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Logistics Service Providers In Brazil: a study of geographic clustering from the perspective of logistics chain integration

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ABSTRACT: The aim of this study is to identify geographical clusters of logistics service provider companies in Brazil. The main contribution is a vision of these clusters based on the articulation of the various activities which make up the the logistic chain. Indicators of spatial concentration (*Herfindahl* index) and regional specialisations (Location Quotient) were used in order to identify geographic clustering. Information about the number of companies, their size and people working in every location in the country, were obtained through the Annual Register of Social Information (RAIS) from the Employment & Salaries Ministry and the Ministry of Labour and Employment (MTE). Due to changes in the classification of these activities in 2007, it isn't possible to carry out a broader time based analysis, which would allow us to identify the advantages of geographic clustering in a more consistent manner. We concluded that there are 922 spatial concentration of logistics service providers in Brazil. Around 41% of spatial concentration are located in the Southeast of Brazil and 33% in the South. In these regions the logistics infra-structure (roads, access to docks and airports) is more developed and also there are other logistics service chain providers.

Keywords*: Brazil, logistics chain, geographic clustering, services.*

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1. INTRODUCTION

The everyday products of a society depend on multiple logistics services before they reach the hands of the end consumer. A company requires logistic support in the planning of products, the acquisition of material, the product assembly and the delivery of the end product. In this way, logistics becomes more than the mere transportation of goods. Logistics service provider offers simultaneous services of stock, control, storage and transport administration.

Due to the characteristics of the logistics operator, which is the integrated activity of the logistics chain, and the importance of the transport infra-structure in providing logistics services, there are a greater number of geographic agglomerations of logistics service (it means spatial concentration) of a higher degree in locations where the logistics infra-structure, such as roads, access to ports and airports is more developed.

According to the literature of spatial agglomeration (Marshall, 1982; Krugman, 1991; Porter 1998), competitive advantage of geographic clustering are related to: 1) external savings that emerge spontaneously from the concentration of manufacturers; 2) organisation and deliberate maintenance of joint action and of cooperative relations between the players (reinforce the external savings).

In service activities the formation of spatial concentration is related to: urban concentration and availability of infrastructures (Pandit et al, 2001, 2002). In this study specifically it is hoped to find logistics service spatial concentration in accordance with aspects such as: i) proximity of docks and airports; ii) storage centres; iii) Urban density and the location of clients; iv) relationships among them.

The study of logistics service provision requires an integral vision of multiple players and multiple functions. Nonetheless, according to a study carried out by Sachan and Datta (2005) in the most important academic periodicals in Europe and the USA (Journal of Business Logistics, International Journal of Physical Distribution & Logistics Management and also Supply Chain Management: an international Journal) about what has been produced in academic research in service logistics are, only 18% of the studies analysed are, being that the greatest points of focus are the logistics functions (24%) and the firm itself (32%). The firms are treated as distinct entities and isolated from the others.

The difficulty of an integrated view of the functioning of logistics activities is reflected in the definition and classification of these activities in official statistics. As shown by Davis and Manrodt (1994), the international standard classification of economic activities (ISIC – International Standard Industrial Classification) does not consider logistics services in an integral form, that is, there is no specific code for this type of activity that can encapsulate the whole logistics chain.

The international studies that have focused supply chain integration are related to issues such as the use of internet based technology (Caniato et al, 2009; Caniato et al, 2003; 2005) and e-clusters formation (Adebanjo et al, 2006), or the adoption of information strategies that helps to better perfom strategic alliances (Vanpoucke et al, 2009) and quick response practices in a supply chain partnership (Perry & Sohal, 2001), including international supply networks (Chiarvesio & Di Maria, 2009). Among these studies only the work of Lu et al (2008) focus on agglomeration effects, but none of them uses a geographic perspective for clustering, since all of the geographic agglomeration identified are based on agglomeration coefficient obtained through ward's partitioning method and swaured euclidean.

The main aim of this study is to identify the incidence of geographical clusters of logistics services in Brazil in an integrated manner, from the integration of the logistics chain. So, the contribution of this study is a vision of geographical clusters of logistics services based on the articulation of the various activities which make up the logistics chain.

The theoretical reference is based on the classic and contemporary authors who deal with geographic clustering and competitive advantage. These include Marshall (1982), Krugman (1991), Porter (1998), Schmitz (1997), Markusen (1995), Suzigan (2003). It is presented their conceptual and operational point of view, that is, in terms of the identification methodology of the incidence of spatial concentration.

The distribution of the geographical clusters of logistics service providers throughout Brazilian Municipalities is mapped out based on the Location Quotient (LQ) and Herfindahl index. The differences of cluster indices between the segments and intra-segments of the logistics activities possibly indicate the dynamic of their localisations from the point of view of the logistics chain. So we seek to identify the evidence of a greater degree of logistics service spa-

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tial concentration in those locations where there are other logistics service supply chain providers.

The database used to identify the spatial concentration is the Annual Register of Social Information (RAIS) from the Employment & Salaries Ministry and the Ministry of Labour and Employment (MTE). In this register we find information about the number of companies, their size and the people working in every location in the country. In this sense, according to Lemos and Szapiro (2004), RAIS is the compulsory source for studies about spatial concentration. For instance, Lemos et al. (2006) used the RAIS database to evaluate the location pattern of service firms in Brazil.

In accordance with published studies and the classification of official statistics, the RAIS data is grouped according to the National Classification of Economic Activities (CNAE). In this article, it was selected twelve classes of activities referring to the activities that make up the logistics chain.

The article is structured in five sections, starting with this introduction. Section 2 consists of a presentation of the theoretical background, where a description of the logistics chain is included along with the main advantages of the cluster, above all those that are related to the spatial concentration of service activities. In section 3 the methodological procedures adopted in identifying spatial concentration are presented (indicators used, cut-off criteria and the database.) Section 4 includes the presentation of the logistics services spatial concentration and an analysis of the results found from the point of view of the logistics chain. And, finally, in section 5 the final considerations are made.

2. THEORETICAL BACKGROUND

To support the study, following we present the theoretical frame of geographic clustering and competitive advantages.

2.1 Geographic Clustering and Competitive Advantages

A cluster represents a method of organising a productive chain. The existing interaction within clusters can be extended to the consumers and, in parallel with this, to manufactured complementary products and firms which are related due to their shared technological ability and/or inputs. Also included here are: Governments and institutions such as universities, regulating agencies, professionalisation centres and commercial associations that provide specialised training, education, computerisation, research and technical support (Porter, 1998).

For some authors, geographical clusters refers to production systems characterized by a large number of small and medium firms specialized in a few phases of the production process (Piore & Sabel, 1984; Carbonara, Giannocaro & McKelvey, 2010). Reinforcing this idea, a study of Chiarvesio and Di Maria (2009, p. 1.195) emphasizes that "district firms are used to finding a high number of specialized suppliers at local level".

