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Tertiary industries' value-added as a linkage's engine: An interstate input-output application for Brazilian regions

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Abstract:

Tertiary industries' value-added have been considered an essential input for any production chain, as they have the potential to connect regions and services activities across networks. Moreover, spatially, services move more straightforward than the manufacturing of resource-based industries. This study estimates the interregional and inter-industry linkages regarding a set of services-related economic sectors and accounts for the trade in value-added (TiVA) measures, considering intraregional and interregional trade based on an interstate input-output application for Brazil. The main findings reveal that the poorest Brazilian states tend to lose linkages opportunities in services activities, remaining hostages to supply natural resources to production networks for subnational and foreign demand. On the other hand, the potential for gains from connections in the services' networks reveals greater spatial dispersion across regional hierarchies, increasing the concentration in large urban agglomerations. In this regard, the paper concludes that the connectivity potential of services at the intraregional level can be an essential starting point to promote innovative systems away from large urban areas in the wealthiest regions inside Brazil, potentially reducing value-added imbalances in internal geography trade flows.

Keywords: Tertiary activities; services trade; value-added trade; structural linkages; vertical integration; regional inequalities.

JEL Classification: R12; R59; C67.

El valor agregado de las industrias terciarias como motor de encadenamientos: una aplicación interestatal de insumo-producto para las regiones brasileñas

Resumen:

El valor agregado de las industrias terciarias se ha considerado un insumo esencial para cualquier cadena productiva, ya que tienen el potencial de conectar regiones y actividades de servicios a través de las redes. Además, espacialmente, los servicios se mueven de forma más sencilla que la fabricación de industrias basadas en recursos. Este artículo estima los vínculos interregionales e interindustriales con respecto a un conjunto de sectores económicos relacionados con los servicios y toma en cuenta las medidas del comercio de valor agregado (TiVA), considerando tanto el comercio intrarregional como interregional basado en una aplicación de insumo-producto interestatal para Brasil. Los principales hallazgos revelan que los estados brasileños más pobres tienden a perder oportunidades de vinculación en las actividades de servicios,

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quedando rehenes para suministrar recursos naturales a las redes de producción para la demanda tanto subnacional como extranjera. Por otro lado, el potencial de ganancias de las conexiones en las redes de los servicios revela una mayor dispersión espacial entre las jerarquías regionales, lo que aumenta la concentración en grandes aglomeraciones urbanas. En este sentido, el documento concluye que el potencial de conectividad de los servicios a nivel intrarregional puede ser un punto de partida esencial para promover sistemas innovadores fuera de las grandes áreas urbanas en las regiones más ricas dentro de Brasil, reduciendo potencialmente los desequilibrios de valor agregado en los flujos comerciales de geografía interna.

PALABRAS CLAVE: Actividades terciarias; comercio de servicios; comercio en valor agregado; encadenamientos estructurales; integración vertical; disparidades regionales.

CLASIFICACIÓN JEL: R12; R59; C67.

1. INTRODUCTION

Services have long been perceived as playing a secondary role in regional supply chain studies. The rise of fragmentation of production increased the value-added flows worldwide, with several implications for input-output (IO) linkages' opportunities and vertical integration among different industries (Atienza et al., 2018; Gereffi, 1994; Haddad & Araújo, 2020; Johnson & Noguera, 2012). In this topic, the economic literature has been focused on the national or firm-level analysis, with scarce evidence on the subnational interdependence on chaining different industries among tradable activities, understudying the role of value-added creation and transfers along with IO production networks (Baldwin & Robert-Nicoud, 2014; Koopman et al., 2014; Los et al., 2015). In an interdependent economic context, the structure of regional supply chains influences the ability of economic areas to generate value for local production chains (Arnarson & Gullstrand, 2022; Cuadrado-Roura, 2009; Nordås, 2018). Production networks have boosted the relevance of trade to regional development and the intensity of tradable services in local production networks' trade flows (Cuadrado-Roura, 2016; Ehab & Zaki, 2021; Francois et al., 2015; Miroudot & Ye, 2019; Villoria & Hertel, 2011). In this regard, the tertiary industries play an essential role in the firm's location decisions, given the spatial distribution of IO linkages (Amador & Cabral, 2016; Baldwin & Venables, 2013; Kierzkowski & Studies, 2016).

To provide evidence of the location of tertiary activity and its potential for interregional chaining, this paper estimates both backward and forward IO linkages of tertiary industries for different geographic scales, whit an application to Brazilian regional economy. In this regard, the spatial organization of tertiary-related networks is analysed, assessing the IO linkages and zooms-in on the role of tertiary services industries in local production networks among interregional and international spatial levels. Therefore, the study focuses on estimating the direct and indirect services-related trade flows in terms of value-added computed for different geographical scales – intraregional, interregional, and international. Value-added accounting allows us to understand the potential of regions and industries to contribute to the generation of value at the local level, which depends on the stage of specialized production and is the measure commonly adopted in supply chain studies (Johnson & Noguera, 2017; Koopman et al., 2014; Los et al., 2016; Miroudot & Ye, 2019). Besides the application of the IO framework, we further evaluate the potential of clustering industries across regional hierarchies based on spatial techniques using regional labour market data (Anselin, 2001; Dall'erba, 2009).

The mobility of production factors regarding the service's activities is an essential engine for dealing with location patterns across regional hierarchies as a matter of the strategic position of companies and local assets development opportunities (Cuadrado-Roura, 2013a, 2016; Gervais & Jensen, 2019). However, less attention has been paid to the geography of interdependencies of the tertiary activity to the rest of the industries in both theoretical and empirical ways. Most early studies were concerned with agriculture, manufacturing, or extractive industries, supported by the idea that the existence of services depended on these other significant categories of economic activity (Eaton & Kortum, 2002). However, the empirical evidence has been pointing that the production systems have become more geographically dispersed, with different stages of a given chain located at various places across spatial hierarchies (Beverelli et al., 2019; Imori, 2015; Suder et al., 2015; Zhong et al., 2021). In this regard, trade across domestic

(subnational) networks needs to gain empirical notoriety (Beverelli et al., 2019; Gereffi, 2019a, 2019b; Ponte et al., 2019;). Consequently, as the mobility of the activities of the service is different from other industries, the regional economic structure provides an essential analytical element in understanding the spatial patterns of linkages and the capacity of local economies to provide the necessary supply of services (Freytag & Fricke, 2017; Haddad & Araújo, 2020; Haller et al., 2014; Hansen et al., 2021; Kierzkowski & Studies, 2016; Oliveira, 2020; WTO, 2017).

For Brazil, despite the consolidated evidence regarding regional inequalities, there is a gap in identifying the role of tertiary industries' location on boosting the regional value-added creation and transfers along with multiscalar production networks (Barufi et al., 2016; Bohn et al., 2018, 2021; Tian et al., 2019). The need to advance in understanding the relevance of the services industries at the regional level was discussed by Cuadrado-Roura (2016), as the manufacturing or resource-based industries have a greater interest in regional development studies (Hansen et al., 2021; Hoekman & Shepherd, 2017). The relationship between the services sectors and Brazilian regional inequalities was pointed out by Azzoni & Andrade (2005), the productivity growth, regional dependency in selected tertiary sectors and interindustry interdependencies (da Silva & Perobelli, 2018). Recently, the role of services' value-added in exports was analysed by Haddad and Araujo (2020), revealing the potential for concentration for proving to global markets in some Latin American countries. In general, the empirical literature has highlighted the role of the Brazilian national economy in the supply of the services chain without observing the inter and intraregional dimensions of vertical integration.

Moreover, despite the untapped opportunities in a large country like Brazil, regional inequalities tend to be restricted to the dispersion of services-content in value-added, reducing the country's participation in more advanced production networks stages (Amador & Cabral, 2017; Aroca et al., 2018; Azzoni & Haddad, 2018; Haddad & Azzoni, 2017). At the subnational level, the regional inequalities between wealthy regions of the South and Southeast and the poorest regions of the North and West tend to drive the uneven prospects for regional development (Azzoni & Haddad, 2018; Haddad & Azzoni, 2017). Furthermore, concentration and regional economic specialization, especially in resource-based regions, raise doubts about supporting natural resource activities and enclave economies within the regional structure (Atienza et al., 2020). At the same time, Brazil is one of the economies with the lowest foreign value-added in its exports, implying opportunities for subnational networks (De Backer et al., 2018). The productive aptitude of Brazilian regions deals with a geographically demarcated structure of diversification and specialization (Haddad & Azzoni, 2017; Sanguinet et al., 2021; Silveira-neto & Azzoni, 2011), which influences the linkages between tertiary sectors and the rest of the local economic activity. In this sense, it is particularly relevant to understand the spatial patterns of chaining, as tertiary training tends to be intensely value-added, which impacts the extension of production networks and practices of regional development (Francois et al., 2015).

The IO linkages of service activities make it possible to add value to the vertically fragmented production process (Cheng et al., 2022; Pahl & Timmer, 2019). Therefore, in an economy with regional interdependencies, inequalities in the provision of services are a determining factor for factor mobility and spatially heterogeneous access to the tertiary activity (Haddad & Araújo, 2020). First, the trade in benefits depend on the reallocation of production or the movement of factors, as services are partially produced where they are consumed (Egger et al., 2017; Francois et al., 2015). For example, in developed subnational economic areas, specialized services may be provided to other peripheral regions through technology transfer, increasing regional disparities. There is evidence of service offshoring at the international level - relocating a company's business processes to a developing country where economic conditions are more advantageous. In countries with large areas and regional disparities, there is potential for this pattern to be replicated domestically. Second, some tertiary activities are based on the movement of consumers or traded goods, so tertiary activity needs to be developed with other industries, such as industry, agriculture, and the service sector (Kimura & Lee, 2006; Nordås, 2018). Both inter and intra industry vertical integration are a spatially non-blind component, as it is related to regional endowments and the ability of territories to offer and integrate relevant stages of adding value to local production (Arnarson & Gullstrand, 2022; Bohn et al., 2018). Accordingly, this paper contributes by adding empirical evidence on three mains aspects: First, we have advanced the inclusion of the sub-national perspective to understand spatial and industrial dependence patterns for both intraregional and interregional trade scope; second, we detailed

the hierarchies of services tertiary sectors in terms of trade in value-added locally identified; and third, we brief on the potential to clustering services' activities associated with the location preferences of companies.

