

## The geographic dynamics of industry employment in Brazilian metropolitan areas: lessons for São Paulo

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**RESUMO:** Este artigo discute as tendências históricas em grandes áreas metropolitanas brasileiras mostrando que a produção diminuiu sua participação no país, mas o movimento foi, em geral, mais intenso nas grandes áreas metropolitanas e, particularmente, na Área Metropolitana de São Paulo (AMSP). Esse movimento foi mais intenso na década de 1980 e na primeira metade da década de 1990. A partir de meados de 1990 até ao final da década de 2000, a tendência da participação na fabricação ficou desgastada. O primeiro período reflete o esgotamento do processo de substituição de importações que ocorreu nas três décadas anteriores (1950-1980). O segundo período, de 1993 a 2009, representa um novo modelo de crescimento e a evidencia do esgotamento do sector manufatureiro reforça a ideia de um novo período, em termos de emprego industrial. Enquanto de 1996 a 2005 a concentração aumentou, ela diminuiu novamente na segunda metade da primeira década dos anos 2000. A AMSP reinventou-se muito rapidamente a partir de final de 1970 até meados da década de 2000.

**PALAVRAS-CHAVE:** Áreas metropolitanas; concentração industrial; manufaturados; serviços.

**ABSTRACT:** We discuss historic trends in large metropolitan areas in Brazil showing that manufacturing has decreased its share in the country but the movement was, in general, more intense in large metropolitan areas and particularly in the São Paulo Metropolitan Area (SPMA). This movement was more intense in the 1980s and in the first half of the 1990s. From mid 1990s up to the end of the 2000s, the manufacturing share trend became flat. We speculate that the first period reflects the exhaustion of the process of import substitution that took place in the previous three decades (1950 to 1980). The second period, from 1993 to 2009, is representative of a new model of growth and the evidence that manufacturing share became flat is reinforcing the idea of a new period in terms of

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manufacturing employment. While concentration has risen from 1996 to 2005, it decreased again in the second half of the first decade of the 2000s. The SPMA reinvented itself very quickly from late 1970s to mid-2000s.

KEYWORDS: metropolitan areas; industry concentration; manufacturing; services.

JEL Classification: R10; R12.

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## INTRODUCTION

In this paper, we look at São Paulo as a leading employment and production center in Brazil, based on previous findings and analysis by Ellison and Glaeser (1997) and Duranton (2007). Over-concentration of economic activity in the city was most likely a consequence of policy decisions implemented during the 20<sup>th</sup> century, in particular the process of import substitution (PSI) but it was also an opportunity. Some industries need a large concentration of people to be productive. This is a classic result of regional economics, a topic that has been deeply-discussed at least since Myrdal (1947) and Hirshman (1958), later refueled by Henderson (1974) and Krugman (1991), who formalized the concept of industries needing a large concentration of workers to be more productive. In fact, we will show that the São Paulo Metropolitan Area (SPMA henceforth) has maintained the labor force concentration in dynamic industries over the last 30 years, despite the fact that those industries have been changing. The concentration in manufacturing has recently been migrating to the medium-sized cities, while large cities now focus on another type of industry denoted in this paper as “high-skill services”.

This paper has five sections including this introduction. The next section describes how the authors cope with classification changes during the 1977-2009 period (detailed data available upon request and analyzes the last 30 years of industry employment dynamics for ten major metropolitan areas in Brazil. The third section takes a different look at these metropolitan areas by observing industry churning and rank movements. We then examine a shorter time period with more detailed industry classification and geographical disaggregation. In the fourth section, we present the dynamics of the concentration index for this sub-period; in the final section, we use the knowledge gained in the previous sections and attempt to provide some valuable information for industrial policies that may be implemented in the São Paulo Metropolitan Area (SPMA).

## METROPOLITAN EMPLOYMENT DISTRIBUTION

In this section we show the general trend in employment distribution among metropolitan areas in the last 32 years. Making the classification consistent among years is one of the main difficulties in this type of study in Brazil. First of all, we have to develop a coding scheme that makes comparisons over time valid. This task

aims at creating direct relationships among different classification systems (of economic activities), in order to make possible the evaluation of employment dynamics for the proposed period, from 1977 until 2009.

As a starting point, we rely on tables provided by the Brazilian Institute of Geography and Statistics (Comissão Nacional de Classificação — CONCLA/IBGE), detailing the direct relationship between different classification systems for economic activities. These tables provide detailed descriptions of the relationship among different industry classifications: CNAE-DOM CNAE 1.0 and 2.0 and the PNAD/CD91 (see below).

The 2000 Census uses the CNAE-DOM classification, the RAIS 1996 and the RAIS 2000 use the CNAE classification, RAIS 2005 uses CNAE 1.0 classification, RAIS 2009 uses CNAE 2.0 classification and the PNAD 1996 uses the PNAD/CD91 classification. So we have to find correspondences between the two Censuses, PNAD and RAIS administrative records. To make these remaining classifications compatible, the authors developed a comprehensive correspondence table, classifying economic activities in 62 industries, further grouped in 15 classes of economic activity. This comprehensive classification is available on-line and makes it possible to reconcile and create direct relationship among the different classification systems used from 1977 to 2009.

