

The Geographic Dynamics of Industry in Brazilian Metropolitan Areas: Lessons for São Paulo

1. Introduction

São Paulo was a relatively small city by the end of the XIX century with approximately 30 thousand inhabitants. It was evidently much smaller than the capital of the country, Rio de Janeiro, with some 275 thousand inhabitants and not even comparable with the capitals of the two strong states in the Northeast (Pernambuco and Bahia). Recife and San Salvador (as it used to be called) had in 1872, respectively, 117 and 129 thousand inhabitants. São Paulo was even smaller than other cities in the state like Santos, where the port was located.

For some random reasons connected to the spread of diseases both in Santos as in Campinas, the capital of the state has never moved to Campinas or Santos although this possibility was considered a couple of times. São Paulo City was, in any case, a good hub for the logistic of the coffee plantation, the main commodity produced in Brazil at that point. Strategically located between the main port, Santos, and the western part of the State on west, where coffee plantation was spreading, São Paulo was able to capture the extra income generated by coffee plantation. Actually, coffee plantation started in the state of Rio de Janeiro in the early XIX century but migrate to São Paulo State during the century. In the last quarter of the XIX century, São Paulo State concentrated most of the coffee production in the country.

The coffee production is somehow different from sugar production because sugar cane grows much faster than coffee bean trees. Coffee trees need around 5 years to give the first crop while sugar cane can be harvested in 1 year. This difference means that the production of coffee would require a larger financial capital than the production of sugar cane. At that point, the main source of funds was the government. In this case, the funding was furnished mainly by the State Government not the Federal government just created¹. Landowners moved to the capital in order to get closer to the source of funding, the government. International and national banks cluster together to these prominent clients and São Paulo was already concentrated in financial services in early XX century.

São Paulo city population more than doubled from 1872 to 1890 growing at 4% per year. By 1890 São Paulo has consolidated its position as the forth city of the country bellow the Federal District (Rio de Janeiro), but not so far from San Salvador and Recife. It is from 1890 to 1900 however that we observe the real boom of São Paulo. In this decade the city population was multiplied by almost 4, growing at 13% per year and beating Salvador as the second city in the country with 239 thousand inhabitants.

As in most cities in the New World, population was increasing in São Paulo based on migration from Europe and Asia. São Paulo experimented a rare kind of migration from rural Europe and Japan towards rural areas in Brazil to work on coffee plantation. There was a combination of factors leading to such migration pattern. Evidently there were migrants going to the urban areas (coming from rural areas or not in their original

¹ Brazil was declared as a republic in 1889. The king, however, has never funded coffee farmers from São Paulo as well. During the empire, it was always the province of São Paulo that was in charge of funding its coffee plantation.

country). By 1872, 31% of the residents in Rio de Janeiro were foreigners. If we consider that these migrants were mainly white men above 15 years old, we would conclude that in the turn of the century there would be more foreigners in this category in Rio de Janeiro than Brazilians².

By 1890 22% of São Paulo population did not declare himself or herself as Brazilian. The ports of Santos serving São Paulo and the port of Rio de Janeiro would receive around 90% of (official) immigrants by 1908: 49% would enter through Rio de Janeiro and 42% through Santos. If we do not consider Portuguese migration, Santos would be responsible for 48% of all migrants entering Brazil in 1908 (Rio de Janeiro would account for 40%).

São Paulo and Rio de Janeiro were the main destination of the (urban) migration in the turn of XIX century that was fueling Brazilian labor force. The presence of the financial capital in São Paulo makes it particularly attractive for the Brazilian industrialization that was just starting. The rents generated by the coffee plantation would end up funding the newborn manufacturing industry. By 1920 São Paulo had the largest proportion of workers in manufacturing among state capital: 17% of São Paulo population worked in manufacturing according to this year's census. It has the second largest stock of labor force in this industry, with 100 thousand workers still below the Federal District with 154 thousand but São Paulo 188 thousand (declared) workers represented less than half of Rio de Janeiro's 405 thousand workers³.

