

CHANGES IN THE SPATIAL CONFIGURATION OF THE METAL_MECHANIC SECTOR IN THE STATE OF SÃO PAULO, BRAZIL : From industrial agglomerates toward local productive arrangements ⁱ

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1.Introduction

This article aims at bringing together the concepts of industrial agglomeration and productive arrangements, focusing on the transformation from the first concept to the second.

Industrial agglomerations, in classical regional development models, played the role of regional engines of economic growth. The regional “pôle de croissance”, idealized by Perroux (1955) is a classical example: agglomeration economies are formed in important axes of propulsive industries or large urban centers. Resident industries benefited from gains of scale and the possible overflowing of activities of the pole would be a dominant factor of regional development.

Half a century later, the industrial organization process underwent significant changes and the new pressures from a globalized economy have printed a new form of articulation between companies and places.

Factors like the so-called fiscal war and the facility to implement new industrial plants have changed entirely entrepreneurial strategies and, therefore, the relation between firms and their place of production. Changes not always bring a positive impact for companies and their localities of operation. The exit of a company or a group of companies can imply great losses in the employment and income structure, which, depending on the place, can generate a negative chain-effect across a regional economic framework.

Also, factors like negative externalities, initially generated by the search for gains of scale, also have devastating effects on productive structures.

Thus the articulation between a company and local players is crucially important when specific resources can be obtained and their reproduction is difficult in another locality. This type of articulation provides a strong link between company and -local, which can bring significant gains throughout a regional productive structure. This model is extremely relevant to developing countries economies, mainly in the contemporary era of global-scale competition.

This article is divided into three sections, besides the conclusions.

The first section, of a methodological kind, consists in applying specific quotients aimed at identifying agglomerations of activities in the metal-mechanic sector of Sao Paulo state’s municipalities, based on the division of the National Classification of Economic Activities -CNAE 95, of the Brazilian Institute of Geography and Statistics (IBGE), which takes into consideration the number of establishments. The information used comes from the Annual Social Information Report (RAIS), produced by the Secretariat of Employment and wage policies of Brazil’s Ministry of Labor and Employment (MTE), for the years of 1995 and 2005. The criterion used is that of locational quotient (LQ) calculation relative to the total of establishments and occupations. This indicator seeks to capture the relative specialization of a municipality, adopting as a basis the value of those variables mentioned in each class pair of the National Economic Activity Classification (*CNAE*)/95 - *municipality*, informed by RAIS.

In addition to the analysis of the indicators of relative specialization, a control variable will also be taken into consideration, based on a criterion of relevance, aimed at ensuring a minimum participation of the municipality, in the establishments of the CNAE

class in the total of the country. This study used the limit of 0.1% to characterize the relevance of each agglomeration. The values considered for this type of control were obtained by dividing the number of establishments of the metal-mechanic sector by that of the national total of this sector. Thus a second criterion was defined for selecting CNAE classes, based on an index of Sectorial Relevance (RS) of that agglomeration in terms of the total number of establishments.

The second section provides a lengthy discussion of the term industrial agglomeration, by drawing in the works by Storper 1997, Porter, 1999, Veltz, 1999; Cassiolato, 2004, among others. To that end, this work opted for identifying the agglomerations of the metal-mechanic sector of the state of São Paulo, Brazil. This choice was made based on the fact that this sector gathers a set of machinery and equipment manufacturers which comprises the production of other goods, permeating all other sectors of industrial activity, of fundamental importance to the industrial basis and to enable the investigation of future agglomerations in other sectors. In the case of these suppliers, geographic proximity is very relevant given the need to provide fast service and maintenance support, and, moreover, for the exchange of tacit knowledge, i.e. , that which is not coded by firms (LASTRES & CASSIOLATO, 2004; AVELLAR, 2004).

