# The Value-added by Intra and International Trade: An Analysis of the State of São Paulo

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## Abstract

The aim of this paper is to identify the share of domestic value-added in the state of São Paulo embedded in exports to other Federative Units - UFs and to other countries, as well as to determine the share of value-added in other states linked to sales to São Paulo, in the years 2008 and 2013. For this, the input-output analysis was used as a methodology. The results show that, in general, the national economy was relatively less centralized in the state of São Paulo. Decentralization may have occurred (i) due to the increase in trade relations between the other States and the Federal District to the detriment of São Paulo and/or (ii) due to the strengthening of the Federative Units domestic market. This strengthening of the domestic market can be linked to the increased participation of the service sectors, both in the economy of São Paulo and in the national economy. Regarding international trade, São Paulo appears as the largest exporter among the Federative Units, in terms of gross value exported. However, it was found that around 20% of the value-added linked to São Paulo exports was generated in other Federative Units, since São Paulo acquires inputs from these UFs to compose its products for export.

**Keywords:** Domestic trade. Hypothetical extraction. Input-output. Value-added.

### O Valor Adicionado Pelo Comércio Intra E Internacional: Uma Análise do estado de São Paulo

**Resumo**

O Objetivo do artigo é identificar a parcela de valor adicionado doméstico do estado de São Paulo embutida nas exportações para outras Unidades da Federação e para outros países, bem como determinar a participação do valor adicionado de outros estados vinculado às vendas para São Paulo, nos anos de 2008 e 2013. Para isso, utilizou-se como metodologia a análise de insumo-produto. Os resultados mostram que, de forma geral, a economia nacional ficou relativamente menos centralizada no estado de São Paulo. A descentralização pode ter ocorrido pelo aumento das relações comerciais entre outros estados e Distrito Federal em detrimento de São Paulo e/ou pelo fortalecimento do mercado doméstico das próprias Unidades da Federação. Esse fortalecimento do mercado doméstico pode estar ligado ao aumento da participação dos setores de serviços, tanto na economia de São Paulo, quanto da economia nacional. No que tange ao comércio internacional, São Paulo aparece como o maior exportador entre as Unidades da Federação, em termos de valor bruto exportado. No entanto, constatou-se que cerca de 20% do valor adicionado vinculado às exportações paulistas foi gerado em outras Unidades da Federação, devido ao fato de São Paulo adquirir insumos dessas UFs para compor seus produtos para exportação.

**Palavras–chave**: Comércio intranacional. Extração hipotética. Insumo-produto. Valor adicionado.

### El Valor Agregado Por El Comercio Intra E Internacional: Un Análisis del Estado de São Paulo

**Resumen**

El objetivo del artículo es identificar la proporción de valor agregado nacional del estado de São Paulo incorporada en las exportaciones a otras Unidades de la Federación y a otros países, así como determinar la participación del valor agregado de otros estados en las ventas a São Paulo, en los años 2008 y 2013. Para ello, se utilizó la metodología del análisis insumo-producto. Los resultados muestran que, en general, la economía nacional se descentralizó relativamente del estado de São Paulo. Esta descentralización puede haber ocurrido debido al aumento de las relaciones comerciales entre otros estados y el Distrito Federal en detrimento de São Paulo y/o al fortalecimiento del mercado interno de las propias Unidades de la Federación. Este fortalecimiento del mercado interno puede estar relacionado con el aumento de la participación del sector de servicios tanto en la economía de São Paulo como en la economía nacional. En cuanto al comercio internacional, São Paulo se posiciona como el mayor exportador entre las Unidades de la Federación en términos de valor bruto exportado. Sin embargo, se constató que aproximadamente el 20% del valor agregado vinculado a las exportaciones paulistas se generó en otras Unidades de la Federación debido a que São Paulo adquiere insumos externos para componer sus productos de exportación.

**Palabras clave**: Comercio intranacional. Extracción hipotética. Análisis insumo-producto. Valor agregado.

## 1 Introduction

According to the assumptions of neoclassical theories, intranational trade presents perfect mobility of the factors of production, consequently, the relative

endowments of factors would be uniform in space, that is, all regions of a country would have similar production costs and the spatial fragmentation of the production process would bring only extra costs (MARKUSEN et al., 1995; (KRUGMAN, 1986). However, it is known that the mobility of factors of production between subnational regions is not perfect, especially in countries with continental dimensions such as Brazil, where the regions have extremely different edaphoclimatic, social, economic and cultural characteristics (COSTA, 2000), which reflects divergences in production costs and levels of specialization between regions (BARROS, 2012).

Thus, there may be gains in the fragmentation of the production process between the different regions of a country. In the Brazilian case, the importance of intranational commercial relations can be confirmed by the volume of trade between the Federative Units – UFs. According to Silva, Almeida and Oliveira (2007), Brazilian intranational trade is, on average, 33 times higher than international trade. Trade between UFs is also enhanced by the fact that Brazil is considered relatively closed to international trade, especially when compared to other developing countries such as China and India (BAUMANN; ARAUJO; FERREIRA, 2010).

The fragmentation of production in the national territory, and the consequent trade in intermediate goods, makes it important to evaluate intranational trade in terms of generating value-added. The evaluation of trade by value-added, instead of the gross value traded, in addition to helping to solve the problem of double counting, which occurs each time a product crosses a border, also contributes to a better understanding of the impact of trade on job and income generation in the region (HUMMELS, RAPOPORT & YI, 1998). Before crossing the international border, a product crosses national currencies several times, geographically distributing the value-added generated in the production process. When tracking the internal trade of a country, a given good can be counted several times, however, it will only be counted once in international exports, in terms of gross exported value (GUILHOTO, SIROËN & YUCER, 2013).

Therefore, some Federative Units (UFs) may present extremely high gross export values. However, part of the value-added present in the exported product may have been generated in other states. Consequently, the UFs that carry out the final export of the good may have their role in international trade overvalued compared to their performance in terms of Domestic Value-added (DVA) (GUILHOTO, SIROËN & YUCER, 2013). In this scenario, identifying the generation of DVA in each State is of paramount importance to understand the relevance of subnational and international trade in the generation and distribution of employment and income among Brazilian states.

It was decided to analyze the state of São Paulo in a more specific way, due to its protagonism in the national economy. According to Magalhães and Domingues (2009) for the year 2003, the state represented about 31.8% of the value-added generated internally by the country, in addition to being the largest national exporter and importer. Thus, the objective of this research was to identify which portion of Domestic Value-added of the state of São Paulo is represented by São Paulo's trade with other states and with other countries. Furthermore, what is the share of value-added from other states linked to its sales to São Paulo?

