplies contracts was significantly higher for Sample C than for Sample B. Consequently, this means that the final probability or odds of a supply procurement being green is higher than either services or work contracts. Regarding the results per contracting authority, the *Ministry's or federal authorities*, *International institutions* and *National* authorities procure more green than the reference group. Logically,

some procuring authorities are less significant for the Type of Contract anal-
ysed. For example, *Water, energy and transport* authorities are more related to
Works Type of Contracts than *Services* contracts.

TABLE 5.3: Results from the logistic and probit regression analysis per Type of Contract.

	Dependent variable: GPP					
	logit	*probit*	*logit*	*probit*	*logit*	*probit*
	(Services)	(Services)	(Works)	(Works)	(Supplies)	(Supplies)
	Type of Procuring Authority (ref: Other)					
Ministeries or fed. auth.	−0.354***	−0.161***	−0.171	−0.062	0.602***	0.341***
	(0.059)	(0.028)	(0.105)	(0.047)	(0.039)	(0.022)
Regional or loc. auth.	−0.489***	−0.240***	−0.423***	−0.222***	−0.543***	−0.272***
	(0.040)	(0.019)	(0.057)	(0.025)	(0.031)	(0.016)
Water, ener. transport	0.142	0.115**	0.275**	0.103*	0.238	0.192**
	(0.115)	(0.055)	(0.121)	(0.059)	(0.183)	(0.087)
EU Inst.	−4.113***	−1.698***	−12.174	−3.785	−0.609	−0.294
	(0.711)	(0.237)	(186.698)	(49.109)	(0.604)	(0.287)
Intern. Inst.	−10.827	−3.408	−11.421	−3.284	1.697***	0.968***
	(67.124)	(18.242)	(207.625)	(55.222)	(0.389)	(0.240)
Bodies public law	−0.493***	−0.218***	−0.328***	−0.176***	−0.288***	−0.150***
	(0.046)	(0.021)	(0.069)	(0.030)	(0.029)	(0.015)
National	0.309*	0.162**	−3.666***	−1.399***	1.514***	0.861***
	(0.169)	(0.081)	(1.005)	(0.303)	(0.108)	(0.064)
Regional	−0.445***	−0.208***	−1.338***	−0.568***	−0.935***	−0.432***
	(0.097)	(0.046)	(0.216)	(0.084)	(0.110)	(0.050)
Constant	−2.709***	−1.578***	−3.148***	−1.560***	−4.196***	−2.185***
	(0.228)	(0.105)	(0.419)	(0.221)	(0.322)	(0.128)
Note:						*p<0.1; **p<0.05; ***p<0.01

Chapter 6

Discussion

6.1 Indication of the main results

6.1.1 Interpretation of the results on Types of Authorities

The results from the analysis carried out in this study imply that there is a positive correlation between a procurement carried out by ministries or federal authorities, water energy, transport and telecommunications and national authorities and the procurement being green. The total amount of observations per authority differed greatly as demonstrated in the first part of the results section (Chapter 4) where the characteristics of the samples were demonstrated. Until now no studies with similar methodologies have been carried out to analyse which authorities procure more green than others in European Union. Therefore, the results are difficult to compare with the academic literature. However, there are some studies that have used different methodologies to analyse Green Public Procurement.

A key takeaway from the results is that regional or local authorities perform significantly worse on the uptake of Green Public Procurement compared to national or federal institutions. In the literature, some studies are performed on a support this hypothesis. For example, a local study on the use of environmental criteria in Spanish government found that national institutions are more likely to include these criteria than local authorities (Fuentes-Bargues, González-Cruz, and González-Gaya, 2017). A survey based on the uptake of Green Public Procurement in Norway concluded that in developed countries, environmental performance in public procurement is better in larger institutions because of the larger resources available (Michelsen and Boer, 2009). Additionally, a 2010 report by the IEEP (Institute European Environmental Policy) found that local and regional authorities did not reach the