The third section will approach how these productive agglomerations convert or no into Local Production Arrangements (LPA). In this case, it is necessary to investigate whether there is a territorialization of the agglomeration, i.e., a link between the companies and their territorial insertion. And it is in this sense that this debate has been gaining momentum in the Brazilian academic scenario focused on Middle-, Small- and Micro-sized companies, revealing originality in the discussion of Brazil's new industrial policy. These arrangements involve the participation and interaction not only of companies and their varied forms of association, but also public and private institutions aimed at para a formation and capacity-building of human resources, R&D, promotion and financing policies (universities, research agencies, consultancy and technical assistance firms, public bodies, private organizations and NGOs, among others). Each LPA is associated with a specific governance structure, which refers to the different coordination modes that bring together agents and activities, involving not only the production and distribution of goods and services, but also the process of generation, dissemination and use of knowledge and innovations (BNDES, 2004; SEBRAE, 2004; Redesist, 2004).

The last section discusses the results obtained in the research, and defines the classification of agglomerations into first, second and third order, according to the methodology employed. The expected results seek a typology of these agglomerates, aimed at delimiting homogeneous areas with some geographic proximity among the agglomerations. Within this perspective, we can delimit the formation of five centers, or regions with higher significance, considering all indicators mentioned.

2. Analysis methodology of the spatial concentration of productive units

The methodology used consisted primarily of applying specific quotients to identify activity clusters in the metal-mechanic sector in municipalities of the State of São Paulo. The National Classification of Economic Activities (CNAE/95) of the Brazilian Institute of Geography and Statistics (IBGE)^{iv} has been used and the number of establishments of the metal working and machinery industry taken into consideration. Data was also drawn from the Annual Listing of Social Information (RAIS), produced by the Secretariat of Employment and Salary Policies of the Ministry of Labor and Employment (MTE) for the year 2003. The basic criterion is the calculation of the Locational Quotient^v (LQ) relative to the total number of establishments and jobs. This indicator seeks to capture the relative

specialization of a municipality. By adopting as basis the value of the variables mentioned in each CNAE/95 class-municipality pair informed by the RAIS, the calculation of the LQ's is done according to the formula below:

$$LQ = \frac{\frac{ei}{et}}{\frac{Ei}{Et}}$$

ei = Metal-mechanic sector's establishments disaggregated to CNAE/95 class, in the municipality

et = Total of establishments in the municipality

Ei = Total of establishments of the metal-mechanic sector disaggregated CNAE/95 class, in the country

Et = Total of establishments in the country

An LQ above 1 shows that the municipality's relative specialization level in activities of the metal-mechanic class is higher than that of the nation in the classes of this sector.

Besides the analysis of the relative specialization indicators, a control variable was included based on a relevance criterion aimed at ensuring a minimum participation of the municipality in the CNAE class establishments in the total of the country. This study used the 0.1% limit to characterize the relevance of each industry cluster. The values considered for this type of control were obtained through the division of the municipality's metal-mechanic establishments by the sector's national total. A second criterion for CNAE class selection was thereby defined, based on a Sectorial Relevance (SR) index of that cluster in terms of total number of establishments:

$RS = (\text{Establishments of the metal-mechanic sector disaggregated to CNAE/95 class, in the municipality}) / (\text{Total of Establishments of the metal-mechanic sector disaggregated to CNAE/95 class, in the country}) > 0.1\%$

After applying these indices, a cut criterion was chosen, i.e., the presence of at least five establishments, so as to be consistent with the basic presuppositions of geographic agglomeration. Municipalities with a smaller presence than five establishments were ignored in the mapping.

Such measure was deemed necessary for two reasons: the specialization index might have arisen from the low density of the local industrial structure and a high LQ value might have resulted from the presence of a single large enterprise. This type of framework was also adopted in other studies, like Suzigan's^{vi}.

3. Industrial clusters

Initially, it is important to bear in mind that the term industrial cluster is currently used in geography, economy and a host of other areas addressing economic and spatial aspects. Thus the precise delimitation of the term is complex.

Porter (1999, p.211), for instance, sees clusters as "*geographically concentrated groups of interconnected firms and associated institutions in the same field*", reminding that the scale of an agglomeration may vary from one city to a group of countries. In the same

vein, Lastres and Cassiolato (2004) understand clusters as having a *territorial proximity of economic, political and social agents*, one that will bring *advantages, including access to knowledge and capacity-building, skilled labor, raw materials and equipment*.