São Paulo has the financial structure and the rent generated by the increase in the global demand for coffee. During Getúlio Vargas dictatorship period rent extracted from farmers was transferred to manufacturing, concentrated in São Paulo. The import substitution industrialization (ISI) strategy adopted reinforced the over concentration of population and activity in SPMA. As a matter of fact the proportion of SPMA in Brazil is more than twice the proportion of New York in the US population, for instance. Centralized government associated with a protected manufacturing production have probably (artificially) induced too much concentration (Singer [1975]).

Over-concentration was probably a consequence of policy decisions but it is also an opportunity. Some industries need a large concentration of population to be productive. This is a classic result in regional economics well discussed at least since Myrdal (1947) and Hirshman (1958) refueled by Henderson (1974) and Krugman (1991) formalization of the issue. As a matter of fact, we will show that São Paulo Metropolitan Area has kept this leadership over the last 30 years or so. But concentration is clearly decreasing. Over these years manufacturing has been moving to medium cities. Large cities are now concentrating another type of industry denominated in this paper as "high-skill services".

This paper has 5 sections including this introduction. The next section describes the last 30 years of industry composition for 10 major metropolitan areas in Brazil. The third section takes a different look at these metropolitan areas observing industry churning and rank movements. We then work with a shorter period of time but with a more detailed

² Foreigners represented 40% of the male population in Rio de Janeiro in 1872.

³ It is hard to split the labor force in the 1920 census since there is a category that includes all categories not classified in the 9 groups defined by the census, not declared activities and population outside the labor force. Not considering this residual category, 53% of São Paulo "labor force" would be in manufacturing.

industry classification and geographical disaggregation. On section 4 we present the dynamics of concentration index for this sub-period. In the final section we use the knowledge gained in the previous sections and attempt to shed some light for São Paulo industrial policies.

2. Metropolitan Employment Distribution

In the 1980s manufacturing employment was decreasing in all metropolitan areas in Brazil. On Table 1 we can see that all 10 metropolitan areas had a lower share of manufacturing employment in 2009 compared to the 1977 share. The case of 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%) below Porto Alegre (24%) and quite close to Fortaleza (21%) and Curitiba. São Paulo had the fastest decrease in the share of manufacturing in total employment among metropolitan areas. This is really more impressive if we consider that it started as a "classic" manufacturing city. This structural change shows that São Paulo is also very flexible for adapting to changes in the business environment.

<Table 1 around here>

The decline in manufacturing employment was actually a process happening in the whole country and even in large part of the world. Productivity gains in manufacturing not matched by increases in demand resulted in the reduction of employment share in manufacturing. As we can see in Figure 1, the main reduction in manufacturing share in the SPMA happened in the 1990s. During the 1980s, the share was reducing but at a slow rate. By 1991, the SPMA had still around 37% of its labor force in manufacturing. From 1991 to 2001, the share dropped to 24%. It was then relatively stable going down to 22% in 2009. Although the process is more radical for SPMA than for the other metropolitan regions, the behavior is similar. In most metropolitan areas, manufacturing share was stable during the 1980s and in most of them manufacturing share declined considerably in the 1990s. Salvador is one of the exceptions decreasing the share of manufacturing more smoothly during the whole period while Porto Alegre delayed its decrease in the share of manufacturing to mid-1990s but stopped the process in the 2000s more intensely than other areas. No wonder why it finished the period with the largest share in manufacturing among metropolitan areas.

<Figure 1 around here>

To understand what was really going on, we split the service sector between personal services (cleaning, food, social assistance, etc.) and high skill services (finance,

insurance, real state, information technology, consultancy, telecomm, etc.). As we can see on Table 1, in the whole period, services compensated part of the job lost in manufacturing in some cities. In particular, in the SPMA, service industries increased its share from 32% in 1977 to 39% in 2009. However, this process happened just after mid 1990s and manufacturing in the SPMA was loosing participation very fast in the first half of the 1990s. We have to remember that the 1980s are known in Latin America as the "Lost Decade". Part of the workers losing job in manufacturing would be unemployed or move to more precarious jobs in trade, for instance.

The movement to the service industry does not guaranty in any circumstances that (the type of) workers that used to go to manufacturing would be hired in less precarious jobs moving to the service industry (vis a vis moving to trade industries). Personal services might be quite precarious and some activities in trade might not be precarious at all. Decomposing the service industry, however, shows that the industries that actually lead the growth in services might be classified as high skill. Personal services have been (slowly) declining in this period. Meanwhile high skill services were incrementing its participation in the labor force.

