

NEW GOVERNMENT CONSUMPTION STATISTICS: PURCHASES OF GOODS MEASURED BY ELECTRONIC INVOICES

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ABSTRACT

This study is focused on bridging the knowledge gap regarding the measurement of public purchases for foreign trade analysis in Brazil. It presents a methodology and results about the construction of new descriptive statistics on the consumption of goods by the government (Federal level, States and Municipalities) using Electronic Invoices - (NF-e).

The statistics were directly compiled in the category used in foreign trade goods transactions in Brazil: The Common Mercosur Nomenclature (NCM). The statistics reveal value and quantity purchased, average price, and coefficients on the participation of imported goods in the value of total government consumption, detailed for approximately 10,300 NCM codes.

The results of this exercise represent the most universal mapping of the governmental consumption of goods in Brazil, at its highest level of disaggregation. They created new managerial information that enhance transparency of government spending and also can be useful to public accounting and public policy analyses in general.

Keywords: Foreign Trade, International Negotiations; Government Procurement; Government consumption; Electronic Invoices.

JEL Classification: F13, H57 e H83.

1. INTRODUCTION

Measuring government accounts has always been a challenge for many sciences as well as a practical exercise for government managers in general. Primarily, it is relevant to express that this paper was inspired by a practical research problem. Based on the diagnosis of the existing knowledge gap regarding the measurement of public purchases for foreign trade analysis in Brazil, methodological solutions were developed to create new descriptive statistics on the consumption of goods by the government, including subnational levels.

Specifically, the practical matter that originally inspired our reflections refers to Brazilian engagement on international negotiations concerning government procurement. This practical issue became more relevant considering the recent announcement about the Brazilian government's intention to accede to the Government Procurement Agreement (GPA¹) of the World Trade Organization (WTO). The Agreement grants market access among its parties under non-discriminatory conditions related to public procurement of goods, services and construction services.

In this regard, the debate in Brazilian government about GPA accession throughout 2019 culminated in the approval of a negotiating mandate to formally start the accession process. This mandate was granted by the Commercial Strategy Council of the Chamber of Foreign Trade, at its meeting on December 16, 2019².

As a first step in fulfilling this mandate, the Brazilian government submitted its formal request of accession to the GPA, on May 19, 2020. Progress of the negotiations requires a number of steps to be accomplished. The first one concerns the provision of statistics on the country's purchasing market, followed by the presentation of its offer, in other words, the scope of purchases of goods, services and public construction services that will be covered by the non-discriminatory rules of the Agreement. Effective accession, however, will depend on the consensus approval of the Brazilian offer by the current members of the Government Procurement Agreement³.

¹ This paper will adopt the acronym for referring to this Agreement.

² As informed by Alcaraz *et al*; *O acordo de compras governamentais da Organização Mundial do Comércio e o pedido de adesão do Brasil*; Revista Brasileira de Comércio Exterior; Ano XXXIV, Nº 144, Julho, Agosto e Setembro de 2020, pp. 4-13.

³ At present, the Agreement comprises 48 World Trade Organization members.

The present study focused on the creation of new statistics related to government purchases of goods, in order to contribute to the accession process to the GPA. Our research provides new analytical tools that accurately describe the magnitude of the public purchasing market in Brazil, that figures among the largest purchase markets in the world. In addition, such measurement, based on the level of disaggregation obtained, as will be detailed in later chapters, may contribute to the formation of Brazilian negotiating position regarding the GPA offer.

In order to contribute to this exercise, we created a methodology to estimate government goods purchases using Electronic Invoices (NF-e), which development and results will be explained in this paper. It is important to point out that interinstitutional cooperation between public agencies and use of data science tools were essential in this process, as we will demonstrate throughout this article.

It should be noted that, due to the initial focus of the study, the statistics were constructed directly in the Mercosur⁴ Common Nomenclature (NCM), the reference for the classification of goods used by Brazil in its foreign trade transactions. The NCM, in turn, is based on the Harmonized Commodity Description and Coding System of the World Customs Organization (WCO). The Harmonized System, or HS, is the international classification in which commercial transactions of goods between countries are recorded.

It is relevant to emphasize, however, that the fruits of our methodology went beyond the initial scope of our research problem, so that we considered it proper to share the results of our study with academic and governmental community in general.

Based on the methodology developed, it was possible to calculate the first statistics on Brazilian government purchases of goods measured in NCM (value and quantity). It should be noted that, from the new statistics compiled we were able to estimate the average price of government goods purchases, as well as the coefficient of imported products on the value of purchases, both by NCM code. It is important to highlight the innovative character of such indicators, since they were never quantified in such level of disaggregation.

⁴ The founding members of the economic bloc are Argentina, Brazil, Paraguay and Uruguay, according to the 1991 Treaty of Asunción. Venezuela subsequently joined the regional integration scheme; however, it was suspended. Bolivia is in process of accession.

The constructed estimators have substantial relevance to the Brazilian government because they reflect and systematize the universe of public purchases, at different levels of aggregation. It is known that the records on public accounts and government consumption are systematized efficiently at the federal level in the Integrated Financial Administration System – SIAFI (Sistema Integrado de Administração Financeira). Nevertheless, the same scenario is not prevalent regarding subnational entities, which may not have records of their public purchases presented timely and harmonized.

Therefore, in addition to its applications from the perspective of foreign trade, the systemic merit of our study is its universal character in metrifying the government purchases in Brazil. In other words, through a unique methodology, it maps the totality of Brazilian governmental purchases of goods (Union, states, municipalities and public consortia) in the NCM code scale. Furthermore, the statistics are suitable for international comparisons at a very disaggregated product since they were constructed considering the Harmonized System of codification (about 5,300 codes), used globally for goods trade transactions.

The compiled statistics, as will be detailed in this paper, allow to map the universe of government purchases at the product level (NCM code) under different profiles: federative entity, government branch, origin of the merchandise and federation unit where the buyer entity is located. In the same level of disaggregation, it is also possible to calculate indicators on the average price of purchases by NCM code, as well as the coefficient of imported products on the total value of purchases.

Previous to this research, there were no descriptive statistics and coefficients in Brazil, which capture, in a concomitant and systematic way: (i) the totality of goods consumed by the government; (ii) detailed by different state entities; (iii) presented in such a level of product disaggregation as presented (about 10,300 NCM codes).

In addition to the innovative methodology, the multidisciplinary application of this study is evident. This research provides contributions to public accounting, in a general sense, since it can inspire reflections on refinements in the calculation of government consumption, from the perspective of national accounts. On the other hand, from the perspective of public accounting in a stricter sense, by measuring expenditure based on invoices emitted for the government with monthly granularity, our study provides food for thought to map government disbursement flows more accurately. Such

mapping, in fact, is connected with recent academic debates⁵ on current assets management in the public sector and constitutes primary data source to boost the discussion.

Moreover, regarding transparency issues, the publication of the methodology and results may be instrumental for government agencies from different government branches and federative entities, as well as to academic research in general. The results of our methodology constitute a complementary database to the official government consumption statistics and can be used as empirical evidence for academic and public policy analysis.

It should also be noted that the compiled statistics represent managerial information captured directly from pre-existing administrative governmental records, the Electronic Invoices. The consolidation, transformation and managerial use of such a mass of existing data demonstrates the practical relevance of this exercise, either by its direct application in Brazilian external negotiations, or in the possibility of improving public procurement policies by different government agencies.

Notably, as it presents estimators of the average price actually paid per product, our research can be useful, including, for future tenders and compliance procedures, particularly, in “painel de preço” modality. On this aspect, it can contribute both to internal auditing processes conducted by purchasing entities, as well as to external control, exercised fundamentally by the “Tribunal de Contas da União” (Federal Court of Accounts) and States and municipal courts of accounts.

Furthermore, the fruitful interinstitutional cooperation among government agencies, formal⁶ and informal, as well as the use of content developed by open data networks, stands out as a learning experience of this exercise. Such synergy is essential as a tool to promote innovation, as well as to improve formulation and evaluation of public policies. Therefore, submitting to public scrutiny our results in such cooperative schemes is also relevant from an institutional perspective, complementing the *stricto sensu* academic-scientific objectives of this inquiry.

Accordingly, apart from the strict contribution of the methodology and results obtained, this article seeks to inspire similar interinstitutional initiatives. Specially, it aims

⁵ See: NASCIMENTO, Luciano Moura Castro do; *Os Impactos da Edição do Decreto nº 9.428/2018 na Gestão das Disponibilidades de Caixa do Governo Federal*. XXIV Prêmio do Tesouro Nacional. Brasília, 2019.

⁶ It will be detailed in a specific section.

to encourage future cooperative initiatives with horizontal application in public policies that can spill over compartmentalized government offices.

In order to fulfill this objective, the details of our methodology are presented in chapter 2. The third chapter presents our results. Chapter 4 demonstrates the practical application of the new statistics in foreign trade field. Chapter 5 indicates the general applications of the compiled statistics, addresses their connection with other academic discussions and suggests a research agenda. In chapter 6, we present a brief conclusion. Finally, chapter 7 presents the bibliographical references.

2. A METHODOLOGY FOR ESTIMATING GOVERNMENT CONSUMPTION OF GOODS THROUGH ELECTRONIC INVOICES

Publicizing the way knowledge is constructed is perhaps the greatest virtue of scientific knowledge. Thus, this work presents special emphasis in this chapter, in order to present the practical steps and the technical-institutional means used to build this new methodology, which enabled estimating the government's consumption of goods through electronic invoices.

Therefore, firstly, we present the interinstitutional cooperation mechanisms that made feasible access to electronic invoices data (Nota Fiscal Eletrônica - NF-e). Then, we detail the methodology, as well as its limitations. Finally, we present some information about the data extractions carried out, as well as its processing that enabled the construction of the statistics and coefficients, which results are disclosed in chapter 3.

2.1. Data searching and the need for interinstitutional cooperation

The Brazilian Electronic Invoices (NF-e), due to their coverage level, represent an almost census picture of formal economic transactions carried out in the country. Thus, access to such administrative records represents an abundant instrument for scientific research, which can be applied in different public policies. In addition, it should be noted that Brazil stands out among countries considered world leaders in the use of electronic invoices⁷.

⁷ As pointed out by CORY, Nigel; *Why Countries Should Build an Interoperable Electronic Invoicing System Into WTO E-Commerce Negotiations*; Information Technology and Innovation Foundation (ITIF);

The first challenge overcome was obtaining access to the electronic invoice system database. The system was developed by the Special Secretariat of the Federal Revenue of Brazil (Secretaria Especial da Receita Federal do Brasil - SFRB), the Brazilian Tax Authority. Thus, this governmental agency was supposed to share subsets of data system to permit the progress of our inquiry.

The access was granted after convincing Federal Revenue officials that data requests and extractions derived from them would be operationalized in an aggregate manner, in order to preserve the fiscal confidentiality of organizations involved in transactions registered by electronic invoices.

After this convincing process, a cooperation agreement was signed between the Ministry of Industry, Foreign Trade and Services (MDIC) at that time and the Brazilian Tax Authority. The cooperation instrument was fundamental to carry out the data extractions to be shared⁸.

It is relevant to point out that previously to this exercise, the authors were engaged in another study regarding the use of electronic invoices to construct statistics. That study proved to be quite fruitful.

In the mentioned initiative, in 2019, the first Brazilian statistics about the value of national production sales were constructed directly in the NCM, using electronic invoices. Additionally, we calculated the apparent national consumption, the import penetration coefficient and the export coefficient for each tariff line, as stated in Technical Note SEI No 16857/2019/ME, 2019.

Therefore, it should be noted that the success of conducting that work inspired us to carry out the present exercise of measuring public purchases.

Thus, the question that guided our study was: how to measure government purchases (consumption) of goods in the most disaggregated way and in a way that is relevant to international negotiations on the subject?

The answers are presented in the following sections, revealing the steps to construct the new methodology.

2.2. The cooperation agreement for electronic invoice data access

março de 2020. Disponível em: <<https://itif.org/publications/2020/03/23/why-countries-should-build-interoperable-electronic-invoicing-system-wto-e>>. Acesso em: 30 ago. 2020 .

⁸ The cooperation agreement will be the subject of a later section.

Firstly, it is worth highlighting the legal-formal instrument that made feasible the access to data from electronic invoices (NF-e).

On December 7, 2018, the Ministry of Industry, Foreign Trade and Services (MDIC) and the Brazilian Federal Revenue Service (SRFB) signed a cooperation agreement that enabled aggregated data sharing from electronic invoices database. An extract of that agreement was published in the Federal Official Gazette on December 13, 2018.

We need to emphasize that the existence of disciplines which expressly circumscribed the scope of information sharing to aggregated data was fundamental for the successful conclusion of the agreement. Such kind of provisions, by mitigating risks concerning fiscal confidentiality, were crucial for the engagement of the SRFB in the initiative.

The aforementioned access to data would enable the MDIC to carry out studies on public policies under the responsibility of the Ministry, as, in fact, it has been happening through the work of its successor agencies.

The Special Secretariat for Foreign Trade and International Affairs (SECINT), as one of the successor bodies of the MDIC, carried out the necessary technical arrangements to operationalize the mentioned cooperation agreement with the National Tax Authority.

SECINT received data input on January 2020. From that, we were able to compile the first descriptive statistics on the consumption of goods⁹ by the Brazilian government in its foreign trade nomenclature.

Finally, it is worth mentioning the cooperative interinstitutional character of the exercise also inside SECINT, the tasks were carried out by members of the Technical Advisory Board of the Special Secretariat for Foreign Trade and International Affairs (ASTECC / SECINT) and the Foreign Trade Intelligence and Statistics Undersecretariat of the Foreign Trade Secretariat (SITEC / SECEX / SECINT).

2.3. The methodology for construction of the first Brazilian statistics on public purchases of goods by NCM code

⁹ In this article, the expressions “consumption of goods by government” and “government purchases of goods” are considered interchangeable.

As previously mentioned, the present study focused on mapping government purchases of goods, classified in the Common Mercosur Nomenclature (NCM).

Thus, in this section, firstly, it is worth presenting more information about the goods classification system referring to the NCM, as well as about the reasons for such cut at the product level. Then, the methodological limitations of the use of electronic invoices to estimate government consumption are explained. Subsequently, the estimators for government consumption are presented, followed by detailed information about the data extraction performed. At the end of the section, the operational processes used in handling the data that enabled its transformation into descriptive statistics and coefficients are briefly presented.

2.3.1. NCM and its registration on the Electronic Invoice

The Mercosur Common Nomenclature (NCM) is the classification system in which foreign trade operations of goods are registered in Brazil, as well as in the other countries of the South American Bloc.

NCM classifies traded goods in codes consisting of 8 digits and totalizes about 10,300 product codes.

The first six digits of NCM are based on the Harmonized Commodity Description and Coding System, or simply Harmonized System (HS), which is an international method for classifying goods from the World Customs Organization (WCO).

The HS was created to promote the development of international trade, as well as to improve the collection, comparison and analysis of statistics, particularly those of foreign trade¹⁰. The composition of the codes of the HS, formed by six digits makes feasible the classification of goods following a logical numerical order that takes into account the level of sophistication of the goods in ascending order. The HS contains about 5,300 codes.

In addition to these preliminary considerations, it is relevant to reflect on why we chose the NCM as a category to measure government purchases if they do not necessarily involve international goods transactions.

¹⁰ <http://www.mdic.gov.br/index.php/legislacao/9-assuntos/categ-comercio-exterior/343-certificado-form-13>. Accessed: September 15, 2020.