Storper (1997) sees in agglomerates locational competitive advantages for industries sharing this territory. Referring to Scott, the author emphasizes that the economic base of a number of cities lies on industries, which need the flexibility achieved through agglomerations.

The Brazilian Service for Small and Micro Enterprise (EBRAE) and the Research Network on Local Productive and Innovative Systems (REDESIST), in a specialized glossary in 2004, admit the same aforementioned advantages and consider that *“the agglomeration enhances the chances of survival and growth of enterprises, thereby being a relevant source of competitive advantages, particularly in the case of micro and small-sized companies”*.

By and large, an industry cluster has some degree of sectorial specificity, and this research opted to identify agglomerations in the metal-mechanic sector. This choice was due to the fact that the latter gathers a set of machine and equipment manufacturers upon which the production of other goods depend, hence permeating all other sectors of industrial activity, i.e., it is a key sector, of crucial importance to the industrial base and to the investigation of future agglomerations of other sectors.

The sector can be characterized by its heterogeneity, present in the competitive market conditions, which are directly related to the industrial segment's rapid technological pace. In other words, it bears characteristics of producers and of buyers of capital goods from the companies comprising it. Moreover, their products vary widely, involving the operations of assembling parts and components, which might be partly manufactured by the factories themselves and partly acquired from specialized suppliers.

In the case of these suppliers, the *geographical proximity* is very important, given the need for fast service and maintenance, and, mainly, for the exchange of tacit knowledge, i.e., that which is not codified by firms (LASTRES & CASSIOLATO, 2004; AVELLAR, 2004).

As seen so far, the industrial agglomeration will depend to a large extent upon a series of factors that enable geographical proximity, gains of scale and advantages arising from positive externalities. Veltz (1999, p.73) shows that it is hard to doubt factors like:

“los bienes colectivos, las infraestructuras materiales y sociales, concentradas en zonas densamente pobladas y que crean un valor que no es más que objeto de cesión o de apropiación comercial; el nivel técnico y cultural de la mano de obra, ligado a competencias especializadas cuyo valor puede ser apreciado en los mercados, pero también ligados a una amplia base de conocimientos difusos, de comportamientos y de disciplinas interiorizadas en la vida social en general; y las redes de relaciones fuera del mercado, que existen entre los empresarios, es decir, la circulación de conocimientos informales o formales que dichas redes permiten”

Hence for an effective tendency for industrial agglomeration an urban contribution is necessary to enable the development of these factors.

Storper (1997, p.13) also shows that *“especially middle-sized cities, are not only urbanized, but have strong sectorial specificities. So urbanization economies are underpinned by localization. This localization involves parts of firms, those that are in certain technological or economic ‘spaces’, in the sense defined by Perroux”*.

The process of productive restructuring of the industry that took place in the 1990's generated important developments in the field of interrelations among agents within supply chains and the pattern of spatial location of industrial activities (NEGRI, 1994).

On the one hand, growing pressures on the search for higher efficiency levels in the use of productive factors have fostered the location of productive activities in regions where the availability of factors such as labor and natural resources, in particular, are the most favorable possible, both under the qualitative and quantitative viewpoints. On the other hand, the process of spatial decentralization of the industry, and subsequent appearance of new industrial areas, which dates back to the 1970s (AZZONI, 1985; BNDES, 2004), has been gaining a new dynamics in recent years, including because of the stimuli from economic policies, defined at federal, state and municipal levels. The productive restructuring and industrial decentralization in the State of São Paulo (AZZONI, 1985; LENCIONI, 1994), mainly in the machinery sector, has enabled the reagglomeration of these industries in medium-sized cities of the interior of the state, which brought about a great change in the locational pattern of these industries and these urban centers.