This paper is organized as follows. Section 2 discusses the background theory and empirical literature. Section 3 provides a short characterization of value-added services activities in Brazil. Section 4 presents the empirical strategy. Section 5 shows the main results. The last sections present our conclusions.

2. Background

As changes in the economic structure towards services and the regional inequalities of the production networks of certain types of services began to attract more attention. The theoretical foundations of economic geography were consolidated by Christaller (1966), who developed a geographic theory to explain the size and location of cities based on the assumption that their primary function was to provide services to the surrounding areas. Other classical studies, such as Berry (1967), have supported Christaller's central place theory to explain the relationship between the characteristics of retail services and settlement patterns (Daniels, 1986; Marshall, 1982; Scott, 1985), mainly focused on the causes and consequences of variations in the way different types of services were distributed. These studies have been including different spatial scales of analysis, such as trade within and between cities, between regions within countries and globally. Overall, the spatial location is a problem in the context of market imperfections, as it directly affects the distance between input-output relationships, transport costs (Mason, 1985) and the unequal distribution of natural resources. Recently, greater importance has been given to the role of value-added trade between countries (Koopman et al., 2014; Los et al., 2016; Miroudot & Ye, 2019) and intra-industry (Davis, 1995; Francois et al., 2015; Gervais & Jensen, 2019; Haddad & Araújo, 2020; Tang et al., 2013), as the tertiary activity can increase the value of both the economy's goods and services production (Hummels et al., 2001; R. W. Jones & Kierzkowski, 2001; Luck, 2017; Spencer, 1996).

Tertiary activities are commonly considered intermediate inputs, playing a significant role in the interregional trade of the domestic supply chain (Hansen et al., 2021). Producer services may include transport, communication, insurance, financial and legal services, among others. On the one hand, the rapid growth of trade in goods accelerates the demand for producer services; on the other hand, the linkages between these services coordinate separate production stages (blocks) that can be located in different regions within a country. Some studies emphasize that such service activities have increasing returns to scale so that the growth of trade in goods influences the demand for services (Arndt & Kierzkowski, 2002; R. W. Jones & Kierzkowski, 2001). At the same time, the rising return to scale of service linkages tends to lower trade costs and coordination costs and thus increases trade in goods and fragmentation, which enhances trade in services (; Sun & Pang, 2017). These mechanisms contribute to understanding the regional development potential associated with providing services.

The role of service industries activities has been increasingly boosted by technological advances, implying changes in how companies operate, ongoing structural changes in national economies and societies and greater specialization in the capital, labour and occupations (Atienza et al., 2016; Koopman et al., 2011). In this regard, the tertiary sector has been considered an integral part of the functioning of local economies (Hoekman & Shepherd, 2017; Johns, 2021; Marshall, 1982). In addition, the emergence of a fragmented structure of production networks leads to different stages of processes taking place in different regions, pointing out the role of linkages between sectors, regions, and countries.

The production networks are consolidated across borders but have a subnational dimension forgotten by empirical studies (Coe et al., 2008, 2010; Fold, 2014; Parrilli et al., 2013). Moreover, restructuring through outsourcing and offshoring of tasks highlights the role of services widely used at different stages of the production process (Zhong et al., 2021). Consequently, the separation of production and the underlying embedded services become essential mechanisms for adding value to production and trade through inter-industry and inter-regional linkages: restrictions on trade and the concentration of production at the subnational level restrict the ability of companies to participate in value chains and connect with service activities (Blank et al., 2022; Francois & Hoekman, 2010).

A specific feature of tertiary activity is the ability to move geographically. Therefore, regional economic conditions to attract service activity become a determining factor in understanding the potential for linkages and local interdependencies (Francois et al., 2015; Freytag & Fricke, 2017; Jiang & Lin, 2020). Furthermore, in a regionally uneven productive structure, trade in different sectors is often influenced by relative costs and prices in the economy (Damijan et al., 2015; Haller et al., 2014). The classic Ricardian models point out the difference in production technology or productivity concerning the endowment of factors in different local economies. For tertiary industries, differences in country endowments consider homogeneous levels of labour and capital and differentiated factors (for example, skilled labour or human capital) into account. Other variables that affect the prices of traded products may also explain the origins of comparative advantage; these include technological changes, market imperfections, sector-specific structures, political environment, institutional quality, and demand-side considerations. Due to its intangible and non-storable nature, the trade in services becomes an essential element to be studied from an intra-regional perspective. It affects crucial decisions regarding companies' location and vertical integration (Gervais & Jensen, 2019; Jensen & Kletzer, 2005).

Three main aspects can explain the patterns of regional location of tertiary activity. First, it depends on the location of consumers and the demand for services, which is not spatially neutral. Regionally, the industrial composition plays a governance role in value chains and is responsible for attracting tertiary activity with greater mobility than other industries (Cuadrado-Roura, 2013b; Daniels, 1986; Davis, 1995). Second, the interaction of different scales of geographic integration further induces the geographic patterns of linkages, determining the scope of intersectoral links (Mudambi et al., 2018). Regional economies may be self-sufficient in providing services necessary for generating intraregional wealth or depend on interregional or international supply. In this regard, the spatial patterns of IO linkages are affected both directly and indirectly and can be interregional and global across borders (Acemoglu et al., 2020; D. Lee, 2019). Third, industrial diversification of value chain integration can determine how well a region can meet the demand for services. In addition, economic diversification makes it possible to assess how they can offer services to intra-regional demand or other areas within the country, potentially increasing regional differences (Cuadrado-Roura & Maroto, 2016; Santos et al., 2009). Diversification of local production and exports can ensure self-sufficiency for regional economies against interregional or international competitors, thus offsetting local revenues and assets and promoting development. Notably, the relatively closed Brazilian economy (Perobelli et al., 2018) can be essential for understanding how regions can supply their value chains.

Recent advances show that intra-industry models shallow the role of intermediate goods, becoming an essential driver of linkages-based growth. The role of distortions in the input markets as an element of explanation for productive inequalities (Acemoglu et al., 2007; Ciccone, 2002; C. I. Jones, 2011). Locally, there is potential of win-win linkages among regions within national borders, pointing out the need to measure connections' size and location, geographic scope, and quality. Moreover, the degree of exposure of regions to production networks is an important aspect of understanding the development from the linkages point of view (Hewings & Oosterhaven, 2015). In this sense, this article seeks to generate evidence of the location of tertiary activity and its potential for interregional linkages.

3. Brazilian regional tertiary industry's location

On both theoretical and empirical sides, the models and evidence on industrial locations have been pointed out in a secondary plan in the case of service activities. At the intra-regional level, the spatial analysis of service activity is relevant as it fundamentally depends on the spatial distribution of a country's productive centres (Baldwin & Ito, 2021). First, at the intra-regional level, territorial extension influences the distribution of both population and economic activity. The forces of agglomeration act as essential drivers for the attraction of support services to both the primary and secondary sectors. In Brazil, relevant structural characteristics influence the vertical integration of services to the rest of the regional industries, mainly due to its market size (in terms of the territorial area, population, and trade patterns), favouring the creation of complex internal production networks (Sanguinet et al., 2021). Second, the Brazilian economy is relatively closed internationally and specializes in exporting raw materials (de Backer et al., 2018; Perobelli et al., 2018).

Furthermore, subnational tertiary sector trade is relevant to national and regional economic development (Atienza et al., 2018, 2020; Atienza, Ronda-Pupo, et al., 2019). Third, the structural linkages between the tertiary sectors and the rest of economic activity have a preponderant geographic component. They influence the local capacity to add value to the production of goods and services (Haddad, Perobelli, et al., 2020). In Brazil, persistent regional disparities influence production location and the demand for support from tertiary industries, affecting the decision to verticalize companies (Haddad & Azzoni, 2017). The spatial concentration of diversified economies, mainly in the economic areas of the southeast and south of Brazil, contrasts with the specialization in natural resource industries in the northeast, Midwest, and part of the north of the country, influencing how local economies add value along the local production chains. In this context, it is relevant to analyse how local economies internalize linkages with tertiary industries, as they serve as strategic support for the aggregation of local value, influencing regional development trajectories.

At the subnational level, knowledge-intensive regions and strategic service provision tend to concentrate on economic agglomerations (Lüthi et al., 2013). As the process of innovation becomes spatially limited, the role of providing services in value-added through networks gains relevance (Mudambi et al., 2018). The increasing sophistication of the supply chain highlights the importance of interregional linkages. Linkages could capture impacts across the interdependency on the production system. There is more demand for intermediate services, which also highlights the potential of regions to increase their local capacities for systems with a higher level of technology, with implications for operating costs and competitiveness gains (Foster-McGregor & Stehrer, 2013; OCDE, 2013). Theoretical background on location decision argues in favour of communication costs and their effect on dispersed management activities from production. There exists a dispersion of activities with low value-added, whereas knowledge-intensive industries concentrate, functional hierarchies are key to explain this (McCann & Ortega-Argilés, 2015). Large urban agglomerations offer the best opportunities to promote new ways of service supply. The connectedness of these activities implies greater accessibility to transportation at the local level, increasing the servicification of cities (Villoria & Hertel, 2011). The outsourcing of specific activities has promoted the growth of knowledge transferring and linkages to foreign markets, which are gaining relevance in production networks (Cuadrado-Roura, 2009, 2013b, 2016).

In Brazil, service-related activities became the activity with the largest share of gross output (Table 1). These activities have been gaining relevance in creating value-added value, representing about 76% of the economy. The main activity is intangible, no storage. The production-distribution-consumption co-occurs. One of the main assets assumed by the demand is the quality associated with a high degree of heterogeneity. Interestingly, 76% of all gross production in services activities remains in Brazil, given the type of activity.

