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New articulations of the Brazilian cities network: an analysis of the heterarchies by the airflow system

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Abstract
Faced with the global order increasingly associated with the networks of connections, their flows and their relations with the cities, the fixed articulators provide elements for new understandings of the network of cities. In the present article, we aimed to analyze the relationship between air flows and the Brazilian urban network, based on data and information from the studies on the regions of influence of the cities (REGICs). In this context, we have used the theoretical-methodological proposal of Urban Heterarchy, a complement to understand the multi and interscalar articulations in the urban network that explode to the rigid hierarchical pattern. For that matter, the article is structured in three analytical focuses: a) to the analysis of the REGIC content, showing the previous studies and the details of its current methodology; b) the definition of what we understand about the relation hierarchy-heterarchy and c) the analysis of the spatial content through the empirical study of the regional flows of the air movement system. The analysis, therefore, showed changes in the structuration and articulations of the network of cities: the flows of the air traffic movement system revealed that, at the same time that there is a reinforcement of the urban hierarchy, there is also a consolidation of the complex relations in the medium cities, promoting the urban heterarchy.
Keywords: Urban Hierarchy-Heterarchy. Airflow. Urban Network. Spatial Concentration. Airport System.

Introductions

The changes that the Brazilian urban network has passed through come from the complexity of processes – urbanization, metropolization, etc. – of which new functionalities appeared, altering the classical standards of the network, marked by the hierarchic structure. These processes, specialized by the

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relationship among the movement of spatial concentration, deconcentration and reconcentration, do not allow us to accept that the urban network can be seen in its complexity only through the hierarchic paradigm anymore, what Kosik (2002) called “fragmentary paradigm of totality”.

When we comprehend the urban network through a paradigm of fragmentation, built on the relation between the totality and the parts, we consolidate the hierarchic paradigm that embraces everything. In relation to the urban network and the process of urbanization, many times, the hierarchic paradigm prevents us from valuing the interscale articulations to the detriment of a rigid structuration of the network.

The urban network, understood from the fragmentary paradigm, resulted in analyses about the interrelations among the cities, with a focus on the hierarchic standard, explained by the spatial concentration of the capital in the territory which occurs in a differentiated way. The companies were spatialized through the process of concentration followed by the deconcentration, mainly from the 20th mid-century, when the São Paulo industry left the metropolitan region towards the central-western region of the state of São Paulo – Brazil. There are also those companies already existent in medium-sized cities and medium cities, even though small and with little sophistication in the organizational model, which get the capacity of production benefited by the regional context and by the articulation of logics in the national and international scope.

Lencioni (2017) affirms that the concentration is the ultimate element of metropolises’ development. We could propose that the concentration is the ultimate element of development in the scope of the urban network, bearing in mind that this process allows us to comprehend the spatial differentiation in density and rarefaction (SANTOS, 1996). Sposito (2017) also contributes when she proposes the pair concentration-extension, since, for the author, we must consider the alterations in the roles of the small and medium cities in contemporary Brazil. In the case of the former, there has been an empiric

dimension of the expansion of the spatial interactions through the new location of airports in Brazil.

That is why the hierarchy standard is still the most visible when we look at the distribution of the companies and the capital. However, exactly because of this bigger thickness and bigger extension of the differentiation in the territory it is that we will begin this text from the pair hierarchy-heterarchy worked in IBGE (2017b), Sposito and Catelan (2015) and Catelan (2013) with the possibility of seeing the interstices of the urban network via the movement undertaken by the air flows.

A new standard was conformed establishing a bigger complementarity of relations among the cities. In a regional network, new functionalities endow cities with hierarchic relations of subordination. However, with the changes made in globalized capitalism, we saw ascending in the last years hierarchic relations of complementarities among cities, breaking the classic relations of subordination. By heterarchical relations, we understand, according to Catelan (2013), a group of elements that look for identifying the interscale articulations in the urban network. The horizontality articulated to the process of spatial concentration in the time-space relation of the Brazilian territory allows us to look at the spatial interactions in the scope of the hierarchic paradigm. But the interrelation of the totality of the geographic scales give rise to new qualities.

The flow networks and their inputs of fixed correspondents are among the main causes of articulations among cities. The flows endow cities with new functions, changing their roles in the urban network. As it is one of the embodiments of the urban network, the air traffic flow system is a cause of these changes. Cities with airports change their relationships towards the hierarchy and the heterarchy and are becoming increasingly important within the network. We analyzed these transformations that occurred mainly from the 2000s, the moment when the endowments of infrastructure in the urban network, which focused in the medium cities, contributed to changes in the

pattern of the structuration of the urban network. We support the hypothesis that urban heterarchy puts some light on the articulations.