<Table 2 around here>

Table 2 also emphasizes that the movement was not lead by financial services as this industry share has been going down in all metropolitan areas but Salvador. The increase in the share of high skill services was lead by information technology and other business services activities. Business services increased its participation from 3% in 1993 to 6% in 2009. It is interesting to notice that manufacturing share in SPMA between 1993 and 2009 decreased 8 percentage points while high skilled service share increased 7 points (the largest increase - together with Recife - among metropolitan areas). Although lagged this type of service replaced manufacturing in SPMA. It might be clear in Figure 2 that high skill services were increasing its share at a slow rate up to mid 1990s. But manufacturing has been decreasing its share very fast since mid 1980s. The first half of the 1990s seemed to announce another lost decade for Brazil that was eventually not confirmed in the second half of the decade.

<Figure 2 around here>

Financial employment was decreasing in general due to bank automation that was quite intense in the 1980s and 1990s. The hyperinflation in Brazil gave the incentives to automate financial activities. As a matter of fact Brazil is now a world leader in this area. However, from 1977 to 1993 financial activities in SPMA reduced at a slower rate than other areas. In 1977 the distance between Rio de Janeiro and São Paulo's share was 0.4%; by 1993 this difference has increased to 0.8%. The data do not allow us to qualify the financial service in each area but we do have anecdotic evidence that many bank headquarters located in Rio de Janeiro moved to São Paulo in the late 1980s. An illustrative example is the stock exchange in Rio de Janeiro (BVRJ), the first of the

country founded in 1845. After loosing most of its share to São Paulo Stock Exchange (BOVESPA), it eventually closed up its operation in 2000 transferring 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 and since 2008 associated with the São Paulo Stock Exchange.

Since manufacturing was decreasing its share very rapid, we would like to understand which industries inside this group were more affected. Table 3 splits manufacturing in 3 groups according to its technological level: high-tech (publishing, pharmaceutics, biotech, etc.); mid-tech (oil, machinery maintenance, metallurgy, automobile, etc.); and low-tech (textiles, food, etc.). As we can see, high tech was the industry most affected by de-manufacturing. This industry share fell in average more than 50% in 32 years. On the other hand the less affected group was mid-tech with an average decrease of 19% in the share. SPMA has a similar behavior for high-tech (keeping its leadership in this group) but reducing 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).

<Table 3 around here>

The mid-tech performance of SPMA is considerably different from other metropolitan areas. SPMA share in this group was reduced 9 percentage points while, for other areas, the share of this group of industries has remained more or less stable in the period. The main reason for this behavior is the automobile industry that was historically very concentrated in SPMA (since the 1950s) but was decentralizing since the 1970s. New assemblers and auto-parts connected to them would locate in other areas of the country. Part of this decision might be connected to wages in highly unionized plants in São Paulo. It might be also connected to the Mercosul, the free trade agreement between countries in the South Cone of Latin America, that turns the south of the country into a more attractive area. Finally some states adopted a more aggressive strategy for attracting firms including subsidies, land donation, etc. This was the case in Bahia that offered a very attractive package to Ford Motors in the late 1990s to install the plant in Camaçari (inside Salvador Metropolitan Area) instead of in the suburbs of Porto Alegre.

An active (old-fashioned) industrial policy may also explain why low-tech manufacturing share has remained almost stable in Fortaleza. The Ceará government was very active in offering subsidies for plants biased towards industries more labor intensive (and consequently with lower productivity). Parana was also disputing companies but it was more concentrated in the mid-tech group. As a matter of fact the only case in all groups/metropolis for which the share has not decreased from 1977 to 2009 was in Curitiba mid-tech manufacturing. The dispute between the states for attracting manufacturing was possibly one of the explanations for the faster decline in manufacturing share in SPMA. The state of São Paulo has never adopted an aggressive

policy to attract plants. The dispute existed⁴ in the 1980s but it was much more intense in the 1990s after 1988 constitution that increased the decision power of the States.