TABLE 1.
Industrial share in Brazilian Economy by large economic activities groups

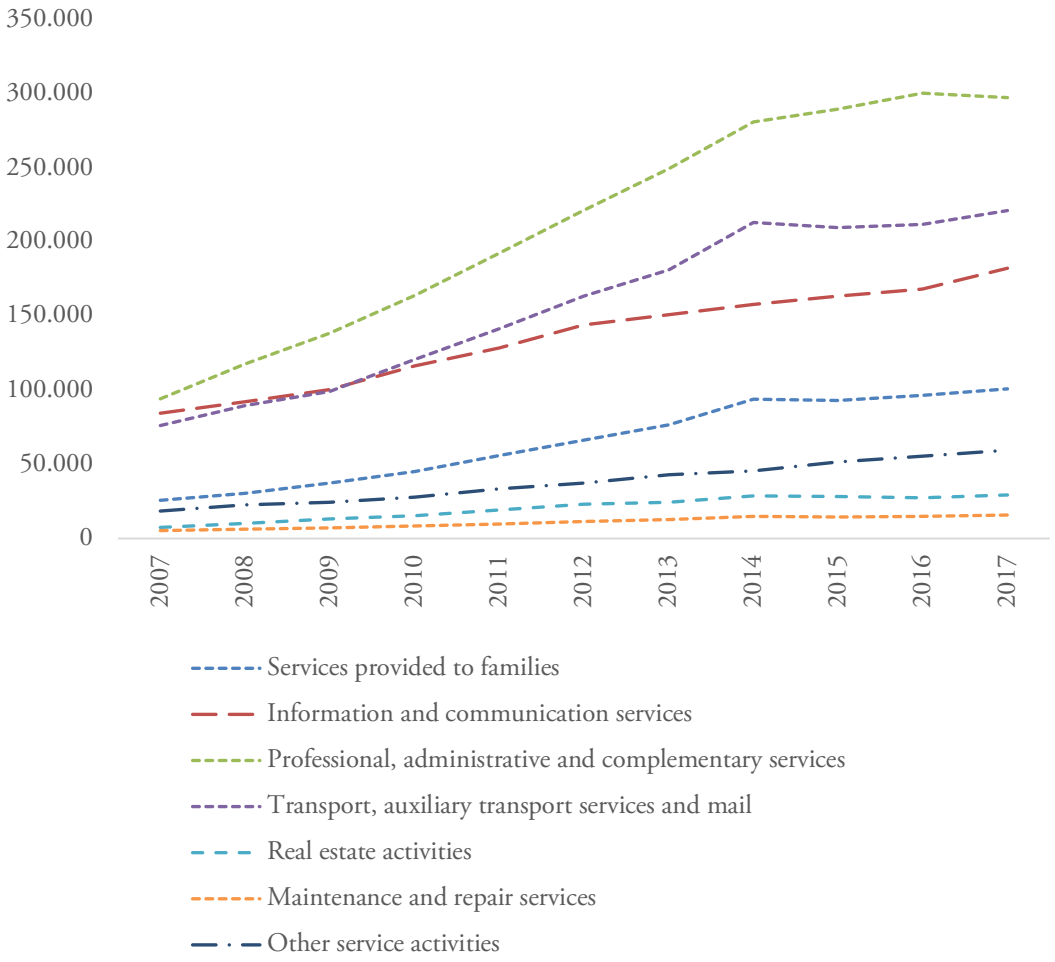
Large Industry Group	Gross Output	Value-Added	Exports
Primary sector	7.9%	9.5%	30.1%
Secondary sector	29.5%	13.9%	46.1%
Tertiary sector	62.5%	76.6%	23.8%
Total	100.0%	100.0%	100.0%

Source: Interstate input-output table for Brazil (Haddad et al., 2017).

Figure 1 shows the expansion of value-added tertiary sectors. There is heterogeneity in the composition of the economic activity. Production networks studies show the growth of the service sector as related to manufacturing performance, given the complementary relationship of economic activity. The rising share related to technical-professional services (non-real estate rentals and management, non-financial intangible assets, office services, and administrative and business support) shed light on the potential for taking-places in this type of sector. The location of business-support-related activities requires proximity to companies, where agglomeration environments are reinforced. Transportation services also

gain importance in the national value-added, indicating that transferring across regions has improved their economic representativeness, and thus follows the sector of Information and Communication Services. Accordingly, this type of activity is characterized by its potential to incorporate knowledge and technology into production and, consequently, into trade flows. A large proportion of its services trade is intra-industry, but Brazil has a concentrated, productive structure, unbalancing the opportunities for growth associated with intensity in value-added. The next section describes the empirical strategy for measuring services linkages at intra and interregional levels and value-added trade measures.

FIGURE 1.
Value-added services in the national economy (BRL millions)



Source: Authors based on Annual Services Survey (Brazilian Institute of Geography and Statistics, 2018).

4. METHOD AND DATA

To analyse the role of tertiary industries linkages at the subnational level, we have adopted a demand-driven IO model (Leontief, 1986). Our empirical strategy is divided into three steps. First, we calculate tertiary industry linkages at different spatial scales to provide insights into the geographic scales of vertical integration. Second, we evaluate the extension of production networks considering value-added trade measures, which allow the dimensioning of the role of tertiary industries in both intra and interregional trade, generating evidence on the geographic organization of networks between the tertiary sectors and the rest the economic activities. Finally, we downscale the spatial unit of analysis to identify spatial patterns of the location of service companies in the country based on Exploratory Spatial Data Analysis (ESDA).

To measure the tertiary activities linkages, let us first consider an interregional input-output model (IRIO) with J industries (labelled as i, j), R subnational regions (r, s), and U final demand components for domestic (U^r, U^s) and foreign (U^{RoW}) consumption, as shown by Figure 2. The final structure given to the data provides a comprehensive and consistent structural picture of the regional income accounting relationships between different sectors. The model is based on the general equilibrium fundamentals within a social accounting matrix (SAM) system, recording the interrelationships of a regional economy, including intermediate uses and final demand (Francois et al., 2015). For our purposes, the IRIO structure offers the advantage of linking consumption and interregional trade patterns to the interindustry structure of intermediate demand at the subnational (internal) level. The modelling allows us to comprehensively analyse the vertical integration of a set of services economic sectors and the value-added content embedded in trade flows.

FIGURE 2.
An interstate IO with *R* regions and *J* sectors

		Industry demand			Final demand				Total
		Region 1	⋯	Region R	Region 1	⋯	Region R	Foreign exports	
		Sector 1	⋯	Sector J					
Region 1	Sector 1	z_{11}^{11}	⋯	z_{1J}^{1R}	F^{11}	⋯	F^{1R}	e^1	x^1
⋮	⋮	⋮	z_{ij}^{rs}	⋮	⋮	F^{rs}	⋮	⋮	x^r
Region R	Sector J	z_{J1}^{R1}	⋯	z_{JJ}^{RR}	F^{R1}	⋯	F^{RR}	e^R	x^R
Foreign imports		z_1^{m1}	⋯	z_J^{mR}	F^{m1}	⋯	F^{mR}	$-$	M^{for}
Value-added		V_1^1	⋯	Z_J^R	Y^1	⋯	Y^R	0	Y^{nat}
Total		$x_1^{1\prime}$	x_i^S	x_J^R	$C^1\ I^1\ G^1$	⋯	$C^R\ I^R\ G^R$	E^{for}	

Source: Authors' elaboration based on (Hewings & Oosterhaven, 2015).

The fundamental relations in the traditional IO model are given by:

$$\mathrm{x} = \mathrm{A}.\mathrm{x} + \mathrm{y} \tag{1a}$$

$$\mathrm{x} = (\mathrm{I} - \mathrm{A})^{-1}.\mathrm{y} = \mathrm{B}.\mathrm{y} \tag{1b}$$

where **x** is the output, **A** is the intermediate input, **y** is the final demand, and **B** is the Leontief inverse matrix. Our approach is based on an interstate model, and the multiregional extension of these basic relative can be expressed as follows:

$$\mathrm{x} = \begin{bmatrix} \mathrm{x}^1 \\ \vdots \\ \mathrm{x}^\mathrm{R} \end{bmatrix}; \mathrm{A} = \begin{bmatrix} \mathrm{A}^{11} & \cdots & \mathrm{A}^{1\mathrm{R}} \\ \vdots & \ddots & \vdots \\ \mathrm{A}^{\mathrm{R}1} & \cdots & \mathrm{A}^{\mathrm{RR}} \end{bmatrix}; \mathrm{y} = \begin{bmatrix} \mathrm{y}^1 \\ \vdots \\ \mathrm{y}^\mathrm{R} \end{bmatrix}; \text{and } \mathrm{B} = \begin{bmatrix} \mathrm{B}^{11} & \cdots & \mathrm{B}^{1\mathrm{R}} \\ \vdots & \ddots & \vdots \\ \mathrm{B}^{\mathrm{R}1} & \cdots & \mathrm{B}^{\mathrm{RR}} \end{bmatrix} \tag{2}$$

Initially, we are interested in measuring the sectoral and regional interdependence of subnational value chains based on linkages indicators (backward (BL) and forward (FL)) from the Leontief matrix (Perroux, 1955; Hirschman, 1958). As these indicators are sensitive to the number of activities, we are weighting the measures by the average of the whole B matrix. We detail the effect of interregional and intraregional feedback, as discussed by (Miller & Blair, 2009). The exclusion of the Leontief diagonal blocks allows the measurement of interregional linkages isolating the spillovers between home and foreign

regions in the system. Accordingly, we estimated both backward and forward linkages of tertiary activities at the national and regional levels, computing interregional and intraregional spillovers.

The second stage considered the trade in value-added (TiVA) measures to understand the interplay between services activities and linkages patterns among Brazilian states from a multisectoral model. The method extended the spatial scope to measure the local content of tradable services in an interregional system (Chen et al., 2018; Haddad et al., 2020; Los et al., 2016). Furthermore, TiVA measures provide the idea that intermediate inputs can affect the production process other than the trade in final goods, leveraging the promotion of services linkages throughout the intra and interregional production networks. The latter focus on vertical specialization allows for identifying market opportunities to add more value to production and increase regional trade competitiveness (Feenstra & Kee, 2004; Gereffi, 2019b).