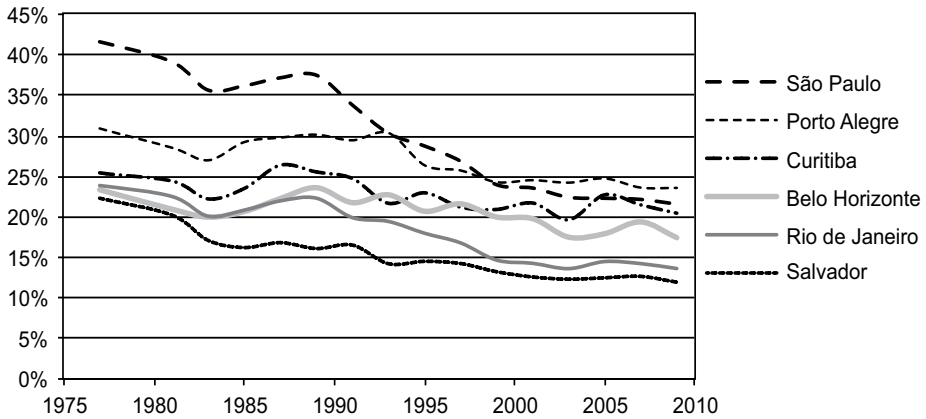
In the 1980s, manufacturing employment was decreasing in all metropolitan areas in Brazil. All metropolitan areas had a lower share of manufacturing employment in 2009 compared to that of 1977. The case of the SPMA, however, is more impressive; by 1977, the SPMA had 42% of its labor force working in manufacturing industries, the largest share in the country, followed by Porto Alegre with 31%. By 2009, this share was almost half (22%) of what it was in 1977, even below that of Porto Alegre (24%) and quite close to Fortaleza (21%) and Curitiba (20%). In fact, SPMA experienced the fastest decrease in the share of manufacturing with respect to total employment among all metropolitan areas. This is even more impressive if we consider that it started as a “classic” manufacturing city. This structural change shows that SPMA is flexible, able to adapt from a manufacturing sector to a business environment.

The decline in manufacturing employment was actually a process that was occurring not only in the SPMA but throughout the country and, to a large extent, throughout the world. Productivity gains in manufacturing not matched by increases in demand resulted in the reduction of employment in manufacturing. As evidenced in Figure 1, the main reduction in manufacturing in the SPMA occurred in the 1990s; though during the 1980s, manufacturing was gradually declining. By 1991, the SPMA still had approximately 37% of its labor force in the manufacturing industry. Between 1991 and 2001, however, the share dropped to 24%. It remained relatively stable thereafter, declining to 22% in 2009.

Although the process was more radical for the SPMA than for the other metropolitan regions, the behavior was similar for all metropolitan areas. In most metropolitan areas, the manufacturing share was stable throughout the 1980s and then

declined considerably during the 1990s. Salvador is one of the few exceptions as it experienced a smoother decline in its manufacturing employment rate during the whole period. Porto Alegre, also an exception, actually delayed its decrease in the share of manufacturing until the mid-1990s, and it ended the decline in the 2000s more intensely than did other areas. As a result, Porto Alegre ended the period with the largest share of manufacturing among all metropolitan areas in Brazil.

Figure 1: Trends in the Share of Manufacturing in Total Employment in Selected Metropolitan Areas (1977-2009)



Source: Pesquisa Nacional por Amostra de Domicílios (IBGE).

To understand what was actually transpiring, we split the service sector between personal services (cleaning, food, social assistance, etc.) and high-skill services (finance, insurance, real estate, information technology, consultancy, telecomm, etc.). As shown in Table 1, during the whole period, in some cities, increased service jobs compensated for some of the manufacturing jobs that were lost. In particular, in the SPMA, service industries increased their share from 32% in 1977 to 39% in 2009. However, this occurred just after the mid-1990s and just after manufacturing in the SPMA experienced its rapid decline. Some of the workers who were displaced when losing their jobs in manufacturing were unemployed or moved to more precarious jobs, such as trade. It is worth noting, as we consider these events, that the 1980s are known in Latin America as the “Lost Decade”.

There was no guarantee that workers who were once employed in the manufacturing industry could easily transfer to the service industry or that they would be employed in more stable jobs (*vis-à-vis* moving to the trade industries), as the personal services sector may be quite precarious and some activities in trade may be extremely secure. Examining the service industry, however, shows that the industries that actually lead the growth in services are often classified as high-skill services. Furthermore, personal services have been (slowly) declining in the 1980s and in the 1990s, while high-skill services placed increasing demands on the labor force.

However, the movement was not led by the financial services (split for classification and analysis purposes) as this industry share has been declining in all metropolitan areas except Salvador. The increase in the share of high-skill services has been led by information technology and other business service activities, with the business service industry increasing its participation from 3% in 1993 to 6% in 2009. It is interesting to note that the manufacturing share in the SPMA between 1993 and 2009 decreased 8 percentage points while the high-skill service share increased 7 percentage points (the largest increase — together with Recife — among all metropolitan areas). Although delayed, high-skill service replaced manufacturing in the SPMA. High-skill services were increasing its share at a slow rate up to the mid-1990s. However, manufacturing has been rapidly decreasing its share since the mid-1980s. The first half of the 1990s seemed to announce another lost decade for Brazil, though this was eventually not confirmed in the second half of the decade.