One of the main modern economic tendencies is the increase of both intra and inter-company relationships, especially those that involve small organisations. The formation and development of company networks has become more and more relevant not only for the economies of several industrialised countries, such as Italy, Japan and Germany, but also for the so-called emerging markets, like Mexico, Chile, Argentina and Brazil (Amato Neto, 2000)

The spatial concentration of industries in certain locations, according to Marshall (1982), is related to the external savings that emerge spontaneously from the concentration of manufacturers. Local geographical conditions, along with available resources, access to inputs and facilities and production output define the economic vocation of each region. The geographical proximity also is related to the advances in the division of work, it allows for other subsidiary activities to arise, providing the main industry with resources which help economise material, labour or improve its processing, that is, reduce business costs. A job well done is also recognised by other workers, the merits are discussed and the inventions, processes and machinery improvements are adopted and divulged throughout other companies, which in turn incorporate new ideas and thus enhance the original idea. This creates a source of ongoing innovation and development for all those who participate in the geographic cluster.

In line with Porter (1998), one of the main reasons for the setting up of the first companies in an area is the availability of a set of factors, such as a specialised labour force, university research, the location itself or an appropriate infrastructure. However, this author affirms that clusters could also originate from

a) A sophisticated or uncommon local demand;

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b) The previous existence of industrial suppliers related or whole clusters of related industries.

c) Events related to a chance occurrence, in which the previous formation of companies in a location generally reflects entrepreneurial input which cannot be attributed to favourable local circumstances.

For Porter (1998) clusters are able to encourage the coexistence between corporations and competition between the players, and as a consequence, promote competitiveness, be it in what is called a company's productivity leverage or in defining the direction and speed of innovation, or even in fostering new business.

Garcia (2006) takes the approach that the three main authors on clusters (Marshall, Krugman and Porter), only focus on external savings that emerge spontaneously from the concentration of manufacturers. Their common ground is the importance of external savings which are created almost as an aside by the clustering of manufacturers. However, Garcia (2006) acknowledges that the chance external savings are not the only way to generate competitive advantages in local productive structures. The organisation and the deliberate maintenance of joint action and of cooperative relations between the players are able to reinforce the external savings, which are generated by chance, by the clustering of companies.

The inter-relations between companies within a cluster are the central theme of a study carried out by De Langen (2004). On analysing the relationships between the companies which form a concentration around Rotterdam (Holland), the author concludes that the ports are not only part of the transport service chain hub, but also of economic concentration in which the development of firms depends on the development of the networks themselves. On the other hand, the port depends on the companies that are part of the cluster for its own development, or even its survival, which shows the network connections among the companies in the cluster.

As said by Chiarvesio and Di Maria (2009), the role of proximity favours the management of subcontractors. Vanpoucke, Boyer and Vereecke (2009, p. 1235), in a study of the advantages of a strategic alliance, emphasize the role of information flow. The authors conclude that there are three basic different levels of information integration groups of firms: silent, communicative, and IT [Information Technology] intensive. These different levels of integration imply different levels of performance, since IT applications in an alliance "improve costs, deliveries, quality, innovation and flexibility". This reason could also be applied to spatial concentration.

Another idea that could be applied to spatial concentration is that one developed by Lu, Liao and Yang (2008). Searching to identify investment incentive preference segments for international logistics zones from the manufacturer's perspective, their factorial analysis had extracted eight factors. One of them, labeled "agglomeration effect" includes variables related to firms' support such as proximity to raw material sources, and the availability of local capital. All this effects are also perceived in spatial concentration, (2008)

Some studies specifically concerning the analysis of service activity clusters, such as the study by Pandit, Cook and Swann (2001; 2002) on financial services, classified as IT intensive, identified the urban concentration and the availability of infrastructures like the main aspects relating to the tendency of these activities to concentrate geographically. In this study specifically it is hoped to find logistics service concentration in accordance with aspects such as: Proximity of docks and airports; storage centres; urban density and the location of clients; relationships among them.

Due to the characteristics of logistics operators, which is the integrated performance in the logistics chain, and of the importance of the transport infrastructure service provision, we seek to identify geographical clusters of logistics services taking place to a greater degree in those places where there are other logistics chain service providers and also a greater number of logistics service clusters in locations where the logistics infrastructure, such as roads, access to docks and airports, is more developed.

3. METHODOLOGICAL PROCEDURES

The identification of geographic clustering of productive activities adopted in this study is based on two indicators: The Hirschman-Herfindahl (HH) index and the Location Quotient (QL) index. Therefore, this is a quantitative study.

The HH index is determined by the sum of the participation squares of each Municipality in the total number of corresponding activities. HI varies between 0 and 1, in which the closer the result is to 1, the more concentrated the activity tends to be in the

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Municipality and, on the other hand, the closer to 0 the less concentrated is the referred to activity in the Municipality. The following equation is used to calculate HI:

$$H_j = \sum_{i=1}^{n} s_j^2$$

Where:

j= municipality;

S= municipality participation in total activity (number of employees or establishments in the municipality for each CNAE under study);

N= total number of municipalities that participate in the activity.

The Location Quotient (QL) allows for the identification, for each specific activity which are the municipalities that present a superior relative participation to that verified in the country average.

The QL is calculated beginning with the following equation:

$$QL_{ij} = \frac{E_{ij} / Ej}{E_i / \sum_{ij=1}^{q} E_{ij}}$$

In which:

E = the dimension by which the cluster is measured (employees or establishments)

i = CNAE;

j= municipality;

Q = intersection between Municipality and CNAE (number of employees or establishments in the municipality for each CNAE under study)

The dimensions by which the cluster is measured in most studies are the number of employees and the added value. Specifically in the service sector, the number of employees has been the variable most commonly used, bearing in mind that in some activities it is difficult to apply measures such as added value (Jennequin, 2008).

In this study in particular, not only the number of employees are considered a dimension but also the number of establishments, bearing in mind that in the service sector, mainly in logistics activities, there are several companies with only one owner and one employee (self-employed). So, the number of employees and the number of the establishments, in each municipality and in each activity (CNAE), were considered the variables of this study.

In this sense, the region or those municipalities that meet these conditions are used as the spatial concnetration identification criteria. The first is that the quantity of establishments and the quantity of employees in a municipality or region must be greater than the average quantity of employees and establishments found in the municipality or region which has such an activity. The average has been the most common criteria to characterize a geographic agglomeration since it considers the minimum and maximum values (Suzigan et al., 2003; Puga, 2003; Guimarães & Meirelles, 2014).