When the gross production flows associated with a particular level of final demand are known, value-added production and trade can be derived simply by multiplying these flows with the value-added to gross product ratio in each industry(Los et al., 2016). Compared to the traditional measure based on gross trade flows, TiVA can provide us with a much more detailed picture of the direct and indirect interaction of the regions along with the networks (Meng et al., 2017). By including the local value-added in trade, we can identify the regional hierarchies within networks. To estimate trade flows at the subnational level, we followed the work of Haddad et al. (2020), Meng et al. (2017) and Chein et al. (2018), which have extended the global flow model to the subnational scale. In particular, we are interested in estimating the value-added content of tertiary activities embedded in local production networks at different spatial scales. To do this, we regionalize Equation (1) as follows:

$$\mathrm{x}^{\mathrm{R}} = (\mathrm{I} - \mathrm{A}^{RR})^{-1}\mathrm{y}^{R} \tag{3}$$

where $\mathbf{x^r}$ $([r\ x\ n] \times\ 1)$ is the gross production of region r, $(\mathbf{I} - \mathbf{A^{rr}})^{-1}$ is Leontief's inverse of this region, and $\mathbf{y^r}$ is their final demand. The value-added needed to produce their final demand is given by

$$\mathrm{va} = \mathrm{diag(v)By}^{R} \tag{4}$$

where $\mathbf{va}$ is a matrix representing the value added by sector n and each region r, $\mathbf{diag(v)}$ is the diagonal matrix of row vector of the ratio between value-added by gross output. According to Meng et al. (2017), the measurement of a region's value-added induced by the other region's final demand' can be written as follows:

$$\begin{aligned}\mathrm{TiVA}^{\mathrm{RS}} &= \mathrm{diag}(\mathrm{v}^{R})[\mathrm{B}^{\mathrm{RR}}\mathrm{y}^{\mathrm{RS}} + \mathrm{B}^{\mathrm{RS}}\mathrm{y}^{\mathrm{SS}}] \\ &= \mathrm{diag}(\mathrm{v}^{R})\begin{bmatrix}\mathrm{B}^{\mathrm{RR}} & \mathrm{B}^{\mathrm{RS}} \\ \mathrm{B}^{\mathrm{RS}} & \mathrm{B}^{SS}\end{bmatrix}\begin{bmatrix}\mathrm{y}^{\mathrm{RS}} \\ \mathrm{y}^{\mathrm{SS}}\end{bmatrix}\end{aligned} \tag{5}$$

where $\mathbf{y^{RS}}$ is the foreign s's region and $\mathbf{y^{SS}}$ is the home region. This provides us with a measure of demand based TiVA. Therefore, at the industry level, we account for the TiVA induced in a specific sector j in region r by the final demand in region s as follows:

$$\begin{aligned}\mathrm{TiVA}_{\mathrm{j}}^{\mathrm{RS}} &= \mathrm{diag}(\mathrm{v}_{\mathrm{j}}^{\mathrm{R}})(\mathrm{B}^{\mathrm{RR}}\mathrm{y}^{\mathrm{RS}} + \mathrm{B}^{\mathrm{RS}}\mathrm{y}^{\mathrm{SS}}) \\ &= \mathrm{diag}\left(\mathrm{v}_{\mathrm{j}}^{\mathrm{R}}\right)\begin{bmatrix}\mathrm{B}_{\mathrm{ij}}^{\mathrm{RR}} & \mathrm{B}_{\mathrm{ij}}^{\mathrm{RS}} \\ \mathrm{B}_{\mathrm{ij}}^{\mathrm{SR}} & \mathrm{B}_{\mathrm{ij}}^{\mathrm{SS}}\end{bmatrix}\begin{bmatrix}\mathrm{y}^{\mathrm{RS}} \\ \mathrm{y}^{SS}\end{bmatrix}\end{aligned} \tag{6}$$

where the vector $\mathbf{v_j^R}$ represents the value-added coefficient for industry j in region r. We are interested in the r's outflow of j's sector from r to s, as $\mathbf{TiVA_j^{RS}} = \sum_{\mathbf{i}} \mathbf{TiVA_{ij}^{RS}}$. So far, it is possible to understand the roles of the regions and the links in subnational (intra and interregional) and transnational (foreign induced) networks in TiVA that extend to different geographical scales (Pike et al., 2011). For analytical discussions, of the total 68 sectors on the interstate system, we consider three large economic activity groups: primary sector (natural resources and unprocessed), secondary sector (manufacturing and transformation), and tertiary sector (services).

The last step incorporates the spatial dependence to look at the hierarchies of services' locations, based on the potential to urban clustering of companies. This study sought to use Exploratory Spatial Data Analysis (ESDA) (Anselin, 2001) to identify the distribution patterns of location, based on a weight matrix on the $k = 5$ nearest neighborhoods. Following Dall'erba (2009), we calculate the Moran's I statistic to measure global spatial autocorrelation of a variable (Anselin, 1995), which null hypothesis is that there exists spatial randomness. Therefore, rejecting this hypothesis indicates the existence of spatial association and global spatial autocorrelation, showing clusters of hotspots.

Using the Moran's I statistic as a base, we compute the Local Indicators of Spatial Association (LISA), which allows us to provide information about the geographic location and statistical significance of these clusters (Anselin, 1995). This local indicator makes it possible to identify areas with high and low spatial values and outliers and elements with no statistical significance (Anselin, 2001). The statistics can be interpreted as follows: positive values of I mean that there are spatial clusters with similar values (high or low); negative values mean that there are spatial clusters with different values between regions and their neighbours. The indicator classifies outliers as low-high and high-low, and clusters are classified as low-low and high-high (Chávez & Rodríguez-Puello, 2022).

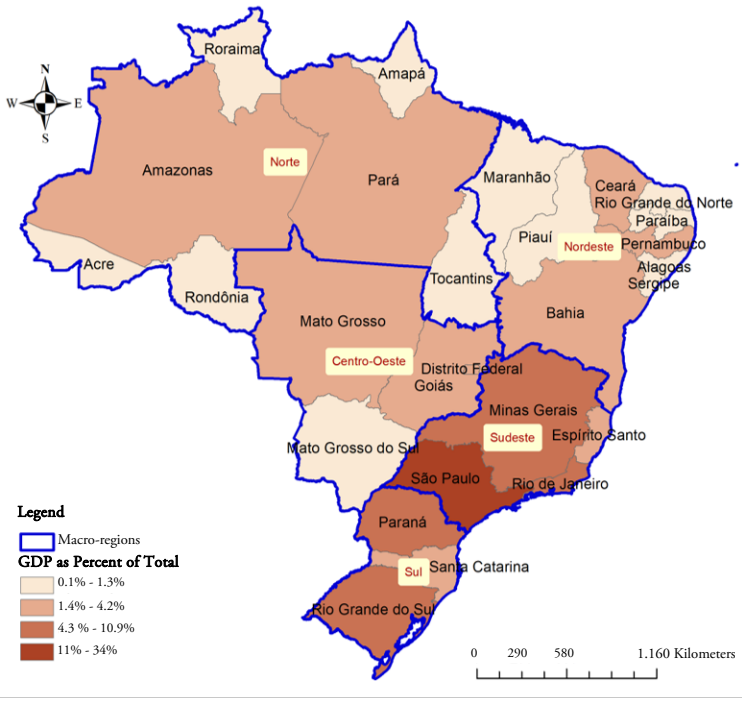
4.1. Data

We use an interstate *input-output* (IRIO) model constructed by the Regional and Urban Economy Lab of the University of São Paulo (NEREUS-USP) for the base year 2011 (Haddad et al., 2017) which contains 68 sectors[1] and 27 regions (Federative Units). Figure 3 shows the IO model's regional setting and indicates the hierarchies of distribution on regional GDP. Evidence in the IO suggests that tables represent interregional and interindustry dependence on the economic structure, which tends to maintain stability over time (Sanguinet et al., 2021). According to the literature, the fragmentation of production has modest changes over time, thereby facilitating the assumption that the economic structure is not considerably different along the time (Timmer et al., 2016). In this regard, the base-year 2011 is adequate to represent the economic structure of interindustry relations and, thus, interregional trade in Brazil. The terms of trade and the spatial distribution of production have not changed drastically in recent years. In this study, we use a public IO table esteemed by a respected research group on regional economics in Brazil available from Haddad et al. (2017).

To improve our knowledge about tertiaries industry's location, we further use the formal labour market data at the municipal level from the Annual Social Information from the Brazilian Ministry of Economy, to identify the potential to service companies' agglomerations. The gap between the wealthiest states of Brazilian Southeastern and Southern compared to the poorest regions of the North and Northeast are persistent over the decades. The concentration and inequality reveal the differentiated opportunities for creating local capacities to supply and production networks (Azzoni & Haddad, 2018; Barufi et al., 2016).

[1] The Annex I present the industrial structure of the model.

FIGURE 3.
Regional distribution of national GDP and regional setting of the model



State	Acronym	Macrorregion
Rondônia	RO	North
Acre	AC	North
Amazonas	AM	North
Roraima	RR	North
Pará	PA	North
Amapá	AP	North
Tocantins	TO	North
Maranhão	MA	Northeast
Piauí	PI	Northeast
Ceará	CE	Northeast
Río Grande do Norte	RN	Northeast
Paraíba	PB	Northeast
Pernambuco	PE	Northeast
Alagoas	AL	Northeast
Sergipe	SE	Northeast
Bahia	BA	Northeast
Minas Gerais	MG	Southeast
Espírito Santo	ES	Southeast
Rio de Janeiro	RJ	Southeast
São Paulo	SP	Southeast
Paraná	PR	South
Santa Catarina	SC	South
Rio Grande do Sul	RS	South
Mato Grosso do Sul	MS	Midwest
Mato Grosso	MT	Midwest
Goiás	GO	Midwest
Distrito Federal	DF	Midwest

Source: Authors based on Haddad et al. (2017).