Contributions of the researches about the regions of influence of cities to the studies of the Brazilian urban geography: changes in the theoretical-methodological aspects

The studies about the Brazilian urban network, arising from the *Instituto Brasileiro de Geografia e Estatística* (IBGE in Portuguese, the Brazilian institute responsible for census researches and data collection) and from the *Instituto de Pesquisa Econômica Aplicada* (IPEA in Portuguese, the Brazilian federal institute responsible for providing data and support to the formulation of public policies and Brazilian economic development) follow a tradition of five decades, what grants us a historical series of researches about the national territory based on the spatial interactions among cities and regions. During this long period, the studies followed the development of the Brazilian cities and the theoretical frameworks about the urban studies in IBGE (1967); IBGE (1970); IBGE (1972); IBGE (1987); IBGE (2000) and IPEA (2002).

The fundamental theoretical frameworks of the studies are found in the classical readings of the Brazilian urban network through the structural classification of the urban centers (ROCHEFORT, 1961) and the theory of the central locations *(*CHRISTALLER, 1966). To Rochefort (1961), the urban network is composed of relations of dependence and complementarity among the polarizing cities in the distribution of the goods and services that endow the denser cities of bigger centrality. Among these cities, there are relations built in intermediate centers and that are also hierarchized, bearing in mind the distribution of goods, services and flows that characterize the urban hierarchy.

In the context of a region, the activity of relation is, therefore, granted by a whole hierarchy of cities that maintain, with one another, relations of dependence. As a result, it is no longer possible to study a city separately, as a

form of activity: the unity must be the urban network, defined inside the boundaries of influence of a big capital, region capital, the existence and the localization of a certain number of types of intermediate cities – all hierarchized, which constitute the network mesh (ROCHEFORT, 1961 p.3).

In this conception, the execution of the urban network is possible only because of the intermediate cities through which the fundamental flows are articulate for the big cities. Rochefort (1961) drew attention to this articulation when he used, as an analytical and empirical approach, the structuration of the transport and communication networks. For the author, "The analysis of the organization of transports, partial cause of the prioritization of the centers, and the study of the telephonic network distribution, consequence of the centrality, became, thus, indirect methods of investigation to define the types of center of a urban network" (ROCHEFORT, 1961, p. 5).

The methodology of the polarizer centers advances to the analysis of the importance of transports, drawing upon the studies of Christaller (1966), which seek to characterize the central locations through the interactions of network links for the consumption of goods and services installed in the cities. According to this theory, the frequency of the demand lead to differentiate patterns of location: goods and services of frequent consumption can be offered by accessible centers to a near population, they have a reduced minimum market and spatial reach. The goods and services of rarer use, on the other hand, have a bigger minimum market and spatial reach and tend to be located in a smaller number of urban centers of higher hierarchy.

The readings of the urban network made from the principles proposed by Rocheford and Christaller demonstrated the hierarchy of the urban center determined by the capacity of the commercial and industrial establishments, present in an urban agglomeration, of providing goods and services to a relatively distant region from the provider center, thereby giving it its spatial polarization.

Although it is still valid, the hierarchic paradigm cannot be the only interpretative group of articulation of the methodology to understand the cities and regions. Recently, mainly since the beginning of the 2000s, many papers (CATELAN, 2013; GÓES, 2016; IBGE, 2017a; 2017b; MELAZZO, 2013; SPOSITO; CATELAN, 2014; SPOSITO, 2017) about medium cities have been contributing to the studies of the urban Brazil before known through methodologies and interpretative systems generated in the scope of the metropolitan logics. Those studies have allowed the creation of many points of view about the process of urbanization and the urban network (SPOSITO, 2017). The starting point of the analysis of the urban network must consider several interpretations,

> […] theoretical interpretations, methodological conductions, method foundations, research subjects, relations between the object and the researcher understood as the central subject in the process of research guiding, empirical basis from which theoretical readings are elaborated etc. (SPOSITO, 2017, p. 186)

Of all the highlighted aspects, we believe that the relation between the methodological conductions and the method foundations helps us to qualify and approximate the idea of urban heterarchy defended as a pair for the hierarchy and ways of comprehending the new arrangements on the movement in the space via air transport. That is because the urban heterarchy is

> […] the possibility of comprehension of the interstices generated in the hierarchic structuration of the urban network and in the complex weave of interscaled spatial interactions. With respect to the medium cities, the urban heterarchy corresponds to the moment when the horizontality and the verticality meet, when the local/regional is definitively articulated to the production of the capital and to the networks that begin to coexist in multiple scales (CATELAN, 2013, p. 78).

When we question the fragmentary paradigm, we have, then, two complementary ways of comprehending the spatial interactions in the urban network. One is directly associated to the hierarchic structure of the network, i.e. its configuration or its spatial arrangement with the urban centers disposed in scale levels of distinct functionalities. Another way is associated with the complexity of the articulations understood by the urban heterarchy, which analyses the interrelations of complementarity in the urban network through the roles and the functions that change according to the group of variables adopted in the different geographic scales.