The second condition is that the municipality or region must have an average QL throughout 2006 and 2007 which is greater than 1, which means that the relative participation of activity "x" in the Municipality analysed is higher than the relative participation of this type of activity on average in Brazil. The higher the QL of a certain activity, the greater the degree of specialisation of the Municipality analysed in this activity with respect to the rest of the country. A QL lower than 1 means that, for the activity being analysed, there are no signs of specialisation in the region being looked at and a QL that equals 1 shows that the specialisation of the Municipality j in sector i is identical to the average specialisation of this sector throughout Brazil.

RAIS is not known to be the best source of data, but it is the only available source about this type of data. As said by Lemos and Szapiro (2004), RAIS is the compulsory source for studies about spatial concentration in Brazil.

It is also important to notice that we used the data available for the years 2006 and 2007, since there have been some changes in National Classification of Economic Activities (CNAE) coding during 2007, a fact that limits the present study due to the lack of more recent data. In an attempt to encompass the whole logistics chain (Figure 1), the logistics activities analysed include the following classes of activities, according to CNAE version 2.0[i]:

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Class 49.11-6 Freight rail transport

Class 49.30-2 Freight transport by road

Class 49.40-0 Transport via pipeline

Class 50.11-4 Sea and coastal water transport

Class 50.12-2 Long distance sea transport

Class 50.21-1 Inland freight water transport

Class 51.20-0 Freight air transport

Class 52.11-7 Warehousing and storage

Class 52.12-5 Loading and unloading.

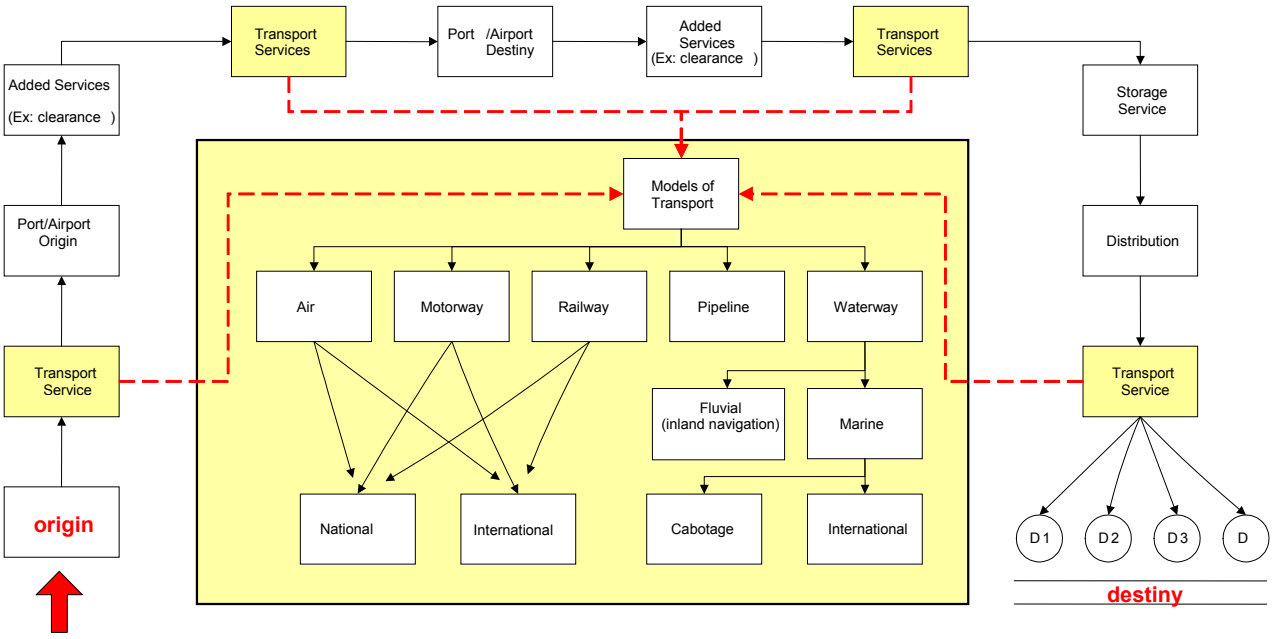
Class 52.22-2 Bus and Train stations

Class 52.32-0 Shipping agency activities

Class 52.50-8 Activities related to cargo transport organisation

Class 53.20-2 Courier activities

Figure 1. Logistics Flow and constituent activities.



Source: Elaborated by the authors, based on Davis & Mandrodt (1994), Ballou (2006), Bowersox & Closs (2001), Rodriguez & Granemann (1997), Christofer (1997), Lambert (1998), Brewer (2001), Ballou (2001), Christopher (1997), Castro (2004).

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4. RESULTS AND DATA ANALYSIS

From among the logistics services on offer in Brazil (Table1), the most important is the Freight transport by road, on its own this accounts for 83% of the total number of establishments. The other logistics services, including that of storage, loading and unloading, bus stations and shipping agency activities, cargo transport organisation, express mail and delivery, partake in only 15.4% of the total number of establishments. 53.1% of all establishments are concentrated in the Southeast. When this region is added to the South region this figure grows to 83.4%. It is worth noting that for the North region, the Inland freight water transport is the biggest, with a total of 376 establishments (55.7%).

Table 1 ***Logistics service establishments, per region of Brazil – Year of reference: 2007***

Logistics services	North	Northeast	Southeast	South	Central east	TOTAL	Part (%)
Freight rail transport	38	111	339	238	102	828	0.5
Freight transport by road	2663	8572	71601	42.699	9.519	135054	83.3
Transport via pipeline	5	56	93	20	11	185	0.1
Sea and coastal water transport	38	64	113	31	8	254	0.2
Long distance sea transport	38	27	82	18	2	167	0,1
Inland freight water transport	376	46	95	127	31	675	0.4
Freight air transport	26	31	108	29	11	205	0.1
Warehousing and storage	239	945	3562	1159	1213	7118	4.4
Loading & unloading	107	291	1028	714	195	2335	1.4
Bus and Train stations	12	60	224	206	39	541	0.3
Shipping agency activities	55	121	848	359	34	1417	0.9
Activities related to cargo transport organisation	188	397	2966	1282	151	4984	3.1
Courier activities	114	645	5047	2128	408	8342	5.1
TOTAL	**3899**	**11366**	**86106**	**49010**	**11724**	**162105**	**100.0**
Part (%)	2.4	7.0	53.1	30.2	7.2	100.0	

Source: Elaborated by the authors, based on data from the Ministry of Work & Employment

In terms of the number of employees (Table 2), Freight transport by road represents 73.7% of employment in the logistics service sector in Brazil. We find the Warehousing and storage sector, with a participation of 7.1%, and those activities related to cargo transport organisation with 4.7%, all together these activities employ 19.9% of the total number of employees. Once again, the Southeast region stands out with a participation of 59.4% of the total number of employees in logistics services. When this region is added to the South region this figure grows to 80.6%.