5. RESULTS AND DISCUSSION

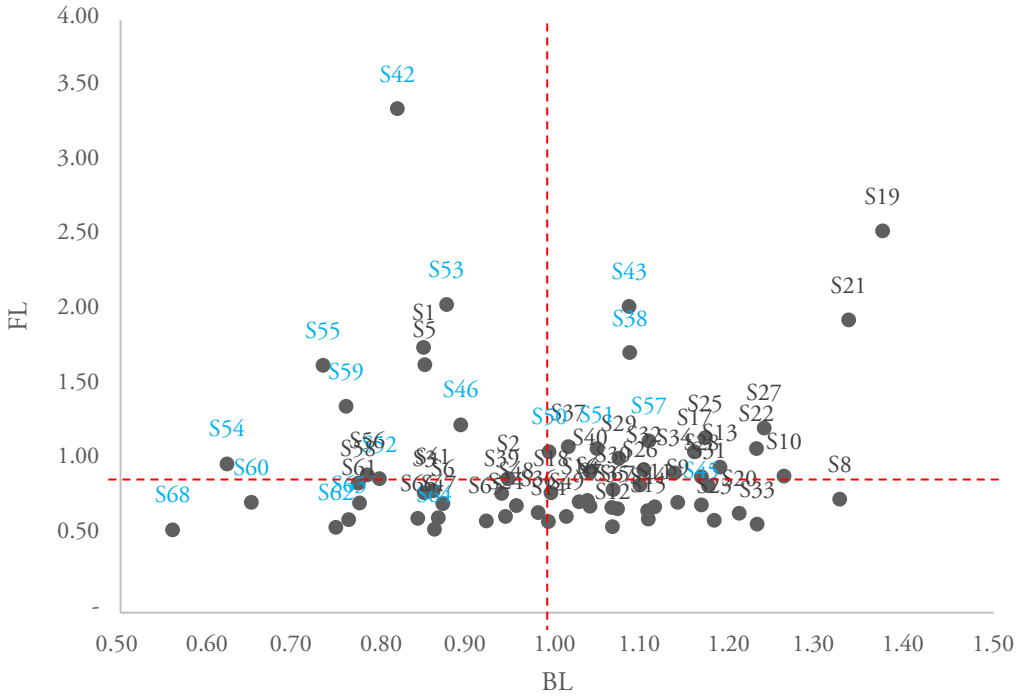
5.1. A LOOK AT THE INTERSTATE LINKAGES

Figure 4 shows the average BL and FL for all Brazilian states (sum of regional results), according to the 68 SCN sectors. A BL greater than 1 indicates the sectors are dependent on interindustry supply in the national production system, while FL is greater than the dependency unit on the interindustry demand side. The role of services in the sectorial interconnectivity in the country can be seen by BL and FL greater than 1, as S38 (Electricity, natural gas, and other utilities), S43 (Ground transportation), and knowledge-intensive business services like S51 (Telecommunications) and S57 (Other professionals, scientific and technical activities). These results suggest that sectors support the supply chain from other upstream or downstream activities. In addition, these service sectors make it possible to add value along with the production network, which is essential for strategies for generating wealth in the territories.

At the regional level, Figure 5 presents BL and FL indicators. Part (a) considers interregional chains, excluding intraregional spillovers, while part (b) considers self-induced effects. Specifically, the analysis considers the regional capacity to provide services necessary for the generation of the local gross product (self-influence) or if there is greater dependence on the supply of other regions (spillover effects). In this regard, the spatial dispersion in the degree of interdependence across regions is a crucial point to regional development based on services' linkages. The comparison between both figures reveals that the wealthiest states in the Southeast (Sao Paulo, Rio de Janeiro, and Minas Gerais) have greater self-influence when compared to the other poorer states, mainly associated with the market size. Northeastern and Northern states are more dependent on the supply of intermediate inputs, with greater BL than FL. The first orders on regional hierarchies see an opposite profile, clarifying the potential of intraregional linkages in these states. The hollowing-out process – process innovation contributes to growth by increasing the range of technologies that a less skilled worker can operate – can occur depending on regional specialization, which increases their demand for other industries (Atienza et al., 2019). In part (a), interregional feedback shows

that states with more diversified regional economies are at the top of the hierarchy, with FL superior to BL, revealing the potential for more pronounced networks inside the country.

FIGURE 4.
Linkages at the industry level (services in blue)



Source: Authors based on results, 2021.

Figure 6 shows the linkages according to the three sectoral groups, disaggregating the regional results presented in Figure 5. The regional hierarchy increases according to the linkage size in the manufacturing and tertiary industries due to the value-added generated by those large economic groups. The States of São Paulo, Minas Gerais, and Bahia present the largest chains ahead, revealing a dependence structure in the Brazilian interregional system. Three main findings are observed for the most prosperous regions of the country. First, they are self-sufficient regions to provide (supply) the productive linkages necessary to generate the regional gross product. Second, they are economic areas that can provide intermediate inputs to other regions (generally poorer and less diversified). Third, the bond of interdependence is stronger for tertiary activities - which are also the industries that contribute the most with added value. Finally, this finding suggests that the country's poorest areas, dependent on natural resources, have a less developed service delivery structure than rich and populated regions in the Southeast and South of Brazil. The three states in the Southeast (São Paulo, Rio de Janeiro, and Minas Gerais) and two others in the South (the Rio Grande do Sul and Paraná) present similar patterns to forward services linkages.

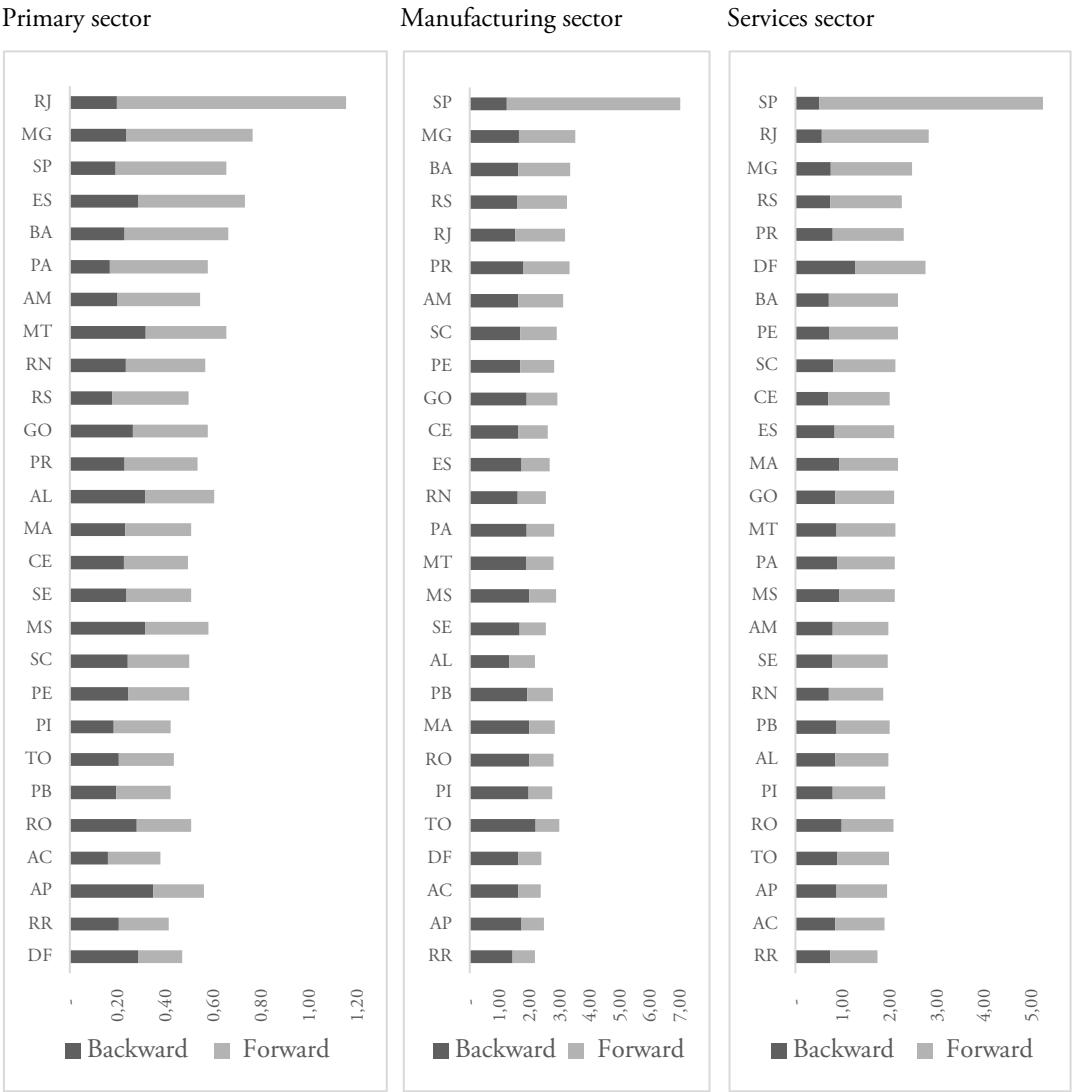
FIGURE 5.
Linkages at the subnational level (BL and FL)

a) Interregional spillovers

b) With intraregional spillovers

Source: Authors based on results, 2021.

FIGURE 6.
Decomposition of linkages by large groups sectors



Notes: The value of linkages increases as the level of interdependence in the intra and interregional supply chain increases.
Source: Authors based on results, 2021.