According to Catelan (2013) and Sposito and Catelan (2015) we have, therefore, a hierarchic perspective and a heterarchical as a way to comprehend the Brazilian urban network, proposed as a pair – hierarchy and heterarchy, to understand the structuration and articulation of the urban network in the multiple scales. This idea was also adopted by IBGE (2017), through a study about the socioeconomic differentiation in urban centers in Brazil, determined by the spatial construction whose perspective of the pair Hierarchy-Heterarchy is assumed as the way of us looking at the articulations among cities. In this study, the IBGE advanced in the proposition placed by Catelan (2013) and Sposito and Catelan (2015), when they brought the idea of articulation through an urban system comprehended from the pair, which reinforces the analysis focused in the flows, in the spatial movement.

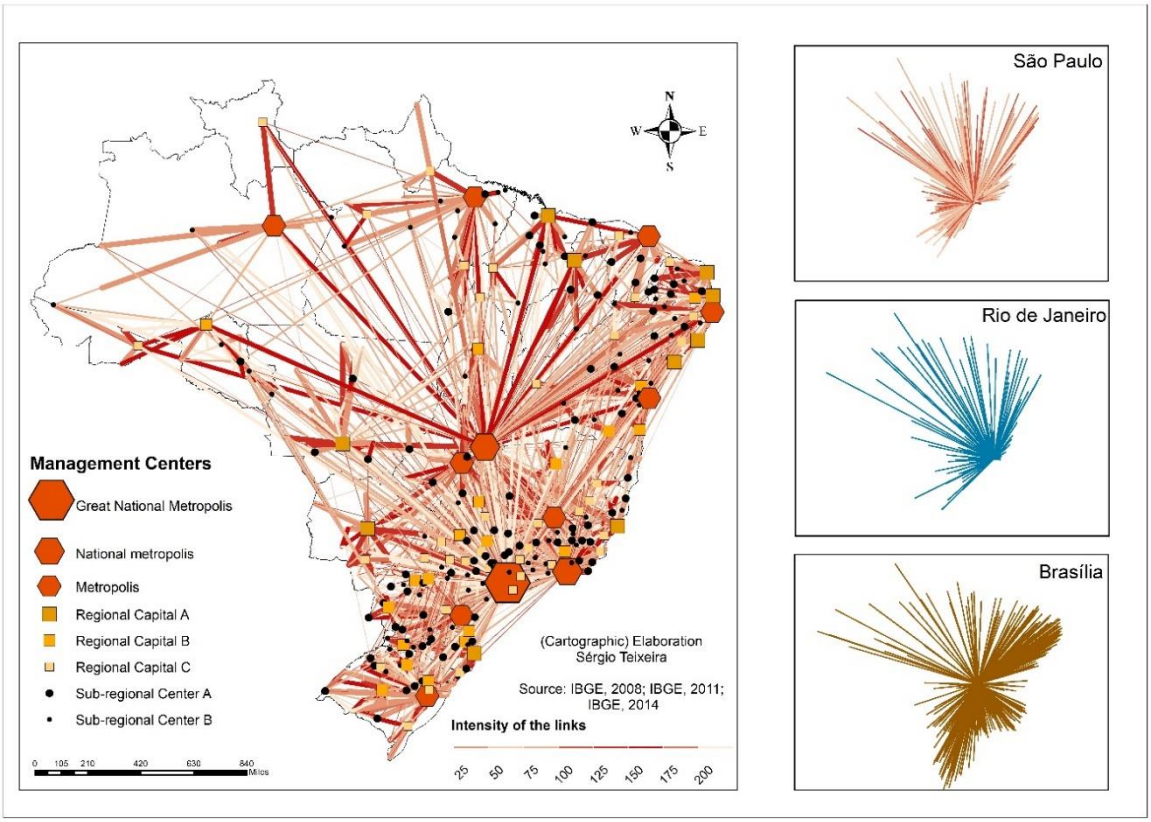
The multiple scales that begin to interact in the urban network manifest themselves in the structure of the flows that make use of the intermediate networks and form the urban heterarchy of the network of cities. The analysis that follows seeks to demonstrate the recent heterarchies created by the new centralities and the reinforcement of some that were already consolidated in the urban network since the mid-20th century.

New elements of contemporary studies of the urban network: management centers and urban heterarchy

The present study of the influence region of the cities tried to update the previous studies when establishing the idea of "hierarchic networks and not hierarchic networks defined by their relations of command flows and complementarity". According to the hierarchic networks, the management – public and business – establishes the relations of control and command among the urban centers, "spreading decisions, defining relations and designating investments" (IBGE, 2008, p.9), characteristics that lead to the conformation of the management centers of the territory (IBGE, 2014).

