

PRODUCTIVE AGGLOMERATION AND DIVERSIFICATION:

A FOCUS ON INFORMATION TECHNOLOGY SERVICES

AGLOMERAÇÃO PRODUTIVA E DIVERSIFICAÇÃO:

UM ENFOQUE SOBRE OS SERVIÇOS DE TECNOLOGIA DA INFORMAÇÃO

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R E S U M O : O objetivo deste artigo é investigar como as externalidades produzidas nas regiões diversificadas geram benefícios para os agentes aglomerados, através de uma análise dos serviços de Tecnologia da Informação na Região Metropolitana de São Paulo. A partir do pressuposto de que tais espaços devem ser entendidos de forma distinta dos ambientes especializados, foi realizado um mapeamento das atividades de TI no Brasil e, em seguida, um levantamento de dados, através de entrevistas, com as empresas. Os resultados mostram o papel das externalidades de diversificação e do contato face a face como dinamizadores de processos de aprendizado interativo, que envolvem troca de conhecimento tácito. Assim, o artigo apresenta como contribuição novas evidências empíricas sobre o papel das externalidades positivas em regiões diversificadas.

P A L A V R A S - C H A V E : Diversificação, Externalidades de Aglomeração, Serviços de Tecnologia da Informação, Geografia da Inovação.

A B S T R A C T : *The aim of this paper is to investigate how externalities from diversified regions generate benefits for the clustering firms, by analyzing information technology industry in the Metropolitan Region of São Paulo. We mapped IT activities throughout Brazil and collected data through interviews at local IT firms. The assumption is that externalities in diversified cities and specialized cities are different to one another. The results have demonstrated the roles of diversification externalities and face-to-face contact in enabling interactive learning processes, which involves the exchange of tacit knowledge. The contribution of this paper is to present new empirical evidence on the positive externalities in diversified regions.*

K E Y W O R D S : *Diversification, Agglomeration externalities, Information Technology, Geography of Innovation.*

Each author's contribution: A. Theoretical-conceptual foundation and problematization; B. Data search and statistical analysis; C. Figures and tables' elaboration; D. Photos; E. Text preparation and writing; F. Bibliographic references' selection.

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INTRODUCTION

The spatial organization of agents is capable of generating externalities, which positively influence regional development. Geographical proximity, mediated by the social context, stimulates the knowledge sharing and at a local level, has the role of fostering processes of interactive learning.

The growing interest in this subject is related with the need to understand the way in which knowledge flows are capable of promoting productive and innovative activities in these agglomerations (BRESCHI & LISSONI, 2001; CARLINO, CHATTERJEE & HUNT, 2007; COMBES, 2000; CRESCENZI; RODRÍGUEZ-POSE & STORPER, 2007; DURANTON & PUGA, 2001). Thus, several studies have identified the externalities generated in clustered regions and have sought to understand the benefits they generate for local firms (ANTONELLI et al., 2017; BEAUDRY & SCHIFFAUEROVA, 2009; BOSCHMA, 2015; CAMAGNI, CAPELLO & CARAGLIU, 2016; CARAGLIU, DOMINICIS & GROOT, 2016; GALLIANO, MAGRINI & TRIBOULET, 2014)

The aim of this paper is to investigate how externalities of diversified regions generate benefits for the clustered firms, by analyzing the information technology (IT) services in the Metropolitan Region of São Paulo (MRSP).

Previous studies have demonstrated that diversified productive structures are able to generate strong positive local externalities, with significant effects on the competitiveness of firms (ANTONELLI et al., 2017; CARAGLIU; DOMINICIS & GROOT, 2016; CRESCENZI, RODRÍGUEZ-POSE & STORPER, 2007; GLAESER et al., 1992). In Brazil, however, the debate on industrial clusters has focused on the analysis of local production systems, which consist of specialized productive structures (CASSIOLATO & LASTRES, 2003; CASSIOLATO & SZAPIRO, 2003; GARCIA et al., 2015; SUZIGAN et al., 2004).

To achieve our goal, the study was conducted in two stages. First, we mapped IT activities across Brazil. Information technology services are transversal, pervasive, and knowledge intensive. Therefore, this sector plays a significant role in strengthening local industry, since it may generate and disseminate new knowledge throughout the whole system. Furthermore, there is a high territorial concentration in the MRSP of these activities. In the second stage, we conducted 13 interviews at IT services firms with headquarters located in the MRSP. The analysis enabled us to evaluate how managerial staff at these firms perceive the locational benefits of their activities.

The results indicate the existence of three distinct types of externalities: specialization, urbanization and diversification. Amongst them, the most outstanding factors are a pool of qualified workers within the region; geographical proximity to the main suppliers of technology; the role of infrastructure and complementary services in establishing these firms; and intense knowledge sharing amongst different agents. Geographical proximity and face-to-face contact play a key role in stimulating interactive learning.