Financial sector employment was decreasing in general due to the rather intense shift to bank automation in the 1980s and 1990s, as the hyperinflation in Brazil provided incentives for banks and financial institutions to automate financial services. In fact, Brazil is now a world leader in this area. However, from 1977 to 1993, financial activities in the SPMA declined at a slower rate than they did in other areas. In 1977, the difference between Rio de Janeiro and SPMA's share was 0.4%. By 1993, this difference increased to 0.8%. The data do not allow us to qualify the financial service in each area, but we do have anecdotal evidence that many bank headquarters located in Rio de Janeiro moved to São Paulo City in the late 1980s. An illustrative example is the stock exchange in Rio de Janeiro (BVRJ), the first in the country, founded in 1845. After losing most of its share to the São Paulo Stock Exchange (BOVESPA), it eventually closed up its operations in 2000 and transferred its operation to São Paulo. In 2002, it was then taken over by the Brazilian Mercantile & Futures Exchange (BM&F) also located in São Paulo; since 2008, it has been associated with the São Paulo Stock Exchange.

Because manufacturing was declining quite rapidly, it is worth identifying those industries inside this group that were most affected. The high-tech industry (publishing, pharmaceuticals, biotech, etc.) was the most affected by de-manufacturing as its share fell, on average, more than 50% in 32 years. On the other hand, the least affected group was the mid-tech industry group (oil, machinery maintenance, metallurgy, automobile, etc.), with an average decrease of 19% in the share of the industry. The SPMA shows a similar behavior for the high-tech industry, though maintaining its leadership in this group, but displays a reduction of the share in other groups at a faster rate than the average metropolitan areas in Brazil (46% for mid-tech and 49% for low-tech — textiles, food, etc.)<sup>1</sup>.

The mid-tech performance of the SPMA is considerably different from other metropolitan areas. The SPMA share in this group was reduced by 9 percentage points while for other areas the share of this group of industries has remained relatively stable. The main reason for this behavior is that the automobile industry, which was historically heavily concentrated in the SPMA (since the 1950s), began to decentralize in the

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<sup>1</sup> Detailed information upon request.

1970s. New assemblers and auto-parts in the supply-chain re-located to other areas of the country. Part of this decision to locate to other areas may be connected to wages in the highly unionized plants in SPMA. It may also be connected to the Mercosul, the free trade agreement among countries in the South Cone of Latin America that contributes to making the southern part of the country a more desirable area. Finally, some states adopted more aggressive strategies, such as subsidies, land donation, etc., for attracting firms. This was the case when Bahia offered a very attractive package to Ford Motors in the late 1990s to install a new plant in Camaçari (within the Salvador metropolitan area) rather than in the suburbs of Porto Alegre.

An active (old-fashioned) industrial policy may also explain why the low-tech manufacturing industry share has remained relatively stable in Fortaleza. The Ceará government was active in offering subsidies for plants that were biased towards more labor-intensive (and, consequently, less productive) industries. Parana was also competing for companies; the mid-tech group was more concentrated in Parana. In fact, the only case in all groups/metropolises for which the share did not decrease from 1977 to 2009 was mid-tech manufacturing in Curitiba. The dispute between the states for attracting manufacturing was possibly one of the explanations for the faster decline in the manufacturing share in the SPMA, as the state of São Paulo has never adopted an aggressive policy to attract plants, and while the dispute existed<sup>2</sup> in the 1980s, it was much more intense in the 1990s, after the 1988 constitution increased the decision powers of States (subnational governments).

Finally, another factor driving manufacturing plants out of the country was the change in the international trade policy in Brazil in the early 1990s under the Collor presidency. During his tenure, many tariffs were reduced or eliminated. After many years under protection, some manufacturing industries were not able to resist the competition and either closed their operations or were taken over by multinational companies. As expected, if the import substitution industrialization strategy inflated the extent of manufacturing in the country, ending the growth strategy would cause the share of this industry to decline. This factor may explain why high-tech manufacturing industries were decreasing their share faster than other industries. Using a comparative advantage rationale, when a country opens its economy, it reduces the production of goods for which it has fewer inputs available. Given that the high-skill labor force in Brazil was scarce, it would be expected that industries intensive in this input would be more affected by the change in the international trade policy.

All in all, de-manufacturing in the country had a greater impact on SPMA for many reasons. The first reason is that among large metropolitan areas in Brazil, the SPMA concentrated most on manufacturing. A reversion to the mean effect may have been in place. The second point is that the state of São Paulo has not adopted an aggressive policy of subsidies or tax reductions to attract new firms (referred to in the literature as the “Fiscal War”) or avoid evasion. Third, SPMA was not particularly well located for Mercosul-related production and trade. It is also possible

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<sup>2</sup> Ceará's first incentive law ( Nº 10.367) dates back to December 1979.

that the universalization of high school graduates in the country has contributed to the manufacturing industry moving to other medium-sized urban areas. The good news, however, is that the SPMA was able to change its vocation and compensate for the lost jobs in manufacturing by increasing jobs in the upper end of the service industry, that is, in the high-skill services sector.