To achieve the proposed objectives, an input-output analysis will be used. For Perobelli and Haddad (2006), this is an important tool in determining the amount of

value-added embedded in interregional trade, since it covers more fully the spatial interactions between regions. Interregional systems built for the years 2008 and 2013 by the SUIT method will be used (GUILHOTO et al., 2019). This interval was adopted by understanding the period with interregional input-output tables available and comparable to each other. In addition, the period encompasses important economic facts, such as the 2008 crisis, which may have directly interfered with both intranational and international trade flows.

## 2 Importance of trade between subnational regions

According to Munroe and Hewings (1999), even though intranational transactions play an important role in the economy of nations, the number of studies focused on this topic is still small, compared to international trade studies. Furthermore, for Guilhoto et al. (2019), information about trade flows between subnational regions is not available for most countries, especially regarding the value-added by each of the states.

The importance of subnational trade relations can be observed in works such as Munroe & Hewings (1999) that addresses the case of the Midwestern United States, in which the volume of trade between the states of the American Midwest greatly exceeds the volume of international trade practiced in the region. Wall (2000) also investigated the importance of subnational transactions, using a heterogeneous gravitational model to determine trade bias at the Canada-U.S. border. According to the author, intranational trade between 1994 and 1996 was about 12.5 times greater than international trade, which highlights the relevance of the theme.

Brazilian interstate commerce is about 33 times greater than international (SILVA, ALMEIDA & OLIVEIRA, 2007); (LEUSIN JR. & AZEVEDO, 2009); (DAUMAL & ZIGNAGO, 2008). In Brazil, intranational trade is enhanced by two factors (i) its continental dimensions, given the different economic potential of UFs, which allows trade in intermediate and final goods; and (ii) its borders are relatively closed, especially compared to other developing countries, such as China and India. The difficulties imposed on international trade create a domestic market bias and can be an enhancer of trade between subnational regions (BAUMANN; ARAUJO; FERREIRA, 2010); (MISSAGGIA & FEISTEL, 2015).

Guilhoto and Yucer (2013) also studied trade between Brazilian UFs using an interregional input-output system for 2008. According to the authors, with the exception of the direct exporting states of raw materials (soybeans, iron ore, oil and others), the exports of the Brazilian states are interconnected by the internal production chains, driven by the demand of the most industrialized states such as São Paulo and Santa Catarina, etc., and by the supply of input supply states such as Rondônia and Piauí.

Despite their economic importance, spatial and trade issues in subnational regions are still neglected. This scenario has gradually changed, since economic agglomerations and transport structures are considered key variables in economic geography, especially for countries the size of Brazil where the distribution of production among domestic regions is as or more important than international trade (CASTRO; CARRIS; RODRIGUES, 1999)

The objective of this section was to highlight the importance of trade between subnational regions and its main determinants, especially between Brazilian states. Also noteworthy is the difficulty of accessing information about trade flows between states, especially in terms of value-added. The next section summarizes some information on the economy of the state of São Paulo, in order to highlight its leading role in the national economy, legitimizing its choice as a reference State for this article.
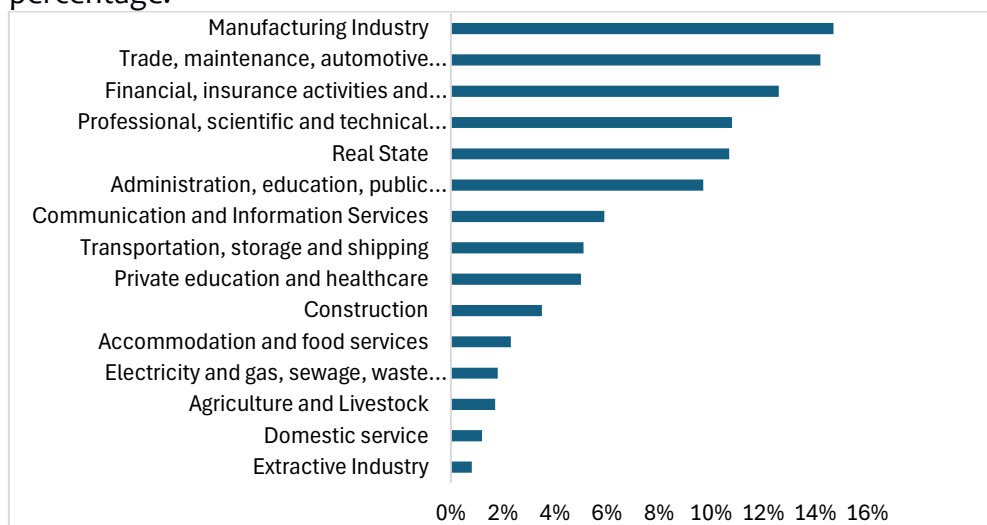
## 2.1 The State of São Paulo

The Southeast region has the best economic performance among the five national regions. São Paulo leads the numbers, accounting for 31.25% of Brazilian GDP, followed by Rio de Janeiro (9.91%) and Minas Gerais (8.97%). Subsequently, the states of the Southern region appear, Paraná (6.41%), Rio Grande do Sul (6.19%) and Santa Catarina (4.59%), according to IBGE data for the year 2020.

The concentration of Brazilian income and industrial production in the Southeast region, especially in the state of São Paulo, can be explained by the country's industrialization process. With the end of the coffee export era and the beginning of the industrialization process, the industry sought to serve the domestic market, which was located mainly in the Southeast region, largely because this region had the minimum criteria of necessary infrastructure. In addition, the political strength of São Paulo and the demand for São Paulo products by the other states conditioned the entire industrialization process of the other regions. Thus, the entire national production chain was articulated with the São Paulo economy, which came to be known as the "locomotive of the Brazilian economy" (SILVA, 2017).

According to data from IBGE and the State System of Data Analysis Foundation (SEADE), the GDP of the state of São Paulo for 2019 was R$2.348 trillion, an amount that is distributed among Services (65.6%), Industry (17.1%), Taxes on Net Subsidy Products (15.9%) and Agriculture (1.4%). Graph 1 shows the sectorial subdivisions of the value-added in São Paulo.

Graph 1- Structure of the value-added of the state in São Paulo for the year 2019 in percentage.



Source: Seade Foundation and IBGE (2019).

According to data from the Ministry of Industry, Foreign Trade and Services – MDIC (2022), the state of São Paulo led both exports and international imports for the years 2008 and 2013. However, in both years, the state was in deficit in the trade balance, since imports were greater than exports.

The main destinations for São Paulo exports, according to MDIC (2022), are the United States, China and Argentina. The most exported products are derived from sugarcane, petroleum products, aircraft and other equipment including its parts, soybean complex, installation and equipment for civil engineering and motor vehicles, and the total amount was US $53.9 billion in 2021.

Also, according to MDIC (2022), among the products imported by São Paulo, organic and inorganic compounds, heterocyclic compounds, nucleic acids and their salts and sulfonamides, parts and accessories of automotive vehicles, products for the manufacturing industry, telecommunication equipment, medicines and pharmaceuticals stand out. And they accounted for a total of $67.2 billion in 2021.