The present paper is structured into 6 sections, including this introduction. In section 2, we discuss the externalities encountered in the different regions, focusing on diversification externalities. Section 3 presents the methodological aspects related to the stages of the research. Section 4 presents the mapping of IT activities in Brazil.

Section 5 presents the results of the interviews and the interlocution with the literature. Lastly, we present the final considerations.

EXTERNAL ECONOMIES AND PRODUCTIVE AGGLOMERATIONS

The analysis of the benefits of clustering highlights the importance of knowledge flows between local producers. In his seminal study on the English industrial districts in the nineteenth century, Marshall (1920) indicated the advantages of the clustering of firms based on three principles: the formation of a pool of workers with specific skills related to local activities; the presence of and attraction for specialized suppliers; and role of knowledge spillovers amongst the clustering firms (MARSHALL, 1920).

Marshall's pioneering contribution led to the emergence of a set of studies based on the geography of production (GIULIANI & BELL, 2005; KRUGMAN, 1991; SCHMITZ, 1999). Similarly, in Brazil, several studies have been developed on local production systems (CASSIOLATO & SZAPIRO, 2003; GARCIA et al., 2015; MATOS, BORIN & CASSIOLATO, 2015; SUZIGAN et al., 2004).

Jacobs (1969) drew attention to the advantages of large cities and their links to the diversity of the productive structure (JACOBS, 1969). Within this context, several studies have empirically demonstrated the importance of externalities in diversified regions (BEAUDRY & SCHIFFAUEROVA, 2009; BOSCHMA, 2017; DURANTON & PUGA, 2001; GLAESER et al., 1992; SIMONEN, SVENTO & JUUTINEN, 2015).

The diversification approach distinguished by understanding how knowledge sharing occurs amongst agents. In these regions, the heterogeneity of the local productive structure is able to promote a set of benefits that include opportunities to imitate, share, and recombine ideas and practices through industrial sectors; the possibility of exchange and cross-fertilization of existing ideas; as well as the generation of new ideas through different industries.

In addition, the improved running of transport and communications infrastructures, the proximity of markets and the access to specialized services also benefit local producers in diversified regions. Complementarity between industries is seen as the basis for knowledge sharing, which is manifested by the coexistence and interaction of a set of activities and specialized services (GLAESER et al., 1992; RODRÍGUEZ-POSE & CRESCENZI, 2008; STORPER & VENABLES, 2004).

Analyzing these externalities enables us to identify some drivers of the territorial dynamics of these regions. One of these elements is face-to-face contact, which facilitates interaction amongst the economic agents and is more heterogeneous in character. In diversified regions, learning involves different knowledge bases, i.e., they may occur with people who work in different economic activities (ASHEIM, COENEN & VANG, 2007; STORPER; VENABLES, 2004).

Face-to-face contact is defined as a form of communication technology that operates in resolving incentive problems, generating trust and socialization amongst agents. Besides stimulating knowledge sharing, face-to-face contact enables us to observe and select individuals with the same social context, such as language, codes of conduct, conventions, norms and institutions (STORPER & VENABLES,

2004). Even with the development of modern communication technologies, such as social networks and instant messaging applications, face-to-face contact still stands as an important driver for the advantages of these regions. Geographical proximity is a stimulus to the transfer of knowledge. Knowledge may be shared more easily through direct interactions, especially when there is a need for the transfer of tacit knowledge, and more complex practices and concepts (GERTLER, 2007; STORPER & VENABLES, 2004).

Another characteristic of the diversified regions is the notion of buzz cities, which are highly urbanized¹ cities with a great productive and social diversity. All apparent disorganization refers to the idea of a constantly moving environment, which a priori appears as disorganized, and possesses a series of well-defined functions and hierarchies that demonstrate important elements of its dynamics.

Individuals in diversified environments are in a buzz environment. They incorporate skills and become able to interact and cooperate, as well as exchange more complex ideas and knowledge (ASHEIM, COENEN & VANG, 2007). In these regions, people are highly productive, which encourages interaction in specialized networks, even in different industries. In these cities, face-to-face contact allows the creation of social filters that reinforce knowledge sharing (CRESCENZI, RODRÍGUEZ-POSE & STORPER, 2007; RODRÍGUEZ-POSE & CRESCENZI, 2008).

Understanding the dynamics of knowledge sharing means recognizing the importance of tacit knowledge. In addition to geographical proximity, other forms of proximity may be relevant when analyzing the geography of activities, such as social and cognitive proximity (BOSCHMA, 2005).² Social proximity is based on the notion that economic relations are embedded in specific social contexts (GERTLER, 2007). These contexts are important for learning, since they create mutual trust between different players and may reinforce the competitive advantages of firms (BANTON et al., 2007; BOSCHMA, 2005; KNOBEN & OERLEMANS, 2006). Cognitive proximity is based on the idea that knowledge is not a public good, which is produced outside the economic system (GIULIANI & BELL, 2005; LISSONI, 2001). Knowledge creation is a cumulative process, which is based on the ability of a firm to learn from this new knowledge. To do this, the absorptive capacity of the firms can make them identify, interpret and exploit this new knowledge (BOSCHMA, 2005; COHEN & LEVINTHAL, 1990).