From the idea of hierarchic links, it is created the classifications for the urban network established by the management centers. The management centers of the territory (business and/or governmental) are characterized as those cities where a large diversity of State agencies and companies head offices are located, from which decisions are made and affect directly or indirectly a given space (CORRÊA, 2006) (Map 1).

Map 1. Brazil: Flows of management and command in the territory, 2018.



Source: IBGE, 2008; IBGE, 2011; IBGE, 2014. Org: Sérgio Teixeira, 2018

The non-hierarchic relations, in turn, occur in cities that maintain relations of "complementarity, which may be defined by the productive specialization, by the functional division of activities and by the differential offer of services" (REGIC, 2008, p. 9). However, "the arrangements given in a non-hierarchic way, both among urban center and among networks, look less clear to us, of bigger difficulties to investigate" (CATELAN, 2013 p. 76). Then we began with the generic idea of the "non-hierarchic" to call it in the scope of the urban heterarchy.

If we already considered that it is relevant to take a look at the spatial concentration and the polarization (IBGE, 2017), it is worth mentioning the relation of the spatial concentration among the production and capital management centers, which is important to analyze the distribution of the flows

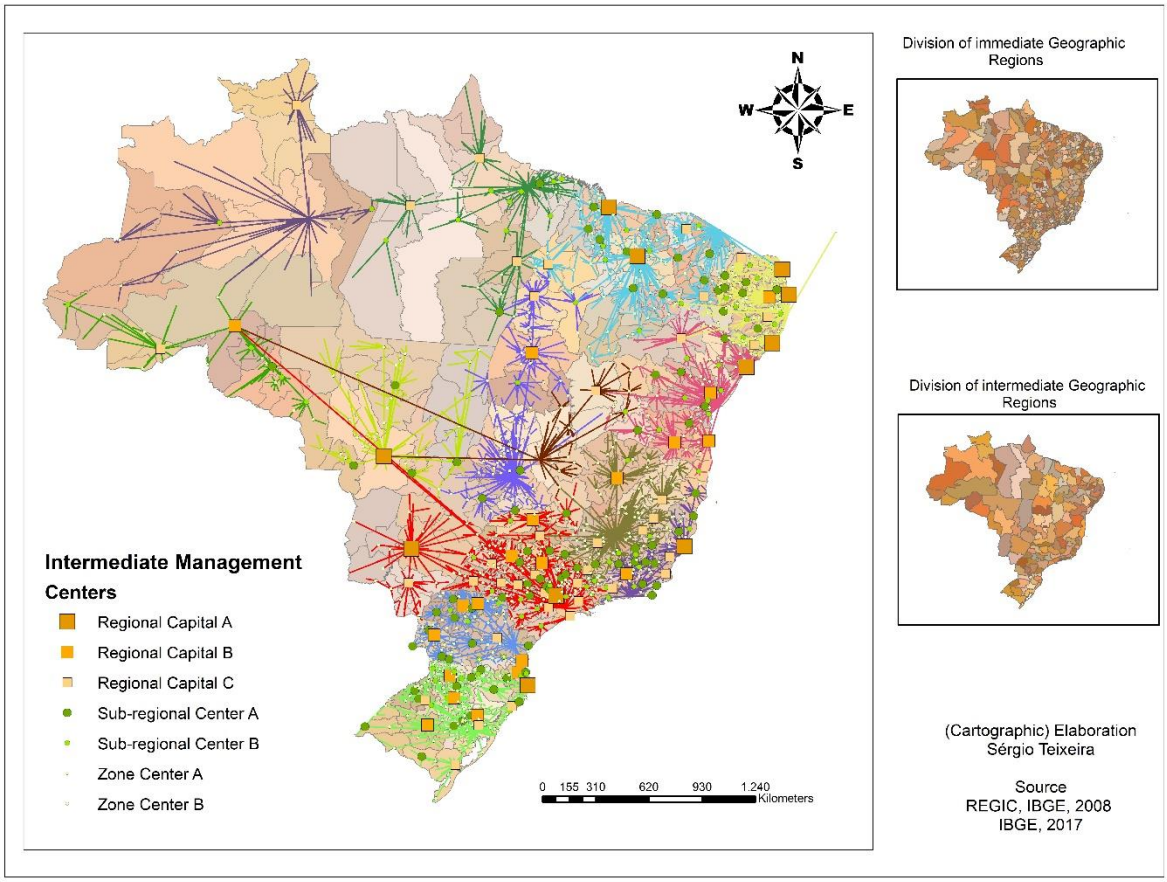
in the Brazilian territory. This is because the capital management centers, according to IBGE (2008, 2014) also follow the standard of concentration originated from the role assumed by the big urban centers that involve metropolises and metropolitan regions (Map 1).