Finally another factor driving manufacturing plants out of the country was the change in international trade policy in Brazil in the early 1990s under Collor presidency. During his tenure, many tariffs were reduced or even eliminated. After many years under protection some manufacturing industries were not able to resist the competition and shut up their operation or were taken over by a multi-national company. As expected, if ISI has inflated the size of manufacturing in the country, ending the growth strategy would induce the share of this industry to go down. This factor may explain why high-tech manufacturing industries were decreasing their share faster than other industries. Using comparative advantage rationale, when a country opens its economy, it will reduce the production of goods for which it has fewer inputs available. Given that high-skilled labor force in Brazil was scarce, it would be expected that industries intensive in this input would be more affected by the change in international trade policy.

All in all, de-manufacturing in the country had a larger impact on São Paulo for many reasons. The first one is that among large metropolitan area in Brazil, it was the most concentrated in manufacturing. A mean-reversion effect might have been in place. The second point is that São Paulo State has not adopted an aggressive policy of subsidies or tax reduction to attract new firms (called in the literature "Fiscal War"). Third, São Paulo was not particularly well located for the Mercosul. It is also possible that the universalization of high school graduates in the country has contributed to this industries moving to other medium urban areas. The good news, however is that SPMA was able to change its vocation and compensate the lost jobs in manufacturing increasing jobs in the upper end of the service industry in high skill services.

3. 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. Industries move fast from one urban center to another contrasting with the slow movement of population. This is well known in the urban economics literature and it is usually called "Zipf law" that was the first one to show the stability of population distribution among cities. Table 4 and 5 compares the rank in specific industries with the rank in population for the 10 metropolitan areas analyzed before.

<Table 4 around here>

There were very few changes in the population rank in the last 3 decades or so. Belém exchange position with Brasília. After many years growing below Lucio Costa's

⁴ Ceará first incentive law (10.367) dates back to December 1979.

forecasts, the city just boomed together with the soy in the neighborhood states of the mid-west. On the other hand, the decay in Recife's population opened space to Porto Alegre and Salvador to catch up and surpass the largest northeastern metropolitan area in the 1970s, now ranking sixth in population in the country. If we sum up the absolute values of all changes in those metropolitan areas we can count 6 changes in population ranking. If we do the same exercise with more specific industries, we can see that the sum is considerable higher. If it were possible to work with a more refined classification⁵, we would probably observe even more movements.

It is interesting to observe that the 3 largest metropolitan areas in the country (São Paulo, Rio de Janeiro and Belo Horizonte) do not change their population ranking in 30 years. This is not the case for the 3 selected manufacturing industries in Table 6. The only exception is São Paulo that sticks to the first position in any industry analyzed as well as in population. The second largest metropolitan area in the country, Rio de Janeiro, has loosed 3 positions in electronics, 1 position in transportation and 2 in the textile industry. SPMA is indeed a quite resilient locus of production. What is worth noticing is that SPMA has been adapting very fast to industrial dynamics as we discussed in the previous sections.

The difference in rank variation for population and for industries is, however, much lower than what we observe for the US or France where the rank change for selected industries is 5 times de rank change in population (Duranton [2007]). The difference cannot be attributed to the industrial decomposition. Duranton (2007) works with two digits industry classification. However the difference can be attributed indeed to the number of metropolitan areas included in the study. We are working with just 10 metropolitan areas whereas Duranton (2007) works with hundreds of units. As a matter of fact, as discussed in the next section, some aspects of the industry dynamics can be understood only looking at the country as a whole.

The movement is faster in Business Services but slower (close to the population rhythm) for Financial Services. This is somehow in line with Findeisen and Sudekum (2008) finding 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 Services⁶. Services are also stickier in the top groups: São Paulo, Rio de Janeiro and Belo Horizonte kept their position in Business Services despite the large positional change in the other end of the population spectrum. In Financial Services we observe just one significant movement for Porto Alegre falling 3 positions.

<Table 5 around here>

⁵ To keep an uniform classification we can work just with 62 industries after dropping agriculture, mining and government.

⁶ The authors found a relative stability for IT services in Germany an industry inside Business Services in our classification.