## THE FAST AND THE STILL

A very important concern in urban economics, at least since Jacobs (1969) seminal book, is the role played by industry churning across locations. Jacobs famous anecdote explores the movement of the photographic industry from New York City to Rochester, NY. The industries transitioned rapidly from one urban center to another in contrast to the slow movement of the population. Well known in the urban economics literature, this phenomenon is often referred to as the “Zipf’s Law”, as Zipf was the first to show the stability of population distribution among cities. Tables 1 and 2 compare the rank in specific industries (manufacturing and services, respectively) with the rank in population for the ten metropolitan areas previously analyzed.

Table 1: Rank in population and in selected manufacturing industries for selected metropolitan areas in Brazil (1977-2009)

Metropolitan Area	Rank in 1977 (change between 1977 and 2009)			
	Population	Electronics	Transportation	Textile
Belém	9 (+1)	10 (0)	6 (+3)	8 (+1)
Belo Horizonte	3 (0)	6 (-3)	3 (-1)	5 (0)
Brasília (DF)	10 (-1)	9 (-1)	10 (0)	10 (0)
Curitiba	8 (0)	5 (-1)	5 (-1)	9 (-2)
Fortaleza	7 (0)	7 (0)	8 (0)	4 (-2)
Porto Alegre	5 (-1)	3 (-1)	4 (+1)	3 (0)
Recife	4 (+2)	4 (+2)	7 (0)	6 (+2)
Rio de Janeiro	2 (0)	2 (+3)	2 (+1)	2 (+2)
Salvador	6 (-1)	8 (+1)	9 (-3)	7 (-1)
São Paulo	1 (0)	1 (0)	1 (0)	1 (0)
Total rank variation	6	12	10	10

Source: Pesquisa Nacional por Amostra de Domicílios (IBGE).

There were very few changes in the population rank in the last Three decades though Belém did exchange positions with Brasília. After many years of growth below the forecasts done by Lucio Costa, the city *boomed* along with the soy in-

dustry in the neighborhood states of the mid-west. On the other hand, the decay in Recife's population opened the door for Porto Alegre and Salvador to catch up and pass the largest northeastern metropolitan area in the 1970s, which now ranks sixth in population in the country. If we sum up the absolute values of all changes in those metropolitan areas, we can identify six changes in population rankings. If we perform the same exercise with more specific industries, we find that the sum is considerably higher. If it were possible to work with a more refined classification<sup>3</sup>, we would most likely observe even more movement.

It is interesting to observe that the three largest metropolitan areas in the country (SPMA, Rio de Janeiro and Belo Horizonte) have not changed their population ranking in 30 years. This is not the case, however, for the three selected manufacturing industries in Table 2. The only exception is SPMA, which remains in the first position in any industry analyzed, and in its population ranking as well. The second largest metropolitan area in the country, Rio de Janeiro, has dropped three positions in electronics, one position in transportation and two in the textile industry. The SPMA is, indeed, quite a resilient locus of production. It is worth noting that the SPMA has adapted very quickly to industrial dynamics, as discussed in the previous sections.

The difference in rank variation for population and industries is much lower than that observed for the US or France where the rank-change for selected industries is five times the rank change in population (Duranton, 2007). However, this difference cannot be attributed to industrial decomposition (Duranton (2007) works with two digit industry classifications). The difference can be attributed, however, to the number of metropolitan areas included in the study. We are working with just ten metropolitan areas, whereas Duranton (2007) works with hundreds of units. As will be discussed in the next section, some aspects of industry dynamics can be understood only by examining the country as a whole.

Movement is faster in the business services sector than it is in the financial services sector, which is closer to the changes in population. This is consistent with Findeisen and Sudekum (2008), who find that "cities specialized in these fairly "modern" sectors are less likely to change afterwards". It is not consistent, however, with the large change observed for business services<sup>4</sup>. Services are also stickier in the top groups, such as SPMA, Rio de Janeiro and Belo Horizonte, as they maintained their position in business services despite the large positional change at the other end of the population spectrum. In the financial services, we observe just one significant movement with Porto Alegre falling three positions.

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<sup>3</sup> To keep an uniform classification we work with 62 industries after dropping agriculture, mining and government.

<sup>4</sup> The authors found a relative stability for IT services, an industry considered part of business services in our classification, in Germany.



Table 2: Rank in population and in selected service industries for selected metropolitan areas in Brazil (1977-2009)

Metropolitan Area	Ranking in 1977 (change between 1977 and 2009)		
	Population	Business	Finance
Belém	9 (+1)	9 (+1)	9 (+1)
Belo Horizonte	3 (0)	3 (0)	4 (0)
Brasília (DF)	10 (-1)	8 (-4)	5 (-2)
Curitiba	8 (0)	6 (+3)	6 (-1)
Fortaleza	7 (0)	10 (-2)	10 (-1)
Porto Alegre	5 (-1)	4 (+2)	3 (+3)
Recife	4 (+2)	5 (+2)	7 (0)
Rio de Janeiro	2 (0)	2 (0)	2 (0)
Salvador	6 (-1)	7 (-2)	8 (0)
São Paulo	1 (0)	1 (0)	1 (0)
Total rank variation	6	16	8

Source: Pesquisa Nacional por Amostra de Domicílios (IBGE).