4. Local Productive Arrangements

So far we have been able to verify that industrial clusters play an important economic role in the productive industry of urban centers. However, this type of synergy among industries within the same territory does not guarantee a significant economic development for the city, insofar as local industries can share knowledge among themselves, but not have a strong participation in the social institutions; an agglomeration may also not guarantee any positive boost, since the establishments within it may be sharing the same territory without exchanging experiences and competing predatorily. Thus a territorialization is required, a link between companies and territory. About this aspect Storper (1999, p. 180) states that:

“Territorialization is thus not equivalent to geographical proximity or agglomeration, although such agglomeration may be at some times the cause and at others the effect of territorialization: it is an effect when scarcities and specificities of key resources such as labor and technology draw producers to a place, and when nonsubstitutabilities keep them there; it is a cause when the transactional structure of production draws producers into an agglomeration, and then key dimensions of the production system become relation-specific and key to its ongoing efficiencies.”

It is in this sense that the debate on Local Productive Arrangements has been gaining increasing space.

SEBRAE (2004) defines Local Productive Arrangements as:

“Spatial agglomerations of economic, political and social agents focused on a specific set of economic activities and that presents links and interdependence. Through these links a learning process originates which enables the introduction of innovations in products, process and organizational formats, generating more competitiveness for the companies integrated in the arrangement. The formation of an LPA is associated with historic trajectories of territorial links (regional and local), grounded on a common social, cultural political and economic base”.

Conceptually, an LPA can be understood as inserted in an agglomeration, even though not every agglomeration presupposes the existence of an LPA. The formation of Industrial Districts, Growth Poles or Hubs or Productive Arrangements presupposes a stronger connection among the actors and specific linkages (BENKO, G; LIPIETZ, A, 1994).

In an LPA, interactive learning, particularly of the kind associated with transfer and dissemination of competences and knowledge of a “Tacit” nature constitutes a fundamental source for the enhancement of the innovative and productive capacity of firms and institutions.

Such arrangements involve the participation and interaction of not only of firms and their diverse association manners, but also of public and private institutions aimed at human resource capacity building, R & D, promotion and financing policies (universities, research institutions, consulting and technical assistance companies, public bodies, private organizations and NGOs, among others). Each LPA is associated with a specific governance structure, which refers to the different ways coordination occurs among the agents and the activities, encompassing not only the production and distribution of goods and services, but also the process of generating, disseminating and using knowledge and innovations (BNDES, 2004; SEBRAE, 2004; Redesist, 2004).

LPAs are a more developed configuration clusters insofar as they have a higher number of territorial interactions and connections, therefore constituting the bridge between an industry cluster and the specific resources of a territory, in this case specific resources provided by the medium -sized cities.

5.Results Achieved

The application of the above-mentioned quotients, allied to the theoretical discussion allowed obtaining a bird's-eye view of the spatial of the spatial distribution of the metal-mechanic sector in the state of São Paulo, which in turn enabled the preliminary delimitation of places and regions with strong specific production in this sector. Thus a classification of first, second and third order clusters was defined.