It turns out that the electronic invoice system has a particular characteristic that is instrumental in measuring Brazilian economic transactions in general, as well as analyzing them from the perspective of foreign trade. The NCM code is a regular field for filling in the Electronic Invoice form. This situation stems from the fact that the Brazilian tax system has a peculiar feature: the NCM classification is used to collect internal taxes also.

The collection of the Tax on Industrialized Products (Imposto sobre Produtos Industrializados - IPI) is carried out based on a NCM twin table, known as Tipi (Table of incidence of the Tax on Industrialized Products). It is necessary to clarify that the IPI is not charged on agricultural production without any processing. However, even in such a hypothesis, which includes a tiny portion of the amount of transactions, the need for administrative registration of this field inside the electronic invoice form remains.

In other words, by capturing the transactions of the national economy, electronic invoices not only represent a source of data for economic research in general, but also presents fundamental analytical utility for carrying out studies related to foreign trade, since, from them, it is possible to capture the NCM codification. Thus, from invoices, it is possible to compile statistics that use NCM directly as a category for product classification. Such statistics enable direct and disaggregated comparison between domestic and foreign market transactions in the same classification category.

Furthermore, as the NCM is codified based on the Harmonized System (HS), electronic invoices provide international comparability to compiled statistics in a very disaggregated level (about HS 5,300 codes).

Such practical applicability permeated the construction of government consumption statistics and coefficients by NCM code, in addition to the relevance of the level of disaggregation obtained, which describes about 10,300 goods codes (NCM).

2.3.2. Methodological limitations on the use of electronic invoices to estimate government consumption.

Considering that the classification of goods used to measure purchases was defined, as the next methodological step, it is necessary to define how to estimate government consumption through electronic invoices.

First of all, due to the legal requirements involved, it is important to highlight the formal nature of government purchases. From this perspective, the use of electronic invoices system as a database to compile statistics on government goods purchases is reasonable and plausible.

However, before the presentation of the estimators used, it is opportune to explain the methodological limitations of the government purchases statistics compiled. They do not capture government purchases that are not transacted by electronic invoices (NF-e). In this sense, sales made by Individual Microentrepreneurs (MEI) and rural producers not included in the National Register of Legal Entities (CNPJ) to government are underestimated. There is a risk of under-registration, because such operators are not require registering electronic invoices mandatory (they can still record their transactions in paper invoices).

It should be noted that in spite of the non-obligation, taxpayers who fall under the hypothesis mentioned in the previous paragraph are encouraged to adhere to the electronic system of invoices and, in fact, paper transactions are extremely residual.

Finally, it is necessary to express a caution note regarding the wide publicization of the compiled statistics at the maximum level of disaggregation achieved. As a general rule, government purchases are subject to active transparency mechanisms, according to the current legal system. Thus, there would be no inconvenience regarding the publication of data about the goods purchased for the vast majority of products. However, no prior filter was made on the subset of purchases that would not merit wide dissemination, as they can be safeguarded by security restrictions or national defense concerns. Thus, for this category of goods, it is recommended formal consultations to competent bodies before any disclosure of data.

2.3.3. Definition of estimators for government consumption

After addressing how the purchase of goods by the government will be coded and expressing the limitations of the methodology constructed, we are going to discuss in this section how to capture the purchasing entities within the scope of the electronic invoices system.

There is a field in the electronic invoice form to register the individual or legal entity for which the invoice is issued. Then, there is nothing more logical than using such a field to track the buyers, based on pre-existing government records.

Thus, as a parameter to measure government consumption we used a list from public entities from the National Register of Legal Entities (Cadastro Nacional de Pessoas Jurídicas - CNPJ) of SRFB database. The aforementioned list was obtained through a table made available by an open data network, and refers to the cadastral position on March 29, 2019.

Briefly, the content of the table reflects the list of CNPJ concerning the universe of public entities, classified in “code 1 – Public Administration” of Legal Nature Code (Código de Natureza Jurídica), classification of the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística - IBGE).

The Legal Nature Code identifies the juridical and institutional constitution of public and private entities in Brazilian public administration registers. Thus, the codes listed below, in 2018 version of IBGE Legal Nature Code Table¹¹, depict the government consumption.

Table 1 - Legal Nature Codes – Government consumption

Code	Description
1.	Public Administration
101-5	Public Body of the Federal Executive Branch
102-3	Public Body of States or the Federal District Executive Branch
103-1	Public Body of the Municipal Executive Branch
104-0	Public Body of the Federal Legislative Branch
105-8	Public Body of States or the Federal District Legislative Branch
106-6	Public Body of Municipal Legislative Branch
107-4	Public Body of the Federal Judiciary
108-2	Public Body of the State Judiciary
110-4	Federal Autarchy

¹¹ Information on the topic can be accessed on the Institute's website. <https://concla.ibge.gov.br/classificacoes/por-tema/organizacao-juridica/tabela-de-natureza-juridica.html>. Accessed: September 18, 2020.

111-2	States or Federal District Autarchy
112-0	Municipal Autarchy
113-9	Federal Public Foundation - Public Law Regime
114-7	States or Federal District Public Foundation - Public Law Regime
115-5	Municipal Public Foundation - Public Law Regime
116-3	Federal Autonomous Public Body
117-1	Autonomous States or Federal District Public Body
118-0	Municipal Autonomous Public Body
119-8	Polinational Commission
121-0	Public Consortium of Public Law (Public Association)
122-8	Public Consortium of Private Law
123-6	State or Federal District
124-4	Municipality
125-2	Federal Public Foundation - Private Law Regime
126-0	States or Federal District Public Foundation - Private Law Regime
127-9	Municipal Public Foundation - Private Law Regime
128-7	Public Fund of the Federal Indirect Administration
129-5	Public Fund of States or Federal District Indirect Administration
130-9	Public Fund for Indirect Municipal Administration
131-7	Public Fund of the Federal Direct Administration
132-5	Public Fund of States or Federal District Direct Administration
133-3	Public Fund of the Municipal Direct Administration
134-1	Union

It should be noted that no records were verified regarding code 134-1, Union, nor for 119-8, Polinational Commission, so that these codes were disregarded for the purposes of the aggregations in Table 2. Consequently, we categorized government entities based on the Legal Nature Codes in the following terms:

Table 2 - Aggregation of Public Administration Legal Nature Codes by Government Level

Government Level	Legal Nature Code
Federal Public Administration	101-5, 110-4, 113-9, 107-4, 116-3, 104-0, 131-7, 125-2 e 128-7
States and Federal District Public Administration	102-3, 111-2, 132-5, 114-7, 108-2, 123-6, 126-0, 105-8 e 117-1
Municipal Public Administration	124-4, 133-3, 103-1, 112-0, 115-5, 106-6, 127-9, 118-0 e 130-9
Public consortia	121-0 e 122-8

2.3.4. The data extraction executed

Since the scope of government entities was defined, we requested to SRFB a data extraction that reveals the invoices issued in favor of that CNPJ list, in the following terms:

Table 3 - Data extraction request

<p>Solicitation</p> <p>Filters:</p> <p>a) Month / year (from 2014 to 2019)</p> <p>b) List of CNPJs of Public Administration entities</p>
<p>Data / columns in the report</p> <p>a) Month / year;</p> <p>b) NCM;</p> <p>c) List of CNPJs of Public Administration entities</p> <p>d) Total Value of Products or Services, by NCM;</p> <p>e) Quantity of the product;</p> <p>f) “ICMS Normal e ST” field - Origin of goods;</p> <p>g) Federated unit of the consumer</p>

We requested in the report information about the aforementioned fields of the electronic invoices form, from 2014 to 2019¹². It is worth mentioning the particular solicitation of the registers about the field “ICMS Normal and ST”, which, according to the constructed methodology, was considered as a tracker¹³ of the goods origin. From this field, it was possible to calculate the coefficient of imported products on the value of government purchases.

From such extraction, the set of electronic invoices issued for the CNPJ list previously presented were considered the basis to calculate the purchases of goods. Thus, it was possible to calculate the first Brazilian statistics on government purchases compiled directly in the NCM (value and quantity).

Moreover, we calculated the average price of government purchases by NCM code, as well as the coefficient of imported products on the value of purchases, both indicators also unprecedented until the completion of this research.

2.3.5. Operational processes for data management

After the reception of such a mass of data provided by the Special Secretariat of the Federal Revenue, some processes were still necessary to convert that large volume of data into an analytical object.

Ideally, well-structured data enable simpler analysis process, with less effort¹⁴. Fortunately, the data provided by SRFB was extracted from information systems modeled for a standardized data collection, and this, in itself, ensured that the gross data were presented in a very organized manner, reducing cleaning and structuring efforts.

Thus, the operational challenge was fundamentally managing the volume of data in order to validate the structure of the information, clean up any discrepancies, make minor adjustments and carry out the exploratory analysis itself. At the end of this process, we were able to generate graphs and synthetic reports reflecting the main cutouts to organize information.

For this operational effort, R software was used, an open source project of statistical programming language. It is a free tool, widely used in data analysis and

¹² For 2019, the data provided refer to the period up to November.

¹³ Codes 0, 3, 4, 5 and 8 refer to national goods and codes 2, 6 and 7 to foreign origin goods.

¹⁴ As discussed by WICKHAM, Hadley; Tidy Data; Journal of Statistical Software; 2014. <https://vita.had.co.nz/papers/tidy-data.pdf>. Accessed: September 18, 2020.

capable of handling large volumes of information in a very flexible way, from the initial handling of gross data to the preparation of graphs and reports.

Six data files were received, separated per year, covering from January 2014 to November 2019, totaling 4.04 Gigabytes. In total, the files recorded 31,357,250 observations. The highest level of detail available in the archives includes 8 variables - Year, Month, NCM, Legal Nature Code, Origin of Merchandise, Federation Unit of the consumer, Value in Reais, Quantity commercialized.

The original data set presented variables with standardized textual content, namely: Legal Nature, Origin of Merchandise and Federation Unit. In order to consolidate the bases to facilitate later handling in future works, the standardized textual variables were converted into numeric codes. This procedure made feasible the base consolidation in a reduced size, without loss of information.

For Legal Nature, the codes themselves were maintained, excluding descriptions. For Merchandise Origin, as there was originally no natural code to identify each occurrence, the following correspondences were defined:

Table 4 - Correspondence for calculating the origin of goods

Codes on consolidated basis	Original textual information
1	FOREIGN - PURCHASED IN THE INTERNAL MARKET, EXCEPT AS INDICATED IN CODE 7
2	FOREIGN - PURCHASED IN THE INTERNAL MARKET, WITHOUT NATIONAL SIMILAR CAMEX LIST AND NATURAL GAS
3	FOREIGN - DIRECT IMPORTATION, EXCEPT AS INDICATED IN CODE
4	FOREIGN - DIRECT IMPORT, WITHOUT NATIONAL SIMILAR IN LIST OF CAMEX AND GAS NATURAL
5	NATIONAL, WHOSE PRODUCTION HAS BEEN DONE IN ACCORDANCE WITH THE BASIC PRODUCTIVE PROCESSES THAT TREAT THE LEGISLATIONS CITED IN THE ADJUSTMENTS
6	NATIONAL, EXCEPT AS INDICATED IN CODES 3, 4, 5 AND 8

7	NATIONAL, MERCHANDISE OR GOOD WITH IMPORT CONTENT LOWER OR EQUAL TO 40%
8	NATIONAL, MERCHANDISES OR GOODS WITH IMPORT CONTENT MORE THAN 40% AND LESS THAN OR EQUAL TO 70%
9	NATIONAL, MERCHANDISES OR GOODS WITH IMPORT CONTENT MORE THAN 70%

After these considerations, it is necessary to point out that there were 34,244 observations whose information on the Origin of Merchandise was empty, a residual amount compared to the total number of observations: about 1% of registers. For these cases, code 99 was assigned, meaning “No Information”. The records have not been discarded.

Concerning the variable Federation Unit, we decided to keep the original 2-digit acronym, as there would be no room gain in changing it for a numerical code. Regarding the NCM codes, a small cleaning was done by removing the punctuation to spare some characters in order to facilitate future work on crossings the new databased constructed with the available foreign trade databases, which typically use NCM coding without punctuation.

The databases were consolidated in “csv” format, maintaining essentially the same information, but reaching a total size of 1.67 Gigabytes and the same number of lines.

This restructuring and initial verification of the available information made exploratory analyses possible in a simpler and faster manner. In the next chapter, some of our results will be presented.

3. SUMMARY OF RESULTS

In this chapter, we are going to present the tangible results delivered to Public Administration, as well as graphic summaries of the compiled statistics. At the end of the chapter, we exemplify the level of disaggregation obtained through an illustrative case.

3.1. Deliveries to Public Administration

As a result of the work carried out, the following products were delivered to the Special Secretariat for Foreign Trade (SECINT) of the Ministry of Economy:

- **Methodological Note on the statistics compiled.** The Note is registered in the Electronic Information System – SEI and presents the methodology created, discussed in the previous Chapter.
- **Clean and validated database for advanced use.** The base includes information at its highest level of disaggregation.
- **Dynamic spreadsheet of statistics and constructed coefficients.** Enables simplified access to statistics at the NCM level, including some other aggregated variables and calculated coefficients.
- **Exploratory graphic reports.** The reports enabled a synthetic visualization of the purchases mapped, by different levels, categories and monthly granularity.

It is necessary to highlight that, as our work was carried out by formal and informal cooperative processes, for coherence, and considering the intention of improvements in public policies, we recommended sharing its results with other government agencies that can apply them.

As a first effort towards this goal, the results of our research were shared with the Brazilian Institute of Geography and Statistics (IBGE), notably the area responsible for National Accounts. The IBGE office has been conducting studies for instrumentalizing electronic invoice (NF-e) in statistical analysis, in similar a manner that we have done.

3.2. Graphical summary of results

In this section, we present the aggregated results for the consumption of goods by the government, including detailed informed for the federal, state and municipal levels.

In addition to the graphic summary, we present tables with information about the top products purchased, detailed by federative level, at the NCM scale.

It should be noted that, to illustrate the statistical profile obtained at the state level, graphs and an analogous table revealing the top products consumed will be presented for São Paulo state. Statistics in the same analytical cut was compiled for the other states and the Federal District.

We consider that the main contribution of our study to Brazilian science and public policy analysis refers to the descriptive power of the statistics and coefficients constructed, as well as the publicization of the methodology that made them feasible. Therefore, the focus of the next section will be the graphic synthesis of our innovative results, sparingly permeated by some analytical comments.

Nevertheless, we encourage future research and analysis based on the statistics compiled, as well as further academic debate on this matter, as it will be discussed in chapter 5.

3.2.1. Consumption of goods by the Brazilian government¹⁵

The information presented in this subsection refers to the sum of goods purchased by Public Administration (Federal government, States and Federal District, Municipalities, and public consortia), as categorized in Table 2 of this paper.

Figure 1 - Annual historical series¹⁶ - Government consumption of goods estimated through Electronic Invoices (NF-e): Value R\$

¹⁵ Excluding state-owned companies and mixed-capital companies. The same applies to the data and graphs presented in the subsequent subsections.

¹⁶ For 2019, the information presented in this chapter consolidates data up to November 2019. We should remark that it is possible to present the historical series with monthly granularity and in dynamic graphs. However, we opted to represent them on an annual basis, for the purpose of better visualization in the format of this article.