Therefore, when we speak, in this period, about territorial integration, we are actually speaking about the interconnection of urban centers that polarize and command the industrial process. The Brazilian urban network starts to be commanded by centers of the highest levels in the urban hierarchy, located in the industrial centers of the Southeast and Center-west regions, especially, in the cities of São Paulo, Rio de Janeiro and Brasília, establishing the connection of command in all the territory (Map 1). The constitution of dense networks of telecommunication and transport enabled the increase in the material, immaterial and people flows among cities and regions.

The functional specialization in the urban network helps to explain the appearance of urban centers that assume the role of intermediate management of the capital with business offices articulated from the production in multiple scales. These management offices are also articulators of interescalarity because they are responsible for the logistics of the foreign trade, acting as intermediators from metropolises, capital cities and regional articulation centers, conforming intermediate regions where the heterarchies happen in a denser way (Map 2).

The Intermediate Geographic Regions are a way to think about the articulated territory, detailed by the Immediate Geographic Regions through a pole of superior hierarchy differentiated from the flows of private and public management and from the existence of urban functions of bigger complexity (IBGE, 2017) (Map 2).

Map 2 – Brazil: Intermediate Management Centers.



Source: IBGE, 2008; IBGE, 2017. Org: Authors, 2018

The repercussions of the refunctionalization in the urban network have effects in the distribution of the airports in Brazil and in the reinforcement that part of it, especially the medium cities, would be the main receptor of these equipment. On one hand, in the management and the command maps in Brazil there is a clear spatial concentration in the South/Southeast and the metropolises like São Paulo, Rio de Janeiro and Brasília are hubs of this concentration. On the other hand, there is a clear movement directing to the new centralities, as it is the case of articulator medium cities of the intermediate

geographic regions. That is because many companies focus on the fusion between the production and the management.

By analyzing Map 2, it is evident that the management centers are hierarchically organized from the urban centers that are metropolises, as well as from areas of population concentration (APC) which embrace a considerable number of cities characterized as regional capitals. In these regional capitals, many of them medium cities, the production management does not pass through the centers of capital command, as the three metropolises depicted on Map 1. It is in these cities that the interescalarity happens in the logic of the companies with leaps of scale between the local/regional and the global.

The cities are articulated among them, compounding a hierarchic and heterarchical system (of complementarity) of functions (SPOSITO; CATELAN, 2014). This way, they are hubs of one or more city networks that are articulated to enable the flow of goods, information and orders (IBGE, 2017, p.9).

Therefore, spatial concentration and functional specialization of the urban network are dimensions of the analytical plan to understand the movement of spatialization of the air traffic system in Brazil, bearing in mind that the implementation of airports and the density of air flows overlay the map of spatial productive differentiation that reveals the heterarchical pattern of the urban network.

Cities Networks and territorial flows of the air traffic movement system

The Brazilian network of cities is constituted by functional linking axes between the fixes and the flows, in which the transport of goods, people and information integrate a complex spatial organization of the production in the territory. The airports establish a system of engineering that anchors itself as a fix of great relevance in the cities, strengthens the hierarchic and heterarchical relations. Therefore, the cities and airports' networks, because they are fixes

determined by their flows, have an inseparable relation, as both qualify their uses through technical densities that they promote and from which they are tributary. A city can earn or lose priority inside an urban network due to the increasing or reduction of the people and goods flow arriving at its airport, as well as an airport can earn more relevance of flux if its city has a new function inside the network. The game between losses and gains of roles, increasing and decreasing of flows is a strong aspect in our analysis, after all, it will depend on many elementary and complementary factors in the process of spatial concentration in these urban centers. Here, they are understood by the presence of airports and air traffic flows, but they can be understood through many other empirical approaches, such as the investments in public policies, implementation of housing policy, tax incentive to the expansion of the industrial zone – with the insertion of technology production, to the trading and consuming companies, to the equipment of higher education and health, etc. By this complex composition is that we propose, following IBGE (2011), an interpretation of the city network through the primary and secondary data about the functionalities of the urban centers, considering the air traffic flows that cross the network.

A city served by an airport characterizes its centrality, because the establishment of good and services of an infrastructure of a fixed airport transmits to the city variable quantities of flows that define a repositioning in the hierarchy, consolidating a complex and heterarchical movement, a new condition in the urban network. Inside a context of increasing popularity of the commercial aviation, the air connections represent an index of the relationship between the urban centers, allowing, in a more accessible way, the fast transport of long distances.

The flows derived from the air transport provide, thus, a geography of the structure of the urban network, since they constitute an instrument of accomplishment of the spatial interactions among the cities, especially regarding the high-level functions (companies management, companies head offices,

service providers, representatives of the State apparatus etc.) (IBGE, 2011, p. 08).