An important factor that can directly impact the amount imported is the fact that São Paulo concentrates a large part of the national industrial complex, consequently importing high value-added inputs. Moreover, the State also has logistical measures and commercial strategies that favor the development of innovation, which generates imports of high-tech products (MARINHO & SILVA, 2013).

According to data from MDIC (2022), for the period from 1999 to 2013, the real growth rate of São Paulo imports was 174.2%. However, not all segments had the same performance, manufactured products grew 162.2% and semi-manufactured products 59.2%. On the other hand, basic products increased by 373.3%, a percentage that is equivalent to more than twice the real growth rate of São Paulo imports (MARINHO & SILVA, 2015).

In this section, some characteristics of the São Paulo economy were highlighted, as well as its importance for the national economy. However, to obtain the value-added embedded in São Paulo exports, both international and for each Brazilian State, the product input analysis was used, which will be detailed in the next section.

**3 Methodological Procedures.**

For the methodological procedures, interregional input-output systems built for the 27 UFs for the years 2008 and 2013 were used, based on the SUIT methodology presented in (GUILHOTO et al., 2019). The method proposed by Los, Timmer and De Vries (2016) based on hypothetical extraction was applied to estimate the value-added embedded in São Paulo's trade with other states and vice-versa.

Hypothetical extraction is a technique initially developed by Paelinck, de Caevel and Degueldre (1965) and Strassert (1968) and can be used in several scenarios, both for sectors and regions. In recent decades, several studies have been carried out adopting this method, such as Dietzenbacher, Burken and Kondo (2019), which used hypothetical extraction to analyze the automotive industry in China, the United States and Germany, using the World Input-Output Database - WIOD matrix of 2014.

Dietzenbacher, Linden, Steenge (1993) used hypothetical regional extraction, extracting coefficients from a region in inter-country matrices of the European Union for the 1970s and 1980s. Bergmann et al. (2022) use hypothetical extraction to identify Brazil's role in the international virtual water trade between 1995 and 2009. Temurshoev (2010) used the method to determine the key sectors in the Australian economy in the years 1994-1995, regarding water use, $CO_2$ emissions, profits and wages.

Los, Timmer and De Vries (2016) originally use hypothetical extraction to determine the value-added embedded in a country's exports. The authors use a hypothetical economy, with an input-output structure similar to that of the real economy, but with some trade flows defined as zero. They then compare the value-added of the real economy with the hypothetical one, obtaining the value-added of a country associated with the extracted links. Thus, the DVA, contained in the exports of an "s" country, is the difference between the real and hypothetical GDP of that country.

In this article, the methodology proposed by Los, Timmer and De Vries (2016) is adapted to the UFs. For this, the value-added was calculated in a hypothetical UF, which resembles the input-output structure of the real economy, but with some trade flows defined as zero. Basically, in this hypothetical economy, some trade links between states are "extracted." By comparing the value-added in the real and the hypothetical economy, the value-added of a state associated with the extracted bonds can be measured. Then, the DVA present in the exports of an "s" state is defined as the difference between real and hypothetical GDP in "s".

In the methodology proposed by Los, Timmer and De Vries (2016), the input-output tables are partitioned. Assuming for didactic purposes an example with only two regions r and s, the matrix A of technical coefficients can be constructed as follows:

$$A = \begin{bmatrix} A_{ss} & A_{sr} \\ A_{rs} & A_{rr} \end{bmatrix} \qquad (1)$$

Each A matrix contains the input coefficients $a_{ij}$ that provide the units of value of the intermediate goods of industry "i" required to produce a unit of value of the gross output of industry "j".

$A_{ss}$ represents the requirements acquired internally from industries in the "s" region, $A_{sr}$ represents the necessary inputs produced in the "s" region that are sold to the "r" industries. As for the final demand block, it is necessary to:

$$Y = \begin{bmatrix} Y_{ss} & Y_{sr} \\ Y_{rs} & Y_{rr} \end{bmatrix} \qquad (2)$$

In which the vectors $Y_{ss}$ and $Y_{sr}$ represent the values of trade flows of the industries in "s" region for all end users, whether domestic or in "r" region.

The coefficients constructed from the ratio of value-added to gross production value in each region are contained in a row vector $v_s$. The length of this vector is equal to the number of sectors in "s" and "r", with the value-added coefficients for industries in "s" as first elements ($\tilde{v}_s$) and zeros for sectors in the region r: $v_s = [\tilde{v}_s \ 0]$. Using the Leontief inverse, the real value-added in region "s" (GDPs) is expressed by:

$$\text{PIB}_S = v_s(I - A)^{-1}Y * i \tag{3}$$

In which "i" is a column vector where all elements are unitary, implying that it sums the elements in each of the rows of the Y matrix. The element $(I - A)^{-1}$ is the known Leontief inverse, in which "I" is the identity matrix that has appropriate dimensions.

To determine the amount of DVA that should be attributed to exports from "s" to "r", a hypothetical world was created in which "s" exports absolutely nothing to "r", keeping the rest of the structure unchanged. Therefore, the blocks $A_{sr}$ and $Y_{sr}$ are set to zero. Therefore, matrices A\* and Y\* are defined as follows:

$$A^* = \begin{bmatrix} A_{ss} & 0 \\ A_{rs} & A_{rr} \end{bmatrix} \tag{4}$$

$$Y^* = \begin{bmatrix} Y_{ss} & 0 \\ Y_{rs} & Y_{rr} \end{bmatrix} \tag{5}$$

The hypothetical GDP in "s" in this situation is obtained by post-multiplying the hypothetical Leontief inverse by the hypothetical final demand.

$$\text{PIB}_s^* = v_s(I - A^*)^{-1}Y^*i \tag{6}$$

Following the same logic, the value-added in exports (DVA) from "s" to "r" is the result of the difference between current GDP and GDP calculated using the hypothetical extraction technique.

$$\text{DVA}_s = \text{PIB}_s - \text{PIB}_s^* \tag{7}$$

The methodology proposed by Los, Timmer and De Vries (2016) is interesting to evaluate the DVA embedded in all trade, since part of the matrix A of subnational technical coefficients and part of the final demand are zeroed, where direct sales are recorded for all elements of the final demand of the destination State, including international exports.

However, given the role of the state of São Paulo in Brazilian international trade, a specific analysis of international exports is necessary. Part of the inputs used in the production of goods exported to other countries by the state of São Paulo is acquired in other states. In this way, a proportion of the value-added created from São Paulo's international exports is generated in other UFs. To analyze this relationship, the decomposition of the value-added by each UF linked to the international exports of each State will be used, described in the next subsection.