target in Green Public Procurement uptake (Hjerp et al., 2010). They concluded that Green Public Procurement is greater at the national level because larger institutions have more economical and technical resources, and their employed are trained in environmental matters for assessing process. This justifies the development currently carried out by the European Institutions to create handbooks and toolkits so that every institution is able to include environmental criteria in the awarding process of the tender. The fact that local or regional procurement accounts for a great share of the total number of procurements underlines the fact that this is an important area for improvements. This room for improvement was also already identified by a report of the European Commission in 2017 (Neubauer et al., 2017). In this study it was concluded that there was far too little training or assistance for the implementation of Green Public Procurements for regional or local authorities. For smaller regional authorities it can be difficult to perform Green Public Procurement for every small tender with limitations such as personnel or knowledge within the authority. The creation of clear criteria alongside useful toolkits and handbooks is an efficient to increase the uptake by these smaller institutions.

At the national level, most countries in the European Union have now released GPP National Action Plans in which targets are set for the uptake of Green Public Procurement. These plans outline the actions and measures that have to be undertaken for the promotion of Green Public Procurement (EC, 2016). Furthermore, they include environmental criteria for the awarding process. However, these plans often rely heavily on life-cycle assessments (LCAs), which are very costly and time-consuming for smaller regional authorities. In order for regional or local to authorities the European Union, national governments and regional authorities must come up with plans more specified and accessible for smaller authorities who procure on a smaller level with less resources. Depending on the current level of uptake of the regional or local authority, targets could be set on a local or regional scale to promote both regions that already have a high uptake to perform even better, and for regions that have a low uptake to set more realistic targets. The GPP criteria set out by the commission should be easy to understand and to apply at regional or local levels. Table 5.3 gives more details on where this difference between national and regional or local authorities come from. It can be concluded that especially for the *Supplies* contracts the regional and local authorities are less likely to perform green. As was stated in the theory and confirmed in the results of this study, the *Supplies* contracts are more easy

to be green since they are often more flexible and contracts have a shorter time-span than *Services* or *Work* contracts. Therefore, environmental criteria for these types of contracts could be a logical first step to increase the uptake of GPP for regional or local authorities.

6.1.2 Interpretation of the results of the other variables

Regarding the Type of Procedure variable, *Open* procedures had generally positive values compared to the other types of procedures. This indicates that opening up the procurement to a wide range of bidders, promotes the inclusion of sustainable criteria in the awarding process compared to other procedure methods, according to the results of this study. Furthermore, although not widely observed in the data, the *Competitive Dialogue* type of procedure was clearly the most positively correlated procedure related to the reference group. Competitive dialogue is a relatively new type of procedure. The greatest differences compared to *Open* or *Restricted* procedures lies in the manner in which the request is made. According to the Dutch government is the "contracting authority uses the solution submitted by the candidates to conduct a dialogue that results in an optimisation of the request and offer." (Rijksoverheid, 2009). Based on the results of this study, *Competitive Dialogue* is an interesting option for contracting authorities to implement in their procurement policies surrounding environmental or sustainable objectives. However, it should be noticed that this type of awarding procedure is only possible in a very explicit circumstances depending on both the bidders and the procuring authority, and is therefore not widely applied in the procurement policies of countries. In Table 4.4 it is shown that *Competitive Dialogue* takes up less than 1% of the tenders in the samples.

The first part of the analysis showed the large number of French tenders in the sample, the limitations of this fact will be discussed later on. Due to this fact not a lot of hard conclusions can be drawn from the country analysis. Compared to France only the Netherlands and Germany had a positive co-efficient, which is also noted by other studies on this subject. These are countries that have been pioneering this subject for a longer time and have showed more interest than the other countries analysed in the data analysis. A positive correlation between the GDP per capita and the uptake of Green Public Procurement is found in the literature (Hsu and Zomer, 2014). This is true for the analysis of this study as well, since The Netherlands, France and Germany have higher GDPs per capita than for example Spain and Italy.