We noticed that, from the 90s, new centralities gained strength in medium cities, derived from the administrative/federative decentralization operated from the Federal Constitution of 1988. The process of decentralization, in the scope of the federal pact, expanded the participation of the municipal sphere, mainly regarding the funds and taxes management. This change made some cities receive more prominence, expanding their capacities of articulation in the urban network. Mostly with focus on corporative businesses, many companies ended up breaking the hierarchic scales of the urban network, stablishing relations directly with the global center, attracting more and more businesses to the medium cities and intermediate centers. It confirms that, besides the verticality,

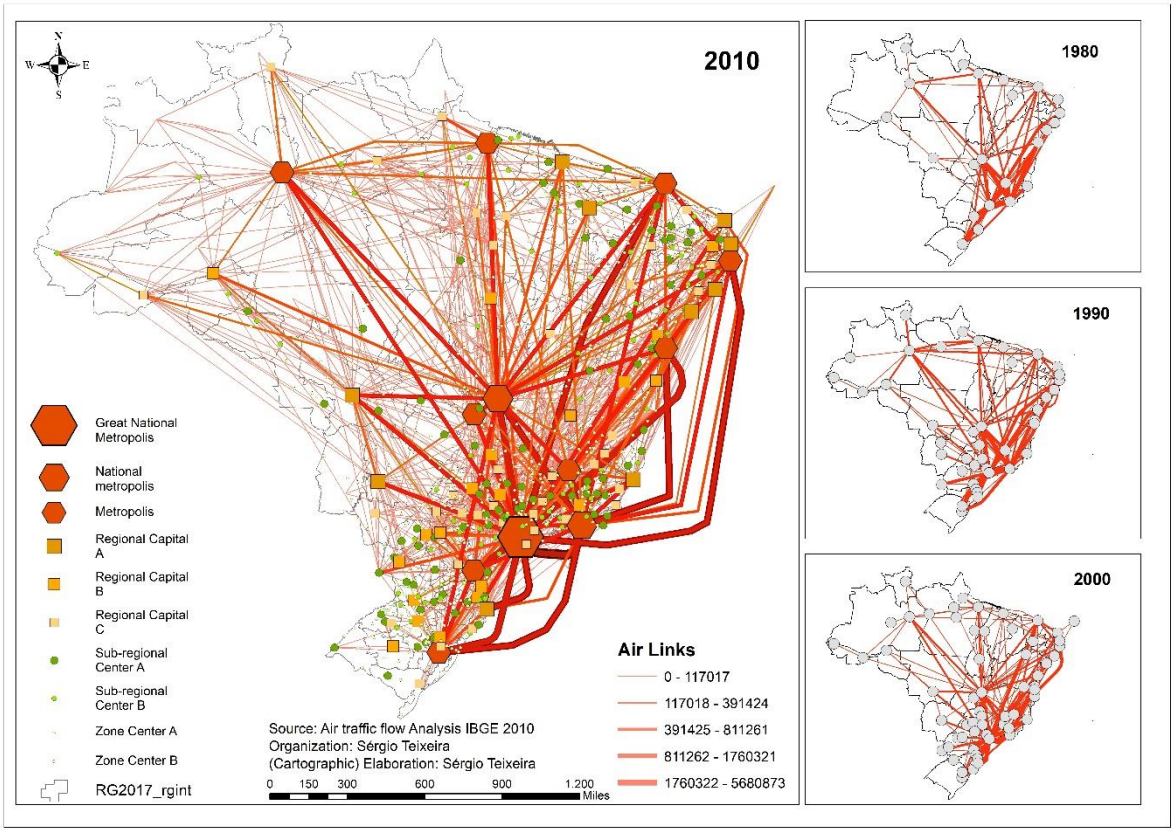
> […] the cities, however, maintain also horizontal relations, of complementarity, that can be defined by the productive specialization, the functional division of activities, and by the differential offer of services. That can occur, inclusively, among centers of the same function and roles in multiple scales. (CATELAN, 2013, p. 76).

The complexity of the air traffic movement incites the valuation of the perspective of urban heterarchies, mainly through the airport connections in medium cities from the second half of the 1970s.

From our analysis, this period is very relevant, since the State begins to conduct historical series of flows, making it possible to detail, even more, the influences of the installation of airports in the cities, identifying its outcomes for its planning and for its refunctionalization in the urban network. In Map 3 we showed the extension of the airport network in four different stages that attest its growth and its relationship with the urban network. It is possible to notice that, after the constitution, in 1980, of the Company of Airport Infrastructure (INFRAERO), a densely articulated network was determined in all the national

territory, but especially with capillarity in the intermediate management centers.

Map 3 – Brazil: Aerial flux of passengers (1980-2010).



Source: IBGE, 2010. Org: Authors, 2018

Following INFRAERO's consolidation as the air traffic flow system operator, the number of cities served by airports in the national territory reached 23. The airflow lines reached 66, spread across the entire national territory, with direct interconnection among the main centers.