### 3.1 Composition of the value-added according to the origin of the final demand

Initially, exports were separated from the other elements of the final demand, in order to measure when the DVA of each UF is linked to the international exports of each UF. For Guilhoto, Siröen and Yucer (2013), the decomposition of value-added can be a more efficient measure than total production to understand the reflection of trade on the growth of regions.

Taking into account that the final demand (Y) encompasses domestic (v) and external (e) demands, it is possible to decompose the VA by pre-multiplying the

inverse Leontief matrix by the diagonalized Value-added Coefficient (VAC), which corresponds to the VA divided by the total production.

$$VA^1 = BCVA^{11}(v^{11} + \cdots + v^{UF1} + e^1) + \cdots + BCVA^{1UF}(v^{1UF} + \cdots + v^{UFUF} + e^{UF})$$
$$\vdots \qquad\qquad\qquad \vdots \qquad\qquad\qquad\qquad \vdots \qquad (8)$$
$$VA^{UF} = BCVA^{UF1}(v^{11} + \cdots + v^{UF1} + e^1) + \cdots + BCVA^{UFUF}(v^{1UF} + \cdots + v^{UFUF} + e^{UF})$$

The term BCVA is the element of the Leontief Inverse matrix multiplied by the diagonalized VAC. Thus, enabling the calculation of the proportion of value-added of each State that is linked to the demand generated by itself, by the other federative units specifically for export (e).

The same Brazilian interregional input-output matrices are used for the years 2008 and 2013 built according to the SUIT methodology presented by Guilhoto et al. (2019).

Given the importance of the state for the national economy, in the two methodologies presented, São Paulo is used as a reference, that is, the percentages of São Paulo value-added that are present in exports to other states and abroad are obtained, as well as the amount of value-added from other states linked to their exports to São Paulo.

## 4 Results and discussions

For better organization, the results were segmented into three sections. The first presents the results obtained when performing the hypothetical extraction of sales from São Paulo for the rest of the states. Next, the results obtained by hypothetical extraction of sales from other UFs to São Paulo are presented. The third section brings an analysis of São Paulo's international trade, in order to identify the composition of the value-added of each UF present in São Paulo's international exports and the composition of the value-added of São Paulo present in the exports of the other UFs.

### 4.1 Hypothetical extraction of sales from São Paulo to the other UFs.

The same Brazilian interregional input-output matrices are used for the years 2008 and 2013 built according to the SUIT methodology presented by Guilhoto et al. (2019). The difference between the GDP of the state of São Paulo, when sales from São Paulo to each of the other states are eliminated, and the real GDP of the state of São Paulo represents when the economy of São Paulo is linked to exports to the other UFs. The greater the difference, the greater the importance of the State as a claimant of São Paulo's production.

Graph 3 shows the percentage decrease in São Paulo's GDP when the state stops selling products to each of the other states in 2008 and 2013, which reflects the share of each state in São Paulo's GDP. It is observed that the largest reductions in São Paulo's GDP are due to the extraction of trade with Rio de Janeiro, Minas Gerais, Rio Grande do Sul, Paraná, Bahia and Santa Catarina.

Graph 2 – Percentage reduction in the GDP of the State of São Paulo given the hypothetical extraction of trade with each State in 2008 and 2013.
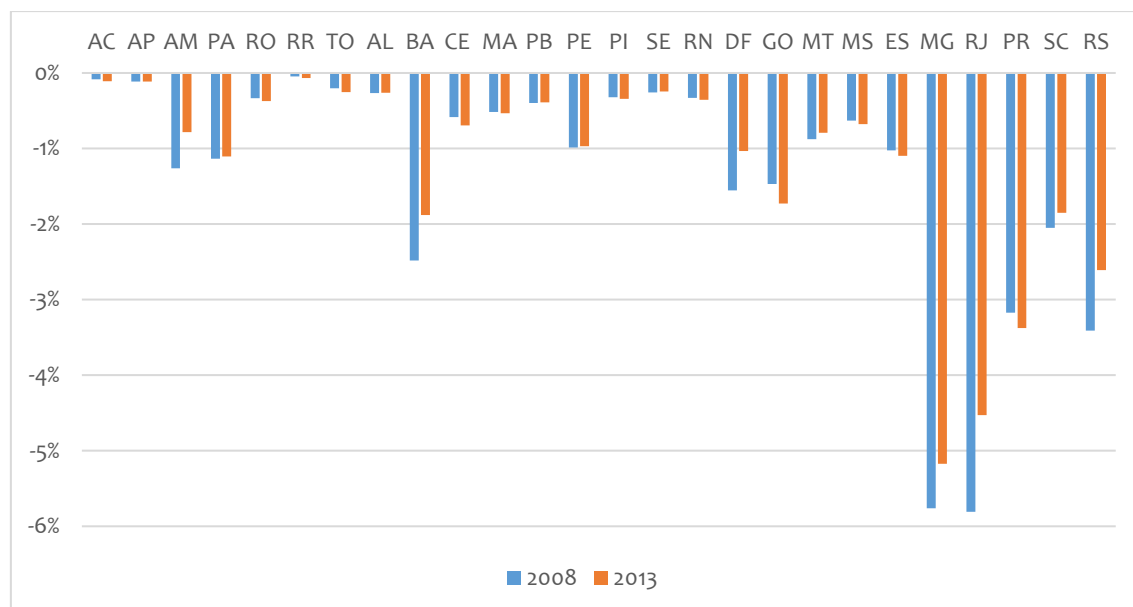


Source: Authors (2022).

Starting the analysis by the Southeast Region, regarding the expressive participation of the states of Rio de Janeiro and Minas Gerais in the São Paulo GDP, it can be inferred that this occurs due to logistical factors, since the proximity of São Paulo to these UFs directly influences their commercial flow. In addition, the relevance of these states in the national economy is evident, especially concerning their participation in the country's GDP. However, it is observed that for the analyzed period, both Minas Gerais and Rio de Janeiro had reductions in the share of São Paulo's GDP.

The state of São Paulo was removed from Graph 3 to provide a better visualization of the data, however, a percentage of 78.75% was obtained in 2008 and 80.99% in 2013, which indicates an increase in the percentage of the state's GDP linked to its own production. Consequently, it is noted that most UFs showed reductions in their percentages of participation in the GDP of São Paulo from 2008 to 2013. It can be inferred that São Paulo decreased its dependence on purchases from other regions in the analyzed period and horizontalized its production.

Regarding the South Region, the state with the highest participation in São Paulo's GDP in the analyzed period was Paraná, which occupies the third position, followed by Rio Grande do Sul and Santa Catarina, which occupy the fourth and sixth positions, respectively. Among them, only the state of Paraná had an increase in the share of São Paulo's GDP considering the years 2008 and 2013, and the other states mentioned had a drop in their representativeness. This can be explained by the increase in sales from São Paulo to Paraná in the period, adding the values of the interregional input-output matrix that represents this transaction in 2008 and correcting the values for 2013. Using the IPCA - Extended National Consumer Price Index, there was an increase of 35.63% in the period. The sectors with the most significant growth were (i) Oil, coke and alcohol refining; (ii) Transport equipment (iii) Electricity; and (iv) Transportation.