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Table 2 Employees in logistics service establishments, per region of Brazil – Year: 2007

Logistics services	North	Northeast	Southeast	South	Central east	TOTAL	Part (%)
Freight rail transport	341	5363	14800	3242	876	24622	2.1
Freight transport by road	28353	70955	512263	198716	55697	865984	73.7
Transport via pipeline	0	33	1423	61	40	1557	0.1
Sea and coastal water transport	69	751	9864	168	0	10852	0.9
Long distance sea transport	130	278	2038	255	24	2725	0.2
Inland freight water transport	6911	248	1709	1479	413	10760	0.9
Freight air transport	317	207	3799	207	107	4637	0.4
Warehousing and storage	2533	8818	50067	13598	7895	82911	7.1
Loading & unloading	2734	6239	21483	10302	2098	42856	3.6
Bus and Train stations	32	375	5016	1358	197	6978	0.6
Shipping agency activities	217	829	7791	3097	169	12103	1.0
Activities related to cargo transport organisation Freight	2698	6109	36942	7247	1885	54881	4.7
Courier activities	1039	7556	30804	8708	5382	53489	4.6
TOTAL	**45374**	**107761**	**697999**	**248438**	**74783**	**1174355**	**100.0**
Part(%)	3.9	9.2	59.4	21.2	6.4	100.0	

Source: Elaborated by the authors, based on data from the Ministry of Work & Employment

Following the Herfindahl indices obtained for the establishment and employment indicators (Figure 2) we see that generally the logistics services show a low geographical concentration. For all services an index lower than 0.5 was found, both for the establishments as well as for the employees. It was Sea and coastal water transport that showed the greatest index of geographical concentration, in terms of employment (0.4893). In contrast, Freight transport by road showed the lowest concentration index for both the number of employees (0.015) as well as for establishments (0.0098).

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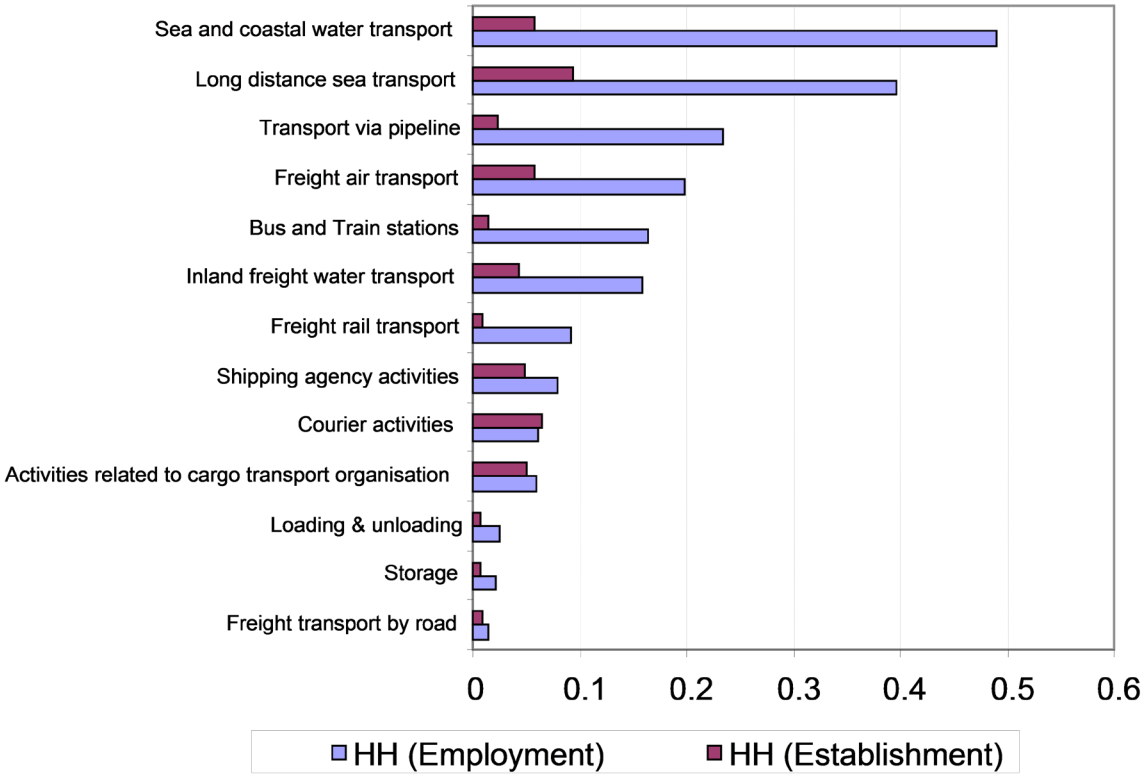
Figure 2. Geographical concentration of Logistics service chain – Herfindhal index (HH) – Reference year: 2007.



Source: Elaborated by the authors, based on data from the Ministry of Work & Employment

Despite the low geographhical concentration, Freight transport by road still presents the highest number of spatial concentration. As can be seen in Table 3 below, out of a total of 922 spatial concentration found, 267 are in the Freight transport by road area (29.0%). The other outstanding activities regarding spatial concentration were: warehousing and storage services, 158 spatial concentration (17.1% of total); 127 spatial concentration are services connected to loading and unloading (13.8%); and bus and train stations make up 99 spatial concentration (10.7%).

From the point of view of the geographical distribution of these spatial concentration, it can be seen that, each region of the country has its own dynamic concerning spatial concentration and logistics services. As can be seen in the total number of establishments and employees, it was shown that the Southeast region is where there is the greatest number of spatial concentration (41.4%). Out of a total of 382 spatial concentrations identified in the region, 135 are in the Freight transport by road area. The Freight rail transport and Transport via pipeline services represent the smallest amount of spatial concentration in the Southeast region, with only 4. Second place in the ranking, the South region, with 305 spatial concentration, also has a predominance of Freight transport by road.