The highlight in this new network are the connections of Manaus, in the Amazonas State, with other urban centers after its incorporation into the national network. The city left its main connection with Belém, in the Pará State, and established direct connections with São Paulo/SP since it was incorporated into the INFRAERO network.

Another highlight was the inauguration of the airport of Brasília, established as a distribution center of the airport network, which became the main hub of the national air network. Besides the changes caused by the dynamics of the urban network, there was a huge extension of it, promoted by the new policies for the sector. Among them, we highlight the investment in the expansion of the network, originated from the *Plano Nacional do Desenvolvimento* (PND, the National Development Plan) *I* (1972-1974) and II (1975-1979). The policy oriented through these plans and the political context in which they were inserted, the Military Dictatorship, had a project of national integration articulated to the proposal of economic development. It happened much more because of a strategic vision on the Brazilian territory. We believe such vision was oriented by the deconcentration of the Center-South directing to the generation of spatial concentration in regions to be consolidated as north and northeast for territory control ends, with investments directed to areas such as the transport and others that would be dependent of the transportation system to be territorialized in the country.

Even with the decrease in the implementation of constructions in the end of the military regime, context of the PND II, the territorial integration and the strengthening of the national market during the PND I created conditions for the insertion of the Brazilian productive dynamics in the international market. After relative success in absorbing foreign investments, industrialization enabled the entrance, although slowly, of Brazil in the international market, increasing the participation of the manufactured goods in the foreign market and increasing the flows in the territory.

The organization of space and urban-regional standard, originated from the integration of the national market, changed deeply during the decades of 1960 and 1970. The territorial integration, commanded by the initiative of foreign capital, promoted private and public investments in specific places in the territory, providing an interconnected spatial organization, although highly hierarchized among the most dynamic industrial urban center of the territory,

Thus, it is possible to recognize, according to the classical definition of the geographic and regional studies, the constitution of a highly polarized city network (CORRÊA, 2006).

The next stage was the transformations originated from the competitive insertion of the national economy in the foreign market after the 1980s. Bresser-Pereira (2005) considers that, from 1978, the "Nation and Development Cycle" is the moment in which Brazil achieved the "Brazilian Capitalist Revolution". From the 1980s, the pattern of productive diversification in the Brazilian industry's exporter agenda has been halted by the crisis of the external debt resulting from the "economic miracle", named after the resumption of the investments during the implementation of the *Plano Estratégico de Desenvolvimento* (1968-1970) and during the PNDs. In the period of the PNDs, the external debt was around 14,9 million dollars, achieving 55,8 in 1979, as the Gross Domestic Product varied from 14 million dollars in 1973 to 6.8 in 1979 (IPEA, 2002; MATOS, 2002). The investments applied in the national productive structures are taken from the country, making it difficult to articulate the internal market. At the same pace, the world economy underwent through the neoliberal adjustments and the productive restructuration that focused on a bigger densification of the insertion of fractions of the peripheral territories into the world economy, creating new articulations of the subnational spaces with the external market.

The productive deconcentration of São Paulo and the Southeast region opened new areas with potential facilitators and old areas (re)functionalized, that started to connect directly with the foreign market, putting even more difficulties to the organization of the development of an internal market and advocating parts of the territory to the logics of the globalized capitalist accumulation.

> In an extremely contrasting way, the period post-1980 was characterized by sector, incoherent, unstable and focused outbreaks of economic growth in restrict points of the space in

> each of the Brazilian micro regions. The generalized loss of economic dynamism and the enlargement of the socioeconomic gaps among its regions were determined by the international macroeconomic environment, the wrong options of economic policy and the loss of systemic and organic quality of the State action, which resulted in arrhythmias among the public and private investments (BRANDÃO, 2011, p.20).

New areas and cities received industries and capital originated from the traditional core area, the Southeast region of the country with a high concentration in the city and in the state of São Paulo, forming new urban centers and frontiers of expansion. The results of this process to the spatial organization of the territory marked a new urban-regional pattern and of urban network formation, characterized by a bigger territorial fragmentation, followed by a bigger articulation of the spatial interactions.

The industrial deconcentration of the São Paulo city to other regions started a process of demographic deconcentration, making the urban network more complex with the rising of new regional centralities (LENCIONI, 2011). At the same time, many urban centers began to articulate directly with centers of decision out of the national territory, thus becoming poles that are independent from the network, connected more to the international than to the national market. These are mostly the cases of cities linked to more dynamic exporting activities, such as the agribusiness and the intermediate industrial goods or of command centralities linked to financial services and of information that would establish new urban heterarchies.

In relation to the air traffic movement system, there was an extension of the articulations of the airports with these new urban centers that started to require air traffic equipment as a way of boosting its flows and network interactions (Map 3), observing the period of 1990.