Among the UFs in the Northeast region, Bahia stands out, which occupies the fifth position among the UFs with the highest representation in São Paulo's GDP. The other states in the Northeast region had a small share of São Paulo's GDP. Bahia's performance can be explained by the fact that it is the Northeastern state with the highest percentage in the Brazilian GDP. The largest trade sectors between São Paulo and Bahia are (i) Transportation Material; (ii) Metallurgy; (iii) Chemicals and pharmaceuticals; and (iv) Petroleum, coke and alcohol refining.

The UFs of the Northern Region, in general, represent a small part of the national GDP, as well as having a small share in the São Paulo's GDP, with emphasis on Amazonas and Pará. It can be inferred that one of the factors that lead Amazonas to stand out regionally in the acquisition of São Paulo products is the Industrial Pole of Manaus.

In the Midwest region, it is observed that Goiás and Mato Grosso do Sul were the only states that had an increase in the share of São Paulo's GDP in the analyzed period. Some factors that may have contributed to this were the increase in exports and the diversification of its export agenda, since for this the region needed inputs from São Paulo. According to data from the Ministry of Industry, Foreign Trade and Services – MDIC (2022), the region had significant increases in its export of industrialized, semi-manufactured and manufactured products.

## 4.2 Hypothetical extraction of sales from other states to São Paulo

This section presents the results obtained when hypothetically the other UFs interrupt their sales to São Paulo. The difference in the GDP of each UF, when sales to São Paulo are suppressed, represents how much of the GDP of these UFs is linked to exports to São Paulo. The greater the difference, the greater the importance of São Paulo as a demander of the production of the other UFs.

Graph 4 shows the percentage reductions in GDP of the other UFs, extracting sales to São Paulo. It is noted that, in general, the reduction in the GDP of the other UFs, when they stop selling to São Paulo, is a higher percentage than the reduction of São Paulo when it stops selling to other UFs. This may indicate a greater dependence of the other UFs on the State of São Paulo than vice versa.

However, the dependence of the other UFs in the state of São Paulo may be decreasing, since most of the UFs had a reduction in the percentage of their GDP linked to São Paulo in the analyzed period. This greater independence of the other UFs in relation to São Paulo may be occurring due to the fact that the UFs are directly exporting their products abroad, without passing through São Paulo. According to MDIC data (2022), there was a real increase in dollars in exports from 18 of the 27 UFs in the analyzed period.

Graph 3 – Percentage reductions in the GDP of the UFs without sales to São Paulo.
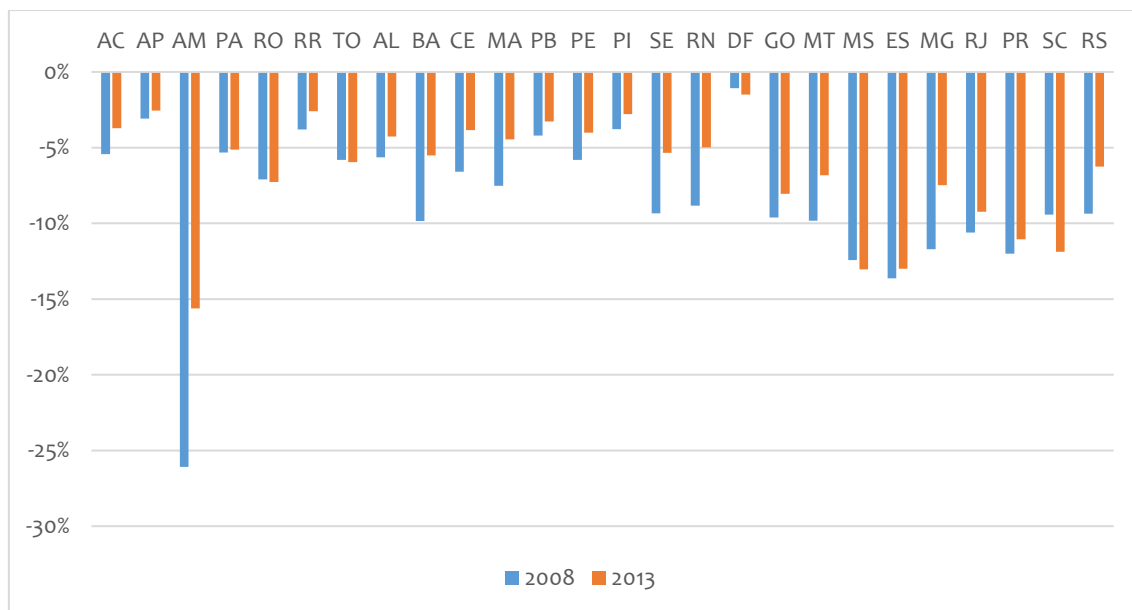


Source: Authors (2022).

In relation to the Southeast region, it is worth highlighting that, according to Chart 3, Minas Gerais obtained reductions in its GDP of 11.72% in 2008 and 7.48% in 2013, when sales to São Paulo were suppressed.

Minas Gerais achieved an accumulated GDP growth of 15.3% between 2010 and 2013. Although the State's economic performance was favorable, the percentage of its GDP that is linked to sales to São Paulo fell. Analyzing the composition of Minas Gerais' GDP, in 2010 the manufacturing industries represented 17.1% of MG's GDP, the extractive industry 5.7% and construction 6.6%, however, in 2013 the representativeness of the manufacturing industry fell to 13.5%, while the extractive industry rose to 7.5% and the construction industry to 7.3%.

In the period between 2008 and 2013, sales from Minas Gerais to São Paulo were strongly linked to the sectors of metallurgy, chemicals and pharmaceuticals, rubber and plastic articles, as well as financial intermediation and insurance. Thus, it can be inferred that the reductions in sales from MG to the state of São Paulo are mainly linked to the decrease in the share of the manufacturing industry, especially regarding the aforementioned sectors in the Minas Gerais GDP.

In regard to the Southern Region, the only UF that showed a percentage growth in its GDP linked to sales to SP was Santa Catarina, with an increase of 2.45 p.p. (percentage points); Paraná and Rio Grande do Sul showed a decrease in the share of São Paulo in their respective GDPs.

In the Northeast Region, the reductions in São Paulo's share of GDP for the states of Bahia stand out, which when it stops selling to São Paulo in 2008 has a reduction in GDP of 9.85%, while in 2013 this reduction is 5.51%. And Sergipe, which in turn shows reductions from 9.34% to 5.35%.