The distribution of the Main Activity of the procuring authority in the sample showed that *General services*, *Health* and *Other* categories were most present. This is in line with was found by a study of the European Commission based on the 2013 TED database (EC, 2017). This variable of the TED database could be revised, since of this data no real conclusions can be drawn since such a large share of the tenders is considered *General services* or *Other*. The large share of *Health and Social Protection* shows the enormous size of this sector, which is in line with the share of the sample of business sectors categories related to health, such as *Medical equipment*, as shown in Table 4.5. This variable of the TED database could use revision, since with the current large share of *General services* it is very difficult to draw conclusions. An option to choose of one of the 21 business sectors as described in the handbook of the European Commission could lead to results that are more easy to interpret.

Another good example of why these studies using quantitative analysis are important can be found in the differences per business sector. It is logical that the different sectors have different levels of importance in limiting their impact on the environment. In order to effectively make an impact with promoting Green Public Procurement, it is of great importance to look at sector where large gains can be made. For example, it is estimated that the *Construction* sector accounts for over 28% percent of the total emissions of governments (Chiappinelli, Gruner, and Weber, 2019). It is therefore important to notice that from our results that *Construction* was one of the poorest performing sectors. A fast implementation of Green Public Procurement in this area is necessary to limit impacts on the environment. It was expected that the *Environmental services* sector would have a positive correlation, however, the value for this sector is still low compared to the food sector, which surprisingly is a very well performing sector. That the food sector is a strong performer is in line with other studies on this topic (Cheng et al., 2018). This is an important and good development, since the food sector is an area that only in recent years has gotten increasing attention as an area where lots of emissions of the public sector could be avoided (Cerutti et al., 2016).

The involvement of Joint Procurement is positively related to the probability or odds of a procurement being green. This makes sense, since the benefits of Joint Procurement as indicated by the GPP Training Toolkit of the European Union are that it is "very effective way of encouraging the market for more environmentally sound products and services" (EC, 2019b). According to the GPP Training Toolkit, Northern European Countries are more developed in

Joint Procurement than Southern European Union countries. Guidance for Southern and Northern European countries to procure jointly could therefore be an excellent tool to increase in the number of Green Public Procurements in the whole of Europe. Additionally, the knowledge transferred in this process will stimulate Southern contracting authorities to procure more green themselves. The European Commission provides financial support for Public Procurement for Innovation (PPI) that is carried out by two different procurers from different Member States via the Horizon 2020 programme (EC, 2011).

The positive value for the size of the tenders, or the value, is in line with the results from the Type of Authority dummy variables. National or federal authorities are logically procuring tenders for larger values, making an increase in probability more likely. This must be taken into account when interpreting the results. That the size of procurement positively correlates is in line with what the literature has concluded (Yu, Morotomi, and Yu, 2020).

Based on Figures 4.7 and 4.8 and the Tables in Appendix B, it can be concluded that Green Public Procurement is more likely to be present in *Supplies* contracts than in *Services* contracts. This could be caused by the fact that *Supplies* generally tend to have contracts based on shorter time-spans and less flexibility. This makes it easier to measure green criteria in the awarding process. For *Services* contracts, it is more difficult to set criteria since the contracts are often for longer periods and the tender should be more flexible.

The TED database has proven to be a good tool in analyzing the characteristics and uptake of Green Public Procurement. This study has only looked into a few variables, but the TED database provides 64 variables which can be studied as well. There are limitless possibilities for researching a specific group or a specific type of Green Public Procurement when the data is analysed well. It provides more detail than qualitative research, since it is not dependent on how well questionnaires are filled out. Therefore, it is recommended that more studies with these methodology are carried out in the near future, provided that the limitations discussed in the next section are carefully considered.

6.2 Limitations

In this next section the reliability and validity of the results will be discussed. The result of study have some limitations which are important to consider

when interpreting the data.

6.2.1 Comparison with existent literature

Although the data of TED is not designed for analysing Green Public Procurements, it does have a sufficient number of variables to meet both requirements as mentioned in the methodology. However, there are some important limitations to take into account when interpreting. First, as mentioned before, a very limited number of studies have been published in the field of public procurement using quantitative methods. The studies that have been published are based on different temporal and geographical scopes, making it difficult to assess the results of these studies (Yu, Morotomi, and Yu, 2020). Therefore, this study cannot build on experiences from methodologies of studies already conducted or compare results. However, from published reports from the European Commission and some studies using similar methodologies it was possible to build on a methodology that was adjustable to the data available (EC, 2017; Yu, Morotomi, and Yu, 2020).