5.2. NETWORKS AT THE SUBNATIONAL LEVEL

From a subnational perspective, Brazil has an advanced productive integration profile. The national integration of global production networks is still small compared to other countries. The foreign value-added in Brazilian exports was around 17% in 2018 (Perobelli et al., 2018). Even though globalization has grown, this relative closeness pattern indicates the potential for geography-based networks at the subnational level. As shown in Table 2, a tendency towards intrastate concentration exists within the country. There is a high level of intraregional flows of value-added for each macro-region, indicating the role of proximity in creating geography-based networks. The wealthier Southeast states demand 52.0% of subnational TiVA, whereas the poorer North accounts for 6.1%. At the same time, it is interesting to note that interregional flows to the Southeast represent about ¼ of the value-added sales of each macro-region.

TABLE 2.
Macro-regions networks of value-added flows (relative share)

		Demand-side					Total
		North	Northeast	Southeast	South	MidWest	
Supply-side	North	69.30%	5.40%	16.70%	5.20%	3.40%	100%
	Northeast	2.40%	78.60%	12.70%	3.30%	3.00%	100%
	Southeast	2.50%	5.70%	78.90%	8.90%	4.00%	100%
	South	1.90%	3.90%	23.40%	67.30%	3.40%	100%
	MidWest	3.60%	6.30%	25.60%	6.80%	57.70%	100%
	Total demand	6.10%	16.00%	52.00%	17.10%	8.90%	100%

Source: Authors based on results, 2021.

Figure 7 shows the share of trade in value-added that is retained in the home state in part (a), and the interstate flows in part (b). Some Brazilian states of the North (Pará – PA and Amazonas – AM), Midwest (Goias – GO, Mato Grosso – MT, and Mato Grosso do Sul – MS), and Southeast (Espirito Santo – ES) have a low share of value-added retained in the home region. This aspect is associated with the companies' decision to spread their activities in space and has been discussed as a horizontal (market) or vertical (efficiency) strategic trend (Fold, 2014). The differences in productivity levels and costs associated with serving local (intraregional) markets than external (interregional or international) markets can be essential aspects of the increasing networks. The large subnational extension and the quality of infrastructure are associated with transport costs, as increasing levels of cultural, institutional, and geographical heterogeneity not only lead to lower levels of interregional investment (Beugelsdijk et al., 2009, 2010) but also to different search strategies for production efficiency. Taking-home decisions are associated with minimizing costs and economies of scale (Hewings et al., 1998).

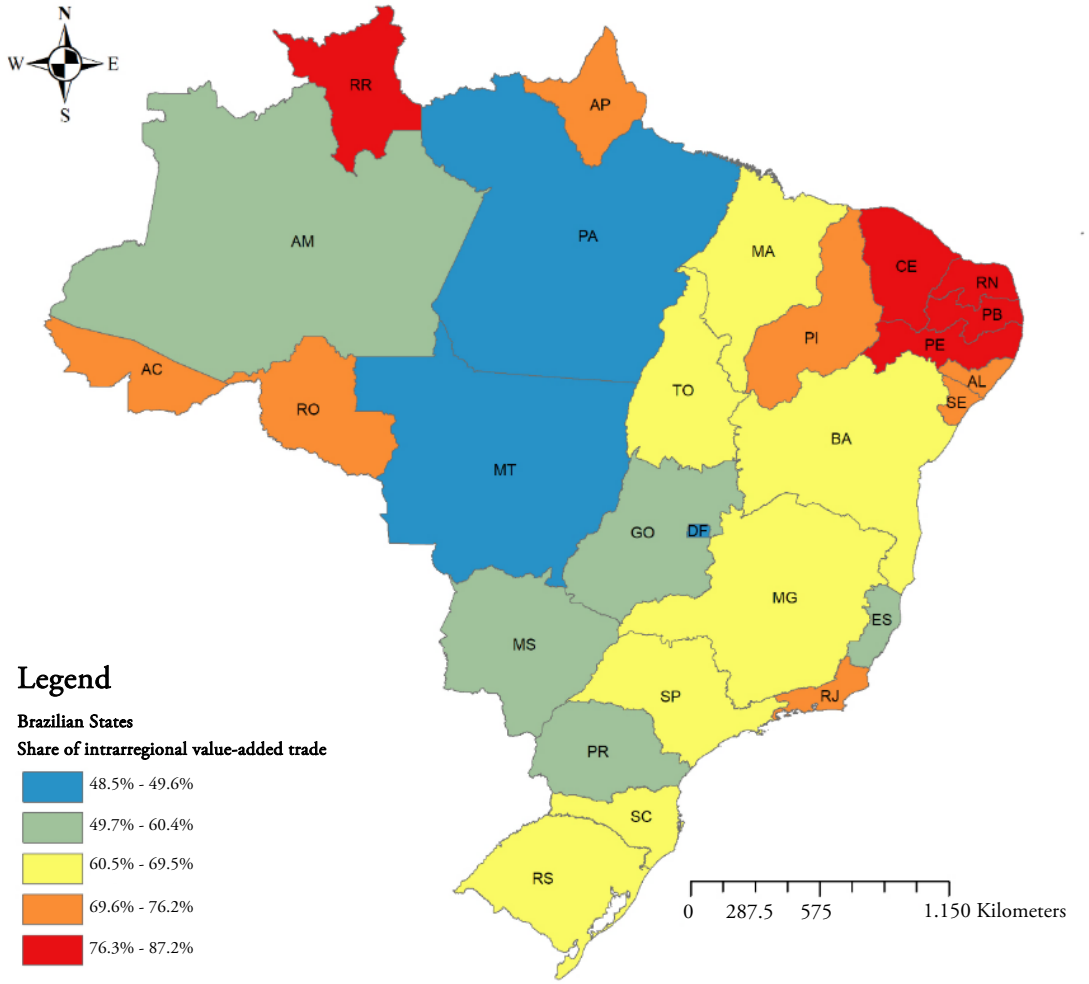
Outsourcing of intermediate inputs increases with the Brazilian regional hierarchy, as Sao Paulo concentrates most of the supply-side in networks inside the country (part b of Figure 7). This state is the largest buyer and supplier and their neighbour states. An intermediary supply level is seen in other states, especially those in the Southeast and those in the South. The remaining states are oriented to attend to home demand or become net importers from other countries. This is a consequence of the spatial pattern of the linkages analysed in the previous section.

Production networking induces changes in the industry location by improving or reducing internal linkages. Table 3 shows the TiVA for each macroregion and three large grouping sectors, considering the sum of columns and rows of the TiVA vector (Equation 6). The market size increases as the requirements for value-added reduce from the primary to tertiary sectors. In the North and Southeast, the value-added of primary sectors increases towards the international markets. No macro-regions have an intra-state orientation in primary industries, revealing an unequal supply of essential inputs processed outside regions. The geography of natural resources influences the location of agricultural and mining sectors.

In the manufacturing sectors, the geographic extension of the regional supply chain demonstrates a greater degree of spatial dispersion. The Northeast and Southeast are the only two macro-regions with more excellent intraregional absorption than the external demand, indicating a disconnected pattern. As far as the manufacturing sector is concerned, the place where these companies are located often depends on specific factors, such as the availability of essential resources or accessibility in any place or region, transport costs, labour supply, and agglomeration economies (Cuadrado-Roura, 2009). It can be noted that the Southern, Northern, and Midwestern states are more integrated with other regions within the country in these sectors, as shown by the largest share of TiVA to attend final foreign demand. Despite the higher value-added embedded by manufacturing, the wealthier Southeastern states tend to meet their need. This macro-region is more oriented towards manufacturing exports from the export-based side, although the Southeast is more representative in trade size.

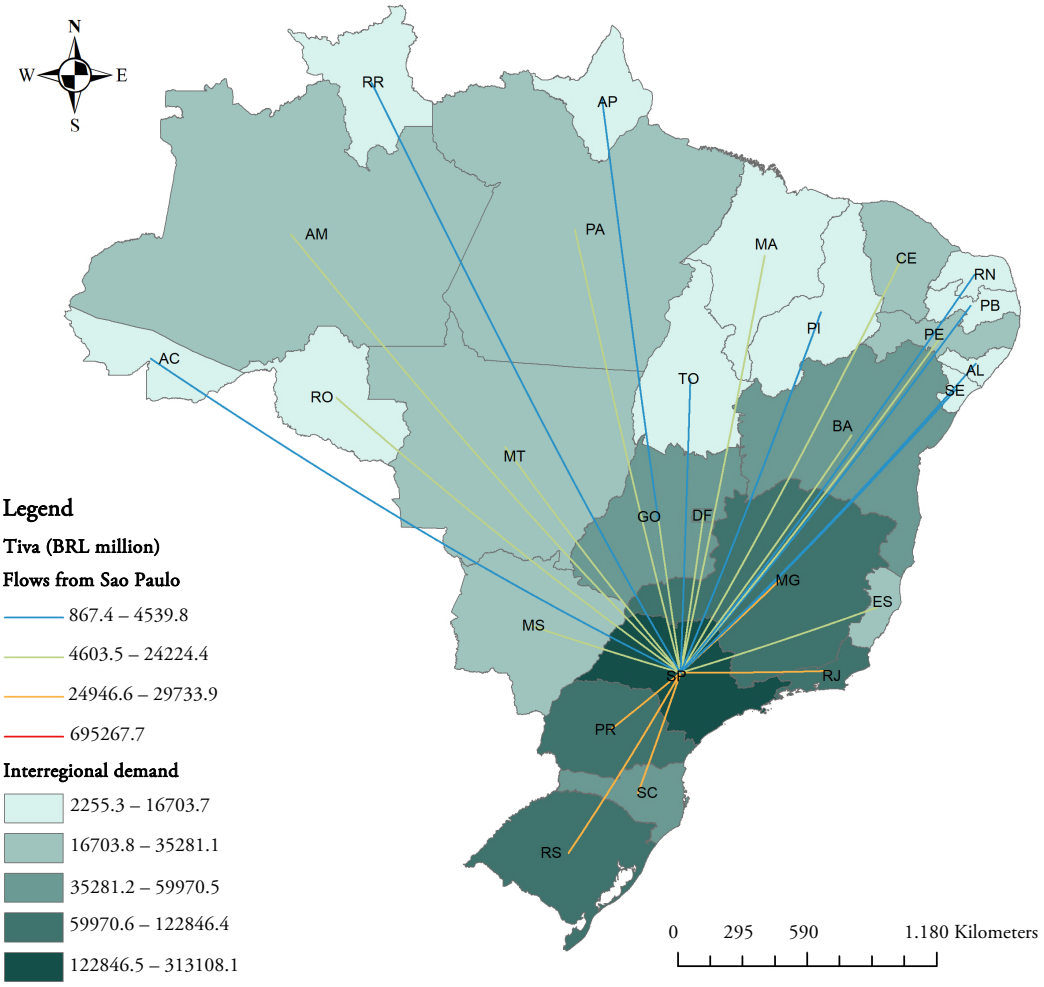
FIGURE 7.
Extension of networks (Intra and interstate relations)