Bahia had a drop of 4.34 p.p. in the share of its GDP linked to sales to SP between 2008 and 2013, one of the factors that may have contributed to the result was the State's economic performance, which in the analyzed period went from 8th to 10th economy among the UFs. According to the Superintendence of Economic and

Social Studies of Bahia (SEI), 2013 was an extremely difficult year for the state. Therefore, it is believed that the reduction in sales to São Paulo did not occur in isolation, but a reduction in sales in the state in general.

Regarding the North Region, the only UFs that showed a percentage growth in their GDP linked to sales to SP were Rondônia (0.18 pp) and Tocantins (0.14 pp). The other UFs obtained reductions in the percentage of GDP linked to sales to São Paulo in the analyzed period, among the most significant are Amazonas, which - when sales to the state of São Paulo were suppressed in 2008 - has a reduction in GDP of 26.09%. In 2013, this reduction is 15.62%.

Amazonas was, among all the states, the one that presented the greatest reduction in the share of sales to SP in GDP. Much of the state's value-added generation is centralized in the city of Manaus, which alone represented almost 77% of the state's GDP in 2013, according to IBGE data. This is largely due to the Industrial Pole of Manaus - PIM, the main supplier of the Manaus Free Trade Zone - ZFM. Therefore, it can be inferred that the impacts on the ZFM and PIM may have directly influenced the results related to this state, presented in Graph 4.

According to data from the Ministry of Industry, Foreign Trade and Services, in 2013 the state of Amazonas had a drop in international imports of 96 million dollars, about 12.9%, compared to the previous year. In addition, PIM revenue showed an unstable behavior in the first decade of the 2000s, oscillating between peaks and falls, and despite having grown by 1.1% in 2013, it suffered significant reductions in 2009 (13.4%) and in 2012 (10.5%). This may have influenced the share of sales to São Paulo in Amazonian GDP, since falls in international imports are related to a decrease in production and a consequent drop in sales.

In the Midwestern Region, two UFs showed an increase in the percentage of their GDPs linked to sales to São Paulo, the Federal District (0.42 pp) and Mato Grosso do Sul (0.61 pp). This may be strongly linked to the sale of agricultural commodities, which has part of its processing carried out by the state of São Paulo.

It is worth mentioning that the basis for calculating the participation of other UFs in the GDP of São Paulo was always the same, that is, the GDP of the state of São Paulo (Graph 2). However, to calculate the participation of São Paulo in the GDP of other states, the percentages are estimated using the GDP of each state as a basis (Graph 3).

Thus, it is important to be careful when interpreting the results to avoid distortions when comparing the percentage of reduction in the GDP of the reference UF when sales to São Paulo are suppressed and of São Paulo when sales to other UFs are suppressed.

Although this type of comparison was not made at any point in the text, Table 1 can help to understand the problem. As an example, when analyzing the values for 2008, presented in Graph 2, São Paulo has a reduction of 0.085% of its GDP when it stops selling its products to Acre, however, the reduction of Acre's GDP without trading with São Paulo (Graph 3) is 5.42%. According to Table 1, in absolute terms, São Paulo suffered a reduction of R$702.39 million and Acre of R$335.67 million, although the absolute reduction suffered by São Paulo is practically double that observed in Acre, compared to São Paulo's GDP, this amount is relatively small.

Table 1 – Absolute reductions in the GDP of São Paulo without selling to other UFs and reductions in the GDP of other UFs without selling to São Paulo (BRL Million).

| Federative Units | 2008 | | 2013 | |
|---|---|---|---|---|
| | SP | Other UFs | SP | Other UFs |
| Acre (AC) | 702.39 | 335.67 | 1,540.70 | 388.19 |
| Amapá (AP) | 933.54 | 194.57 | 1,589.94 | 300.25 |
| Amazonas (AM) | 10,444.43 | 9,916.20 | 11,036.87 | 10,742.88 |
| Pará (PA) | 9,394.22 | 2,808.59 | 15,576.37 | 5,661.36 |
| Rondônia (RO) | 2,753.34 | 1,129.71 | 5,224.12 | 2,013.37 |
| Roraima (RR) | 377.89 | 171.00 | 967.06 | 217.32 |
| Tocantins (TO) | 1,666.68 | 692.18 | 3,557.81 | 1,288.54 |
| Alagoas (AL) | 2,203.60 | 983.72 | 3,690.15 | 1,435.75 |
| Bahia (BA) | 20,529.53 | 10,385.61 | 26,528.31 | 9,794.50 |
| Ceará (CE) | 4,806.49 | 3,474.31 | 9,798.10 | 3,636.64 |
| Maranhão (MA) | 4,257.70 | 2,607.00 | 7,543.88 | 2,675.00 |
| Paraíba (PB) | 3,267.71 | 971.49 | 5,477.00 | 1,343.84 |
| Pernambuco (PE) | 8,136.58 | 3,492.62 | 13,686.19 | 4,840.11 |
| Piauí (PI) | 2,659.98 | 563.95 | 4,838.42 | 775.33 |
| Sergipe (SE) | 2,142.92 | 1,644.11 | 3,426.69 | 1,681.94 |
| Rio Grande do Norte (RN) | 2,732.01 | 1,977.41 | 5,033.71 | 2,285.45 |
| Federal District (DF) | 12,829.88 | 1,115.31 | 14,592.38 | 2,245.60 |
| Goiás (GO) | 12,140.84 | 6,331.77 | 24,397.30 | 10,743.14 |
| Mato Grosso (MT) | 7,243.70 | 4,643.27 | 11,195.49 | 5,345.18 |
| Mato Grosso do Sul (MS) | 5,217.85 | 3,464.80 | 9,587.05 | 7,970.38 |
| Espírito Santo (ES) | 8,473.81 | 7,566.05 | 15,465.15 | 12,666.21 |
| Minas Gerais (MG) | 47,639.62 | 28,752.15 | 73,066.74 | 32,012.98 |
| Rio de Janeiro (RJ) | 48,014.47 | 30,772.90 | 63,960.34 | 49,280.91 |
| São Paulo (SP) | 650,975.21 | 650,727.45 | 1,144,023.82 | 1,144,023.82 |
| Paraná (PR) | 26,221.69 | 18,574.35 | 47,692.22 | 31,711.97 |
| Santa Catarina (SC) | 16,928.68 | 10,080.98 | 26,145.41 | 23,928.10 |
| Rio Grande do Sul (RS) | 28,180.45 | 16,110.09 | 36,826.07 | 16,543.01 |

Source: Authors (2022).

In short, Graphs 2 and 3 and Table 1 present an overview of intranational trade, with São Paulo as the reference state. The hypothetical extraction of SP sales for each UF showed that, in general, the percentage of São Paulo's GDP linked to sales to the other UFs decreased. This demonstrates an increase in the representativeness of the internal value-added to the detriment of the value obtained through trade with the other UFs, since the value-added of the state of São Paulo generated internally increased from 78.75% in 2008 to 80.99% in 2013.