The benefits of diversified regions are based on the greater opportunities for the exchange and cross-fertilization of knowledge among local players (ANTONELLI et al., 2017; BOSCHMA & IAMMARINO, 2009; CAMAGNI, CAPELLO & CARAGLIU, 2016; DURANTON & PUGA, 2001; FELDMAN & AUDRETSCH, 1999; FRITSCH & SLAVTCHEV, 2010). Thus, we may conceptually divide the externalities into three main categories, which was used in the empirical analysis (Table 1). The proposed analysis indicates the way in which externalities occur for the specific case of a region in a developing country, such as Brazil.

¹ This term originates from an allusion to the sound of insects (RODRÍGUEZ-POSE & CRESCENZI, 2008; STORPER & VENABLES, 2004).

² Besides social and cognitive proximity, studies also indicate the existence of other dimensions of proximity, such as organizational and institutional (BOSCHMA, 2005; GILLY & TORRE, 2000; KNOBEN & OERLEMANS, 2006).

Table 1: Division of externalities

Externality	Indicators
Specialization	Labor Market Pooling in the region Proximity of technology suppliers Knowledge spillovers
Urbanization	Agglomeration of agents – close to a consumer market Infrastructure
Diversification	Complementary services Knowledge spillovers (exchange opportunities outside the main activity of the firm)

Source: Produced by the authors.

THE METHODOLOGICAL APPROACH

We developed this paper in two stages. First, we mapped IT activities in Brazil. For this, we used data from the Ministry of Labor (*Relação Anual de Informações Sociais* - Annual Social Information Report - RAIS/MTE) in 2011. In addition to mapping, two indicators were constructed: the Krugman Index (K-index) and the Locational Quotient (LQ).

The Krugman Index (K-index) measures regional diversification, by assessing the relative concentration of an industry and identifying the disparity between the productive activities of a region and a predetermined analytical base. The result may range from zero to two. A result closer to zero indicates that the region may be considered diversified; and a result closer to two, the more a region may be considered specialized in some productive sector. The Krugman Index has been used by several studies to assess industrial diversification (MIDELFART-KNARVIK, OVERMAN & VENABLES, 2000).

The Locational Quotient (LQ) measures whether the region has specialized in one particular economic activity. This indicator measures the ratio between the share of an economic activity in a micro-region and the share of the same activity in the productive structure of all micro-regions. Thus, the higher the LQ score, the greater the specialization of the region in the activity. Moreover, to be considered specialized; it must present a LQ greater than 1 and be responsible for at least 1% of the total employment in the respective activity throughout the whole country (SUZIGAN et al., 2004; 2006).

The second stage consisted of collecting qualitative information from IT professionals of local firms. Through prior communication with professionals, we contacted 21 IT services firms; and we visited 13 domestic firms, between January and February 2014. We conducted interviews with managers.³ The profiles of the firms are presented in Table 2.

³ The complete questionnaire used is available in Costa (2014).

Table 2: Firms visited: activity, size and year founded

CNAE (ISIC) Code 62	# Firm	Employees	Year founded
Code 6201 – Developing personalized computer programs	1	15	2000
	2	28	2004
	3	30	2007
	4	10	2006
	5	150	1999
Code 6202 – Developing and licensing customizable computer programs	6	20	1999
Code 6203 – Developing and licensing non-customizable computer programs	7	30	1994
	8	55	1987
	9	200	1998
Code 6204 – IT Consultancy	10	05	2013
	11	35	2004
	12	32	2008
	13	300	2008

Source: Produced by the authors.

IT ACTIVITIES IN BRAZIL

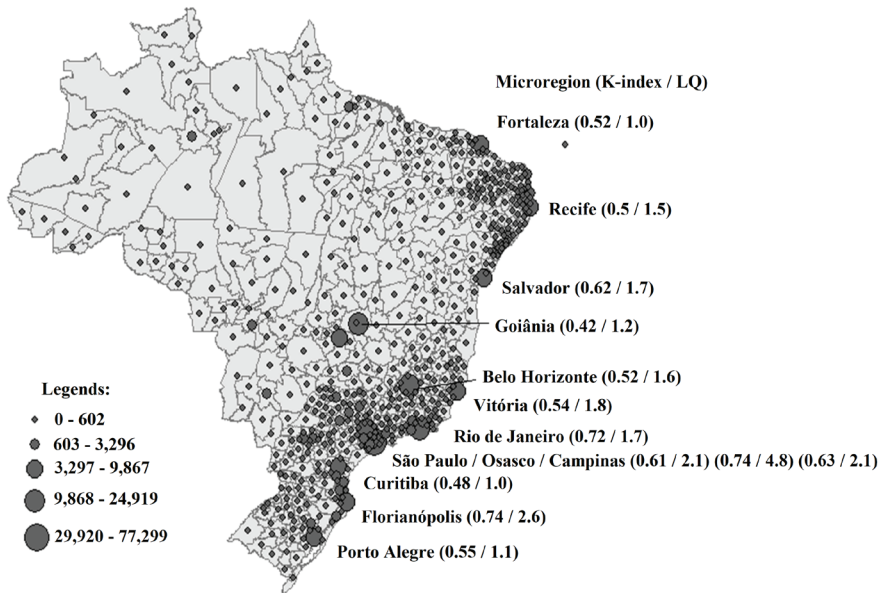
Information technology activities have a pervasive and transversal character on local industry. These activities are spread throughout the set of economic activities and extrapolate the limits of the segment (DIEGUES, 2010; ROSELINO, 2006). This characteristic brings benefits that are associated to strengthening local industry, especially through the intersectoral knowledge spillovers (DIEGUES, 2010). Therefore, IT activities can invigorate and thereby promote efficiency and productivity amongst different firms.