6.2.2 Differences per Member State

Secondly, the percentage of the total procurements per Member State. Although this study does not contain specific data on this, from previous studies it has become evident that the total share of procurements published in the TED database can range from 8 (The Netherlands) to 33 percent (United Kingdom) (EC, 2017). This is a limitation that is also present in this study. The total amount of tenders included in the database from France is over represented compared to the rest of the Member States. In Sample B, France takes up over half of the total number of tenders in the sample. On the other hand, countries such as Ireland and Austria only published a very limited number of tenders in the database. Although these are smaller countries than France, the distribution right now is not representative. A strong improvement is needed in the registration of all tenders in the database, so that the results of studies are more detailed and of a higher accuracy. This is supported by the study of Appolloni, Coppola, and Piga (2019). The rise trend in the total amount of tenders published by the TED database per year is already an indication that improvement is possible. However, some countries are still lacking behind quite significantly. Promoting an environment in which the tenders are well registered in the database could increase the percentage of tenders eligible for data analysis significantly.

6.2.3 Quality of the TED database

Thirdly, the detail of the data published in the database can vary greatly among member states and different types of authorities. This affects the reliability of the results. This is important to take into account when the different lists of keywords are discussed, as it can influence the number of Green Public Procurements found through this method. Tenders with a lot and detailed information published in the TED database will be easier to find through this method than tenders that are in essence sustainable but cannot be established as such based on the information available in the procuring documents. This can result in a large difference in the number of tenders per Member State, resulting in different levels of validity across the data. In order to make policy tailored per authority or sector, it will be essential that a detailed and clear database is available of all tenders for researchers and national or supranational organisations to analyse. To track the uptake of Green Public Procurement, more detailed information on how the environmental criteria are set should become available when a tender is registered in the database. With this extra variable, it will become far easier to indicate the Green Public Procurements and to perform quantitative analyses such as this study. Researchers and policy makers would then not anymore have to rely on questionnaires or keyword lists.

Chapter 7

Conclusion

7.1 Summary of the study

It has become clear that Green Public Procurement will play a large role for the European Union in achieving the net zero goals as set out in the Paris agreement. Green Public Procurement has the ability to reduce the impacts of the public sector as well as stir the private sector in using more sustainable or green practices. This leading role cannot be underestimated. This research focused on the types of authorities currently performing Green Public Procurement in Europe. The following research question was constructed:

- What types of contracting authorities within Europe are performing sustainable procurement?

A quantitative analysis was performed on the Tenders Electronic Database (TED) of the European Commission. The TED database records tenders in all countries of the European Union based on a great number of variables. Based on the Award Criteria variable this study determined whether a procurement qualified as a Green Public Procurement within the temporal and geographical scope of the study. Thereafter, with the other variables present in the database, an analysis is carried out to determine what authorities procure more green than others, what sectors and countries are performing well, which procedure is most beneficial for Green Public Procurement, the effect of Joint Procurement and the influence of the size of the procurement. With these variables, a logistical and probit regression analysis was done alongside a more basic analysis on variables that could not be included in the regression analysis.

7.2   Main conclusions

The results of the analysis on the types of authorities show that when a procurement is done by a national or federal authority, including water, energy or transport authorities, it increases the probability or odds of a procurement being green compared to the reference group. Regional or local authorities are less likely to procure green based on the tenders analysed. Of the types of procedures, the competitive dialogue is the best performing procedure along with the Open procedure. Germany, Austria and The Netherlands are more likely to procure green compared to the reference country France, while Italy and Ireland are the least likely to procure green. Of the Business Sectors, the food, furniture and environmental services sectors show positive correlations, while the construction, business service and architectural services sectors are less likely to procure green. The presence of Joint Procurement increases the likelihood of a procurement to be green, as well as an increase in the size of the procurement. Finally, this study found that supplies contracts are more likely to be green compared to services contracts. This study recommends that in order to limit the impacts of the public sector, more attention for regional or local procurement is necessary. Additionally, special attention is necessary for sectors such as the construction sector and supplies contracts, which takes up a large amount of the emissions but from this study it is clear that Green Public Procurement is not yet common practice. Joint Procurement is definitely a possible tool to increase the uptake of Green Public Procurement. With the help of this study, more direct promotion, toolkits or trainings can be developed directly impacting the authorities or sectors so that the right areas can be targeted.