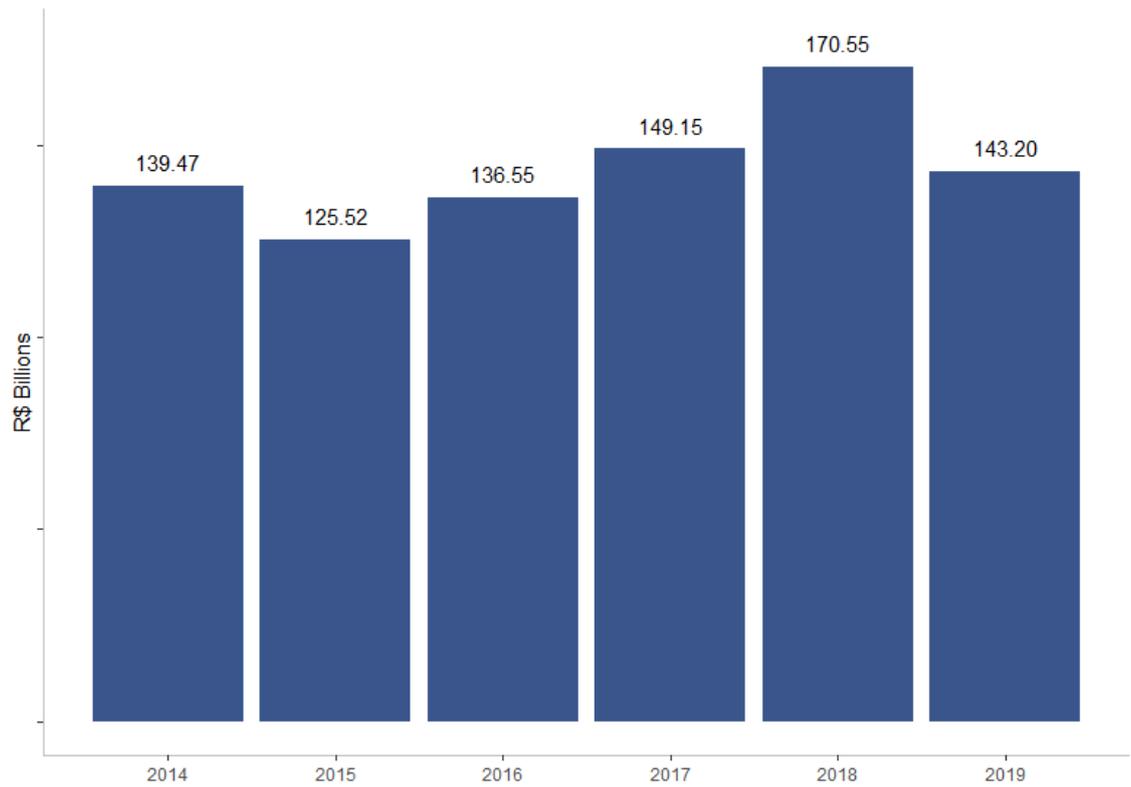


Figure 2 - Origin of goods purchased by Brazilian government: Value R\$

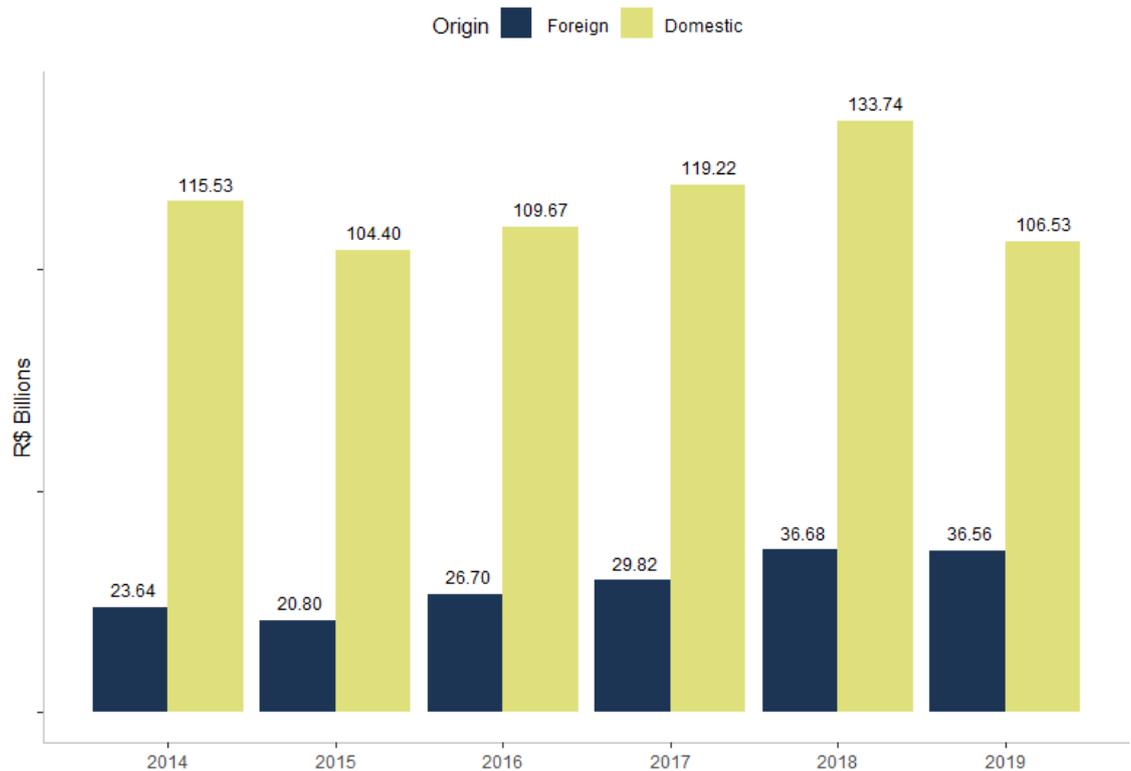


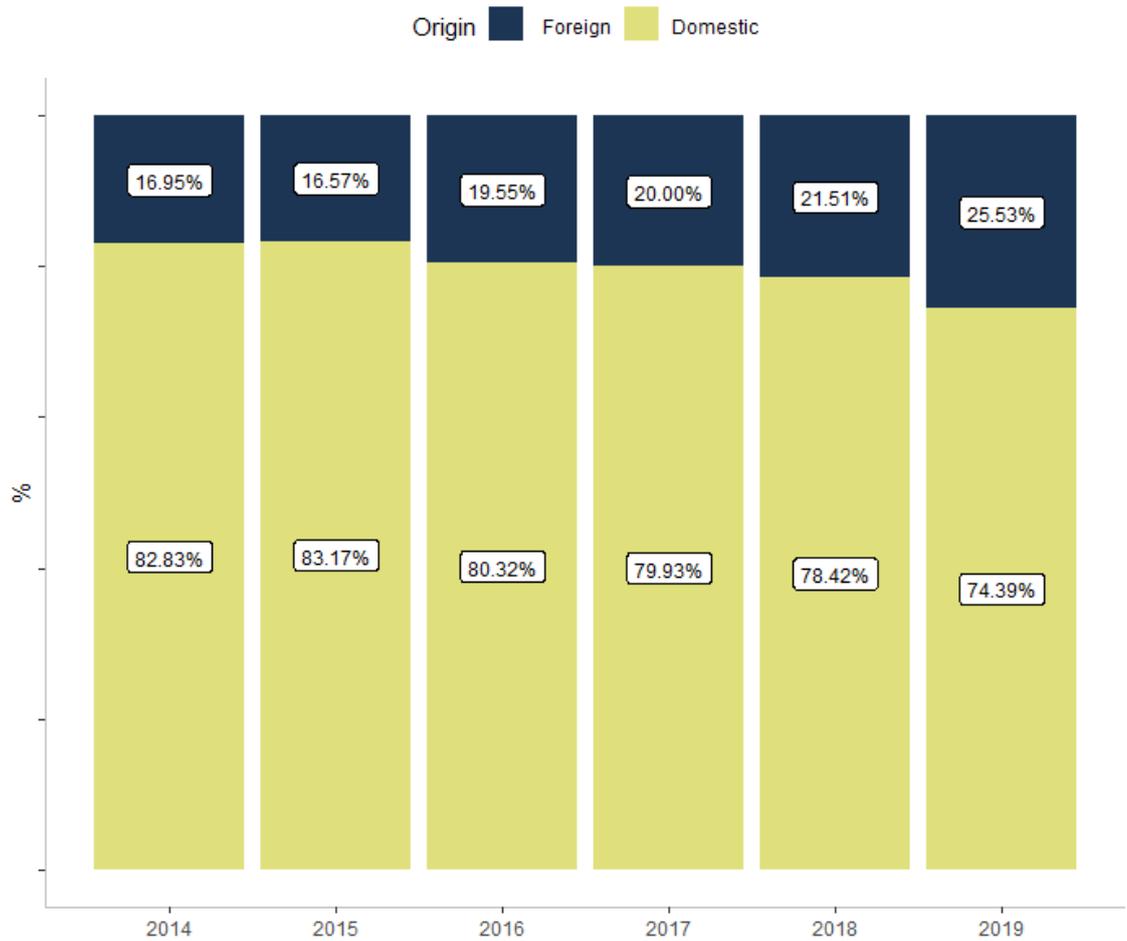
Figure 3 - Share by origin of Brazilian government goods purchases

Figure 4 - Share by government level in total government consumption:
2018


Figure 5 - Origin of goods purchased by government level: R\$, 2018

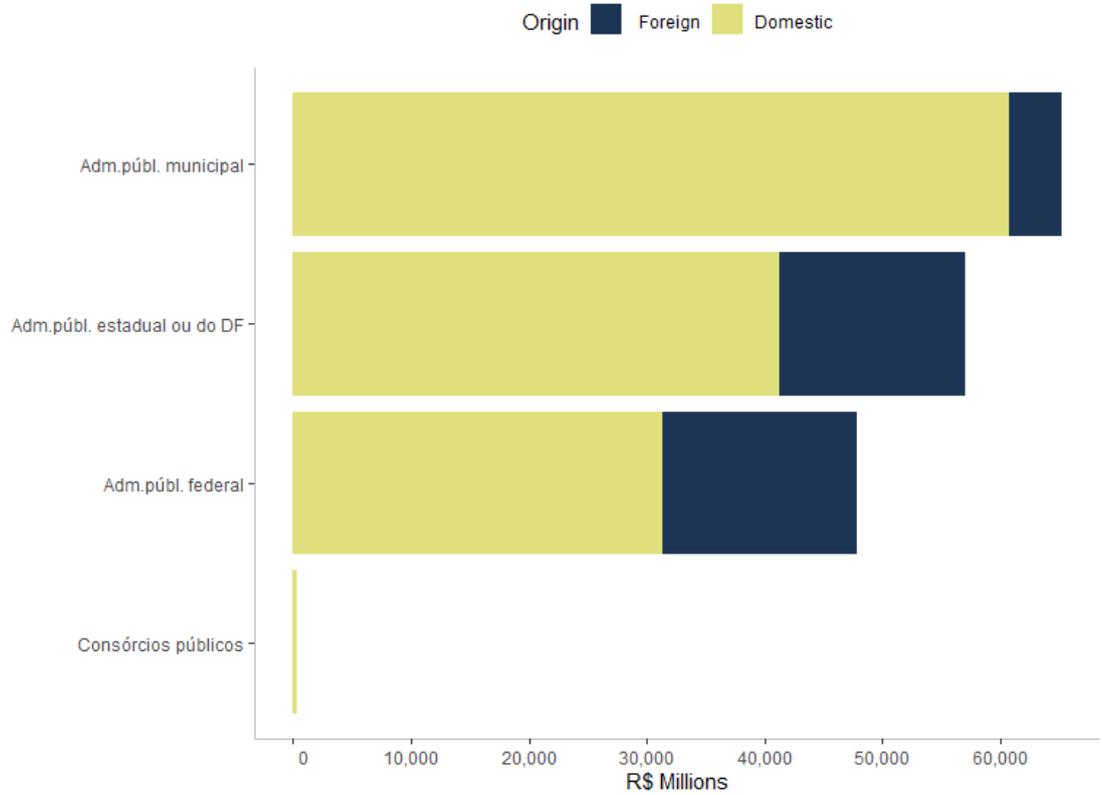


Figure 6 - Brazilian government consumption by place of purchase - 2018

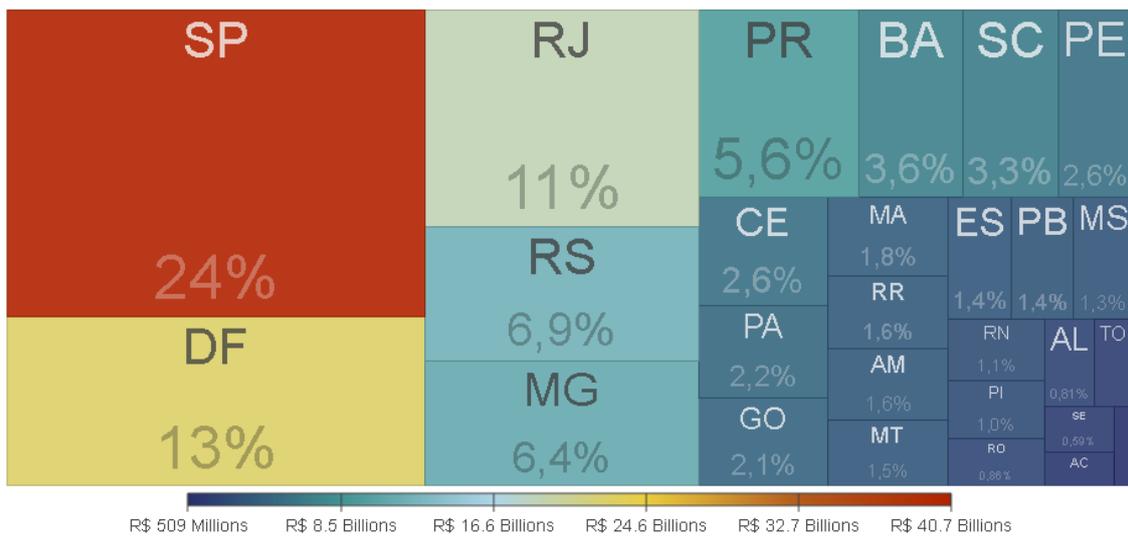


Figure 7 - Consumption of Brazilian government, by origin and place of purchase – 2018