In general, Brazilian IT activities firms operate in specific market niches that require knowledge of the client's activities. This involves developing personalized or customized services, with the possibility of selling other associated services. Brazilian firms are characterized by performing within a vertical market, with more sophisticated demands, which demonstrates their high technological capacity (PIANNA, 2011).

The formation of Brazilian software has been linked with the demands of local clients, related to the diversity and heterogeneity of the local structure. Most Brazilian firms were established to attend the markets of lower added value and were highly specific to the needs of local demand. At the same time, large public firms specialized in data processing for Brazilian public agencies were also developed (PIANNA, 2011; ROSELINO, 2006). Thus, the development of Brazilian IT firms is considered to be “genetically inward” (ROSELINO, 2006).

Taking into account the pervasive and transversal character, we analyzed the location of IT activities at a micro-region level, and at the same time, identified the micro-regions with a diversified productive structure. Map 1 presents the 13 micro-regions that were considered with diversified industrial structure in 2011 ($K\text{-index} < 0.85$) and had a relevant presence of IT activities ($LQ > 1$ and a share of employment $> 1\%$).

Map 1 – Number of employees in IT activities, K-index and LQ by micro-region – 2011



Source: RAIS Data – CNAE Code 62. Produced by the authors.

Information technology activities are concentrated in metropolitan regions. The micro-region of São Paulo presents the highest volume of employment, accounting for 27.8% of jobs (77,299), followed by the micro-regions of Rio de Janeiro with 24,919 jobs; Osasco, with 24,616; and Campinas, with 17,611 jobs. These four micro-regions account for 51% of the total IT employment. Among 558 Brazilian micro-regions, 14 accounted for more than 80% of the jobs.

However, the high volume of employment reveals part of the importance of the IT activities to the productive structure of these regions. Information technology services are configured as knowledge-intensive business services (KIBS) that aggregate a series of technological and professional activities considered key-factors for innovation (FREIRE, 2006)⁴.

When analyzing the spatial distribution of KIBS, comparing them to manufacturing, it may be observed that these services are strongly spatially concentrated in metropolitan areas (Table 3). For example, in Brazil the share of KIBS in the employment of selected activities is 26%. In the micro-regions of Brasília, Florianópolis, Rio de Janeiro, Osasco and São Paulo, the share rises to 76%, 60%, 54%, 49% and 46%, respectively.

⁴ The KIBS were selected by the National Classification of Economic Activities (CNAE) and may be traditional professionals (focused on the administrative issue, as in advertising, training, design, amongst others), such as technology-based services (as in telecommunications and informatics and IT services, amongst others), (FREIRE, 2006).

Table 3: IT activities in Brazil – selected micro-regions (2011)