However, when observing the GDP variations of the other UFs when sales to São Paulo are suppressed, only 5 of the 27 UFs showed increases in the share of GDP linked to sales to SP in the period (Graph 3). This may indicate that, despite the heterogeneity of the Brazilian territory and its peculiarities, most UFs are becoming relatively less dependent on trade with São Paulo.

In general, the reduction in the percentage of the GDP of São Paulo linked to the other UFs, as well as the participation of the other UFs in the GDP of São Paulo may be linked to the increase in the participation of the services sectors in the total GDP, and the consequent decrease in the participation of the industry, between the years 2008 and 2013, both in the state of São Paulo and in Brazil.

Service sectors are less prone to trade, since much of their products are intangible, so they demand less raw material from other regions than manufacturing sectors. Thus, an increase in the participation of services can cause, relatively, trade to lose a share in the GDP of each State.

According to IBGE (2022), the share of services sectors in São Paulo's GDP went from 60.09% in 2008 to 65.35% in 2013. The industry went from 27.62% to 22.76% in the same period. Regarding Brazil as a whole, the percentage of GDP linked to services went from 50.73% in 2008 to 53.49% in 2013, and the participation of the industry decreased from 28.08% to 24.34% in the same period.

The results presented so far refer to the total trade of São Paulo with the other UFs and vice versa, since in the adapted methodology of Los, Timmer and De Vries (2016), part of the intranational trade matrices related to intermediate consumption and part of the final demand vectors, where international exports are, are zeroed. However, given the importance of São Paulo in Brazilian exports abroad, the next section analyzes only São Paulo's international trade, in order to identify the composition of the value-added of each State present in São Paulo's exports and vice versa.

## 4.3 International Trade

Tables 2 and 3 present a specific analysis of the value-added generated exclusively from international trade.

The input-output relationships between the other UFs and the state of São Paulo mean that part of the total value-added created from the international exports of the state of São Paulo is generated in other UFs, since SP buys inputs from the other UFs to produce goods that will later be exported. The share of each state in the total value-added generated by São Paulo's international exports is shown in Table 2.

Table 2 - Participation of each State in the total value-added generated by São Paulo international exports (R$ Million).

| Federative Units | 2008 | | 2013 | |
|---|---|---|---|---|
| | Value-added | Participation % | Value-added | Participation % |
| Acre (AC) | 47.8 | 0.04% | 23.71 | 0.02% |
| Amapá (AP) | 28.15 | 0.03% | 25.62 | 0.02% |
| Amazonas (AM) | 1051.24 | 0.96% | 777.39 | 0.60% |
| Pará (PA) | 439.88 | 0.40% | 570.88 | 0.44% |
| Rondônia (RO) | 167.98 | 0.15% | 113.78 | 0.09% |
| Roraima (RR) | 20,21 | 0.02% | 13.31 | 0.01% |
| Tocantins (TO) | 100.73 | 0.09% | 115.79 | 0.09% |
| Alagoas (AL) | 147.65 | 0.14% | 306.3 | 0.24% |

| | | | | |
|---|---|---|---|---|
| Bahia (BA) | 1285.24 | 1.18% | 749.28 | 0.58% |
| Ceará (CE) | 357.19 | 0.33% | 255.93 | 0.20% |
| Maranhão (MA) | 398.54 | 0.37% | 287.37 | 0.22% |
| Paraíba (PB) | 94.27 | 0.09% | 93.67 | 0.07% |
| Pernambuco (PE) | 447.48 | 0.41% | 459.16 | 0.36% |
| Piauí (PI) | 82.75 | 0.08% | 58.44 | 0.05% |
| Sergipe (SE) | 257.31 | 0.24% | 179.91 | 0.14% |
| Rio Grande do Norte (RN) | 293.12 | 0.27% | 205.93 | 0.16% |
| Federal District (DF) | 165.16 | 0.15% | 177.3 | 0.14% |
| Goiás (GO) | 753.56 | 0.69% | 989 | 0.77% |
| Mato Grosso (MT) | 611.77 | 0.56% | 434.91 | 0.34% |
| Mato Grosso do Sul (MS) | 425,98 | 0.39% | 772.79 | 0.60% |
| Espírito Santo (ES) | 1228.53 | 1.13% | 1412.1 | 1.10% |
| Minas Gerais (MG) | 3796.99 | 3.48% | 3095.09 | 2.40% |
| Rio de Janeiro (RJ) | 5189.13 | 4.76% | 5255.3 | 4.08% |
| São Paulo (SP) | 86518.82 | 79.33% | 107515.54 | 83.45% |
| Paraná (PR) | 2087.33 | 1.91% | 2321.38 | 1.80% |
| Santa Catarina (SC) | 1147.68 | 1.05% | 1280.5 | 0.99% |
| Rio Grande do Sul (RS) | 1916.57 | 1.76% | 1346.06 | 1.04% |
| TOTAL | 109061.07 | 100.00% | 128836.44 | 100.00% |

Source: Authors (2022).

Of all the value-added created by São Paulo's exports, 4.76% was generated in the state of Rio de Janeiro, other states with the highest participation are: Minas Gerais, Paraná, Rio Grande do Sul, Bahia, Espírito Santo and Santa Catarina. The greater participation of these states may be related to their weight in the national economy, since RJ, MG, PR and RS are the largest economies in the country after São Paulo, so SP acquires a large part of the inputs of these UFs.

Furthermore, of the 27 Brazilian UFs, only 5 had increases in the percentage of DVA linked to São Paulo's international exports, namely, Mato Grosso do Sul, Goiás, Alagoas, Pará and Tocantins. A common factor in these UFs is the production of commodities. Therefore, it can be inferred that the main inputs acquired by SP from these states to compose São Paulo's export products belong to agriculture and/or livestock. In addition, MS and TO are part of the 5 UFs that had an increase in the share of GDP related to intranational trade with São Paulo, as already presented in the previous section.

Consequently, it is observed that for 21 of the 27 UFs, the percentages of value-added generated domestically linked to international exports of SP had reductions in the period, as can be seen in Table 2. The most significant reduction was in Minas Gerais, with more than 1 percentage point, which can also be explained by the increase in the participation of mining industries in the GDP of MG, which are responsible for products that the state may be trading directly with other countries instead of using São Paulo as intermediary.

In the period under review, the percentage of value-added generated in the state of São Paulo itself linked to its international exports increased. This indicates that the state may be horizontalizing its production domestically, and thus

increasingly using its own resources in the production of goods for international export, from 79.33% to 83.45%.