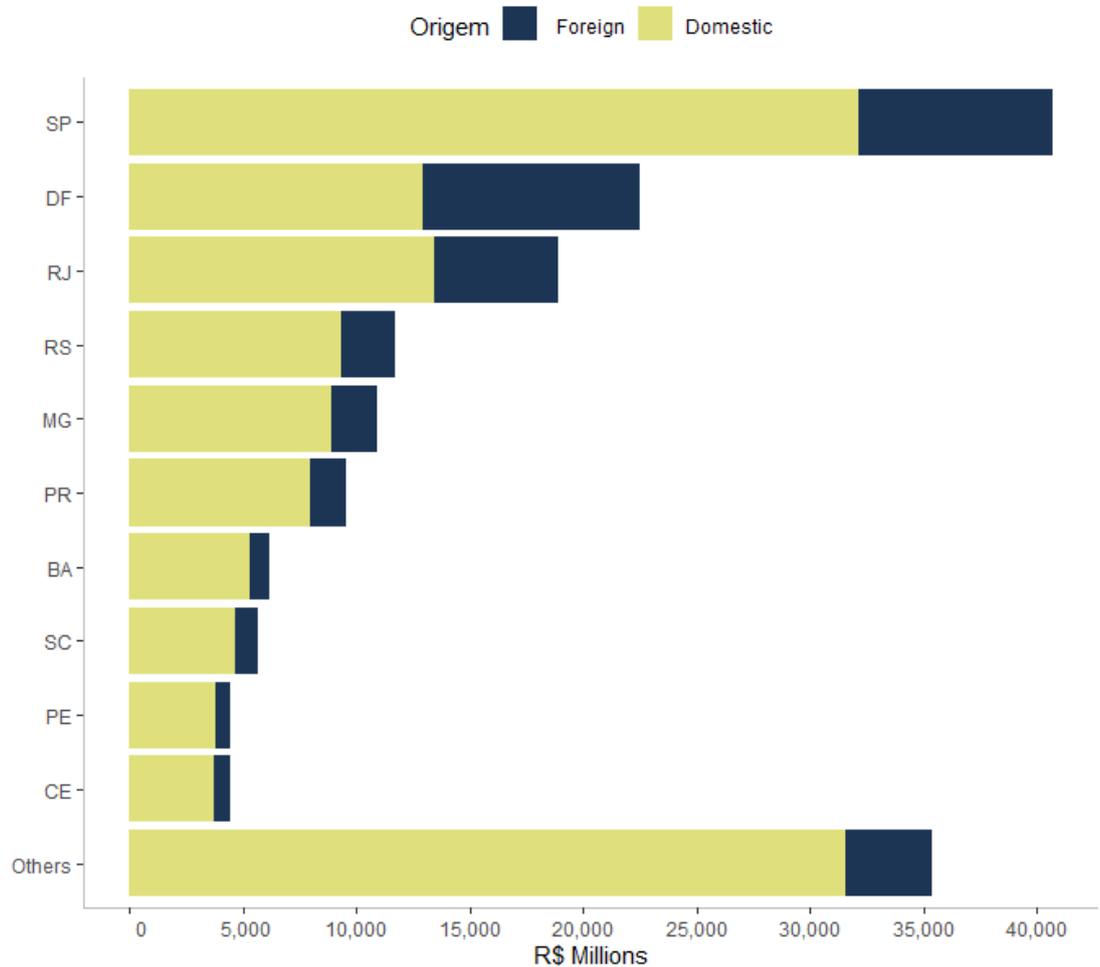


Table 5 – Top 10 consumed goods by Brazilian government - 2018

NCM	Description	R\$ Value (million)	Quantity (million)	Price (R\$/Qty.)	Imported coefficient (%)
30049099	Oth.medicament cont.prod.for therapeutic uses, etc.doses	10,265.50	3,884.57	2.64	5.07
21069090	Other food preparations	6,388.87	2,425.43	2.63	4.24
27101921	Diesel oil	4,631.12	1,304.94	3.55	0.13
49019900	Oth.printed books, brochures and similar printed	4,408.28	939.57	4.69	0.39
30022029	Other vaccines for human medicine, in doses	4,272.77	71.90	59.42	10.49
30021520	Basiliximab (DCI); bevacizumab (DCI); daclizumab (DCI); etanercept (DCI); gemtuzumab ozogamicin (DCI); oprelvekin (DCI); rituximab (DCI); trastuzumab (DCI)	4,034.06	3.49	1,154.45	97.65
30021590	Other immunological products, in measured doses or put up for retail sale	3,854.02	17.30	222.79	89.14
69041000	Ceramic bricks	3,731.40	107.87	34.59	0.00
30049069	Ot.medicaments c/comp.heterocyc.heteroat.nitr.in doses	2,748.02	5,150.89	0.53	36.21
90211020	Articles and fracture appliances	2,585.03	24.14	107.10	52.81

It should be noted that the table can be easily presented for the universe of purchased goods, classified in the approximately 10,300 NCM codes, year by year, or month by month, since 2014. Thus, the statistics capture also the variation of the total consumed by the government monthly, movements in prices of goods and in the coefficients of imported goods in relation to the total purchases.

Such a picture sets up the most detailed and universal systematization on the consumption of goods by the government and has direct application in Brazilian trade negotiation, since they are directly classified in the NCM. Besides, by their disaggregation scale, the statistics compiled can be used for a range of economic studies on government procurement policy.

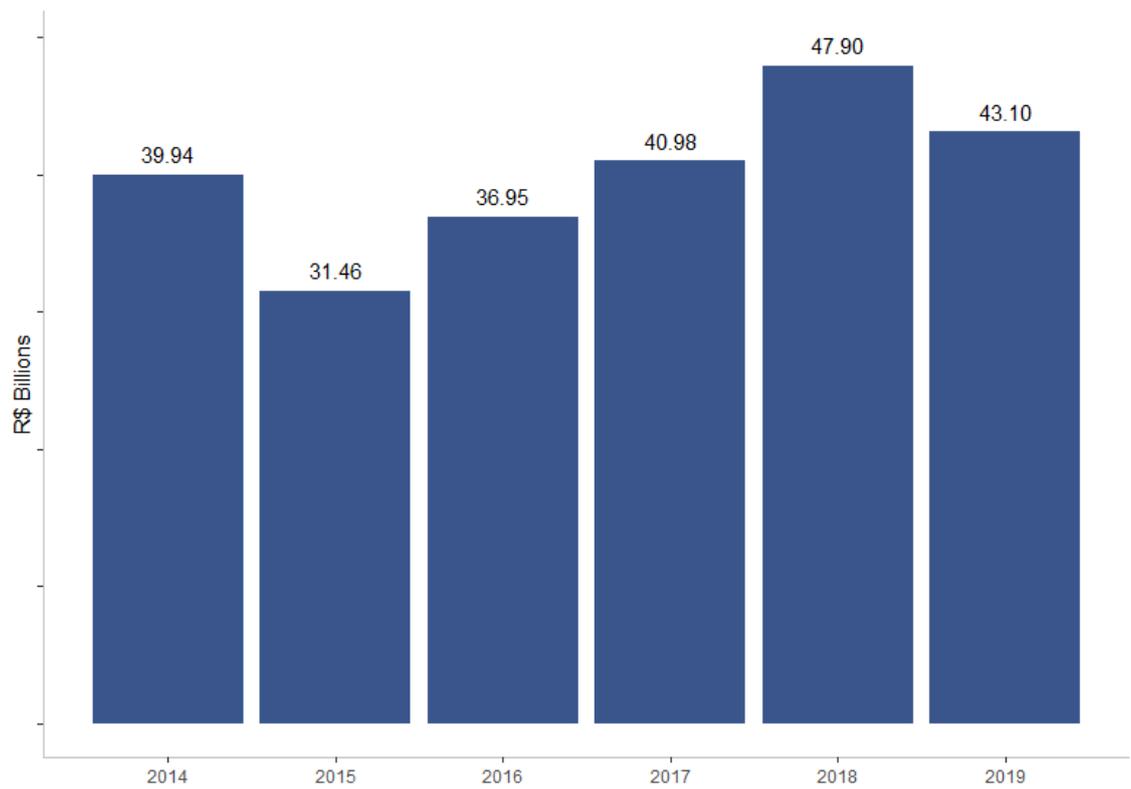
In few words, from the analyses of Table 5 it is evident that the share of imported goods regarding the codes 30021520 and 30021590, at levels of 97.65% and 89.14%, respectively, demonstrates the strong importation dependence on supply of immunological products and medicines with high technological content, classified in that NCM codes.

Finally, we can infer that there is a strong concentration of purchases in the health sector (NCM codes 30049099, 30022099, 30021520, 30021590, 30049069, 90211020). The education sector is represented by NCM codes 49019900 (textbook) and 21069090 (school lunch). It is also remarkable the presence of diesel oil in the list, NCM 2710192,

consumed in general transportation, as well as bricks, NCM 69041000, widely used in public works.

3.2.2. Consumption of goods by the Federal Public Administration

Figure 8 - Annual historical series - Consumption of goods by the Federal Public Administration estimated through electronic invoices: Value R\$



**Figure 9 - Origin of goods purchased by the Federal Public Administration:
Value R\$**

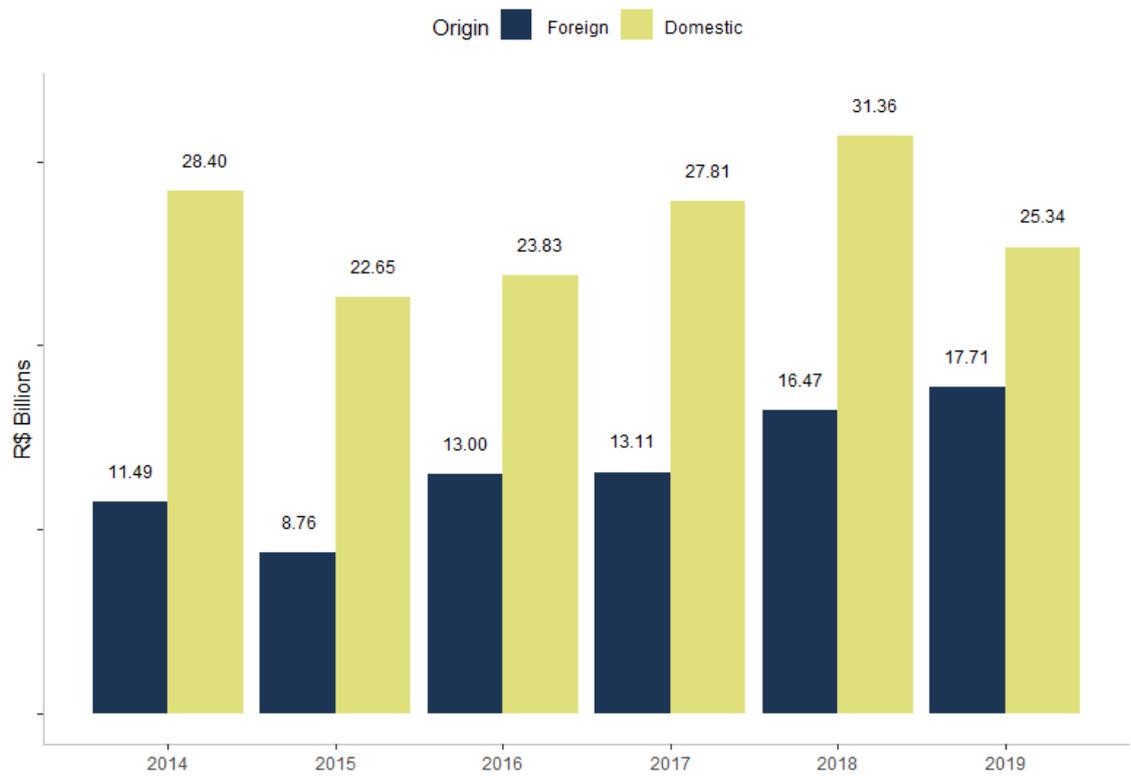


Figure 10 - Share by origin of the Federal Public Administration goods purchases

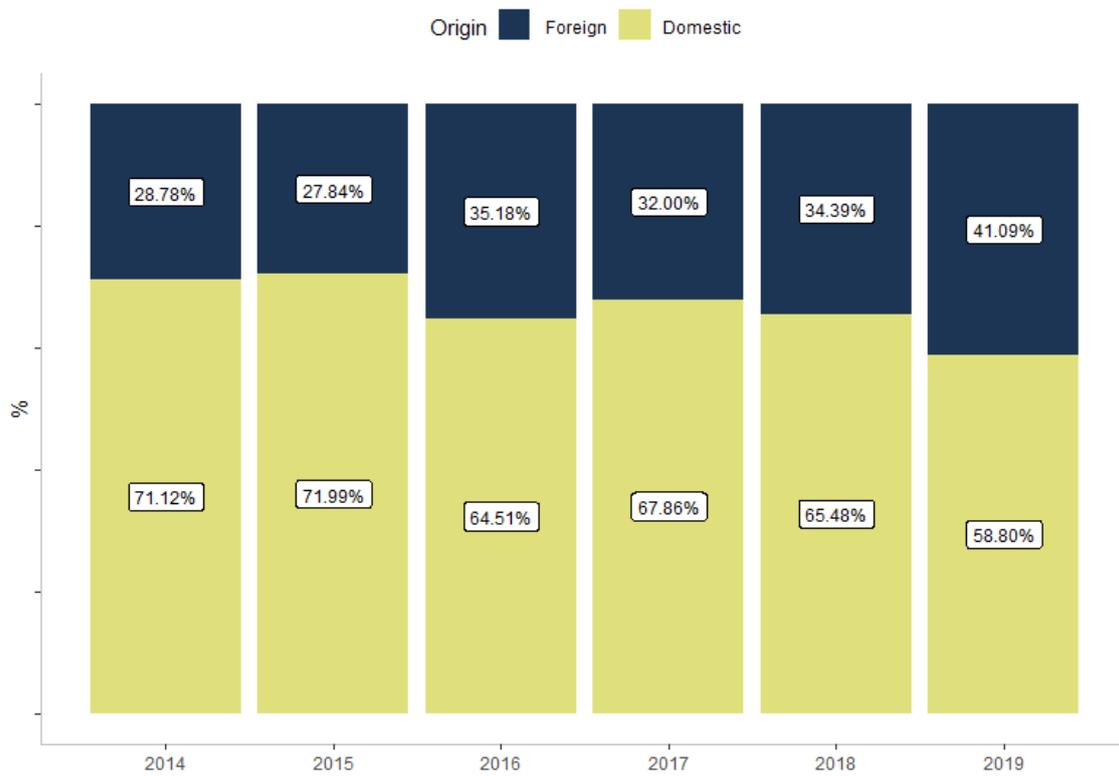


Figure 11 – Top 15 Chapters (NCM in two digits) – Consumption of goods by the Federal Public Administration, by origin – 2018

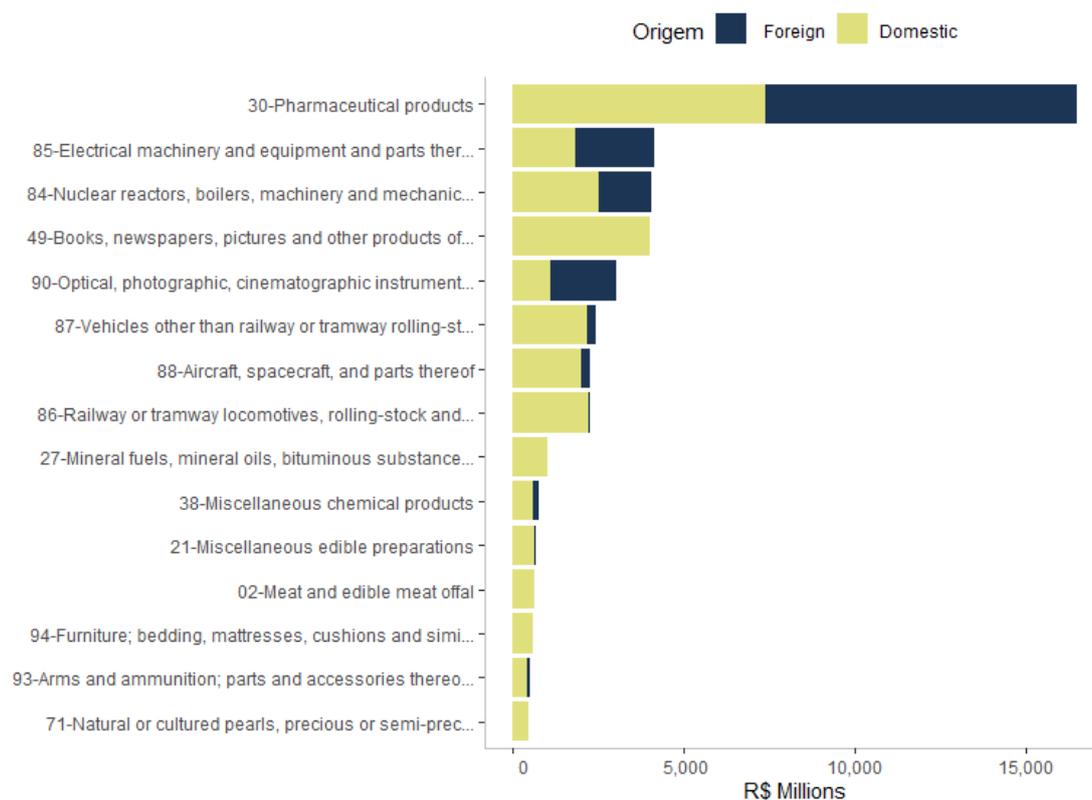


Table 6 – Top 10 consumed goods by the Federal Public Administration - 2018

NCM	Description	R\$ Value (million)	Quantity (million)	Price (R\$/Qty.)	Imported coefficient (%)
30022029	Other vaccines for human medicine, in doses	4,054.00	70.39	57.60	10.87
49019900	Oth.printed books, brochures and similar printed	2,595.12	351.08	7.39	0.13
30021590	Other immunological products, in measured doses or put up for retail sale	2,285.87	4.52	505.71	89.01
86090000	Containers includ.the transport of fluids,etc.	2,229.94	0.00	463,797.78	0.14
30021520	Basiliximab (DCI); bevacizumab (DCI); daclizumab (DCI); etanercept (DCI); gemtuzumab ozogamicin (DCI); oprelvekin (DCI); rituximab (DCI); trastuzumab (DCI)	2,096.41	1.05	2,003.92	98.82
30021239	Other fractions of blood, prepared as medicines	876.95	1.37	640.89	95.07
30049019	Medicament containing enzymes, in doses	865.03	0.34	2,552.65	99.77
30049079	Medicament c/compounds heterocyclic, etc.in doses	839.16	66.89	12.55	49.50
30049069	Ot.medicaments c/comp.heterocyc.heteroat.nitr.in doses	750.37	200.26	3.75	45.60
38220090	Other diagnostic or laboratory reagents	655.26	39.89	16.43	26.75