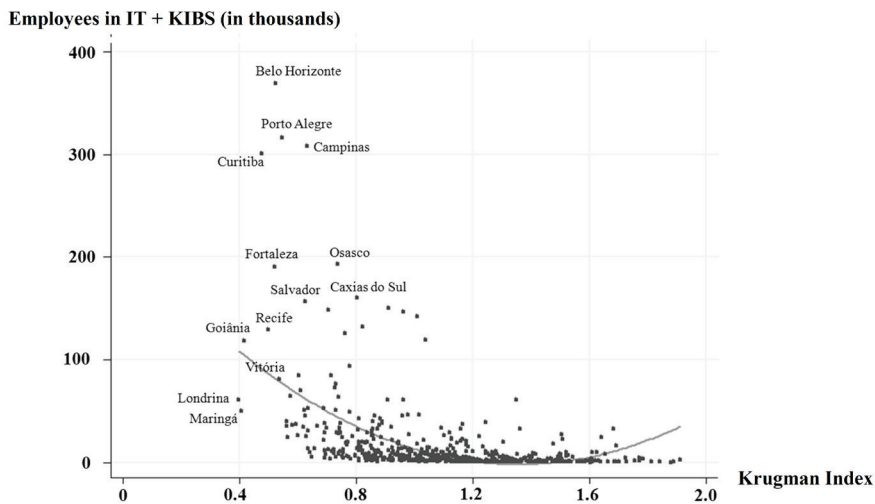
Micro-region	Total Employees	Total Employees (%)	Knowledge-intensive business services (KIBS)	Manufacturing (Manuf)	<i>KIBS</i>	<i>K-index</i>	LQ	% IT in Brazil
					$\frac{\text{Manuf} + \text{KIBS}}{\text{Manuf} + \text{KIBS}}$			
São Paulo	77,299	27.8	633,221	753,420	0.46	0.61	2.101	27.8
Rio de Janeiro	24,919	9.0	296,681	254,529	0.54	0.72	1.704	8.9
Osasco	24,616	8.8	94,640	98,120	0.49	0.74	4.813	8.8
Campinas	17,611	6.3	68,070	239,686	0.22	0.63	2.157	6.3
Brasília	17,009	6.1	90,607	28,663	0.76	1.04	5.374	6.1
Belo Horizonte	16,523	5.9	147,304	222,359	0.40	0.52	1.684	5.9
Porto Alegre	9,867	3.5	90,062	226,335	0.28	0.55	1.175	3.5
Curitiba	8,011	2.9	97,530	203,621	0.32	0.48	1.002	2.9
Salvador	7,294	2.6	72,755	83,641	0.47	0.62	1.758	2.6
Fortaleza	5,278	1.9	46,998	143,385	0.25	0.52	1.045	1.9
Recife	5,213	1.9	61,852	67,057	0.48	0.50	1.524	1.9
Florianópolis	4,412	1.6	38,045	25,643	0.60	0.74	2.611	1.6
Vitória	3,970	1.4	32,022	49,224	0.39	0.54	1.841	1.4
Goiânia	3,911	1.4	34,695	83,266	0.29	0.42	1.249	1.4
Others micro-regions	52,554	18.9	963,978	5,247,560	0.16	-	-	19.0
Total	278,487	100	2,768,460	7,726,509	0.26	-	-	100

Source: Produced by the authors with data from RAIS – CNAE Code 62.

The K-index data (Graph 1) demonstrates that regions with a greater presence of KIBS tend to be more diversified. In general, regions with a high volume of employment, both in KIBS and in manufacturing, present a low K-index score. Regions with higher rates of employment present a more diversified productive structure. On the other hand, regions with lower employment in the selected activities, less than 100 thousand employees, tend to have a less diversified productive structure (K-index > 0.8).

It is important to emphasize that the study of the diversified regions should take into account regions that have a significant labor force, capable of generating agglomeration externalities. Thus, it is possible to perceive that some regions considered diversified, with a low level of employment, should indicate little economic dynamism.

Graph 1 – Number of employees in the Manufacturing and Knowledge-Intensive Business Services by *K-index* (2011)



Number of micro-regions = 555, Excluding the micro-regions of São Paulo (SP), Rio de Janeiro (RJ) due to the scale used on the graph. Source: Produced by the authors with Ministry of Labor (RAIS) data.

We also calculated the Locational Quotient (LQ), in addition to the locational analysis of IT activities. LQ is used to identify the weight of an activity within a region, compared to the same activity in all other Brazilian micro-regions. The LQ analysis indicated the strong presence of IT activities in the South and Southeast (Map 1 and Table 3).

Through the LQ, it was possible to identify 14 specialized micro-regions in IT activities. It may once again be observed that this result is linked to the state capitals, except for the micro-regions of Osasco and Campinas in the state of São Paulo.⁵ Of the fourteen micro-IT activities specialized micro-regions, 13 (with the exception of Brasília) were also designated as diversified regions, with a K-index <0.85 (Table 3).

⁵ Both micro-regions are part of the metropolitan regions with strong economic and industrial activity: Osasco is contiguous to the MRSP; Campinas is an important center of technological activities and has great economic importance for the State of São Paulo.

RESULTS AND DISCUSSION: THE ROLE OF EXTERNALITIES IN THE DIVERSIFIED REGIONS

MAIN RESULTS

Specialization externalities are important for local producers, even in a diversified region. They refer to the clustering of firms and to the pool of skilled labor and suppliers within a region (MARSHALL, 1920; SUZIGAN et al., 2004). Thus, the concentration and availability of IT professionals is a driver for the development of local activities. However, certain points need to be taken into account for this analysis.

Information technology services require skilled staff (technicians and graduates), of which there is abundance in the MRSP. However, even with such an availability, certain professional characteristics are also required. The specificity of a number of

IT services makes the hiring of employees a critical process for firms, even in an environment with high availability of high-skilled labor. Complexity activities, which require external knowledge, such as the users' operations and processes, hiring professionals requires the search for more than formal knowledge. Many firms seek experienced professionals, who have accumulated knowledge from previous work. Therefore, establishing a team with the capacity to link both the functions of IT development and the users' operations is an important factor for developing IT services in the MRSP. Hence, the inclusion of such a professional profile represents a positive specialization externality for the region.