a) Intrastate share



The role of services in value-added derive from the linkage structure shown in the last section. Services outsourcing is a form of functional fragmentation. increasing the density of transactions and linkages within an economy (Romero Luna et al. 2009). The overall impact of networks on the complexity of regional and national economic systems depends on the net effect of the distribution of services activities. The spatial-industrial configurations of the tertiary sector are strongly concentrated in Southeast states. representing 56% of total services in value-added from the whole economy. Sectoral patterns of innovation and the problems posed by the heterogeneity of companies (E. Lee & Yi. 2018; K. Lee et al.. 2018) can be determinants of the disconnection of more impoverished regions. Expressed in value-added. the contribution of domestic services is more outstanding than flows between states. There are more domestic services in all macro-regions than exported (interregional or international). It is interesting to note the size of the self-induced intraregional structure.

b) Interstate flows



Source: Authors based on results. 2021.

5.3. Zoom-in: Services in value-added inside the country

This section describes the nature and importance of tradable services at the regional level. whether to attend intraregional or external regions' demands. Figure 8 shows the hierarchies of services sectors in interregional TiVA. The commerce. finance. public administration. and real estate activities concentrate most of the services in value-added embedded across interstate flows inside Brazil. However. there is a relevant role in the service sector's potential to link activities of other types. associating it to the support. management. and physical interconnection of production. Therefore. many services have knowledge and skills that would be costly for verticalization. mainly for smaller companies (which are the majority in Brazil according to the National Companies Database. IBGE) with a tendency to co-location to consumer services.

Table 3.
Macroregional TiVA according to a large group of sectors

Origin	Primary sector			Secondary sector			Tertiary sector		
	Intrastate	Interstate	International	Intrastate	Interstate	International	Intrastate	Interstate	International
Midwest	4.271	19.482	12.692	7.212	15.098	3.921	172.667	97.682	13.425
	12%	53%	35%	27%	58%	15%	61%	34%	5%
Northeast	15.692	22.047	10.203	21.190	16.370	6.702	338.609	64.161	17.344
	33%	46%	21%	48%	37%	15%	81%	15%	4%
North	6.103	14.445	22.893	6.026	14.608	4.381	111.763	25.823	8.312
	14%	33%	53%	24%	58%	18%	77%	18%	6%
Southeast	60.871	38.224	75.552	165.228	93.895	52.885	1.201.877	251.640	120.781
	35%	22%	43%	53%	30%	17%	76%	16%	8%
South	12.485	23.562	13.928	35.049	64.642	18.590	311.785	87.393	26.321
	25%	47%	28%	30%	55%	16%	73%	21%	6%
Total TiVA	**99.421**	**117.760**	**135.268**	**234.705**	**204.614**	**86.478**	**2.136.701**	**526.699**	**186.184**

Source: Authors based on results. 2021.

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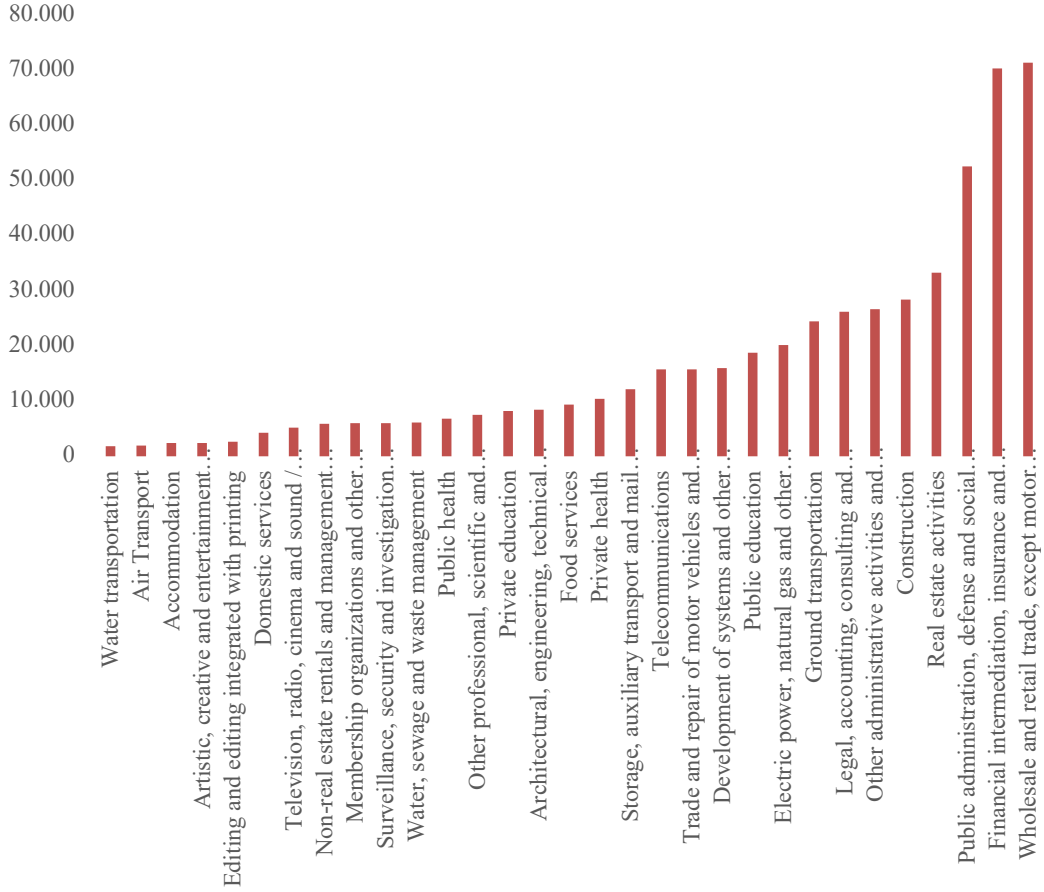
FIGURE 8.
Services in interregional VA flows (BRL million)



Source: Authors based on results. 2021.

Services operate in all stages of production. from conception until distribution. Nevertheless. the intensity of local value-added embedded into these steps differs considerably. As discussed. the creation and transfer of value-added are essential for regional development and the potential for linkages with other sectors and regions. directly and indirectly contributing to production and trade at the local level. The spatial organization of service provision is revealed by the hierarchical structure of the economic areas. where there is a high concentration of the provision of services incorporated into the interregional flows originating in São Paulo (Figure 9). Some of these service inputs are horizontal because they are necessary for any type of company in any value chain. In contrast. others are specific to certain value chains in the manufacturing sector. For example. financial services represent the largest share of supply from São Paulo to other states. There is a reproduction of international logic in business services. which explicitly distinguish between horizontal activities (consultancy. accounting. training) and vertical activities (investment research. risk analysis. insurance. etc.). Most of this group of activities does not require physical proximity between companies. where providers can take advantage of the economies of scale and agglomeration offered by the large urban centres of São Paulo.

The contribution of other states to the value-added service network is not negligible. The Southern. Southeastern. and Northeastern states also present proportionally similar (in size) and heterogeneous holdings in sectoral composition to domestic service networks. The complexity of regional economies can be assessed by assessing the content of services incorporated into production networks. To complement this zoom-in of services activities inside the country. we apply classical spatial clustering analysis based on services companies' locations. Specifically. we compute LISA indicators that show us the location and

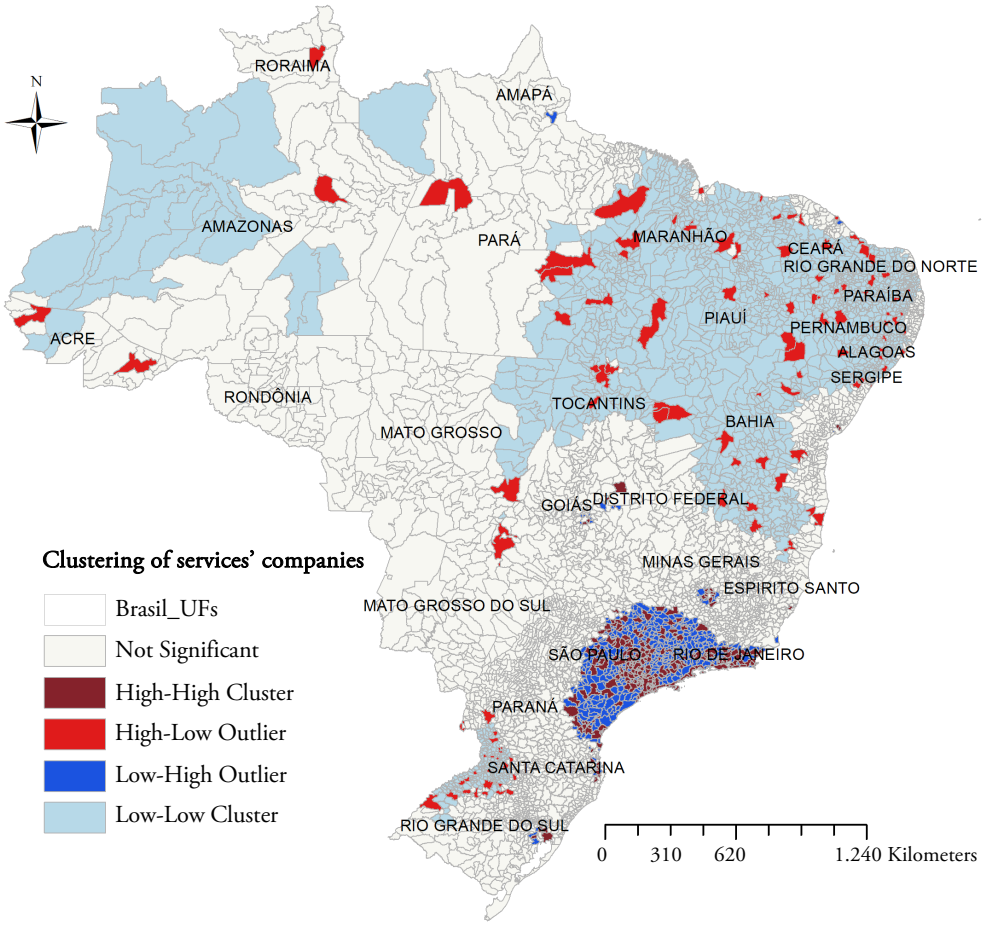
significance of clusters in the space. Numerous theories have been developed about the location decisions of firms. These decisions depend on several factors. including the availability of basic resources. transport costs. labour supply. and agglomeration economies (Cuadrado-Roura. 2013). In the case of firms in the service sector. the literature has found spatial concentration with the presence of specialized labour pools and externalities (Coffey & Polése. 1987; Haddad & Araújo. 2021).