The number of cities served by airports increased at a low proportion, but the lines of flows accrete in more than 50%. While in 1990 there were 42 cities with airports, in 2000 there were 60. However, while in 1990 there was a total of 104 lines of air traffic flux among the cities, in 2000 there was 163.

A relevant question must be considered for the theme of this article. While the decade of 1990 was marked by the policy of privatization and more autonomy for the cities to make their business planning with the influence of the international capital, in the air traffic system there was State investment. That happened due to the infrastructure of territorial fixes and flows being overly expensive for the capitals that requested its application through the State. It is not by chance that, in the following decade, the number of airports and state investments in the sector increased exponentially (TEIXEIRA, 2018)

However, besides the great autonomy, the urban network is influenced by the territorial planning exerted in the scale of sociospatial formation. For this reason, the endowment of resources of the federal scale caused a big dispute among the cities, which led Santos and Silveira (2001) and Rolnik (2015) to identify a real "war of the places", a metaphor that expresses the considerable number of different cities in dispute for territorial infrastructures to embrace offices and industrial plants of big corporations. It is the case of the resources from the *Programa de Aceleração do Crescimento* (PAC, Growth Acceleration Program) created in 2013.

From the PAC's investments in infrastructure to the air traffic movement system there was a vertiginous growth of the air flux connections among the cities (Map 3). The number of cities served with airports increased from 60 to 149 between 2000 and 2010, an increase of almost 200% in one decade. In the same decade, the number of flux connections underwent from 163 to 879 lines, attesting an increase of more than 500% (IBGE, 2011).

We noticed the presence of the urban heterarchy expressed in new centralities created by the new flows that endow the medium cities of bigger interscaled interactions. These ones overcome the hierarchy of the management centers of the territory of higher hierarchic level, confirming the idea of Santos (1996) when the author calls it "overexposure of actions of many scales". For the author,

> Many distant points are, at the same time, reached, from a same decisive center that sends its messages and orders with efficiency. At the same time, the current possibility of globalization of a big number of actions causes, for many places, the problem of overexposure, in it, of actions with many scales, carriers of contexts with diverse geographic coverage and active force (or reactive) (SANTOS, 1996, p. 149).

It is highlighted, in these global articulations, the role of the medium cities. They became bearers of bigger flows, increasing the number of cities that conformed as centers of importance in the urban network, regarding their influence in the regional network, promoting more territorial and spatial interactions. These cities supplied by bigger quantities of flows, become strategic places to the globally extraverted corporative logics. Moreover, currently, the cities themselves generate hegemonic economic agents with regard to the dynamics and logics of their production and the consolidation of their roles. That is because now they are not only affected but also promote sociospatial differentiation. This is an unexplored fundament of the urban heterarchy: the urbanization of the Brazilian territory is increasingly resultant of the scale articulation, therefore, the urban hierarchy is consolidated not only by the rigid and classic structuration, but also by complex articulations of scale jumps and multivectorial directions. Although organized from the already consolidated centralities, the air flows also consolidate others still in formation.

Final Considerations

Analyzing the alterations of the air traffic system, we noticed that the structuration of the flows and airport networks kept the pattern of density and fragmentation of the cities network. At the same time, the system extended itself establishing new densities related to the urban heterarchy. This happened because of the inseparable relation among the technical networks of the air traffic system and the changes that the cities network has been passing through in the multiple scales.

The analysis of the air traffic flows in the urban network shows that it is still verifiable a pattern of concentration in the coastal metropolises, in the Southeast region of the country and in the city of São Paulo, attesting the permanence of the technical density in the concentrated region of the territory. However, new centralities emerged in the network, highlighting the medium cities that have been composing urban agglomerations of spatial interactions with the local cities and their influence areas and, in some cases, with cities of the same function. It is the case of the medium cities that received capital investments, above all, from the decade of 1970, with the process of industrial deconcentration irradiated from the São Paulo metropole. At the same time, these cities generated in themselves actions of politics and economic agents that were incorporated in the logics of reproduction of the capital in multiple scales.

This process consolidated in the decade of 1990, with the intensifications of the war of places, legitimized both in the political-administrative plan and in the approval of the federative pact in the Federal Constitution of 1988, as well as in the economic plan, with the opening of the territory to the globalization. A bigger complexity in the hierarchic structure in the urban network originated from these two plans. Medium cities and medium-sized cities outside of the metropolitan region, commanded by metropolises, explode their spatial interactions promoting the urban heterarchy.

From the 2000s, with the investments in infrastructure from PAC, the medium cities implemented infrastructure of circulation that endowed them of bigger centrality, reaffirming their regional roles. At the same time, new infrastructure systems and regional equipment were implemented, such as airports. So, we consider these relations with aspects of functional interaction in a pattern of complexity in the scope of the urban heterarchy.

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