To examine the churning of industries in general, rather than examining each industry, we use an aggregate index that reveals how fast industries are moving across locations. Davis and Haltiwanger (1998) propose an index that averages the yearly relative employment gains and losses over all sectors and years:

$$Chrun_r = \frac{1}{IxT} \sum_{i=1}^{62} \sum_{t=1977}^{2009} \frac{|e_{rit+1} - e_{rit}|}{e_{rt}}$$

where the employment variables were defined before, I is the total number of industries in the sample and T is the total number of periods. In this analysis, we used the classification that would be consistent for the 32 years of PNADs available biannually, i.e., we have  $16 \times 62 = 992$  in the denominator of the churning measures as proposed by Davis and Haltiwanger (1998) to understand the industry dynamics. The total employment change, however, should normalize this index. Following the method of these authors, it is possible to construct a similar index for total employment:

$$\Delta Emp_r = \frac{1}{T} \sum_{t=1977}^{2009} \frac{|e_{rt+1} - e_{rt}|}{e_{rt}}$$

While it is evident that industry churning will always be larger than the total employment churning, the interesting question is, by how much? In Table 3, it is evident that churning in Brazil both by industry and by total employment is very high compared to other countries for which we obtained information. For example, while churning in the US or France is twice as high as it is in Germany, it is only

half the rate of churning in Brazil. This pattern is almost unchanged when we limit the estimations to manufacturing industries. Furthermore, this relationship between countries can be observed by considering only industry, employment or excess churning, which is defined as the difference between churning in industry and in employment.

Table 3: Churning in employment and in industries for selected countries

Panel A: All industries

Country	Churnc	$\Delta$ EMPc	Churnc/ $\Delta$ EMPc
Brazil	20.24%	9.83%	2.06
Germany	4.98%	2.29%	2.17
US	8.26%	4.10%	2.01
France	11.40%	5.20%	2.19

Panel B: Manufacturing industries

Country	Churnc	$\Delta$ EMPc	Churnc/ $\Delta$ EMPc
Brazil	24.23%	11.00%	2.20
US	9.81%	4.82%	2.04
France	12.24%	6.62%	1.85

Sources: Pesquisa Nacional por Amostra de Domicílios (IBGE), Duranton (2007), Findeisen and Sudekum (2008).

It is evident that employment in Brazil is much more volatile than it is in the countries with available data. The differences are quite consistent with respect to the labor market in each country. The German labor market is most likely more stable than other countries, and Latin American countries are most likely more volatile. However, it is important to support this intuition with evidence. While any indicator of churning is higher for Brazil than it is for Germany, France or the US, it is interesting to note that the ratio between churning in the industry and in total employment is stable among countries at approximately 2. It is not clear where this coincident pattern comes from, though the indicators suggest there is much more volatility in Brazil.

When we observe the rate of churning for the ten metropolitan areas analyzed here, we notice that the SPMA has a relative low level of churning in both industry and total employment. However, excess churning for the SPMA is closer to the average. This simply confirms the previous observation that the SPMA has not moved in the rankings either in population or in the selected industries. Recife has the largest

excess churning level, which is perhaps connected to the population decay observed in the last few decades. However, excess churning cannot be correlated with growth, a fact that was made evident by Findeisen and Sudekum (2008).

Our analysis suggests that Brazil is most likely changing faster than the developed countries. This characteristic represents both an opportunity and a threat, because it is not difficult to attract an industry, but it is not difficult to lose it. On the other hand, the SPMA is more stable than any other Brazilian metropolitan area, and this stability may be related to the stability of the modern sectors noticed in Germany. However, it is difficult to reconcile this result with the evidence that the SPMA has changed from a manufacturing city to a service city in just one decade. Surprisingly, this fast transition of a large group of industries does not seem to have had a considerable impact on the overall index.

## RECENT GEOGRAPHIC CONCENTRATION DYNAMICS IN BRAZIL

The analysis undertaken in the previous section does not allow us to determine if industries, in general, were concentrating or de-concentrating in the country. The movement within industries does not reveal the overall change pattern. One way to examine the overall pattern is by examining the concentration indices and their changes over the years. In this section, we will focus on one of the most used indices in the regional economics literature introduced by Florence (1948), known as the “Raw Concentration Index” (usually denoted by the letter *G*). Florence (1948) explains why this is a better index than, for instance, the Gini index to measure industry concentration, and many researchers adopted the use of the *G* index after its proposal (e.g., Fuchs (1962), Enright (1990), etc.). Interest in this index was renewed after Ellison and Glaeser (1997) added micro-foundations to it, and Dumais, Ellison and Glaeser (2002) proposed a methodology for its decomposition. It is still the most accepted index in industrial organization together with the Herfindahl-Hirshman index. Formally, we can define the index as follows:

$$G_{it} \equiv \sum_r \left( \frac{e_{rit}}{e_{rt}} - \frac{e_{rt}}{e_t} \right)^2$$

where

$e_{rit}$  is industry  $i$ 's employment in region  $r$  at time  $t$ ;

$e_{rt}$  is the total employment in region  $r$  at time  $t$ ;

and  $e_t$  is the total employment in the country at time  $t$ .