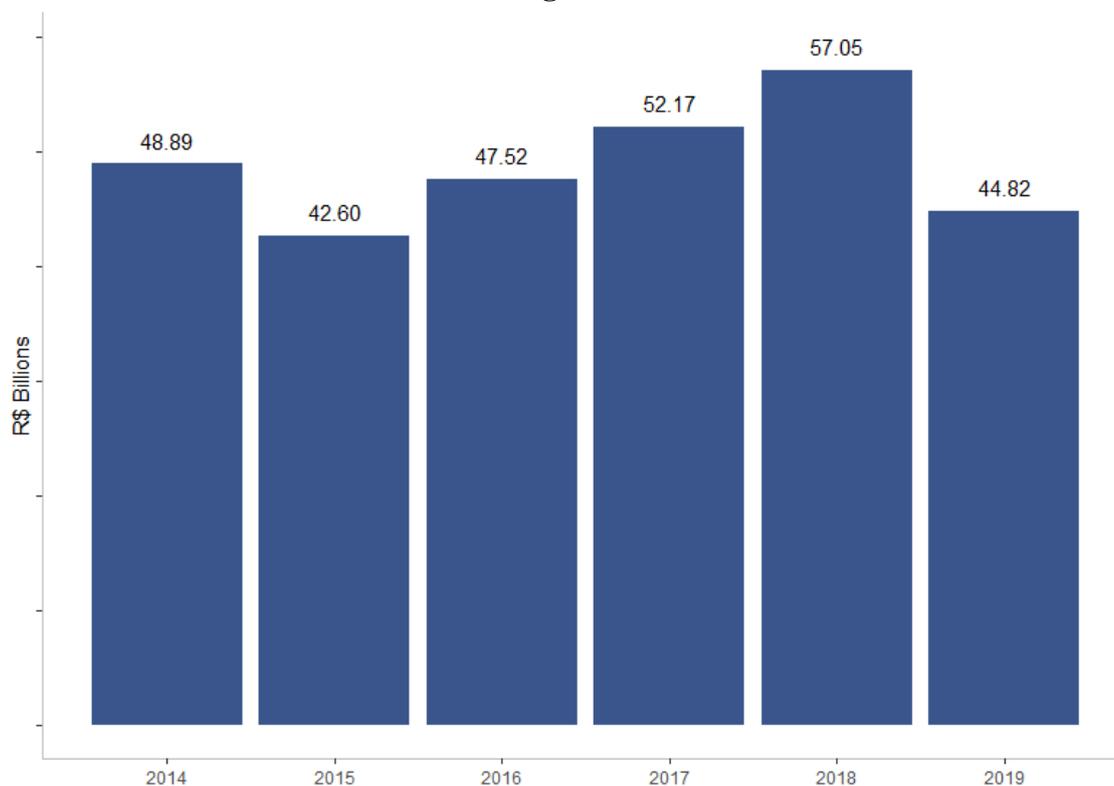
We reiterate that the table about the top ranked products purchased by the Federal Public Administration can be easily presented for the universe of goods purchased by this

government entity, classified in the approximately 10,300 NCM codes, year by year, or month by month, since 2014¹⁷.

In addition, when analyzing the purchasing profile in the period, it can be seen that the federal government is the entity that most supplies itself with imported goods, about 34%, in 2018.

3.2.3. Consumption of goods by States and Federal District (DF) Public Administration

Figure 12 - Annual historical series - Consumption of goods by States and DF Public Administration estimated through electronic invoices: Value R\$



¹⁷ The same observation is valid for the tables that will be presented in the following subsections.

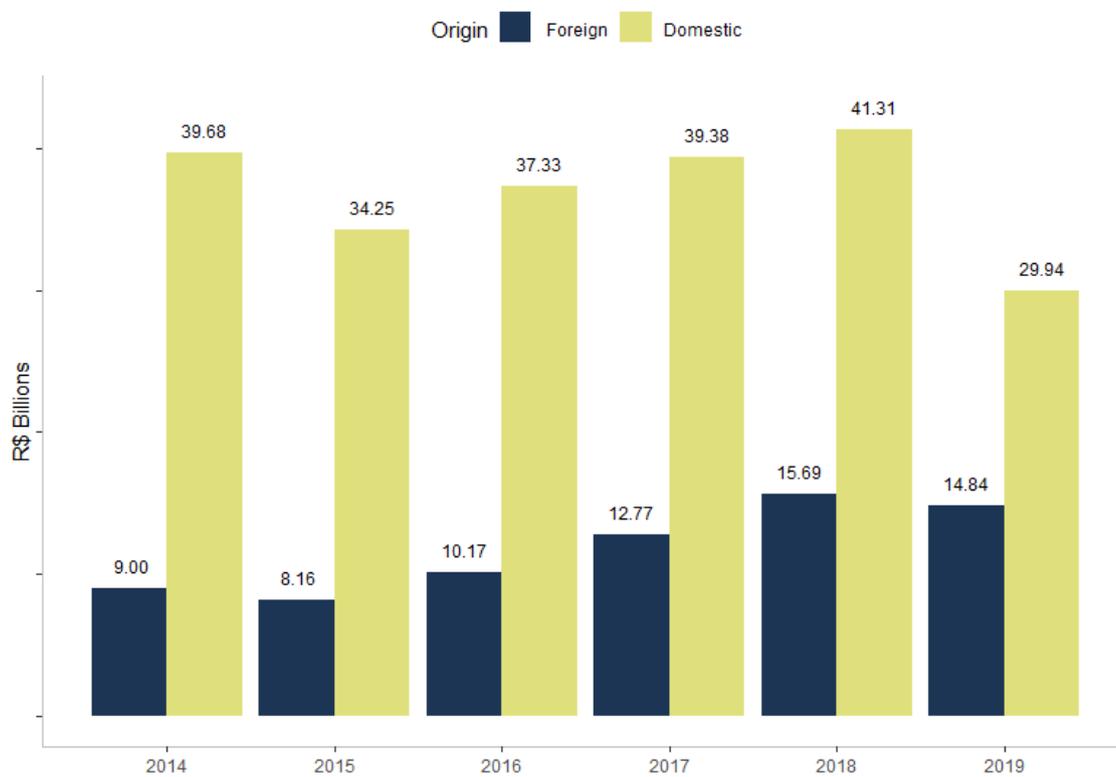
Figure 13 - Origin of goods purchased by States and DF Public**Administration: Value R\$**

Figure 14 - Share by origin of State and DF Public Administration goods purchases

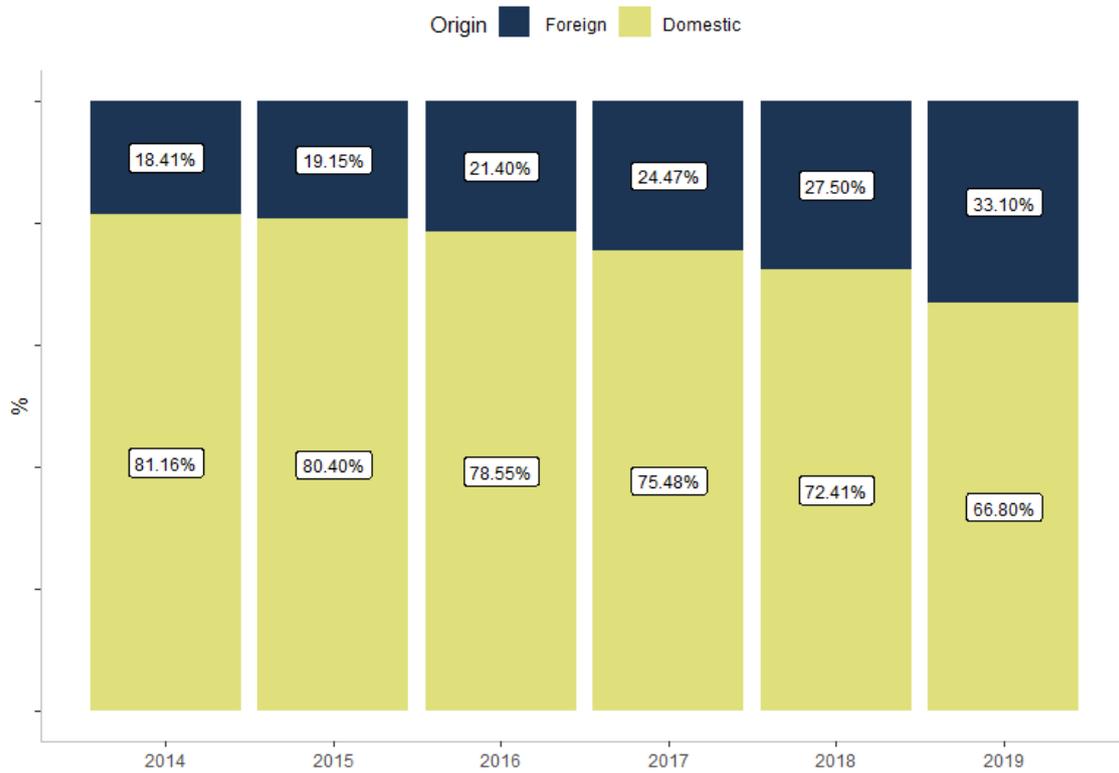


Figure 15 - Top 15 Chapters (NCM in two digits) – Consumption of goods by States and DF Public Administration, by origin – 2018

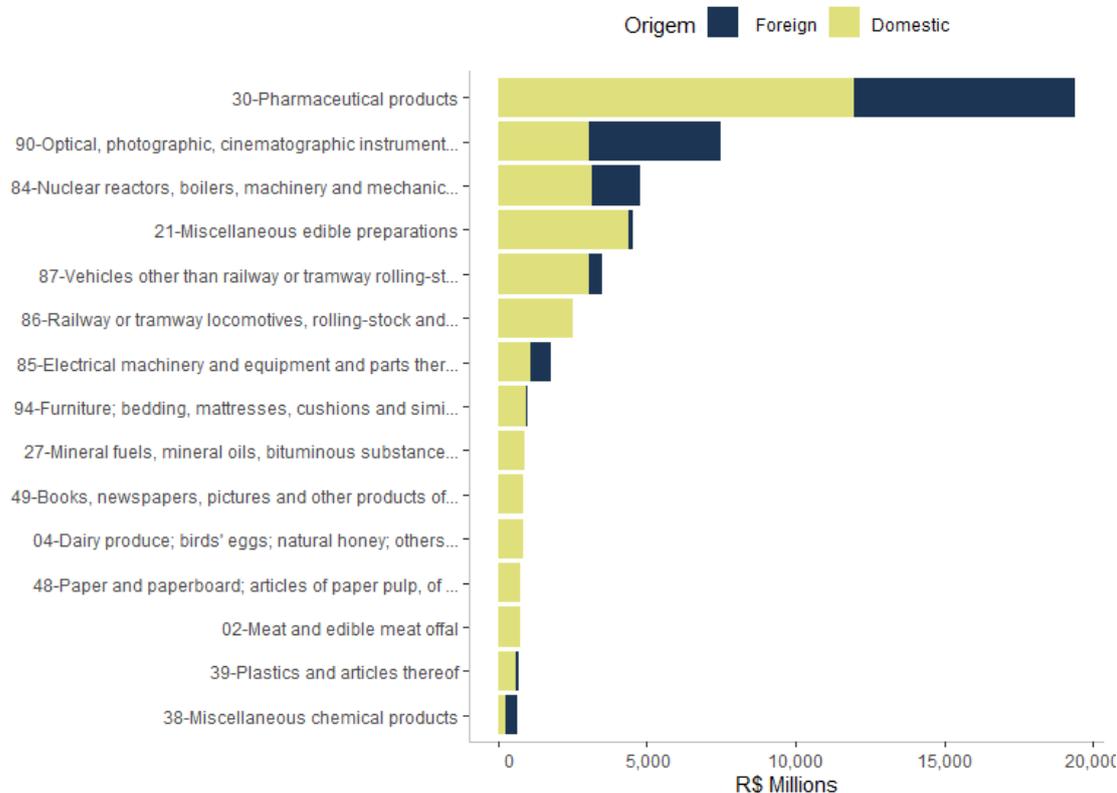


Table 7 - Top 10 consumed goods by states and DF Public Administration – 2018

NCM	Description	R\$ Value (million)	Quantity (million)	Price (R\$/Qty.)	Imported coefficient (%)
30049099	Oth.medicament cont.prod.for therapeutic uses, etc.doses	8,210.24	1,461.29	5.62	2.99
21069090	Other food preparations	3,872.87	1,784.74	2.17	4.35
30021520	Basiliximab (DCI); bevacizumab (DCI); daclizumab (DCI); etanercept (DCI); gemtuzumab ozogamicin (DCI); oprelvekin (DCI); rituximab (DCI); trastuzumab (DCI)	1,922.16	2.44	786.73	96.65
90211020	Articles and fracture appliances	1,803.49	10.25	175.97	59.11
30021590	Other immunological products, in measured doses or put up for retail sale	1,442.92	9.78	147.54	89.69
90189099	Oth.instrum.and appliances used in medical,surgery,etc	1,344.63	22.98	58.52	69.04
30049069	Ot.medicaments c/comp.heterocyc.heteroat.nitr.in doses	1,115.14	603.39	1.85	51.99
84715010	Digital proces.unit small cap.microproces.fob<=us\$12500	982.60	0.35	2,800.34	3.23
30021239	Other fractions of blood, prepared as medicines	954.41	1.41	677.76	76.34
84334000	Straw or fodder balers, including pick-up balers	933.03	0.00	13,721,023.62	99.93

Taking into account their constitutional competencies regarding public health, states government purchases are strongly concentrated in this sector. It is also noteworthy that microcomputers, 84715010 NCM code, are on the list of most purchased goods, as well as agricultural machinery, 8433400 NCM code, whose supply to states governments is heavily based on imports, at 99.93%.