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Table 3 Quantity of spatial concentration found in logistics services, per region of Brazil

Logistics services	North	Northeast	South-east	South	Central east	TOTAL	Part (%)
Freight rail transport	1	4	4	4	3	16	1.7
Freight transport by road	3	9	135	101	19	267	28.7
Transport via pipeline	-	1	4	3	2	10	1.1
Sea and coastal water transport	2	7	8	5	-	22	2.4
Long distance sea transport	2	7	8	5	-	22	2.4
Inland freight water transport	22	5	11	16	8	62	6.7
Freight air transport	2	2	5	4	2	15	1.6
Storage	3	7	73	20	55	158	17.0
Loading & unloading	9	24	41	43	10	127	13.7
Bus and Train stations	1	6	27	54	11	99	10.7
Shipping agency activities	1	2	17	16	1	37	4.0
Activities related to cargo transport organisation	1	2	19	17	1	40	4.3
Courier activities	-	4	30	17	3	54	5.8
TOTAL	**47**	**80**	**382**	**305**	**115**	**929**	**100.0**
Part (%)	5.1	8.6	41.1	32.8	12.4	100.0	

Source: Elaborated by the authors, based on data from the Ministry of Work & Employment

The predominance of Freight transport by Road in the Southeast and South regions reflects the extensive Road network and industrial infrastructure in these regions (see Figure 3). Besides this, some industries apparently have a positive influence on the location of Freight transport by Road establishments, so as to actually form the spatial concentration. Possibly, this is true for municipalities with high QL indicators, for both the number of employees and for establishments, such as Lajeado (RS) where there is an industrial hub for food, chiefly processed chicken (Co. Perdigão), Toledo (PR) which produces pork for exportation (Co. Sadia) and Sertãozinho (SP) where the sugar-alcohol industry is very well developed, among others.

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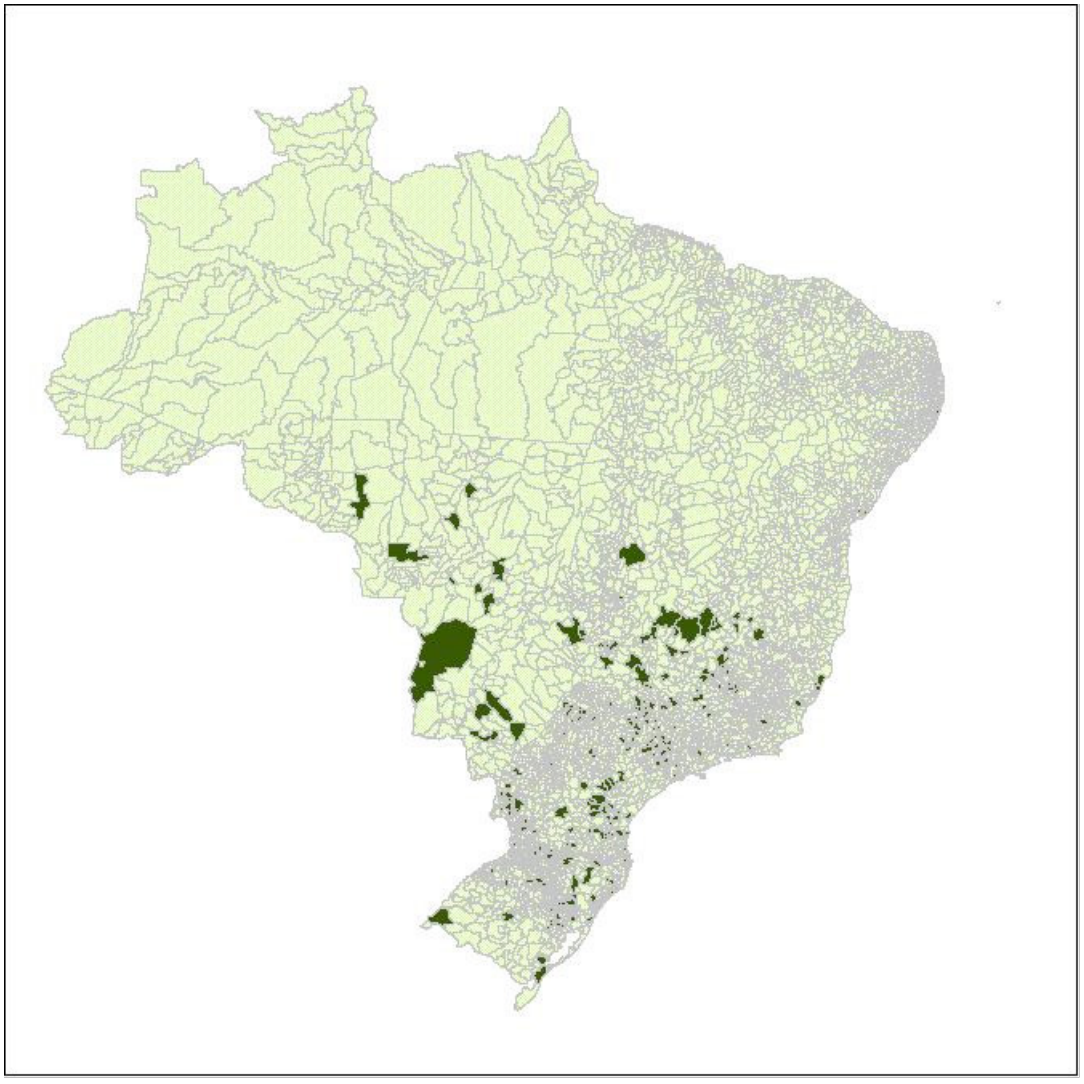
Figure 3. Spatial concentration of Freight transport by road - Brazil.



Source: Elaborated by the authors based on data from the Ministry of Labour and Employment Reference period: 2006-2007

In the North region, in its turn, Inland freight water transport has the greatest cluster, of a total 47 spatial concentration identified in the region, 22 are active in this area (see Figure 4). In this region the rivers take the place of roads and motorways in the South and Southeast.

Sixty two municipalities were identified where CNAE service spatial concentration form, 35% of which are found in the North region of the country and 47% of them (27) are in the South and Southeast. Municipalities like Barra do Guarita (RS) on the banks of the River Uruguai bordering Santa Caterina State and Santo Amaro (SP) are characterised as spatial concentration despite a low number of companies and employees, even though they have high QL indices and have employees and establishments among those clusters identified. the municipalities in São Paulo of Anhembi, Araçatuba, Arealva and Pederneiras, on the banks of Barra Bonita reservoir, on the river Tiete, can be seen as important Inland freight water transport service spatial concentration. In the same way, the 'gaucho'(Rio Grande do Sul) municipalities, Charqueadas, São Jerônimo and Triunfo all belong to the Metropolitan region of Porto Alegre and are only separated by the banks of the river Caí and the tributaries of the rivers Jacuí and Taquari. The same proximity can be seen between the neighbouring municipalities of Ladário and Corumbá, in Matto Grosso do Sul. None of the spatial

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concentration, however, comes near to what happened in the North region of Brazil, regarding the quantity of labour employed. When only two cities from the region of Manaus and Belém are taken together, where the spatial concentration have an average employee QL of 28.5 and 28.4 respectively, we find there are 5,829 employees in these two cities, or 54% of all those employed in this CNAE in Brazil, Working in 180 establishments that represent 27% of all establishments in this CNAE.

Figure 4. Spatial concentration of Inland freight water transport.