The index shows the share of employment in one region based on the weight of this region in the country. For instance, we would not say that the SPMA is concentrated in a specific industry if it concentrates 10% of the workforce of one specific industry given that the SPMA represents approximately 10% of the country's labor force. Notice that if each region had, in each industry, exactly the same

proportion of the country's labor force, the index would be zero, meaning that the index will be zero if employment is uniformly spread across space<sup>5</sup>. This provides an intuitive rationale for a concentration index.

We have access to plant-level information<sup>6</sup> detailed by municipality and 5-digit industries for five years, namely, RAIS administrative records for 1991, 1996, 2001, 2005 and 2009. However, we will not use 1991 information, as the industry classification in this year is quite different from the classification in the following year, thus making it impossible to work with 5-digits sector classification for the entire period. During this relatively short period, there were three changes in the classifications: from 1991 to 1996; from 1996 to 2001; and from 2005 to 2009. The changes from 1996 to 2001 were, however, negligible. We made a conscientious effort to reconcile 2005 with 2009; however, certain shortcomings persist. Therefore, the analysis will include data from the last 13 years, from 1996 to 2009.

Using this information allows for the disaggregation of the data into much more detailed divisions than is possible when using PNAD in regional and industry terms and this is the reason why we are using RAIS instead of PNAD. The shortcoming is that we are analyzing exclusively the formal sector since RAIS do not cover informal labor arrangements. Since we are working with indices it makes no sense to inflate the sample in order to get the full labor force. However, the index for the full labor force may be different from the index for the formal labor force if there were differences in informality dynamics among regions. We did not find significant differences using a less aggregated (by industry) version (with 62 industries as discussed above). As explained before it is not possible to have a more disaggregated version compatible for the different sources along the years.

The finest level allowed by the data is the municipality, which in Brazil is also called "city". The definition of a municipality is more or less consistent with the US/UK county definition, although we believe that one level up, the micro-regions, is even more consistent with the US/UK county concept in terms of size, but it is rather difficult to compare these historically different geographical classifications. There is still a third level between the micro-region and the state called the meso-region. This classification may be compared to the metropolitan area definition in the US, although once again, we must be careful when making such comparisons.

Figure 2 shows a comparison of the distribution of the raw concentration index for these four geographies, i.e., municipality, microregion, mesoregion and an

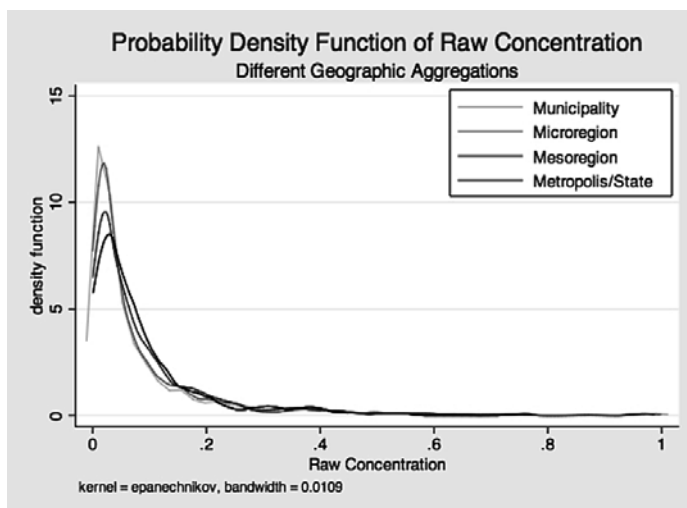
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<sup>5</sup> Ellison and Glaeser (1997) variation of the index (EG index) will be zero "if employment is only as concentrated as it would be expected to be had the plants in the industry chosen locations by throwing darts at a map" (p. 890). This difference is relevant since it allows for a more precise comparison among industries with a different number of plants. In practice, the variation of the G index represents the bulk of the variation of the EG index. As noted by Dumais, Ellison and Glaeser (2002), "the trends in raw concentration and in the EG index are fairly similar" (footnote 8 — p. 195). Given the difficulties involved in estimating the Herfindahl-Hirshman index, we will concentrate on the G index in this paper.

<sup>6</sup> We thank the department of statistics of the Brazilian Minister of Labor (MTE) that kindly furnished plant-level data for this analysis.

idiosyncratic division as follows. For the 9 states that have one metropolitan area surveyed by IBGE (PNAD<sup>7</sup>), the state, for analysis purposes only, will be split between this metropolitan area and the remaining municipalities; for the remaining seventeen states and the DF, the unit will be the state (or the national capital, DF) itself. Thus, we end up with 36 units per year. We will call this idiosyncratic division “states/metropolitan areas”. The distribution is more and more biased (toward low values of G) when we move to a more disaggregated geography. This is surprising as we would expect greater variance moving down in the scale of analysis. For instance, an indicator for the whole country will necessarily be zero for all industries. In any case, the indices are decreasing as we move to more disaggregated geographical units.

Figure 2: Probability Density Function of Raw Concentration for Different Geographic Aggregations in Brazil (1996-2009)



Source: Relação Anual de Informações Sociais (MTE).

In Table 4, we show the concentration index dynamics for the previously considered industries using microregions as the unit of analysis<sup>8</sup>. The trends are very similar to the trends observed for any other geographical division<sup>9</sup>. As expected, the indices with more disaggregated geography are lower. Once again, the main

<sup>7</sup> Those are the metropolitan areas presented in the previous sections that are consistent with the 1967 definition.