This spatial concentration of services firms can be observed in Figure 10. which shows the LISA indicator for companies in the country and its statistical significance. Companies are strongly concentrated in the Southeast states. mainly Sao Paulo and Rio de Janeiro. In the previous section. we found that these regions are the prominent productive linkages. as well as greater supply indicators. The data presented allowed us to contrast how value generation in services is also concentrated in specific areas of each state. as it increases urban agglomerations. The application of a spatial autocorrelation test made it possible to verify this premise and reject the hypothesis that value chain formation occurs in spatially random regions. Service companies' spatial distribution reveals a positive trend towards clustering. as shown by the Moran's I local index. There is a positive tendency to clustering services companies in the largest urban areas. mainly in Sao Paulo and Rio de Janeiro. as well the Rio Grande do Sul and Federal District (Brazil's capital).

FIGURE 9.
Services value-added activities at the state's level. (BRL millions)

Source: Authors based on results. 2021.

FIGURE 10.
Local Moran's I test



Source: Authors based on results. 2021.

6. CONCLUSIONS

Spatial variations at the subnational level are evidenced in Brazil. in which the production networks' architecture has been considered an aspect-oriented to regional development. The mobility of production factors regarding the service's activities could be conceived as an essential engine for dealing with location patterns across regional hierarchies as a matter of the strategic position of companies and local assets development opportunities (Atienza et al.. 2020; Fold. 2014; Timmer et al.. 2019). Therefore. intra-country spatial variations become relevant mechanisms to enhance the competitiveness of the regions and promote structural changes that allow the generation of quality linkages.

Our interstate input-output application allowed us to capture the relative dimension of tertiary industries' linkages. pointing out the opportunities for regional growth. We found that the spatial patterns of services' companies imply unequal regional opportunities for promoting strong high-tech linkages. The business services can be considered a key point to increase local capacities to the creation of long-run connections. Therefore. the higher average productivity in agglomerations results in the selection of companies to prioritizing large urban concentrations.

The spatial impacts resulting from the distribution of services raise doubts about the role of clusters and agglomerations to promote regional convergence. The higher share of services-related activities on the total value-added created and transferred across networks indicates the potential of geographic proximity. Regional functional specialization can be considered the key to connectivity through service linkages. Policies linked to services content in trade lead to the removal of essential trade frictions. helping to increase competitiveness and productivity at the regional level. Logistical. transport cost and trade facilitation issues explain the increase in trade flows and dispersion of the potential of large distance services' linkages. However. on the intraregional scale. the role of services becomes relevant in Brazil. The servicification of activities is based on a horizontal strategy to companies' operations. and the ability of tertiary activities to relocate based on urban characteristics reveals a geography pattern inside the country (Hauknes & Knell. 2009; Zighan et al.. 2021).

Based on our results. the promotion of tertiary activities in peripheries areas towards diversification is interesting. The potential for the connectedness of services at the intrastate level can be an important starting point to promote innovative systems away from large urban areas in the richest Brazilian core regions. The experience of the Southeast in successful cluster services' sector is forwards related to the ability to move services supply chains. despite the non-dependency geography and resources-based to operate efficiently. The orientation towards the creation of agglomeration increases the potential for linkages at the subnational and international levels. becoming a powerful instrument for anchoring territorial development.

The study opens the way for research on the determinants and links between interindustry relations across services supply chains. The literature suggests that the advantages of location influence a region's ability to generate competitiveness and centralize the aggregation of value to production. However. it is notorious for examining how national production is shaped in inter-sectoral terms. where the present analysis allows us to show whether the production of export goods occurs entirely within the country. The supply of intermediate inputs and raw materials for the final product sold for other regions is based on the productive base at the national level. Inter-regional fragmentation. that is. the exchange of national production. plays a role when it focuses on the regions. Domestic verticalization is intimately linked to fragmentation at the international level. in which regional income trends have recently become more dependent on the extent to which subnational regions can contribute to value chains. The limitations of this analysis include the fact that we have not considered all the elements raised by the literature for the decomposition of the value-added and that the view to the sectors was not better evidenced. where it is possible to analyse the exports of the states towards the exterior.

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Annex

Table A1.
Industries of Interstate Input-Output Model for Brazil

Sector Code	Description	Industry
S1	Agriculture. including support for agriculture and post-harvest	Primary sector
S2	Livestock. including support for livestock	Primary sector
S3	Forestry production fisheries and aquaculture	Primary sector
S4	Extraction of mineral coal and non-metallic minerals	Primary sector
S5	Oil and gas extraction. including support activities	Primary sector
S6	Iron ore extraction. including beneficiation and agglomeration	Primary sector

TABLE A1. CONT.
Industries of Interstate Input-Output Model for Brazil

Sector Code	Description	Industry
S7	Extraction of non-ferrous metallic minerals. including processing	Primary sector
S8	Slaughter and meat products. including dairy and fishery products	Secondary sector
S9	Sugar manufacture and refining	Secondary sector
S10	Other food products	Secondary sector
S11	Beverage Manufacturing	Secondary sector
S12	Manufacture of tobacco products	Secondary sector
S13	Manufacture of textile products	Secondary sector
S14	Manufacture of clothing artifacts and accessories	Secondary sector
S15	Manufacture of footwear and leather goods	Secondary sector
S16	Manufacture of wood products	Secondary sector
S17	Manufacture of cellulose. paper and paper products	Secondary sector
S18	Printing and playback of recordings	Secondary sector
S19	Oil refining and coking plants	Secondary sector
S20	Manufacture of biofuels	Secondary sector
S21	Manufacture of organic and inorganic chemicals. resis and elastomers	Secondary sector
S22	Manufacture of pesticides. disinfectants. paints and various chemicals	Secondary sector
S23	Manufacture of cleaning products. cosmetics / perfumery and personal hygiene	Secondary sector
S24	Manufacture of pharmaceutical chemicals and pharmaceutical products	Secondary sector
S25	Manufacture of rubber and plastic products	Secondary sector
S26	Manufacture of non-metallic mineral products	Secondary sector
S27	Production of pig iron / ferroalloys. steel and seamless steel tubes	Secondary sector
S28	Non-ferrous metal metallurgy and metal casting	Secondary sector
S29	Manufacture of metal products. except machinery and equipment	Secondary sector
S30	Manufacture of computer equipment. electronic and optical products	Secondary sector
S31	Manufacture of maquis and electrical equipment	Secondary sector
S32	Machinery and mechanical equipment manufacturing	Secondary sector
S33	Manufacture of cars. trucks and buses. except parts	Secondary sector
S34	Manufacture of parts and accessories for motor vehicles	Secondary sector
S35	Manufacture of other transport equipment. except motor vehicles	Secondary sector
S36	Manufacture of furniture and products from different industries	Secondary sector
S37	Maintenance. repair and installation of machinery and equipment	Secondary sector
S38	Electricity. natural gas and other utilities	Tertiary sector
S39	Water. sewage and waste management	Tertiary sector
S40	Construction	Tertiary sector
S41	Trade and repair of motor vehicles and motorcycles	Tertiary sector
S42	Wholesale and retail trade. except motor vehicles	Tertiary sector
S43	Ground transportation	Tertiary sector

TABLE A1. CONT.
Industries of Interstate Input-Output Model for Brazil

Sector Code	Description	Industry
S44	Water transportation	Tertiary sector
S45	Air Transport	Tertiary sector
S46	Warehousing. auxiliary transport and mail activities	Tertiary sector
S47	Accommodation	Tertiary sector
S48	food	Tertiary sector
S49	Editing and editing integrated with printing	Tertiary sector
S50	Television. radio. cinema and sound / image recording / editing activities	Tertiary sector
S51	Telecommunications	Tertiary sector
S52	Development of systems and other information services	Tertiary sector
S53	Financial intermediation. insurance and private pension	Tertiary sector
S54	Real estate activities	Tertiary sector
S55	Legal. accounting. consulting and corporate headquarters activities	Tertiary sector
S56	Architectural. engineering. technical testing / analysis and R and D services	Tertiary sector
S57	Other professional. scientific and technical activities	Tertiary sector
S58	Non-real estate rentals and management of intellectual property assets	Tertiary sector
S59	Other administrative activities and complementary services	Tertiary sector
S60	Surveillance. security and investigation activities	Tertiary sector
S61	Public administration. defense and social security	Tertiary sector
S62	Public education	Tertiary sector
S63	Private education	Tertiary sector
S64	Public health	Tertiary sector
S65	Private health	Tertiary sector
S66	Artistic. creative and entertainment activities	Tertiary sector
S67	Membership organizations and other personal services	Tertiary sector
S68	Domestic services	Tertiary sector

Source: Based on National Accounting System. IBGE.