Source: Elaborated by the authors based on data from the Ministry of Labour and Employment Reference period: 2006-2007

In the Northeast, the predominant cluster is that of loading and unloading (see Figure 5). Out of the total of 80 spatial concentration identified in the region, 24 work in this activity, 7 in the State of Maranhão, 5 in Ceará, 4 in Bahia, 3 in Pernambuco and Sergipe and 1 in Alagoas and Paraíba. Similar to Freight transport by road, most of the loading and unloading spatial concentration can be found in the South and Southeast regions, where 84 spatial concentration have been found, representing 66.14% of all the CNAE spatial concentration in the region. The following municipalities are those with the highest indices of spatial concentration in loading and unloading activities: Santa Maria do Quitério (MA),

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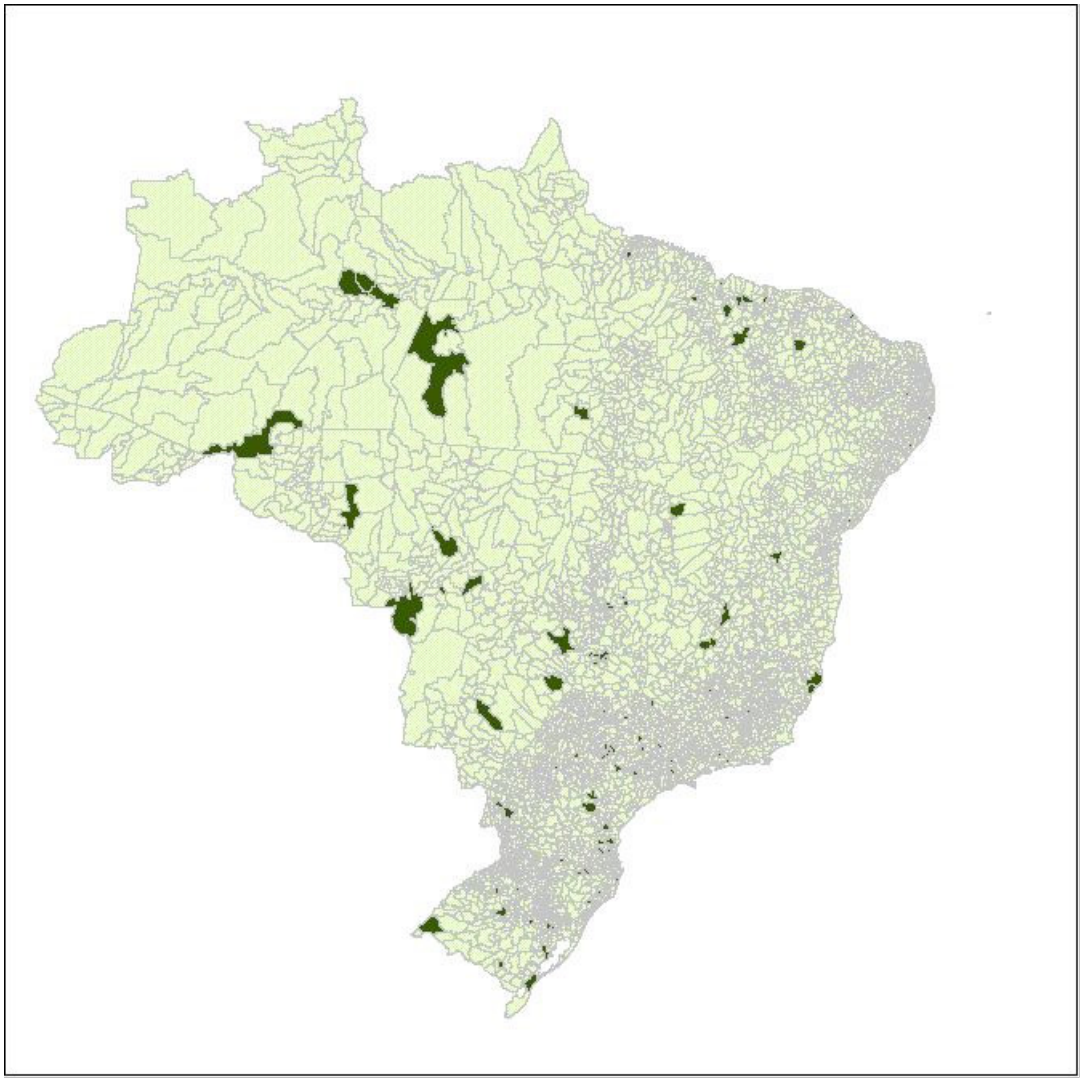
Viçosa (MG), Campo Grande (MS), Toledo (PR), Triunfo (RS), Várzea Grande (MT), Itapiranga (SC), Santo André (SP) and Trabijú (SP). Other municipalities where relevant spatial concentration have been found are those with a high number of establishments or employees such as; Manaus (AM), Recife (PE), Itacoatiara (AM), Itaguaí (RJ), Uruguaiana (RS) Itajaí (SC), Joaçaba (SC), Guarujá (SP) and Santos (SP). Most of the municipalities are located near docks or international border posts.

Figure 5. Spatial concentration of loading and unloading activities – Brazil.



Source: Elaborated by the authors based on data from the Ministry of Labour and Employment Reference period: 2006-2007

In another region, the Central west, the highest number of spatial concentration was found in Warehousing and storage activities (see Figure 6). In Brazil, 158 municipalities were identified where there are spatial concentration of Warehousing and storage. The main Warehousing and storage service spatial concentration are located in the Municipalities of Santo Andre (SP), Campo Grande (MS), Cachoeirinha (ES), Várzea Grande (MT), Triunfo (RS) besides the Municipalities of Nova Santa Rita (RS), Campestre (MG), Ponte Preta (MT), Santa Maria (RS), Campestre (MG) and Várzea Grande (MT).

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Figure 6. Spatial concentration of Warehousing and storage activities – Brazil.

Source: Elaborated by the authors based on data from the Ministry of Labour and Employment Reference period: 2006-2007

The dominance of the South and Southeast regions in the logistics services spatial concentration is also reflected in the participation of its States. As could be seen in Table 4, the State of São Paulo is most in evidence with 202 logistics services spatial concentration (21.9% of the total). Rio Grande do Sul follows, with 142 spatial concentration (15.4% of the total) and then Minas Gerais, with 104 spatial concentration (11.3% of the total). Together these three States answer for 48.6% of the total number of spatial concentration found. The ten largest States account for 86.6% of all logistics services spatial concentration in the country.