<sup>8</sup> We make a small variation in the microregion theoretical definition, separating São Paulo from the cities that comprise ABCD, all officially part of the same microregion. The region is known as ABCD given the name of its municipalities: Santo André, São Bernardo, São Caetano and Diadema.

<sup>9</sup> Results available upon request.

question is, how much lower? The difference between the concentration indices when the geographic division is composed by microregions and the concentration indices when the geographic division is composed by state/metropolitan areas is very small. Because there are approximately 500 microregions and 36 states/metropolitan areas, we would expect a much larger difference among indices. For instance, Ellison and Glaeser (1997) find for their index a median 0.005 at the county level compared to 0.023 at the state level, a difference consistent with the difference among the number of units. With the ratio among the indices for Brazil at 0.8, the effect of spillovers is such that approximately 80% of the excess tendency of plants to locate in the same state/metropolitan area involves plants' locating in the same microregion. In other words, in Brazil, spillover effects seem to vanish at the microregion level, while this is not the case for the US.

Table 4: Raw concentration in Brazil and variations for selected industries using microregions as the unit of analysis (1996-2009)

Industry	Raw Concentration		Average Variation per Year		
	Average	Freq.	96-01	01-05	05-09
Full Sample*	0.0882	1981	1.0%	0.8%	-6.9%
Manufacturing	0.1055	1042	0.6%	-2.3%	-5.1%
High-Tech	0.1261	245	2.7%	-4.0%	-4.3%
Mid-Tech	0.1205	448	-0.3%	-4.2%	-3.4%
Low-Tech	0.0716	349	-0.3%	4.3%	-8.7%
Services	0.0851	592	1.2%	2.6%	-4.6%
Personal	0.0326	111	-9.0%	23.0%	-21.0%
Skilled	0.0904	378	1.8%	3.9%	-4.9%

\* Manufacturing, Services and Commerce  
Source: *Relação Anual de Informações Sociais (MTE)*.

From 1996 to 2005, industry concentration was increasing on average. However, this was not the case for the manufacturing industry, for which concentration began to decline in 2000, and all industries were reducing concentration in the second half of the first decade of the 2000s. In reality, the mid-tech industries were de-concentrating during the whole period of analysis, while the low-tech industries have a more unpredictable path with decreasing concentration in the second half of the 1990s, increasing concentration in the 2000s and then decreasing concentration again at a very rapid rate at the end of the period. The service industries were also becoming more and more concentrated up to 2005 when they, too, started to de-concentrate.

We also check the correlation between the indices along the years. While the correlation is slightly larger than the one observed for the state/metropolis division, it is consistent when comparing different periods. The correlation between indices, when the geographic division is the microregions is, however, considerably below

the correlation observed in the US, where it is possible to observe a 0.9 correlation after 20 years. We believe that by using microregions and plant-level 5-digit data our results may be comparable to the estimates of Ellison and Glaser.

We interpret the differences between concentration indices in Brazil and the US as suggesting that there is more volatility in the Brazilian industry than in the US. This is expected since developing countries are not as stabilized as developed countries. It is worth noting that the de-concentration observed for the metropolitan areas (not shown in this paper) is not reproduced at the country-level, except for the final period between 2005 and 2009. This would suggest that the preferred location of industries may no longer be large metropolitan areas. Industries, however, are, most likely, not moving to remote locations with very low activity either, otherwise we would observe a much lower correlation among indices over time. It can be assumed that industries are likely moving to locations that may not be as large but that still have a concentration of some original industries. We have anecdotal evidence that some of the firms leaving the SPMA moved to medium-sized cities within the state of São Paulo.

## CONCLUSION: WHAT CAN WE LEARN? LESSONS FOR SÃO PAULO

In this section, we attempt to summarize what was learned from the exercises performed in the previous sections and apply the results towards a possible industrial policy for the SPMA. We have learned, for instance, that the increase in jobs in the service industries has occurred basically in the high-skill services. Additionally, while the proportion of personal services has increased in most regions, this did not completely compensate for the considerable reduction in manufacturing jobs. Furthermore, the increase in the share of high-skill jobs was not connected to the financial industry. Rather, business services were compensating for the losses in manufacturing jobs.

The most relevant high skill services currently in the SPMA are education and health services, which currently employ 7.7% of all workers in SPMA: these two industries similarly represented 6.5% of all jobs in São Paulo in 1996. It is also interesting to note that employment share in the real estate sector has not been reduced during this period, different from other financial services. The increase in productivity in the financial industry was concentrated in more typical financial industries, mainly in banking. Nevertheless, it would be more precise to define the SPMA as the capital of business services than the capital of financial services, despite the concentration of primary financial facilities (such as the stock market).

Another particular detail is that mid-tech manufacturing is highly concentrated in the SPMA, a fact that is clearly connected to the auto industry's classification as a mid-tech industry. By 1991, 39% of the jobs in the southeast part of the metropolitan area<sup>10</sup> were in mid-tech manufacturing (most of it in assembly and

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<sup>10</sup> The southeast part of SPMA is a destination of manufacturing industries since 1950s.

auto-parts). While this is still the main type of manufacturing in the SPMA, its relevance in terms of employment is far from what it used to be. It is also interesting to note that SPMA, during the period analyzed, has never been a leader in high-tech industries, a factor that is different from other large metropolitan areas in developing and developed countries with a concentration of high-tech industries.