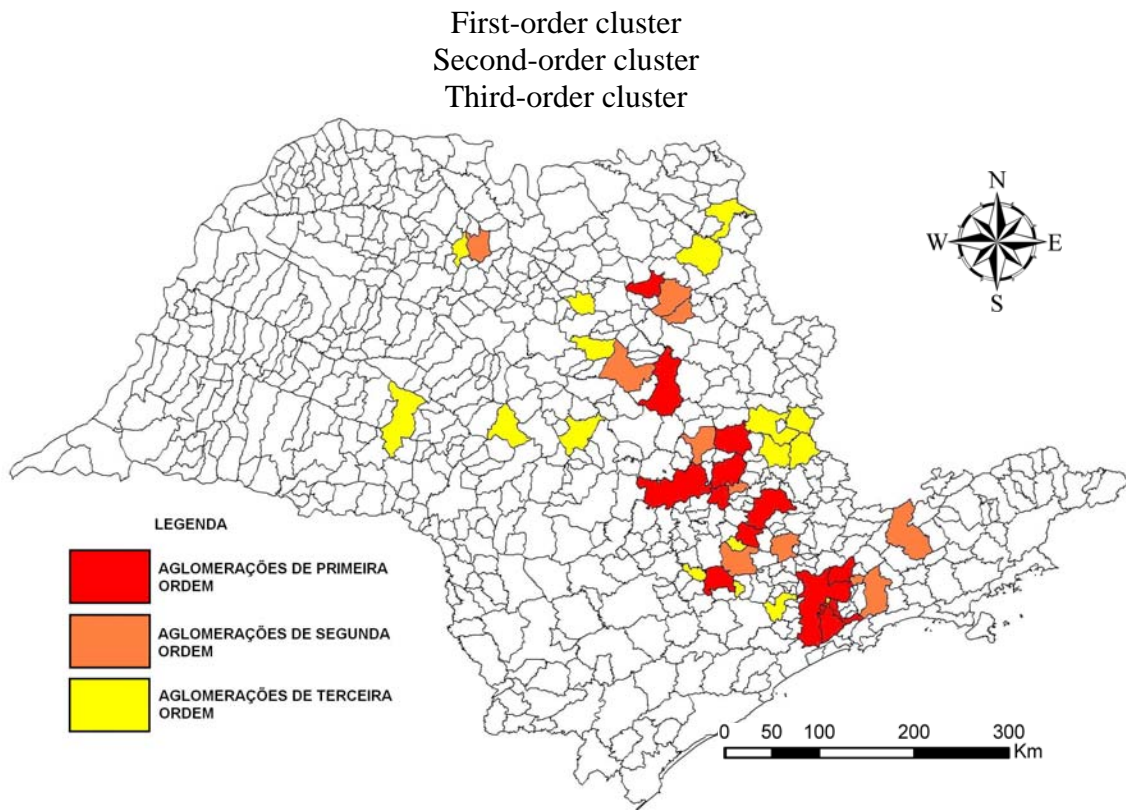
First-order clusters are those possessing the best characteristics for the development of productive arrangements; the municipalities within this category are seen as important central cores sheltering the main constituents of the arrangements.

Second-order clusters do not have all the characteristics of the first order agglomerations. Nevertheless, they enjoy an important “industrial atmosphere”; the municipalities herein identified have a strong degree of complementarity with first-order cores.

As for third-order clusters, they have some important principles of arrangements, but have not reached a degree of “Maturity” in terms of size of agglomeration; the municipalities under this category have the future possibility of developing the metal-mechanic sector or integrating more complex cores.

It is thus possible to seek an approximation among these agglomerations, aimed at delimiting homogeneous areas with some geographical proximity. Under this perspective, the formation of five cores, or regions with a more significant expression, was established taking all aforementioned indicators into consideration. This configuration can be visualized in Map 1.

MAP 1 – GENERAL CLASSIFICATION OF THE CLUSTERS IDENTIFIED



(Created by the author)

Region 1 – Consolidated earlier than the other regions and traditionally known for its metal-mechanic industries is the region formed by the municipalities of São Paulo, São Bernardo do Campo, Guarulhos, Santo André, Osasco, Mauá, Cotia, São Caetano do Sul, Ribeirão Pires, Taboão da Serra and Diadema. The number of metal-mechanic factories here is high and almost all municipalities have over ten clusters, whether in terms of establishments or employees. According to the indicators, it is possible to state that the municipalities of São Paulo, São Bernardo do Campo, Santo André, and particularly Guarulhos, are highly inclined to develop more complex productive arrangements than the agglomerations identified.

Region 2 – This region is equal to the previous one in terms of establishments and employees, but the degree of specialization is high and comprises several municipalities. Limeira, Piracicaba, Araras and, to some extent, Santa Bárbara do Oeste are the municipalities with the highest number of clusters and constitute the regional “core”, with a high tendency to configure more complex arrangements. The city of Americana appears next in number of agglomerations. Also integrating this region are the municipalities of Rio Claro, Cordeirópolis, Iracemápolis and Rio das Pedras. Due to the proximity with the municipalities of Limeira and Araras, Mogi-Mirim, Mogi-Guaçu and Itapira can be included as a sub-regional center, where the metal-mechanic sector is able to become a large-sized cluster. It is possible to state that this region has a high potential to interact and integrate among the industries of this sector, mainly due to its number of specialized municipalities and establishments.