In order to illustrate the level of analytical cutting got in states purchases map, singular results will be presented for São Paulo state. Beforehand, we clarify that the same disaggregation level is easily replicable for all other states and the Federal District.

Consumption of goods by São Paulo State government

Figure 16 - Annual historical series - Consumption of goods by São Paulo State Government estimated through electronic invoices: Value R\$

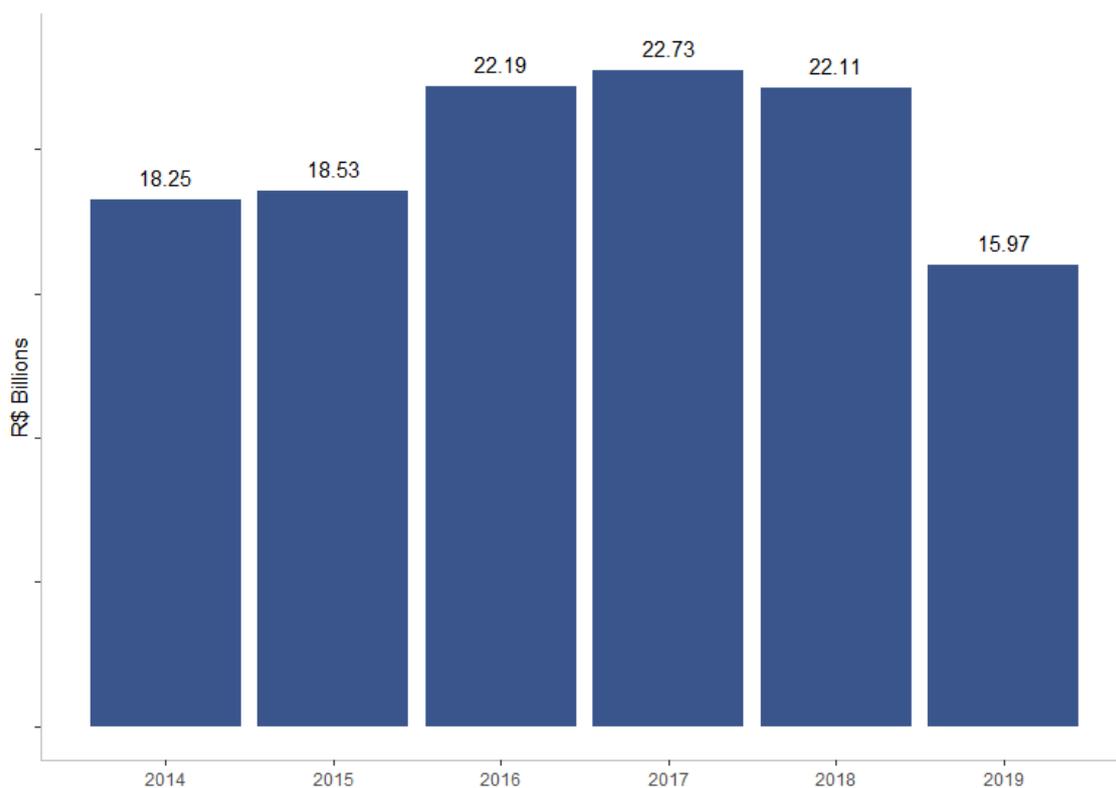


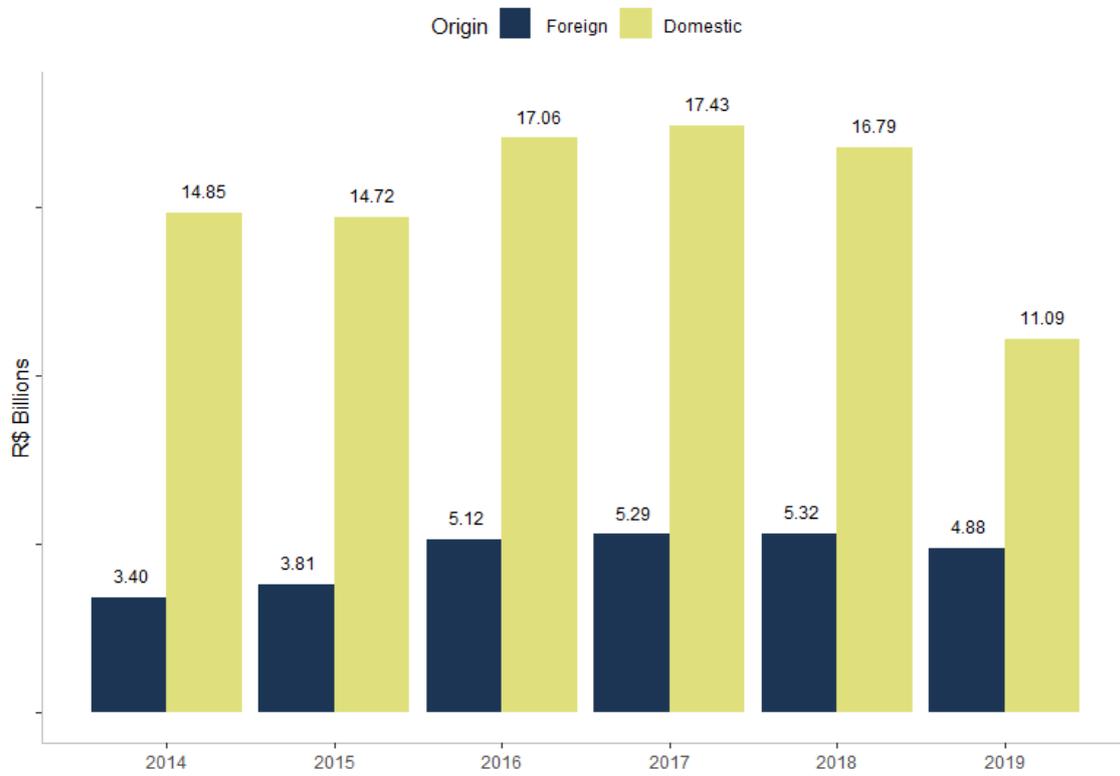
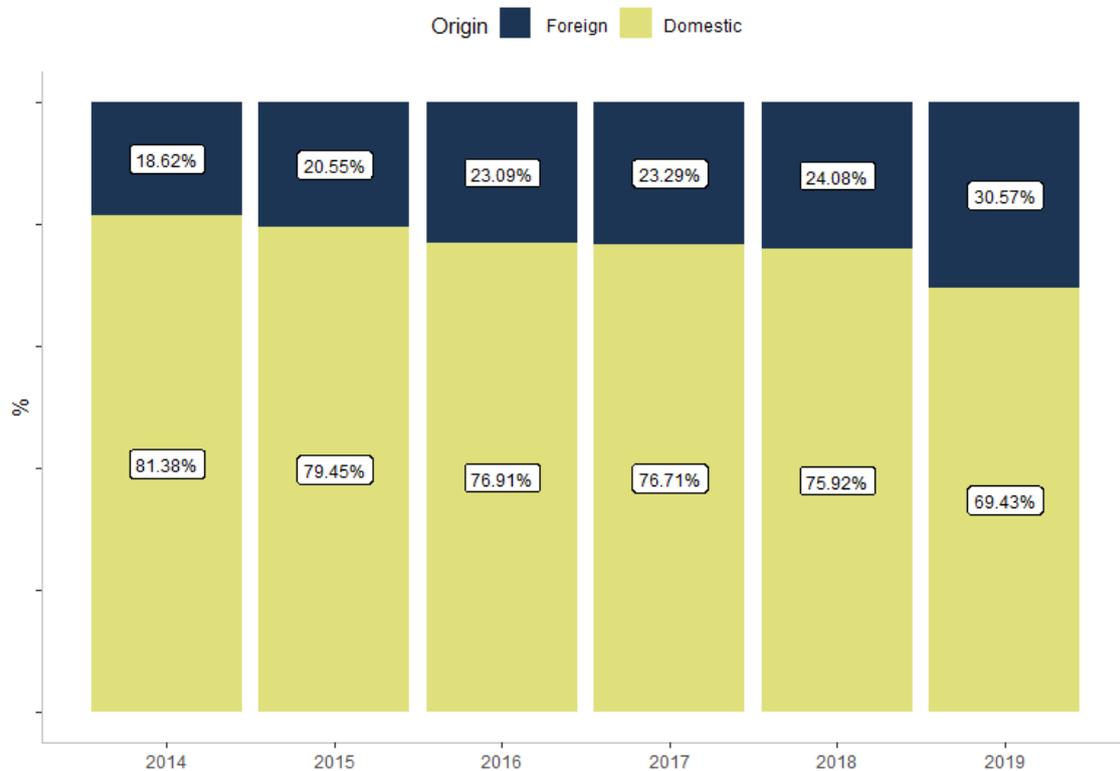
Figure 17 - Origin of goods purchased by São Paulo State Government: Value R\$

Figure 18 - Share by origin of São Paulo State Government goods purchases


Table 8 – Top 10 consumed goods by São Paulo State Government – 2018

NCM	Description	R\$ Value (million)	Quantity (million)	Price (R\$/Qty.)	Imported coefficient (%)
30049099	Oth.medicament cont.prod.for therapeutic uses, etc.doses	7,260.45	1,181.75	6.14	1.15
90211020	Articles and fracture appliances	1,445.04	4.75	304.15	66.89
90189099	Oth.instrum.and appliances used in medical,surgery,etc	932.27	7.09	131.42	76.37
21069090	Other food preparations	559.99	908.65	0.62	11.58
30021520	Basiliximab (DCI); bevacizumab (DCI); daclizumab (DCI); etanercept (DCI); gemtuzumab ozogamicin (DCI); oprelvekin (DCI); rituximab (DCI); trastuzumab (DCI)	497.08	1.83	271.35	93.46
30021590	Other immunological products, in measured doses or put up for retail sale	412.30	1.08	382.54	92.27
30049069	Ot.medicaments c/comp.heterocyc.heteroat.nitr.in doses	270.70	127.02	2.13	38.73
30021239	Other fractions of blood, prepared as medicines	249.14	0.35	715.27	66.77
30022029	Other vaccines for human medicine, in doses	209.74	1.43	146.26	0.01
84715010	Digital proces.unit small cap.microproces.fob<=us\$12500	169.20	0.09	1,977.12	3.59

3.2.4 Consumption of goods by the Municipal Public Administration

Figure 19 - Annual historical series - Consumption of goods by the Municipal Public Administration estimated through electronic invoices: Value R\$

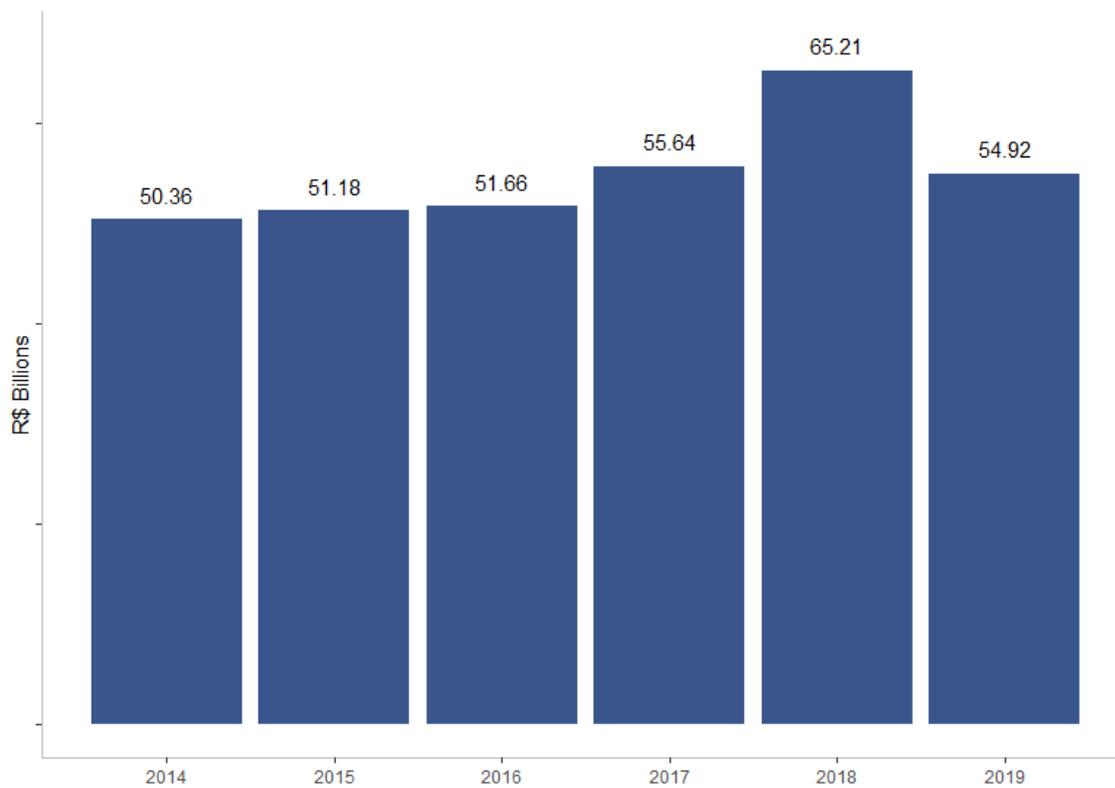


Figure 20 - Origin of goods purchased by Municipal Public Administration: Value

Figure 21 – Share by origin of the Municipal Public Administration goods purchases

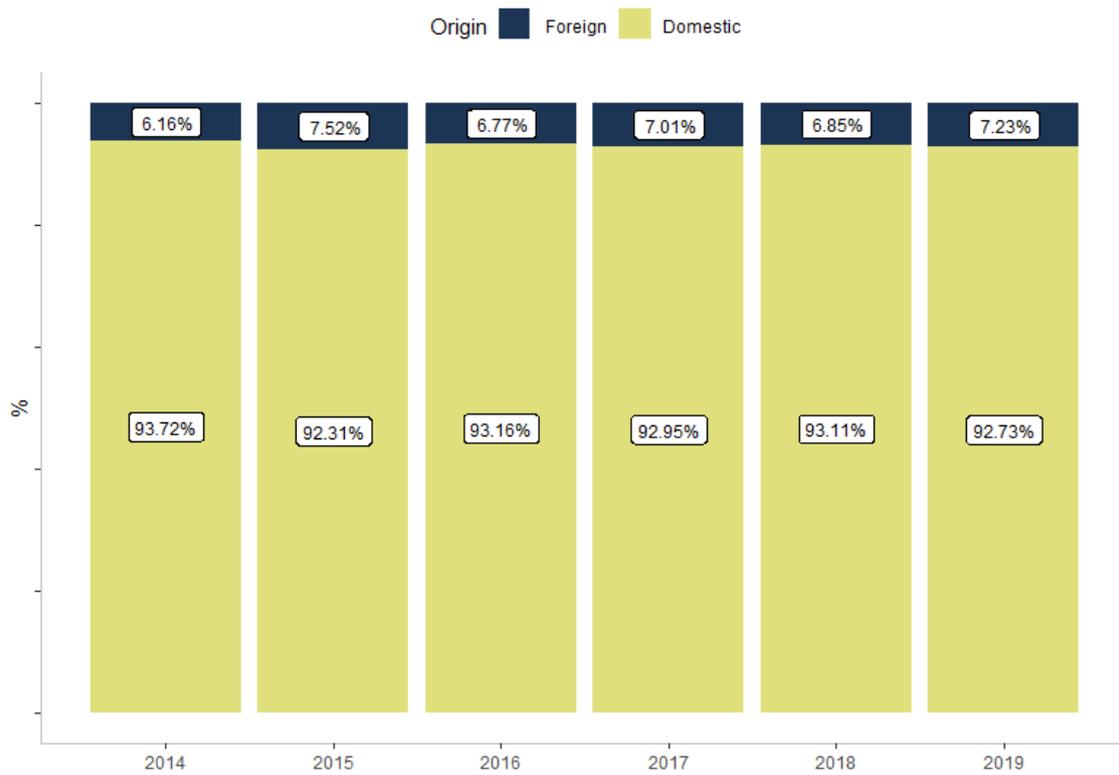


Figure 22 – Top 15 Chapters (NCM in two digits) – Consumption of goods by the Municipal Public Administration, by origin – 2018