When we examined the SPMA, we noticed that a trend of job reduction in manufacturing, which was happening everywhere in the country, was occurring with much greater intensity in this originally manufacturing-centric city. As a result, the SPMA is no longer a manufacturing mecca. When considering the microregions within the metropolitan area, however, we noticed that while the process of de-manufacturing is indeed taking place in most cities, it is still far from a complete vocational change. The ABCD, for instance, has retained one-third of its formal jobs in manufacturing. In any case, it is clear that large cities are no longer the location of choice, as they were in the 1970s, for manufacturing.

One of the reasons why large cities are not so attractive to manufacturing anymore may be, in part, the increase in the number of high-school graduates throughout the country, as mid-tech manufacturing demands a labor force with at least a high-school education, a commodity that was rare in the country 40 years ago. In the current century, the proportion of high-school graduates in the medium-sized cities is similar to that of the large cities. This fact, associated with congestion costs, would make intermediate cities more attractive to mid-tech industries.

Consequently, the first lesson is that São Paulo could act more aggressively in attracting high-skill industries as the industries are looking for a high-skill labor force that is still not available in intermediate cities. The large concentration of health services in São Paulo City, for instance, represents an opportunity to develop a biotech cluster in the area. On the other hand, industries that are “serving” the service industries, such as publishing, remain predominantly concentrated in the SPMA. Publishing is also an industry that would garner more attention when building a strategy for the city to remain an important center of economic activity. Furthermore, the de-manufacturing period seems to be phasing out. For example, in the second half of the 2000s, the share of industries seemed to be quite stable, thus suggesting that ignoring manufacturing may not be the best strategy.

It is true that the SPMA assumed the leadership in high-skill services, the most dynamic industry in the 1990s and 2000s. However, this leadership was not led by the financial sector. Despite the fact that the financial industry generates a significantly large value-added factor, consequently contributing a considerable share in tax revenues, concentrating efforts in this industry seems risky, as it is reducing its employment share, thus suggesting a lack of stability not unlike what was observed for manufacturing. Furthermore, this industry may not be considered significantly volatile, as it stays close to its original location and close to its main clients and other firms in the same industry. In other words, the financial services industry does not seem to need many incentives to remain in the SPMA, still the most important economic center in the country.

The results also suggest that Brazil is more volatile than the US or France. This



observation is not surprising given the characteristics of each country. Furthermore, concentration indices are less correlated in Brazil than they are in the US. This lack of stability in Brazil represents a risk for any industrial policy. However, the SPMA was very resilient during the analyzed period, a characteristic not observed in Rio de Janeiro, for instance. In any case, in such a volatile environment, it is important to be more active and avoid dependence on historic resiliency. For example, considering the results of standardized tests in various regions, some metropolitan areas, such as Belo Horizonte, have been much more focused on improving public education services.

Some de-concentration is expected and is actually highly desirable. There is no reason to resist such movement. The main question is how to maintain a relevant share of the industries that contribute the most towards the welfare of the residents of São Paulo. For decades, industrial policies attempted to move some economic activity to the poorer states in the northeast. The de-concentration, however, did not go exclusively in this direction (with some exceptions mainly in Ceará), and it does not seem to be connected to the regional policy adopted by the federal government. Thus, there is a need for a modern industrial policy as the old, traditional subsidies seem to be more deleterious than beneficial for the lagged regions. The SPMA has to adapt and come up with new policies that help maintain its position as the center of production in the country, without being detrimental to other regions. This effort will, instead, promote and spread development throughout the country.

The concentration of manufacturing in the SPMA in the 1970s is very much a consequence of the PSI. The government, inducing the process, has to choose where to locate the investment. It seemed natural to invest where the industries were already established. The consequence was too much concentration and the Northeast is the dark consequence of the policy. It is not a surprise that Celso Furtado, one of the main scholars behind PSI, was worried about regional imbalance at the same time.

On the other hand, SPMA is somehow an asset achieved from the PSI. Having such a large agglomeration allowed Brazil to lead some activities. It is bad to Rio de Janeiro that São Paulo concentrated the top end of the financial sector. But it is better to Brazil that São Paulo did it and not Buenos Aires or Santiago. When the PSI model became outdated, the federal government had no new industrial policy and insisted in a model that was already exhausted. When the government eventually recognizes that the model was not efficient anymore, it decided to give up on industrial policy. Very recently the government is attempting to implement an industrial policy but using again something very similar to the PSI model.

Our vision is that this is a mistake. Ignoring industrial policy will not do any good to the country but repeating the model that has no room anymore is also a big mistake. The new industrial policy has to consider that manufacturing in general will not take the lead in innovation. Certainly meat processing and packing will not do the job. High skilled services such as Information Technology and Telecommunications probably will. The new industrial policy has to be connected to education that is a growing industry itself. We need industrial policy but it has

to be different from PSI. We have some ideas on how to do it but unfortunately we have not seen them flourishing in Brazil in the last decades.

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