Another relevant point for the analysis is related to the demand for local high-skilled labor. There is a high mobility of skilled workers, expressed through huge opportunities for jobs in the region. The MRSP concentrates several IT firms and related activities that also require high-skilled workers.

In terms of knowledge spillovers, there is an important relationship between local IT firms and technology suppliers. These suppliers are larger multinationals with well-known brands. Local, and domestic, IT firms work to adapt or customize systems provided by these multinational companies to end users. Geographical proximity helps to build trust between the IT firms and their multinational suppliers, and also enables more affordable access to the frequent events and workshops promoted to disclose these suppliers. These relationships include trade agreements that usually occur through joint sales opportunities or system customization. Frequent interaction and face-to-face contact are important drivers in consolidating and continuing these agreements between local IT firms and their technology suppliers.

With regard to the **urbanization externalities**, proximity to the consumer market is indicative of the importance of agglomeration, not only from a commercial viewpoint, but also because of developing of new activities. However, the benefits of customer proximity vary according to the type of business developed by the IT firm. The various IT services involve different degrees of knowledge complexity, which may be "software development or consultancy", an activity that requires greater user-producer interaction; or "product software", in which the knowledge is more codified, even if advanced. The differences between these two activities are presented throughout the analysis.

In software development activities, geographical proximity plays an important role because it enables a direct exchange of information between user and producer during the development of a product. In other words, it allows the specification of the product to be in line with the user's request. The physical presence, and the associated geographical proximity, allows interventions and directives that are very important to fulfilling the requirements of the user in developing a solution. In addition, proximity creates a good reputation for the IT firm in their relationship with the user, thereby enabling new projects to be developed and new solutions to be offered. On the other hand, for product software firms, proximity to the consumer market is less relevant for their activities, since the offered product is not modified according to the user.

Thus, the need for direct contact is due to the complexity of the projects. Users with more clear demand specifications require less direct contact, which does not however make it any less important. Even with the development of interactive communication technologies (such as instant messaging solutions, social networks and the possibility of rapid contacts at an international level, such as teleconferencing

calls), the possibilities of exchanges and alignments with clients still occur, preferably, face-to-face.

In relation to local infrastructure, the MRSP stands out comparatively to other Brazilian regions. The MRSP has adequate communication services, as well as better possibilities for the displacement of personnel, due to the road network and the presence of airports, which allow consultants and partners to travel more easily. The improved quality of infrastructure in various services is a factor that also influences the location of the firms' units. When firms have non-local units, they are strategically located in regions with easy access to the city of São Paulo, either by land or by air. In addition, the quality of the infrastructure and communications networks, which are essential for the activities of these firms, limits the expansion of enterprises to other regions, and thus they increasingly concentrate their activities in areas close to the MRSP. The diseconomies of agglomeration, such as high rental costs, congestion, and higher salary costs, do not hamper the location of activities in the MRSP. The advantages of clustering outweigh the disadvantages.

In relation to **diversification externalities**, we may highlight two main factors, namely the relevance of complementary services within the region and the influence of knowledge sharing on IT services. First, complementary services are those located in the region that assist a range of firms in a transversal way, since they involve activities outside the core activity of the contracting firm, such as marketing, accounting, finances, consulting, amongst others. In this case, the existence of complementary services was not assessed as being relevant for the analyzed firms. From the viewpoint of the productive structure of MRSP, the activities of IT services may be considered as complementary services to other firms in the region.

The services of IT firms offer competitive tools to the firms that adopt them. Thus, we may observe the transversal, pervasive character of these activities in the region's productive structure. The gains generated in regions where different types of activity coexist provide higher returns to IT firms than those generated in regions where only one type of activity predominates. For this reason, we may conclude that the presence of IT services, as other knowledge-intensive services, is able to foster interactive learning with other local firms, with positive effects on the whole region.

With regard to the knowledge sharing between IT firms and users, it is important to remember that it involves different activities, which generates interactions between IT firms and users. This relationship varies according to the type of activity developed by the firms. Software development activities, i.e., customized solutions for end users, include important knowledge exchanges between the firms' staff and their users. These firms operate in specific market niches, which allows them to cater to a range of different clients. In this way, they are able to acquire knowledge on the operations and processes of their users, which allow them to constantly incorporate new capabilities. IT firms are configured as agents that are capable of disseminating good practices to a set of users. This expertise differentiates the activities generated by the firms from the specific activities of the IT departments of the users.

In addition, the exchange of information and knowledge with external agents involves, as well as the users, the abovementioned major technology suppliers, since multinational companies are an important source of information and of creating local networks that lead to new opportunities.