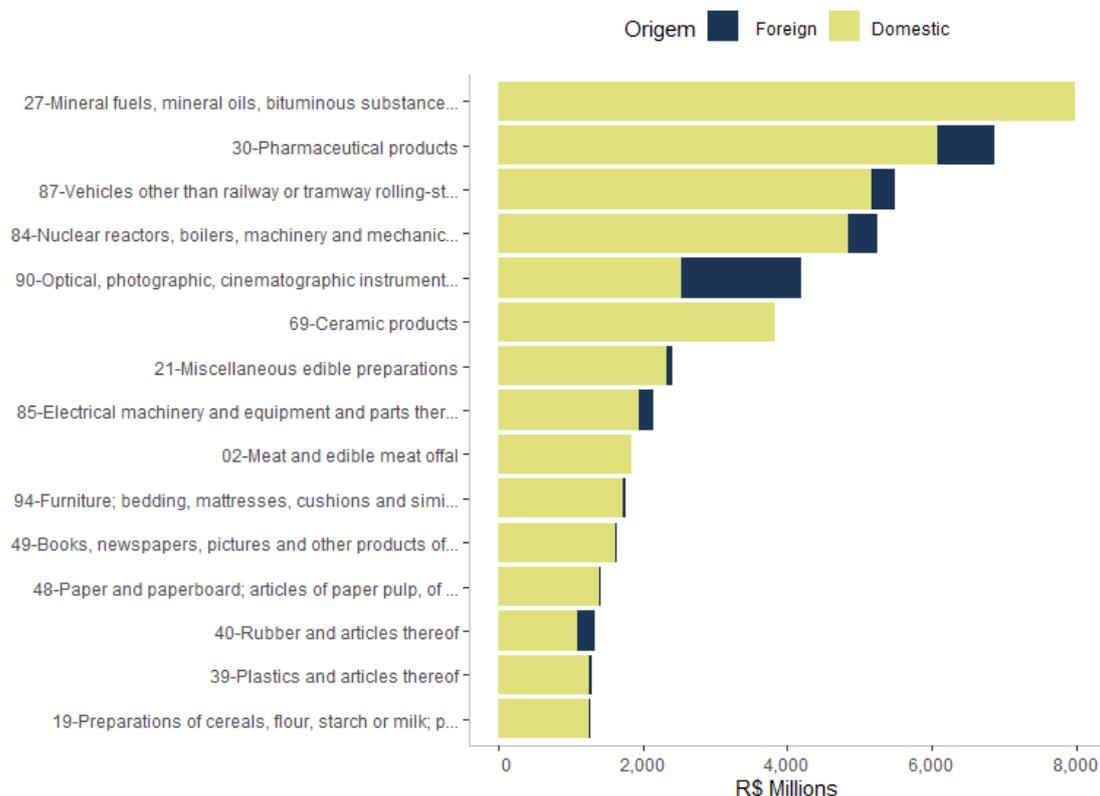


Table 9 - Top 10 consumed goods by the Municipal Public Administration – 2018

NCM	Description	R\$ Value (million)	Quantity (million)	Price (R\$/Qty.)	Imported coefficient (%)
27101921	Diesel oil	4,181.77	1,175.09	3.56	0.09
69041000	Ceramic bricks	3,725.37	100.56	37.04	0.00
27101259	Other gasolines, except for aviation	2,176.19	495.19	4.39	0.06
21069090	Other food preparations	1,939.95	564.88	3.43	4.27
30049099	Oth.medicament cont.prod.for therapeutic uses, etc.doses	1,434.23	2,115.89	0.68	7.31
49019900	Oth.printed books, brochures and similar printed	1,305.14	449.93	2.90	0.76
30049069	Ot.medicaments c/comp.heterocyc.heteroat.nitr.in doses	865.60	4,222.75	0.20	8.33
87021000	Motor vehicles f/transp.>=10 persons,with diesel engine	816.17	0.32	2,543.02	9.37
90189099	Oth.instrum.and appliances used in medical,surgery,etc	780.19	39.20	19.90	60.14
38220090	Other diagnostic or laboratory reagents	635.82	261.81	2.43	59.27

When analyzing municipal information, there is clearly a change in the government consumption pattern. Brazilian municipalities essentially buy from domestic suppliers. In 2018, only 7% of their purchases was related to imported goods. On the other hand, import goods constituted 21% of Brazilian government purchases in general.

Moreover, we can observe that the consumption of goods is relatively less concentrated in the health sector, as is illustrated in the variety of products that compounds the list of most purchased goods. For instance, buses, 8702.10.00 NCM code, used in school transportation, emerged in the municipal top 10 list.

Lastly, we remarked. However, it should be noted that the material developed includes information for the tariff universe (all NCM codes), as well as documents with interactive (dynamic) graphics, for specific queries.

To sum up, in this subsection, we presented static samples of the graphical and numerical syntheses of our results. However, it is necessary to remark that the resulting material of our work includes disaggregated information for the tariff universe (all NCM codes), as well as interactive (dynamic) documents that enables specific queries and graphs creation.

3.3. Coffee break

In the last subsection, we presented the aggregated results of our methodology. In this topic, in order to demonstrate the exact dimension of the disaggregation reached in our study, we consider appropriate to illustrate it with a very tangible example: coffee purchases.

An icon of Brazilian culture and Brazilian public offices, coffee is classified under 0901.21.00 NCM code, concerning “roasted coffee, not decaffeinated”.

For this code, the following values of government purchases were found to 2018. Government consumption for code NCM 0901.21.00 was R\$ 281.61 million. Federal government purchases of such product represented R\$ 46.5 million, while state and municipal expenditures totalized R\$ 74.23 million and R\$ 160.46 million, respectively.

The percentage of purchases of imported coffee, at the three government levels, represents less than 1% of the total purchased, confirming that the government mainly buys national coffee.

To illustrate a little more, let us move on to government purchases from the largest coffee producing state. Minas Gerais was the destination of 7.95% of the coffee purchased by government entities in 2018. In São Paulo, in turn, the largest consumer market for coffee in Brazil, public offices from the three levels of governments consumed R\$ 95.3 million in coffee, performing 33.84% of government coffee purchases across the country.

It is relevant to highlight that the information presented for coffee can also be detailed, month by month, by Legal Nature Code, according to the list presented in Table 1 of this article.

Such level of granularity in data was made available for the universe of goods purchased by the government, measured in NCM product classification (10,300 codes).

We remind that the initial focus of our study was its application in the foreign trade field, as we are going to discuss in the next chapter. However, by executing this exercise, as an extra, we created the most universal and disaggregated mapping of goods consumption by Brazilian government. Such mapping was translated into tools of direct application by possible users through a consolidated database, and new descriptive statistics and coefficients. Therefore, the general applicability of this study will be the subject of chapter 5.

4. PRACTICAL APPLICATION OF THE COMPILED STATISTICS IN FOREIGN TRADE FIELD.

After the presentation of a synthetic approach of our results, we move on to their practical applications, taking into account the initial focus of our exercise. In other words, we will discuss the usefulness of our study to subsidize decision making process in Brazil about international negotiations on government procurement.

In this chapter, we will provide an overview of the Brazilian participation in international negotiations on the topic, highlighting, in parallel, the practical application of our methodology regarding agreements already concluded on the matter, as well as ongoing negotiations.

4.1. Government procurement agreements signed by Brazil

Brazil has been effectively engaged in international negotiations for reciprocal trade liberalization and non-discriminatory treatment on government procurement since last decade. These negotiating efforts resulted in the signature of commercial agreements containing specific disciplines for governmental purchases¹⁸, including transparency measures.

The first refers to the Economic-Commercial Expansion Agreement between the Federative Republic of Brazil and the Republic of Peru¹⁹, of April 2016, which covers investments, services and government procurement. Subsequently, the MERCOSUR Public Procurement Protocol²⁰ was signed in December 2017. Besides, at the end of 2018, the Free Trade Agreement between Brazil and Chile²¹ was celebrated, including a chapter with disciplines on the subject.

Concerning the goods coverage of such agreements, it is remarkable that the Brazilian government basically excluded of its offers only clothing used by the Ministry of Defense (military uniforms). However, in the specific case of the Mercosur Procurement Protocol, some purchases from the Ministry of Health were also excepted, namely, medicines, sterilizers, instruments and medical equipment. Bearing in mind that in the agreements signed with Peru and Chile such NCM codes were not exempted, it seems that such exclusion by Brazil resulted from a reciprocity measure, since Argentina expressly excluded such products from the scope of its offer under the Protocol.

Regarding the coverage of the levels of government, it is a common feature of these agreements that public purchases by subnational entities have not been offered. In the agreement with Peru, there is a clause that establishes:

“From the entry into force of this Agreement, Brazil will initiate an internal consultation process with its states

¹⁸ It should be noted that, prior to the decade of 2010, a MERCOSUR Public Procurement Protocol had been negotiated and was signed in 2006. However, this legal instrument failed to advance in ratification process by national legislatures and, then, it was renegotiated in the following decade.

¹⁹<https://www.gov.br/produtividade-e-comercio-exterior/pt-br/assuntos/comercio-exterior/negociacoes-internacionais/acordos-dos-quais-o-brasil-e-parte/acordo-de-ampliacao-economico-comercial-brasil-peru-ainda-sem-vigencia>. Accessed: September 05, 2020.

²⁰https://www.gov.br/produtividade-e-comercio-exterior/pt-br/images/REPOSITORIO/secex/deint/cgtm/DECa_037-2017a_PTa_Protocolo-de-Contrataes-Pblicas.cleaned.docx.pdf. Accessed: September 05, 2020.

²¹http://www2.aladi.org/biblioteca/publicaciones/aladi/acuerdos/ace/pt/ace35/ACE_035_064_pt.pdf. Accessed: September 06, 2020.

governments in order to achieve its incorporations, on a voluntary basis, under the scope of this Agreement. Brazil shall conclude these consultations no later than two years after the entry into force of this Agreement, and shall notify Peru of the results of such consultations within the maximum period of these two years²²” (emphasis added).

In the chapter on public procurement in Chile’s agreement²³, the discipline on subnational entities is quite similar to the one above mentioned, provisioning consultations with the aim of the voluntary incorporation of the states within two years of the agreement's entry into force.

In turn, the MERCOSUR Public Procurement Protocol, on this topic, disciplines:

"From the signature of this Protocol, Brazil will maintain an internal consultation process with its states and municipal governments in order to obtain its incorporation on a voluntary basis²⁴". (emphasis added).

The Federal Executive is responsible for celebrating international agreements on behalf of the Union, with subsequent ratification by the National Congress in the hypothesis of onerous commitments²⁵, as in the government procurement case.

From the disciplines above exposed, it is clear that the Brazilian government has opted for the voluntary engagement of subnational entities in terms of international compromises on government procurement. This strategy is convergent with the future need of approval of the commitments by the representatives of subnational entities in the National Congress. Therefore, we infer that the position adopted aims to maximize the chance of future incorporation of that treaties into the national legal system and seeks to engage constructively states and municipal authorities in the process.

²² Anex_III_BRAZIL_Offer_Purchases. SECTION B: GOVERNMENT SUBCENTRAL (SUBFEDERAL) LEVEL ENTITIES.

²³ Chapter 12 of the mentioned agreement.

²⁴ Brazil, SECTION B - SUBCENTRAL LEVEL ENTITIES (SUBFEDERAL).

²⁵ Joint reading of articles 49 and 84 of the Federal Constitution. https://www.planalto.gov.br/ccivil_03/Constituicao/Constituicao.htm. Accessed: September 26, 2020.

Therefore, the compiled statistics will be very useful in the process of elaborating the offers of subnational entities concerning the aforementioned agreements. They will be essential to map sensitivities and the potential need to exclude specific products, as well as to provide the Brazilian government with evidence-based decision-making capacity, including information about the share of imported goods purchased by each government level, in NCM scale.

It is simple to exemplify the immediate applicability of the statistics constructed, taking into account the existence of threshold values above which procurement activities are covered by the Agreement. Goods purchases over the amount of 95,000 Special Drawing Rights (SDRs)²⁶, according to monthly publications by the International Monetary Fund (IMF), are those covered in the aforementioned international commitments of Brazil. Therefore, by simply converting such threshold into reais, it is possible to define a List of goods, encoded directly in the trade nomenclature, NCM, that could be offered without further need of analysis by governments, as their purchases recorded are fewer than 95,000 SDR.

In addition to the agreements that Brazil signed in Latin America, it is noteworthy that the Brazilian government also was engaged, through Mercosur - Southern Common Market, in negotiations with European partners. In 2019, negotiations on the Mercosur-European Union²⁷ Association Agreement and the Mercosur-EFTA²⁸ Free Trade Agreement were concluded. Such agreements are under technical and legal review, a stage prior to incorporation by member States.

²⁶ They are calculated monthly by the International Monetary Fund (IMF). The level corresponds to 709,051.50 reais, conversion rate of September 11, 2020, as consulted in the Central Bank of Brazil website. Conversion rate: 1 Special Drawing Right = 7.4637 Real. <https://www.bcb.gov.br/conversao>. Accessed: September 11, 2020.

²⁷ The European Union is an economic bloc constituted by 27 countries. Informative summary on the Agreement is available at: https://www.gov.br/produtividade-e-comercio-exterior/pt-br/images/REPOSITORIO/secex/deint/cgne/2019a_07a_03a_-a_Resumoa_Acordoa_Mercosula_UE.pdf Accessed: September 11 Accessed: September 12, 2020. In addition to this summary, parts of the agreement are published at: https://www.gov.br/produtividade-e-comercio-exterior/pt-br/assuntos/comercio-exterior/negociacoes-internacionais/acordos-em-negociacao_-1_/mercursos-european-union. Accessed: September 12, 2020.

²⁸ European Free Trade Association - EFTA, the European Free Trade Association, is formed by Iceland, Liechtenstein, Norway and Switzerland. Informative summary available at: http://www.itamaraty.gov.br/images/MERCOSUL-EFTA/2019_09_03_-_Acordo_Mercosul_EFTA-2.pdf. Accessed: September 12, 2020.

Additionally, to subsidizing the elaboration of goods offers for subnational entities under these agreements, the statistics will be useful from another perspective, namely, in implementing the cooperation provisions.

The agreements establish cooperation mechanisms for information, statistics and best practices exchanges in matters of government procurement. Thus, they constitute institutional loci for sharing, at the international level, about statistics compilation and the methodology presented in this article.

It is particularly relevant sharing our methodology of compiling statistics on government purchases through electronic invoices with the European Union. The European bloc, in spite of the wide transparency in its public procurement processes, does not have the same level of vanguard as Brazil²⁹ regarding the registration in electronic invoices of almost the totality of the economy transactions. Thus, it is relevant to share Brazilian methodologies, particularly with developed countries, since they can inspire other innovative initiatives at the international level due to its accuracy.