7.3   Further research

This study proves that with a good database, it is very well possible to analyse the different variables of procurement. However, the quality of the TED database is sometimes still problematic. An increase in the quality of the information provided by the database could lead to a lot more and a lot better researches, report and studies on this topic. Additionally, a clearer indication of when a public procurement is green can lead to a better understanding of the characteristics of Green Public Procurement. Studies on determining Green Public Procurements are necessary so that clear vocabularies can be

developed. A development of clear award criteria templates would be a major improvement in the area of Green Public Procurement.

The range of variables in the TED database is very broad. This study serves as a general analysis into a lot of variables. Specific studies can be developed just focusing on one or two variables are possible to provide more detail. Additionally, certain groups, such as countries or business sectors could be sampled and analysed in more detail to provide details on the characteristics of this specific group. From databases such as the TED database, a plethora of quantitative methods are possible to zoom in on different areas of not only Green Public Procurement, but on all the characteristics of procurement in Europe. All in all, there is still a lot to information possible to be gained in order to increase the uptake of Green Public Procurement in the European Union.

Appendix A

CPV-codes for Industry Sectors

14—Mining, basic metals and related products

15—Food, beverages, tobacco and related products

16—Agricultural machinery

18—Clothing, footwear, luggage articles and accessories

19—Leather and textile fabrics, plastic and rubber materials

22—Printed matter and related products

24—Chemical products

30—Oce and computing machinery, equipment and supplies except furniture and software packages

31—Electrical machinery, apparatus, equipment and consumables; lighting

32—Radio, television, communication, telecommunication and related equipment

33—Medical equipments, pharmaceuticals and personal care products

34—Transport equipment and auxiliary products to transportation

35—Security, fire-fighting, police and defence equipment

37—Musical instruments, sport goods, games, toys, handicraft, art materials and accessories

38—Laboratory, optical and precision equipments (excl. glasses)

39—Furniture (incl. oce furniture), furnishings, domestic appliances (excl. lighting) and cleaning products

41—Collected and purified water

42—Industrial machinery

43—Machinery for mining, quarrying, construction equipment

44—Construction structures and materials; auxiliary products to construction (except electric apparatus)

45—Construction work

48—Software package and information systems

50—Repair and maintenance services

51—Installation services (except software)

55—Hotel, restaurant and retail trade services

60—Transport services (excl. Waste transport)

63—Supporting and auxiliary transport services; travel agencies services

64—Postal and telecommunications services

65—Public utilities

66—Financial and insurance services

70—Real estate services

71—Architectural, construction, engineering and inspection services

72—IT services: consulting, software development, Internet and support

73—Research and development services and related consultancy services

75—Administration, defence and social security services

76—Services related to the oil and gas industry

77—Agricultural, forestry, horticultural, aquacultural and apicultural services

79—Business services: law, marketing, consulting, recruitment, printing and security

80—Education and training services

85—Health and social work services

90—Sewage, refuse, cleaning and environmental services

92—Recreational, cultural and sporting services

98—Other community, social and personal services

Appendix B

Full regression results per Type of Contract

TABLE B.1: Regression results from the sample with solely the
tenders with services contracts.