Still regarding diversification externalities, even in large metropolises, we can

see the occurrence of professional recommendation, even with the formal selection processes for hiring employees. Recommendation is one of the most common ways which employers may filter résumés within an extensive supply of labor. Recommendation, besides being an efficient means to reach professionals with a suitable profile for a certain function, is a form of efficient selection in extremely specialized networks.

Finally, in reference to the importance of informal contacts, personal relationships positively influences interaction between the firms' founders and other peers, such as former work colleagues and contact with former suppliers. Many firms that we interviewed in the MRSP were formed by the influence of such contacts, mainly in establishing the first clients. In certain segments, with very specific niches (development and consulting), the informal networks may be considered even more important, since the relationship of trust between technology supplier, user and IT firm is very relevant when hiring. In the markets of more commoditized technologies, such as software products, these relationships appear less frequently and are less important for establishing the activities.

DISCUSSION ON THE RESULTS

With regard to the specialization externalities, the availability of local high-skilled labor, the existence of specialized suppliers and the knowledge sharing amongst agents of the same activity are typically Marshallian externalities (BEAUDRY & SCHIFFAUEROVA, 2009; CARAGLIU, DOMINICIS & GROOT, 2016; GALLIANO, MAGRINI e TRIBOULET, 2014; MARSHALL, 1920; VAN DER PANNE, 2004). These three factors affect significantly the development of IT activities, even in large urban centers. These externalities reinforce the importance of the clustering and specialization in these activities.

In relation to the advantages of diversification, proximity to other agents, such as users and technology suppliers, plays an important role in fostering interactive learning. Due to the nature of the activity analyzed, the importance of geographical proximity is less related to typically logistical issues, such as the value of freight and the need to deliver products, factors highlighted in location theory studies (FUJITA, KRUGMAN e VENABLES, 1999; KRUGMAN, 1991).

The advantages of proximity to users and suppliers are related to the possibilities of sharing tacit knowledge, through frequent interactions and face-to-face contact (RODRÍGUEZ-POSE & CRESCENZI, 2008; STORPER & VENABLES, 2004). This contact stimulates the creation of relationship networks among local producers, since they carry a set of diversities, and normally complementary capabilities and skills. In addition, other dimensions of proximity, such as social proximity and cognitive proximity, also emerge as important drivers in the location analysis of these activities in diversified environments (BOSCHMA, 2005; GERTLER, 2007).

In these environments, relationship networks involve the benefits of social proximity. Individuals are members of groups that share the same social context, which creates trust between the firm, its users and supplier (BOSCHMA, 2005). The results demonstrate that direct contact plays an important role in coordinating, aligning and creating solutions for users. Understanding user specifications is a critical factor for IT activities, and problems are easily mitigated through direct contact

(ASHEIM, COENEN & VANG, 2007; RODRÍGUEZ-POSE & CRESCENZI, 2008; STORPER & VENABLES, 2004).

Furthermore, local firms perceive less difficulties in hiring new employees. Such problems are solved through face-to-face contact, since the recommendation of professionals becomes an important screening tool. To a certain degree, the selected high-skilled professionals have already been selected by the people who recommended them (RODRÍGUEZ-POSE & CRESCENZI, 2008; STORPER & VENABLES, 2004). Thus, face-to-face contact also reinforces trust in diversified environments, which is a key factor of socialization. This contact allows agents to become candidates for members of specific groups and they remain in those networks (RODRÍGUEZ-POSE & CRESCENZI, 2008; STORPER & VENABLES, 2004).

In addition, proximity facilitates the exchange of information, fostering interactive learning between IT firms, their users and suppliers. Hence, the cognitive proximity becomes relevant in this analysis, since it enables the accumulation of knowledge throughout the service rendering towards a distinct diversity of clients of IT firms (BOSCHMA, 2005; BOSCHMA & IAMMARINO, 2009). With respect to the possibilities of knowledge sharing, face-to-face contact plays a very important role not only for the beginning of the relations amongst local agents, but also for maintaining them over time, favoring the development of IT activities. The quality of infrastructure, of both communications and roads, reinforces the role of clustering in these regions (GLAESER et al., 1992, STORPER & VENABLES, 2004). Thus, the benefits of these regions go beyond those generated in specialized regions.

The results demonstrate how face-to-face contact is a key factor for the dissemination of knowledge between local producers, and it is an important tool for activities in diversified environments. Face-to-face contact involves: (i) an efficient form of communication technology; (ii) a means of overcoming coordination problems and incentives in uncertain environments; (iii) stimulating new ventures; and lastly (iv) a key factor of socialization, which allows people to become members of certain groups and also to remain so (RODRÍGUEZ-POSE & CRESCENZI, 2008, STORPER & VENABLES, 2004). All these characteristics were encountered throughout the analysis.