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Table 4 Quantity of spatial concentration identified per state in Brazil

UF	49116	49302	49400	50114	50122	50211	51200	52117	52125	52222	52320	52508	53202	Total	Part%
SP	2	83	1	1	1	8	3	28	23	10	8	14	20	**202**	21,9
RS		35	1	1	2	11	2	9	16	46	3	8	8	**142**	15,4
MG		43				1	1	32	11	9	2	1	4	**104**	11,3
SC	2	32	1	1		2	1	3	19	5	9	3	4	**82**	8,9
PR	2	34	1	3	2	3	1	8	8	3	4	6	5	**80**	8,7
GO	1	7				2		30	4	3		1		**48**	5,2
MT	1	7	1			2	1	18	4	5			1	**40**	4,3
ES	1	7		2	2			10	4	5	3	3	2	**39**	4,2
RJ	1	2	3	5	1	2	1	3	3	3	4	1	4	**33**	3,6
BA	1	4		4	1	4	1	4	4	2	1	1	1	**28**	3,0
MS	1	5	1			4	1	7	2	3	1		1	**26**	2,8
PA		2		1		12	1	1	4	1				**22**	2,4
AM				1	1	5	1	1	3			1		**13**	1,4
CE					1			1	5	3	1		2	**13**	1,4
PE		2		1			1	2	3				1	**10**	1,1
MA	1								7					**8**	0,9
SE		2	1		2				3	1				**9**	1,0
RN		1		2	1							1		**5**	0,5
RO		1				1		1	2					**5**	0,5
AP	1				1	2					1			**5**	0,5
AL						1			1					**2**	0,2
PB	1								1					**2**	0,2
AC						1								**1**	0,1
DF													1	**1**	0,1
PI	1													**1**	0,1
TO						1								**1**	0,1
TOTAL	**16**	**267**	**10**	**22**	**15**	**62**	**15**	**158**	**127**	**99**	**37**	**40**	**54**	**922**	**100,0**

49116	Freight rail transport	50122	Long distance sea transport	52125	Loading & unloading	53202	Courier activities
49302	Freight transport by road	50211	Inland freight water transport	52222	Bus and train stations		

Source: Elaborated by the authors, based on data from the Ministry of Work & Employment

It can be noted that Rio de Janeiro, together with São Paulo, Santa Catarina and Paraná, are the only states to present the occurrence of spatial concentration in all CNAEs. The State of Bahia, as in Rio Grande do Sul, presented spatial concentration in all CNAEs, except in Transport via pipeline. Following Porter (1998) and Chiarvesio and Di Maria (2009), this make sense because concentration encourages the coexistence between corporations and competition between the players. On the other hand, States such as Acre, Distrito Federal, Piauí and Tocantins presented only 1 cluster each.

The 922 spatial concentration identified are distributed over 617 Municipalities, none of which have spatial concentration in all the service areas studied. In Table 5 below the municipalities which were outstanding in terms of spatial concentration in various CNAEs are presented. The Municipality of Campo Grande has the highest number of spatial concentration, 9 in all. Second come the Municipalities of Rio Grande, Santo André, Santos and São Francisco do Sul, with 8 spatial concentration each. Campinas, Cascavel and Rio de Janeiro contain 7 spatial concentration each, with Cariacica, São José dos Pinhais and Vitória having 6 a piece.

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The Municipalities of Candeias, Guarulhos, Itajaí, Manaus, Paranaguá, Triunfo and Uruguaiana come next with 5 spatial concentrations each. Aracruz, Barueri, Guarujá, Itumbiara, Lajeado, Macaé, Toledo and Várzea Grande all have 4 spatial concentration a piece. 37 Municipalities contain 3 spatial concentration each, in 28 of which there are spatial concentration in Freight transport by road, CNAE 40302, and in 18 of these there are Warehousing and storage services. In 114 Municipalities there are only 2 spatial concentration a piece, and 437 Municipalities where there is at least one cluster.

From the point of view of articulation of the activities that make up the logistics chain, the freight transport by road has close ties with Sea and coastal water transport, Warehousing and storage, Loading and unloading, Bus and Train stations, Shipping agency activities, activities related to cargo and transport organisation and courier activities.

Table 5 Municipalities that had the greatest number of spatial concentration per CNAE.

Municipality	49116	49302	49400	50114	50122	50211	51200	52117	52125	52222	52320	52508	53202	Total
Campo Grande		■	■			■	■	■	■	■	■		■	9
Rio Grande		■	■			■		■	■	■	■	■		8
Santo Andre		■				■		■	■	■	■	■	■	8
Santos		■		■	■	■		■	■		■	■		8
São Francisco do Sul		■		■	■	■		■			■	■	■	8
Campinas		■	■				■			■	■	■	■	7
Cascavel	■	■						■	■		■	■	■	7
Rio de Janeiro			■	■	■		■				■	■	■	7
Cariacica		■						■	■		■	■	■	6
São José dos Pinhais		■					■	■	■		■	■		6
Vitoria				■	■				■		■	■	■	6
Candeias		■		■	■			■	■					5
Guarulhos		■					■	■			■	■		5
Itajai		■						■	■		■	■		5
Manaus						■	■	■	■			■		5
Paranagua		■						■		■	■	■		5
Triunfo		■						■	■	■				5
Uruguaiana		■						■	■	■		■		5
Aracruz		■		■	■				■					4
Barueri		■						■				■	■	4
Guaruja						■		■	■	■				4
Itumbiara		■				■		■	■					4
Lajeado		■				■				■			■	4
Macae			■	■	■						■			4
Toledo		■							■		■	■		4
Varzea Grande		■						■	■				■	4

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49116	Freight rail transport	50122	Long distance sea transport	52125	Loading & unloading	53202	Courier activities
49302	Freight transport by road	50211	Inland freight water transport	52222	Bus and train stations		
49400	Transport via pipeline	51200	Freight air transport	52320	Shipping agency activities		
50114	Sea and coastal water transport	52117	Storage	52508	Activities related to cargo transport organisation		

Source: Elaborated by the authors, based on data from the Ministry of Work & Employment

As can be seen in Table 6, in the municipalities where there are spatial concentration of freight transport by road (CNAE 49302) spatial concentration of Inland freight water transport were also identified (CNAE 50211), warehousing and storage (CNAE 52117), loading and unloading (CNAE 52125), Bus and Train stations (CNAE 52222), Shipping agency activities (CNAE 52320), Activities related to cargo transport organisation (CNAE 52508) and Courier activities (53202).

This mixing of activities reinforces the competitive advantages of geographic clustering pointed by some authors, such as access to inputs and facilities and production output, which helps economise material, labour or improve its processing (Marshall, 1982) According De Langen (2004, the ports are not only part of the transport service chain hub, but also of economic concentration in which the development of firms depends on the development of the networks themselves.