	Dependent variable: GPP	
	logistic	*probit*
Type of Procuring Authority (ref: Other)		
Ministry or federal authority	−0.354*** (0.059)	−0.161*** (0.028)
Regional or local authority	−0.489*** (0.040)	−0.240*** (0.019)
Water, energy, transport	0.142 (0.115)	0.115** (0.055)
European Institutions	−4.113*** (0.711)	−1.698*** (0.237)
International Institutions	−10.827 (67.124)	−3.408 (18.242)
Body governed by public law	−0.493*** (0.046)	−0.218*** (0.021)
National	0.309* (0.169)	0.162** (0.081)
Regional	−0.445*** (0.097)	−0.208*** (0.046)
Type of Procedure (ref: AWP)		
Competitive Dialogue	0.236 (0.339)	0.153 (0.160)
Innovation Partnership	−9.990 (172.920)	−2.946 (47.280)
Negotiated with competition	−0.991*** (0.167)	−0.399*** (0.077)
Negotiated without competition	−0.869*** (0.312)	−0.375*** (0.139)
Open	−0.140 (0.150)	−0.028 (0.070)
Restricted	−0.777*** (0.169)	−0.315*** (0.078)
Country (ref: France)		
Austria	1.104*** (0.101)	0.496*** (0.052)
Belgium	0.907*** (0.078)	0.445*** (0.040)
Germany	0.559*** (0.047)	0.267*** (0.022)
Spain	0.913*** (0.050)	0.436*** (0.025)
Ireland	−2.318*** (0.320)	−0.863*** (0.105)
Italy	0.020 (0.089)	0.002 (0.041)
The Netherlands	1.109*** (0.058)	0.516*** (0.029)
United Kingdom	−0.557*** (0.077)	−0.215*** (0.032)
Business Sector (ref: Medical equipment)		
Food	0.286 (0.271)	0.142 (0.126)
Transport	0.641*** (0.191)	0.277*** (0.089)
Furniture	−0.096 (0.252)	−0.046 (0.116)
Construction	0.107 (0.186)	0.022 (0.085)
Architectural services	−0.703*** (0.173)	−0.327*** (0.079)
Business services	−0.692*** (0.172)	−0.302*** (0.079)
Environmental Services	0.580*** (0.169)	0.269*** (0.077)
Joint Procurement	0.233*** (0.078)	0.096*** (0.037)
log(Award Value in €)	0.002 (0.003)	0.003* (0.002)
Constant	−2.709*** (0.228)	−1.578*** (0.105)
Observations	107,871	107,871
Log Likelihood	−17,642.380	−17,665.370
Akaike Inf. Crit.	35,350.750	35,396.740
Note:		*p<0.1; **p<0.05; ***p<0.01

TABLE B.2: Regression results of the sample with solely the tenders with work contracts.

	Dependent variable: GPP	
	logistic	*probit*
Type of Procuring Authority (ref: Other)		
Ministry or federal authority	−0.171 (0.105)	−0.062 (0.047)
Regional or local authority	−0.423*** (0.057)	−0.222*** (0.025)
Water, energy, transport	0.275** (0.121)	0.103* (0.059)
European Institutions	−12.174 (186.698)	−3.785 (49.109)
International Institutions	−11.421 (207.625)	−3.284 (55.222)
Body governed by public law	−0.328*** (0.069)	−0.176*** (0.030)
National	−3.666*** (1.005)	−1.399*** (0.303)
Regional	−1.338*** (0.216)	−0.568*** (0.084)
Type of Procedure (ref: AWP)		
Competitive Dialogue	1.528*** (0.244)	0.764*** (0.116)
Innovation Partnership	−13.004 (162.209)	−4.275 (42.653)
Negotiated with competition	0.202 (0.186)	0.041 (0.077)
Negotiated without competition	−0.024 (0.349)	−0.090 (0.174)
Open	0.568*** (0.140)	0.208*** (0.054)
Restricted	−0.109 (0.175)	−0.134* (0.075)
Country (ref: France)		
Austria	0.981*** (0.104)	0.465*** (0.049)
Belgium	1.138*** (0.261)	0.542*** (0.128)
Germany	0.832*** (0.118)	0.413*** (0.054)
Spain	1.732*** (0.125)	0.848*** (0.066)
Ireland	0.965*** (0.291)	0.418*** (0.140)
Italy	1.090*** (0.144)	0.516*** (0.071)
The Netherlands	2.878*** (0.102)	1.452*** (0.056)
United Kingdom	0.677*** (0.090)	0.307*** (0.043)
Business Sector (ref: Medical equipment)		
Food	−12.704 (273.133)	−4.048 (71.875)
Transport	−1.211*** (0.448)	−0.641*** (0.236)
Furniture	−1.795*** (0.547)	−0.873*** (0.266)
Construction	−1.616*** (0.389)	−0.810*** (0.212)
Architectural services	−2.146*** (0.509)	−1.028*** (0.255)
Business services	−2.951*** (1.079)	−1.366*** (0.432)
Environmental Services	−1.815*** (0.473)	−0.879*** (0.243)
Joint Procurement	1.466*** (0.070)	0.699*** (0.035)
log(Award Value in €)	0.058*** (0.007)	0.024*** (0.003)
Constant	−3.148*** (0.419)	−1.560*** (0.221)
Observations	63,856	63,856
Log Likelihood	−8,382.599	−8,368.839
Akaike Inf. Crit.	16,831.200	16,803.680
Note:		*$p<0.1$; **$p<0.05$; ***$p<0.01$