When observing the percentage of the value-added of the state of São Paulo linked to its international exports, it becomes evident the importance of analyzing trade in terms of value-added and not the gross value exported. In 2009 about 20.67% of the value-added linked to São Paulo exports was generated in other states and although this value has decreased in 2013, it still represents more than 15% of the total value-added of São Paulo exports.

The other UFs also demand inputs from the state of São Paulo to produce goods that are later exported by them to other countries. Table 3 shows how much of São Paulo's value-added is linked to the demand of other states, specifically for export products. Furthermore, of the 27 UFs, 14 had an increase in the share of São Paulo's value-added resulting from their exports.

Table 3 - Value-added generated in São Paulo resulting from the international exports of each State ( R$ Million).

| Federative Units | 2008 | | 2013 | |
|---|---|---|---|---|
| | Value-added | Partic. | Value-added | Partic. |
| Acre (AC) | 3.58 | 0.00% | 8.44 | 0.01% |
| Amapá (AP) | 31.65 | 0.03% | 88.06 | 0.06% |
| Amazonas (AM) | 317.65 | 0.29% | 899.81 | 0.66% |
| Pará (PA) | 1418.01 | 1.30% | 1516.41 | 1.11% |
| Rondônia (RO) | 100.69 | 0.09% | 177.73 | 0.13% |
| Roraima (RR) | 2.53 | 0.00% | 4.37 | 0.00% |
| Tocantins (TO) | 34.62 | 0.03% | 114 | 0.08% |
| Alagoas (AL) | 129.59 | 0.12% | 117.32 | 0.09% |
| Bahia (BA) | 1622.9 | 1.49% | 1609.61 | 1.18% |
| Ceará (CE) | 153.46 | 0.14% | 293.56 | 0.21% |
| Maranhão (MA) | 267.5 | 0.24% | 235.07 | 0.17% |
| Paraíba (PB) | 38.1 | 0.03% | 36.43 | 0.03% |
| Pernambuco (PE) | 136.77 | 0.13% | 262.45 | 0.19% |
| Piauí (PI) | 19.52 | 0.02% | 52.81 | 0.04% |
| Sergipe (SE) | 19.8 | 0.02% | 41.78 | 0.03% |
| Rio Grande do Norte (RN) | 49.57 | 0.05% | 53.19 | 0.04% |
| Federal District (DF) | 66.75 | 0.06% | 90.48 | 0.07% |
| Goiás (GO) | 732.47 | 0.67% | 1607.22 | 1.18% |
| Mato Grosso (MT) | 1301.04 | 1.19% | 2601.2 | 1.90% |
| Mato Grosso do Sul (MS) | 355.36 | 0.33% | 983.69 | 0.72% |
| Espírito Santo (ES) | 1309.35 | 1.20% | 1188.17 | 0.87% |
| Minas Gerais (MG) | 4278.98 | 3.92% | 5811.75 | 4.25% |
| Rio de Janeiro (RJ) | 2767.48 | 2.53% | 2965.16 | 2.17% |
| São Paulo (SP) | 86518.82 | 79.19% | 107515.54 | 78.65% |
| Paraná (PR) | 3009.56 | 2.75% | 3729.05 | 2.73% |

| | | | | |
|---|---|---|---|---|
| Santa Catarina (SC) | 1239.43 | 1.13% | 1295.74 | 0.95% |
| Rio Grande do Sul (RS) | 3330.76 | 3.05% | 3410.68 | 2.49% |
| TOTAL | 109255.94 | 100.00% | 136709.71 | 100.00% |

Source: Author (2022).

As shown in Table 2, Minas Gerais, Rio de Janeiro, Paraná and Rio Grande do Sul were the most representative states. However, Minas Gerais, which had suffered the greatest reduction in Table 2, showed an increase in Table 3, from 3.92% in 2008 to 4.25% in 2013. In other words, the value-added of the state of SP was more dependent on exports from Minas Gerais, while exports from São Paulo have become less dependent on inputs acquired in Minas Gerais, as well as most other states.

According to the results presented in Tables 2 and 3, it is noted that the value-added generated by São Paulo's international exports is decreasingly linked to the demand of the other UFs and more focused on the state itself. However, when evaluating the percentage of São Paulo value-added linked to international exports from other Ufs, there is an increase in the period for most Ufs. That is, even though São Paulo is becoming more self-sufficient in the scope of international exports, the other states still do not follow the same path, at least when it comes to international trade.

In general, the results indicate a trend towards greater independence of São Paulo in relation to other Ufs, both in intranational and international marketing. Like most Ufs, some more than others are also becoming less dependent on São Paulo, at least in intranational trade. At the international level, this result cannot be confirmed.

## 5 Conclusion

The objective of this article was to identify the share of domestic value-added of the state of São Paulo linked to exports to other states and to other countries, as well as to determine what is the share of the value-added of other states linked to exports to São Paulo.

The results obtained indicated that, in the analyzed period, São Paulo relatively increased its independence in relation to the other UFs, both in intranational marketing and in the products purchased from the other UFs for its international exports. Just as most UFs - some more than others - are also becoming less dependent on São Paulo, at least in intranational trade.

In general, there was a reduction in the participation of São Paulo in the GDP of the other UFs, as well as a reduction of the other UFs in the participation of São Paulo's GDP. Therefore, it can be inferred that, in the analyzed period, the national economy was relatively less centralized in the state of São Paulo. Concomitantly, there was a possible horizontalization of the São Paulo production chain, and the consequent relative increase in the acquisition of inputs within the state.

It is also inferred that the apparent decentralization of the national economy in relation to the state of São Paulo occurred mainly due to two factors: (i) the increase in commercial relations between the other UFs to the detriment of São Paulo and/or (ii) the strengthening of the domestic market of these UFs, increasing the percentage of value-added produced domestically.

Another factor that may have contributed to the reduction of both the participation of São Paulo in the GDP of the other UFs and of the other UFs in the GDP of São Paulo is the increase in the participation of the services sectors in the GDP of São Paulo and in the national GDP. Services are less marketable than industrial products, so an increase in the participation of these sectors in the economy can promote a relative reduction in trade between UFs, as a proportion of GDP.

As far as international trade is concerned, São Paulo appears as the largest exporter among all UFs, regarding the total exported value. However, it was found that about 20% of the value-added linked to São Paulo exports was generated in other UFs, since São Paulo acquires inputs in these UFs to compose its products for export.

This finding reinforces the importance of evaluating the contribution of international trade in generating income for UFs, not by the gross value exported, but by the generation of value-added. The measurement of international exports by their gross value tends to overestimate the states that carry out the final sale of the product abroad, since when evaluated by the DVA, the real relevance of each State in Brazil's international exports becomes evident.

For future research, it is recommended to use other UFs as a reference, since, due to large regional differences, each UF can present a unique result in relation to the value-added linked to trade with the others.

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