Table 6 Quantity of spatial concentration identified in the same municipality, by CNAE

	49116	49302	49400	50114	50122	50211	51200	52117	52125	52222	52320	52508	53202
49116		5	1	0	0	1	0	2	3	1	2	1	2
49302	5		4	4	4	15	5	48	44	22	18	23	21
49400	1	4		2	2	2	3	3	2	4	5	3	3
50114	0	4	2		22	4	1	3	4	0	5	4	3
50122	0	4	2	22		4	1	3	4	0	5	4	3
50211	1	15	2	4	4		3	10	13	7	8	5	5
51200	0	5	3	1	1	3		5	6	2	5	6	3
52117	2	48	3	3	3	10	5		28	17	14	19	11
52125	3	44	2	4	4	13	6	28		12	11	12	15
52222	1	22	4	0	0	7	2	17	12		8	7	0
52320	2	18	5	5	5	8	5	14	11	8		16	10
52508	1	23	3	4	4	5	6	19	12	7	16		11
53202	2	21	3	3	3	5	3	11	15	9	20	11	

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49116	Freight rail transport	50122	Long distance sea transport	52125	Loading & unloading	53202	Courier activities
49302	Freight transport by road	50211	Inland freight water transport	52222	Bus and train stations		
49400	Transport via pipeline	51200	Freight air transport	52320	Shipping agency activities		
50114	Sea and coastal water transport	52117	Storage	52508	Activities related to cargo transport organisation		

Source: Elaborated by the authors, based on data from the Ministry of Work & Employment

It may be inferred that the logistics activities, as they are linked to docks, airports and terminals, need the freight transport by road services so that connections between them and other services can be made. Further and deeper studies are required so as to discover the reasons behind these interrelations, but they are not part of this study.

5. CONCLUSION

The main question in this study was if the existence of a spatial concentration in a specific municipality influences the reality of another spatial concentration in the same class of activity in neighbouring regions. As has been seen throughout this study, the 922 spatial concentrations identified are distributed over 617 municipalities, none of which have spatial concentrations in all the service areas studied. But there are in fact spatial concentration of logistics services in greater number in those regions where there are other logistics service chain providers, as in the municipalities of Campo Grande (9 spatial concentrations), Rio Grande (8), Santos (8), Santo Andre (8) and São Francisco do Sul (8).

The dominance of the South and South-eastern regions confirms the hypothesis that there is a greater number of logistics service spatial concentrations in locations where logistics infra-structure, such as roads, access to docks and airports, is more developed.

From the point of view of articulation of the activities that make up the logistics chain, the freight transport by road has close ties with Sea and coastal water transport, Warehousing and storage, Loading and unloading, Bus and Train stations, Shipping agency activities, activities related to cargo and transport organisation and courier activities

Logistics activities can be identified spatially under two points of view: one is general in nature, by way of the zones and hubs, clearly identified in a region and the other being specific in nature, linked to the municipalities and locations, some specific activities which contribute to, or even determine, the presence of logistics services activity spatial concentration in the surrounding area and in its operation. As an example, the greatest number of logistics activity establishments is to be found around docklands and international airports. In the same way, large industries, or specific activities, can make spatial concentration form around them. This becomes more evident in freight and road transport, which is present with spatial concentration in several locations where correlated activities can be noted, especially in loading bays, warehousing and storage, loading and unloading, as well as in docks, airports and the border regions of the country. The use of micro regions or even an analysis carried out on a State level, can produce a better understand of these activities, if done on a deeper level.

The main limitation of this study, which indicates a future research, is to quantify the influence that one region exerts over another in order to prove that there is a spatial relationship between the locations of similar classes of activity in neighbouring municipalities

The logistics "sector" is too wide and heterogenous to be treated as a whole. The real competition is between distinct segments that are dedicated to supplying services in specific geographic environments, which may or may not be part of one or more spatial concentration, depending on regional needs. In this way, another analysis that could be carried out is one into the relationship of how close the spatial concen-

tration are, that is, to check if the spatial concentration are located in neighbouring geographical spaces.

If, on the one hand, the features of logistics activities bring a broader and more complex dimension, which does not allow one to fit or treat it as the sole chain of production, compared with a conventional industry, on the other hand, an activity of such size and importance can only be planned as an integrated system, when one considers the variables involved. In this way, the intention of this study is to set the foundations for the analysis of these activities, both academically as well as in the business environment.

From an academic perspective, this study may be used as a starting point for innumerable other pieces of research, whether they be those that investigate a specific region, or those that intend to examine a particular activity of the logistics chain.

Despite studies into the forming of spatial concentration having advanced over the last few years, the methodology used is still not well-formed and free from the bias and interests of researchers. Improvements need to be made into methodologies involving the identification and measurement of spatial concentration and company networks, mainly using a qualitative approach. However, this criticism does not invalidate the QL calculation methodology, which despite its shortcomings is widely used both in Brazil and internationally.

The possibility of a subjective determination of the concept of spatial concentration by way of calculating the QL allows researchers to choose between looking for a broader profile of clustering or narrow the subject down and identify only those that have certain minimum parameters, such as a minimum number of employees, establishments, or even, the spatial concentration forming in a certain type of population density.

Seeking to overcome this restraint, it is here suggested that for future studies, the municipalities that make up the majority, or more than 50% of employees in the sector being analysed, be defined as spatial concentration with a certain economic activity. In this way, those municipalities with few employees and establishments, but which are taking into consideration based only on their QL indices calculation, can be eliminated. This proposal privileges and filters those municipalities that are more relevant in terms of employment, since logistics services activities are heavy users of the labour force.

The concentration indices used here only capture some relevant aspects of a spatial concentration, basically, the so-called passive elements, which are nothing more than the external economies associated with the firms' spatial and sectoral concentration. Additional studies therefore become necessary, such as field research, to better understand the active dimensions of a cluster, such as its potential for growth, and whether or not there are intentional interdependences, or cooperation with other entities etc.

Besides being a foundation for other academic studies that seek to understand the dynamic of the formation of spatial concentration in the sector, this study opens also the way for the improvement of economic and regional development policies, for the location of future enterprises and the analysis of the relationship between the players in the service provider logistics chain process.

From a business perspective, the growing importance of small and medium sized companies in the economy, above all in the services sector, makes it important to deepen our knowledge of the dynamic of these companies. It is a fact that both small and medium sized companies are more and more present in the production chains dominated by large companies. In this way it becomes necessary to better understand the relationship dynamic between companies of differing sizes in the logistics services market, where in many cases, the activities could be carried out by companies of different sizes.

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ENDNOTES

1 CNAE 2.0 follows the International Standard Industrial Classification (ISIC), revision 4, of the United Nations' Statistics Division, which came into force in 2007. According to the Brazilian Institute of Geography and Statistics (IBGE), the CNAE 2.0 maintains an identical structure to that of ISIC/CIIU 3.1 even to the level of section and division (2digits). In the following levels, group (3 digits) and class (4 digits), the CNAE introduces more details so as to help reflect on the structure of the Brazilian economy, but according to IBGE the reconstitution of intenational classification categories is still possible

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