TABLE B.3: Regression results from the regression analysis with
solely the tender with supplies contracts.

	Dependent variable: GPP	
	logistic	*probit*
Type of Procuring Authority (ref: Other)		
Ministry or federal authority	0.602*** (0.039)	0.341*** (0.022)
Regional or local authority	−0.543*** (0.031)	−0.272*** (0.016)
Water, energy, transport	0.238 (0.183)	0.192** (0.087)
European Institutions	−0.609 (0.604)	−0.294 (0.287)
International institutions	1.697*** (0.389)	0.968*** (0.240)
Body governed by public law	−0.288*** (0.029)	−0.150*** (0.015)
National	1.514*** (0.108)	0.861*** (0.064)
Regional	−0.935*** (0.110)	−0.432*** (0.050)
Type of Procedure (ref: AWP)		
Competitive Dialogue	0.870 (0.615)	0.362 (0.280)
Innovation Partnership	2.948*** (0.786)	1.444*** (0.454)
Negotiated with competition	0.796** (0.342)	0.292** (0.140)
Negotiated without competition	0.023 (0.404)	−0.030 (0.163)
Open	1.703*** (0.320)	0.751*** (0.127)
Restricted	1.320*** (0.342)	0.557*** (0.140)
Country (ref: France)		
Austria	−1.572*** (0.171)	−0.716*** (0.072)
Belgium	−0.745*** (0.073)	−0.354*** (0.035)
Germany	0.613*** (0.038)	0.330*** (0.020)
Spain	−0.753*** (0.043)	−0.357*** (0.021)
Ireland	−1.192*** (0.149)	−0.619*** (0.074)
Italy	−3.305*** (0.171)	−1.367*** (0.059)
The Netherlands	0.109 (0.076)	0.081** (0.039)
United Kingdom	−0.409*** (0.053)	−0.206*** (0.026)
Business Sector (ref: Medical equipment)		
Food	0.838*** (0.029)	0.452*** (0.016)
Transport	−0.119*** (0.038)	−0.047** (0.019)
Furniture	0.311*** (0.036)	0.173*** (0.019)
Construction	−0.223 (0.159)	−0.090 (0.076)
Architectural services	−2.317*** (0.508)	−0.981*** (0.190)
Business services	0.071 (0.137)	0.070 (0.069)
Environmental Services	−0.543*** (0.143)	−0.258*** (0.068)
Joint Procurement	−0.197*** (0.046)	−0.111*** (0.023)
log(Award Value in €)	0.039*** (0.003)	0.019*** (0.002)
Constant	−4.196*** (0.322)	−2.185*** (0.128)
Observations	108,763	108,763
Log Likelihood	−30,903.950	−30,905.780
Akaike Inf. Crit.	61,873.890	61,877.570
Note:		**p<0.1; **p<0.05; ***p<0.01*

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