After a synthetic view of the applicability of the compiled statistics regarding the agreements already negotiated by Brazil, we will move on to explain the contribution of our methodology to negotiations on government procurement in which the Brazilian government is currently engaged.

4.2. The process of accession to the Government Procurement Agreement (GPA) of the World Trade Organization (WTO)

Certainly, the most relevant negotiating process on government procurement in which Brazil is currently engaged concerns the WTO Government Procurement Agreement (GPA).

The GPA³⁰ is a plurilateral agreement within the framework of the World Trade Organization, that do not encompass all of the Organization members. Currently, forty-eight WTO members³¹ have their government procurement regulated by the agreement. In addition, it should be noted that thirty-six members of the Organization participate as

²⁹ See note 7.

³⁰ The descriptive information about the GPA in this section was based on the World Trade Organization (WTO) website. https://www.wto.org/english/tratop_e/gproc_e/gp_gpa_e.htm. Accessed: 13 September, 2020.

³¹ The agreement was signed by relevant players from international trade, such as Canada, South Korea, the United States, Hong Kong, Japan, Singapore and the European Union.

observers in the WTO Committee for the GPA, among which, twelve³² are in the process of accessing to the agreement, as is the case of Brazil, which formalized such intention on May 2020.

The agreement's objective is to promote the mutual opening up of the public procurement markets of its members, by commitments in the subjects of procedures, non-discrimination and market access. In the first two areas, the GPA Parties compromise, respectively, to follow minimum transparency requirements in their tenders and to extend to Parties suppliers the same treatment they grant to domestic suppliers. In the third one, GPA members define the procurement entities covered by the commitments of transparency and non-discrimination concerning goods, services and construction services, as well as the minimum purchases values covered by the treaty³³. It is from the perspective of market access for goods that our statistics are able to contribute to the Brazilian offer conformation process.

By promoting the opening of the tender markets, GPA brings significant benefits to public administration, that, as a result of increased competition, can pay less for their purchases, consequently increasing the efficiency of its spending. Equally positive effects resulting from this opening also have an impact on the civil society - which starts to enjoy cheaper and better quality public services - and the productive sector, due to the opportunities arising from privileged access to tenders carried out abroad. Furthermore, it is worth noting the potential increase in foreign direct investments as a result of the positive change in investors' perception of legal certainty and transparency in general businesses environment³⁴.

Government purchases covered by the Agreement and subject to international competition between its members refer to the amount of US \$ 1.7 trillion annually, in terms of the supply of goods, services and public works. Thus, given the importance of the subject, enabling decision-making based on evidence, measuring reality as accurately as possible, was the primary contribution of this research. Thus, its results prove to be quite opportune to be applied, in practice, to guide the construction of the Brazilian goods

³² Brazil, China, United Kingdom and Russia stand out.

³³ WTO Government Procurement Agreement (GPA). Ministry of Economy. <https://www.gov.br/produtividade-e-comercio-exterior/pt-br/assuntos/comercio-exterior/negociacoes-internacionais/acordos-em-negociacao-1/acordo-de-compras-governamental-of-omc-gpa>. Accessed: September 13, 2020.

³⁴ Idem.

offer under the scope of GPA, which it is supposed to be approved by the GPA members in the end of accession process.

It is remarkable in GPA that goods coverage concerning the central government refers to the threshold of 130,000 Special Drawing Rights (SDR)³⁵ for the majority of countries offers, with exception of Aruba and Japan³⁶. In this sense, if the Brazilian government chooses to offer the ordinary threshold, by simply converting such threshold into reais, it is possible to define a List of goods, encoded directly in NCM, that could be offered without further need of analysis, as their purchases recorded are fewer than 130,000 SDR.

Therefore, the Brazilian government can concentrate its analytical effort, at the federal level, on the evaluation of goods that have purchases recorded above that level. Based on objective measurements of reality, it possible to focus on eventual sensitiveness of specific goods, taking into account, in addition to the descriptive statistics compiled, the coefficients calculated on the share of imports in government consumption.

Moreover, similarly, by the same metric, we made available analytical tools to conduct the reflection about the definition of subfederal thresholds and, in parallel, deperate eventual sensitiveness in the NCM scale.

Furthermore, in the GPA accession process, the first task for the applicant country is to provide information and statistics about its government procurement internal structure. It should be noted that, prior to our research, there was no consolidated information, by NCM, on purchases of goods from the federal government. Neither were there statistics at the equivalent aggregation level that captured the total consumed at the subfederal level. The statistics of the Government's Purchasing Panel³⁷, no matter how much they have improved in recent years, do not reveal the universe consumed, as they do not cover, on a mandatory basis, the purchases of subnational entities. Thus, the panel's statistics have, necessarily, an under-registration bias.

Thus, the constructed methodology proves to be useful to strengthen the Brazilian negotiating position and demonstrate, in the World Trade Organization, the magnitude

³⁵ It corresponds to 970,281.00 reais, at conversion rate of September 11, 2020, as consulted on the website of the Central Bank of Brazil. Conversion rate: 1 Special Drawing Right = 7.4637 Real. <https://www.bcb.gov.br/conversao>. Accessed: 11 September, 2020.

³⁶ They offered goods purchases over the threshold of 100,000 SDRs.

³⁷ Website available at: <http://paineldecompras.economia.gov.br/>. Accessed: September 26, 2020.

and attractiveness of the Brazilian government purchases goods market, estimated at 170 billion reais in 2018³⁸.

Additionally, it is important to note that the GPA Committee³⁹ has a specific work program on statistics, the Work Program on the Collection and Reporting of Statistical Data⁴⁰. Such program establishes that the Committee takes into consideration the potential for harmonizing the statistics to be reported by members of GPA. In this regard, concerning goods, the Brazilian government is ready to report its purchasing statistics directly in its trade nomenclature, the NCM, which is based on the Harmonized Commodity Description and Coding System (HS). Thus, it is reasonable thinking that, opportunely, Brazil can suggest HS to measure purchases in the GPA, because such categorization is, by definition, internationally harmonized and widely used in goods trade in general.

It is also remarkable that the Work Program mentions that the Committee should seek ways to facilitate the collection of origin information in goods covered by the agreement. In this regard, our methodology presents some advanced in this direction, since it is capable of tracking information on whether the good is imported or national (domestic)⁴¹, summarized by coefficients of share of imported goods on the total purchased, by tariff line.

In summary, in addition to the usefulness exemplified in this section in order to support the elaboration of Brazilian offer, the methodology also innovates by anticipating the provision of harmonized statistics for goods, a subject that has been evaluated by the GPA Committee since 2012.

Finally, we remark that, through research and institutional contacts with foreign government authorities and international organizations, we were not capable to find out any country that have compiled such statistics about government consumption of goods directly in its trade nomenclature or in the Harmonized System. This fact strongly corroborates the relevance of the methodology and results presented in this paper.

³⁸ As a parameter of the magnitude of the discrepancy in the estimated total market, the data from the Purchasing Panel report 25 billion reais for the materials consumption by the government in 2018.

³⁹ WTO collegiate body responsible for managing the Agreement.

⁴⁰ Annex D, Appendix 2 of the GPA.
<https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/PLURI/GPA/113.pdf&Open=True>.
Accessed: 26 September, 2020.

⁴¹ As explained in section 2.3.5.

4.3. Other negotiation processes

After showing the applications of our study regarding the main negotiating process in which Brazil participates, it is worth remembering that Brazilian government, through Mercosur, is also involved in other negotiations encompassing government procurement chapters. Such initiatives concern negotiations between Mercosur and Canada, South Korea and Singapore.

Additionally, Brazil participates, without Mercosur partners, in a broad trade negotiation with Mexico, which also includes disciplines on government procurement.

In the context of such negotiating processes, the observations we made in the previous sections of this chapter on the analytical usefulness of the compiled statistics are equally valid.

After addressing the foreign trade aspects of our study, let us move on the analysis to its application for public policy in general, that constitute a substantial positive externality of our research.

5. GENERAL APPLICATIONS OF COMPILED STATISTICS, OTHER ACADEMIC DISCUSSIONS AND RESEARCH AGENDA

In the course of our study, as the research on the measurement of government consumption of goods was progressing, we realized that our results would go beyond the initial applicability purpose, concerning foreign trade and international negotiations.

Therefore, in this chapter, we will indicate possible uses of the compiled statistics in public accounting and public procurement policies in general. Then, interconnections and complementarities of our study will be explored in light of the recent academic debate. At the end of the chapter, in order to indicate paths for future work, we move on to the theme of research agenda, which, in particular, will briefly reflect on the feasibility of using electronic invoices as estimators of transactions in the national economy.

5.1. General applications in public policies

Prior to the research presented in this article, the Brazilian government did not have a detailed map of its governmental consumption of goods that encompassed the purchases universe, encompassing all federative entities.

Thus, the present study has horizontal application in public policy field, public accounting, as well as in matters of transparency of government expenditures.

The consolidated database is of general interest to Brazilian government and, particularly, to the Management Secretariat of the Ministry of Economy, as the central organ of the government's purchasing policy. It will also be useful to purchasing offices of subnational entities governments, notably States and the Federal District. From the constructed base, it is possible to map directly the purchases of States and DF in the same level of disaggregation reached for the federal government.

Moreover, in contacts with the National Accounts area of IBGE, we were informed that the access to the database would be useful for the Institute. The methodology created by SECINT captures the totality of government of goods purchases. On the other hand, the methodology used by IBGE registers certain residual transactions related to goods, as consumption of services.

In summary, we identified the potential applicability of our study concerning the following themes:

- Improvement of the price panel policy in tenders. The Management Secretariat of the Ministry of Economy has a correlation table between the NCM and the Merchandise Catalog (CATMAT), product coding used in tenders. Using this tool, the agency will be able to estimate the price of goods sold to the government in the reference category of tenders (CATMAT) and analyze the convergence between panel prices and the effective sale price calculated from invoices. This is also relevant from the perspective of internal and external control, as well as transparency.
- Impact assessment of the preference margin policy used by Brazilian government in the past. From the constructed database, it is possible to verify how much the government, effectively, bought national merchandise regarding the NCM codes that were encompassed by the policy.
- Complementary base of statistics on the government consumption of goods, at the higher level of disaggregation available, to be shared with IBGE.

- Systematic data source for state governments measuring their purchases.
- Evaluation of the amount of government purchases of goods that were beneficiary of basic production processes (PPB) policy⁴².

To conclude this section, we highlight a practical application of our research that we were particularly proud. We have contributed to the efforts in gathering managerial information to be used in the current epidemiological context.

On March 31, 2020, early, in the context of coronavirus spreading in Brazil, SECINT presented calculations on the value of government purchases for a subset of NCM codes with application in combating Covid-19.

5.2. Other recent academic discussions

Recently, in May 2019, Ribeiro and Júnior⁴³ stressed the relevance of conducting studies that shed light on Brazilian public purchases, taking into account the scarcity of researches on this topic in view of the importance of public procurement policy and market.

Therefore, they conducted a study based on secondary sources and bibliography review, in which they estimated that the Brazilian government procurement market represents 12.5% of the country's GDP. The exercise was motivated, according to the authors, by government procurement policy protagonism, given its magnitude in the role of public policies, as well as the current context of international negotiations on the matter.

We remark that the present article was encouraged by the same diagnosis of the existing information gap in the subject. Thus, our contribution to this debate was constructing primary sources of knowledge by calculating the government consumption of goods at an unprecedented level of disaggregation, as widely discussed in this paper.

⁴² The information turned out to be a positive externality of our work. Government purchases related to PPB refer to a subset of invoices issued presenting the following record in the origin field: "4 - National, whose production has been made in accordance with basic production processes". As defined by Decree-Law N°. 288/67 amended by Law No. 8,387 / 91, the Basic Productive Process (PPB) is the minimum set of operations, in the manufacturing establishment, which characterizes the effective industrialization of a given product, concerning Manaus Free Trade Zone and informatic goods. Thus, the PPB consists of the minimum necessary manufacturing steps that companies must follow in order to manufacture a certain product.

⁴³ RIBEIRO, Cássio Garcia, e JÚNIOR, Edmundo Inácio. *O Mercado de Compras Governamentais Brasileiro (2006-2017): Mensuração e Análise*. Texto para Discussão n° 2476. Brasília, maio de 2019.

In addition to the public policy field, our paper dialogues with public accounting in general sense, since it can inspire reflections on refinements about the government consumption calculation, from the perspective of national accounts.

On the other hand, from the perspective of public accounting in a stricter sense, when measuring expenditure based on invoices issued in favor of government with monthly granularity, a criterion is presented to improve the mapping of the government disbursement flow. Thus, such picture can contribute to debates on current assets management, in line with discussed by Nascimento, 2019⁴⁴.

5.3. Research agenda

Electronic invoices capture systematized information on transactions of the formal Brazilian economy with an impressive level of detail and almost instantaneously. They represent virtually an intermittent electronic census of the national economy. Thus, electronic invoices can answer any research question related to economic, tax or accounting matters in Brazil.

It is up to researchers and public policy operators to go beyond what is directly observable when analyzing the fields inside the invoice form. As viewing electronic invoices as primary sources of scientific knowledge, it is possible, through the use of data science tools, to construct new descriptive statistics for a range of variables. Such studies may consider both the macro analytical approach, at the national economy level, as well as addressing very specific research questions.

Descriptive statistics that accurately reflect reality are essential for the development of less distorted analyses. Thus, this study seeks to inspire other researchers, managers, or public policy analysts to venture into this field.

Finally, it should be noted that the authors were also engaged in trying to calculate the consumption of state-owned and mixed-capital companies, using a methodology similar to that presented in this article. However, there is a methodological issue that has not been still overcome. In transactions between public companies and their subsidiaries, there would be a risk of double counting. Unlike direct public administration, corporate

⁴⁴ NASCIMENTO, Luciano Moura Castro do; *Os Impactos da Edição do Decreto nº 9.428/2018 na Gestão das Disponibilidades de Caixa do Governo Federal*. XXIV Prêmio do Tesouro Nacional. Brasília, 2019.

equity transfers need to be registered by invoice. Thus, there would be cases where this kind of transfer is counted as a purchase. Nevertheless, given the inexistence of indicators to measure the purchases of state-owned companies at such a level of disaggregation, we considered opportune to draw attention to this theme, as a potential research agenda topic.

6. CONCLUSION

The compiled statistics are of great relevance as they present information on public purchases directly in the category of Brazilian foreign trade operations, the NCM, organized by subfederal entities. Such a map of government consumption of goods is of particular prominence in the process of Brazil's accession to the Government Procurement Agreement (GPA) of the World Trade Organization (WTO).

Our study makes available to Brazilian government and society information on the magnitude of the purchasing market in Brazil and details it by different cuttings. Thus, it can contribute to the elaboration process of GPA goods offer, as well as to organizing information in the required questionnaires related to GPA accession.

Furthermore, the publication of this article is relevant to increase government transparency, as well as to provide managerial information directly applicable to public policy analyses and public accounting, in particular.

Our study was fundamentally guided by the assumption that improving descriptive statistics is crucial to reach out better impact analyses, in terms of less distorted results and more convergence to the metrified reality.

Therefore, we sought to compile the best Brazilian descriptive statistics on government consumption of goods for use in foreign trade analysis and, as a positive externality, we created the most universal and disaggregated government consumption statistics known.

We reiterate the innovative character of our study, since we do not know about any country in the world or international organization that makes available statistics directly constructed in foreign trade nomenclature or in the Harmonized System.

In light of these consideration, by this article, we submit our methodology and results to public scrutiny. We hope we have contributed to the subject from the perspective of national public policies on government procurement, as well as international initiatives in which Brazil is engaged.

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