Face-to-face contact is economically efficient, as it helps to solve incentive problems, facilitates socialization and promotes psychological motivations. The results illustrate that this contact is very important for the IT firms in a diversified region and for several small and medium enterprises. Moreover, face-to-face contact is associated with a process of multidimensional communication, in which interactions allow local producers to send and receive messages simultaneously, which generates the possibility of interruptions and instantaneous feedback. Thus, face-to-face contact allows for various means of sharing, interpreting and codeveloping tacit knowledge between two or more individuals (ASHEIM; COENEN; VANG, 2007).

The notion of buzz cities may also be related to the results. Buzz cities are those where critical problems of coordination in modern economies are solved through face-to-face contact (ASHEIM, COENEN & VANG, 2007; RODRÍGUEZ-POSE & CRESCENZI, 2008; STORPER & VENABLES, 2004). The results revealed that interaction between suppliers (largely multinational companies) located in the region is very important for IT firms on the local market, even by generating new opportunities for business. Big cities are places where there are several possibilities

of contacts with highly specialized technology networks. Moreover, multinational companies have well-known brands for the contracting users. These characteristics show that the typical forces of clustering are reinforced (ASHEIM, COENEN & VANG, 2007; RODRÍGUEZ-POSE & CRESCENZI, 2008; STORPER & VENABLES, 2004)

From the evidence, the advantages of localization are important for clustering firms. However, the advantages of localization are not in themselves decisive for generating, creating and maintaining the firms' competitive advantages. The main advantages are those involved in the tacit knowledge sharing, through frequent interactions and face-to-face contact amongst agents. In other words, the main advantages are those that involve knowledge sharing or wide possibilities of exchange of information. Thus, this paper presents a counterpoint to the analysis of static advantages of location, focusing on the importance of dynamic advantages, i.e., those involving knowledge exchange and interactive learning.

FINAL REMARKS AND POLICY IMPLICATIONS

An analysis of the IT activities in the MRSP was conducted with the aim of investigating how externalities produced in diversified regions are able to generate benefits for the clustering firms. It is possible to perceive that IT activities are related to more diversified productive structures, given their pervasive and dynamic nature.

The results demonstrated the presence of different types of externalities, which involve knowledge sharing and have important implications for firms, since they are able to foster interactive learning. A full comprehension of the different externalities is very important to understand the geography of the productive activities in regions that have different structures (ANTONELLI et al., 2017; BEAUDRY & SCHIFFAUEROVA, 2009; CAMAGNI, CAPELLO & CARAGLIU, 2016; CARAGLIU, DOMINICIS & GROOT, 2016; GALLIANO, MAGRINI & TRIBOULET, 2014).

In reference to the advantages of specialization, access to high-skilled labor, which is highly concentrated in the MRSP, and the presence of specialized suppliers are factors that play an important role for local firms. With regard to the advantages of urbanization, access to the consumer market and the infrastructure of the region, both physical and technological, are important externalities. Finally, the advantages of diversification express the complementary role that these services play for other local firms and the interactions between different producers (suppliers, users or other firms). Within these interactions, face-to-face contact can invigorate the exchange of information and knowledge sharing. Furthermore, buzz cities represent important links for the creation of new firms, reinforcing the typical agglomeration forces by knowledge spillovers amongst different agents.

Empirical evidences show that the advantages of localization are important for the clustering firms. However, for the analyzed firms, locational advantages are not the key-factors for their competitiveness. The main advantages are those involving face-to-face interactions and frequent contacts. Thus, the evidence from this paper moves in an opposite direction to analyzes based only on the static advantages of location. This analysis focuses

on the importance of the advantages brought by knowledge sharing, i.e., the dynamic advantages of agglomeration (CAMAGNI, CAPELLO & CARAGLIU, 2016).

This paper has sought to contribute to the debate on agglomerated regions, presenting new empirical evidence on the benefits of locating producers in diversified regions in the case of Brazil. In diversified regions, it is possible to verify the advantages of productive specialization, but these advantages have been inserted into a more complex structure. In fact, we have discovered that these activities, even being specialized, are located in diversified regions, and the benefits generated in these regions are beyond those generated in the specialized regions.

Finally, with regard to policy implications, we should emphasize the importance of public policies that stimulate the activities of Brazilian IT firms, since they may reinforce their role of invigorating efficiency amongst different firms and in the development of metropolitan regions. On the national level, the improvement of infrastructure, whether roads or communications, as well as stimulating local development, generates implications for evolving these activities in regions outside the South and Southeast, where these activities are largely concentrated. In complex environments, professionals with a more established background are required to follow the changes demanded both by users and by the development of new technologies. Such policies could also have a regional focus, since stimulating these activities would generate greater employment opportunities of greater value added for the region, thereby attracting skilled labor.

From the viewpoint of development policies in metropolitan regions, recognizing the importance of externalities and the advantages of agglomeration in diversified regions could represent an important opportunity for establishing policy instruments to stimulate the attraction and maintenance of KIBS within these regions. To do this, it is necessary to create measures that are capable of reinforcing and broadening the advantages and benefits related to the location in metropolitan regions, which have a diversified production structure.

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