Region 3 – Here an axis of agglomerates exists. From the city of Campinas appears one line, comprising the municipalities of Indaiatuba, Salto and Itu as far as Sorocaba. Campinas and Sorocaba polarize the region, having over ten agglomerations, concerning factories. Around Campinas, there is Sumaré, Hortolândia, Jundiaí and Valinhos and around Sorocaba we have Boituva and Iperó.

Regions 4 and 5 – These regions do not present a high number of municipalities with agglomerations, but concentrate a considerable number of establishments. Hence, thus it possible to consider them as high potential regions, increasingly apt to have a more effective consolidation, with higher concentration. The municipality of São Carlos is the core Region 4, with over ten agglomerations, beside the municipalities of Araraquara e Matão. Sertãozinho is the only one in Region 5, being next to an important industry cluster, Ribeirão Preto, where the municipalities of Batatais and Franca can be inserted.

6. Final Considerations

Within the local scenario, the urban center of Piracicaba, Limeira, Araras (mesoregion of Piracicaba), São Carlos and Araraquara (mesoregion of São Carlos) stands out for the large number of highly specialized clusters. Next come Americana and Indaiatuba, followed by Santa Bárbara do Oeste, Sumaré and Hortolândia as important medium-sized cities that concentrate a large number of specialized clusters in the Campinas meso-region.

Towards western São Paulo state the medium-sized cities that play an important role as regional centers also have metal-mechanic agglomerations. These are: Jaú, Bauru, Marília and Presidente Prudente. Other important clusters are those in the northern part of the state, in the cities of Araçatuba, São José do Rio Preto and Franca; and in the southwest with Santos and Taubaté.

An important factor to bear in mind is that the basic presence of the metal-mechanic sector in these cities is related to other specializations. Examples of such instances can be seen in its connection with the show sector in Franca and Jaú, with the textile sector in Americana, the high-technology centers of São Carlos or the very sector of machinery, as is the case of agricultural inputs in Araras and Piracicaba.

Therefore, as previously mentioned, on the one hand, the development of this sector is significant for the cities' dynamics, and, on the other hand, factors found in these cities, such infrastructure, a wide range of highly-specialized services, the existence of a large market, economies of scale and multiplicity of contacts, allow developing this sector, in a dynamic and complementary partnership .

It is expected that this research may contribute to the search for preliminary methods for identifying clusters. These quantitative methods are essential for this first approach to agglomerates, but it is not possible to state that they suffice to safely trace the features of these clusters and their configuration into productive arrangements. A deeper analysis of the municipalities is required which observes their industrial base, actors involved, public policies implemented, and, finally, all the industrial atmosphere present. To this end, field research is required, both in the representative clusters and in potential ones, so as to identify their profile, thereby allowing the establishment of pattern and creating meaningful taxonomies. Moreover, local specificities could be thus identified ensuring unique characteristics to these possible arrangements.

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^{iv}The following classes have been selected: 27413, 27510, 27529, 28118, 28126, 28223, 28320, 28339, 28347, 28398, 28428, 28916, 28991, 29130, 29149, 29157, 29220, 29238, 29297, 29319, 29327, 29408, 29610, 29629, 29637, 29645, 29653, 29696.

^v This index appears in the literature (Crocco *et all*, 2003) withy some criticisms are restrictions, but it is still much recommended and widely used to identify agglomerations. Several studies on industrial agglomerations have used the Locational or Location Quotient, among which those conducted by professor Suzigan's research team and those carried out by SEBRAE.

^{vi} The specific method developed by Wilson Suzigan *et all*. can be consulted in the article Clusters or Local Production Systems, published by the *Revista de Economia Política*, v. 24 n°4, 2004. In this study, this methodology is applied to micro-regions of the state.