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

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

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 proposed by Davis and Haltiwanger (1998) to understand the industry dynamics. Total employment change, however, should normalize this index. Following the authors it is possible to construct a similar index for total employment as:

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

It is evident that industry churning will be always larger than the total employment churning but the interesting question is evidently by how much. In Table 6 we can notice that churning in Brazil both by industry as by total employment is very high compared to the other countries for which we could get information. Churning in the US or France is twice higher than churning in Germany but half of the rate of churning in Brazil. This pattern is almost unchanged when we circumscribe the estimations to manufacturing industries. Furthermore this relationship between countries can be observed looking just at industry, employment or excess churning defined as the difference between churning in industry and employment.

<Table 6 around here>

It is evident that employment in Brazil is much more volatile than in the other countries arbitrarily selected. The differences are quite consistent with the labor market in each country. The German labor market is probably more stable than other countries and Latin American countries are probably more volatile. Adding evidence to this intuition is evidently important. Any indicator of churning is higher for Brazil than for the other countries. However it is interesting to notice that the ratio between churning in the industry and in total employment is very stable among countries around 2. It is not clear where this coincident pattern come from. In any case, the indicators are suggesting much more volatility in Brazil.

When we observe the rate of churning for the 10 metropolitan areas⁷ used in this study we can notice that SPMA has a relative low level in both industry and total employment churning. However excess churning for the SPMA is closer to the average. This is just confirming the previous observation that SPMA has not moved in the ranking both in population as in the selected industries. Recife has the largest excess churning level maybe connected to the population decay observed in the last decades. However excess churning cannot be correlated with growth as it is clear in Findeisen and Sudekum (2008).

The analysis suggests that Brazil is probably changing faster than developed countries. This characteristic represents an opportunity and a threat at the same time. It is not so difficult to attract an industry so it is not so difficult to lose it. SPMA is more stable, on the other hand. The stability of SPMA might be connected to the stability in the "modern sectors" noticed in Germany. However it is difficult to reconcile this result with the evidence that SPMA has changed from a manufacturing city to a service city in one decade. Such a fast movement in one large group of industries seems not to have a considerable impact on the overall index.

4. Recent Geographic Concentration Dynamics in Brazil

The analysis undertaken in the previous section does not allow us to see if industries, in general, were concentrating or de-concentrating in the country. The movement within industries does not reveal the overall pattern of change. One way to examine this pattern is looking at concentration indices and its change over the years. In this paper we will concentrate in one of the oldest indices in the Regional Economics literature, introduced by Florence (1948) also known as "Raw Concentration Index" and usually denominated by the letter G. Florence (1948) explain why this is a better index than, for instance, a Gini index to measure industry concentration. Many authors used the index after that (e.g. Fuchs (1962), Enright (1990), etc.). The interest was renewed after Ellison and Glaeser (1997) furnished micro-foundations to the index and Dumais, Ellison and Glaeser (2002) proposed a methodology for decomposing it. It is still the most accepted index in industrial organization together with the Herfindahl-Hirshman index. Formally we can define de index as:

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

where:

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

e_{rt} is total employment in region r at time t .

e_t is total employment in the country at time t .

⁷ Data available upon request

The index shows how much the share of employment in one region is far from the weight of this region in the country. For instance, we would not like to say that SPMA is concentrated in one industry because it has 10% of the employment in this industry in the country since SPMA represents around 10% of the country labor force. Notice that if each region had in each industry exactly the same proportion of the region in the country labor force, the index would be zero. It means that the index will be zero if employment is uniformly spread across space that is an intuitive appeal for the index.⁸ This furnishes a very intuitive rationale for a concentration index.

We could have access to information⁹ detailed by municipality and 5-digit industries for 5 years namely 1991, 1996, 2001, 2005 and 2009. We will not use 1991 information though since the industry classification in this year is different from the classification in the following year making it impossible to work with 5 digits for the whole period. So, the analysis will be concentrated in the last 13 years. Actually, making the classification consistent among years is one of the main difficulties in this type of study in Brazil. In this short period there were 3 changes in the classification: from 1991 to 1996; from 1996 to 2001 and; from 2005 to 2009. The changes from 1996 to 2001 were however negligible. We did an effort to reconcile 2005 with 2009 but it has certainly some shortcomings.

Using plant-level survey (RAIS) allows the disaggregation of the data into much more detailed divisions than it is possible using PNAD in regional and in industry terms. The finest level allowed by the data is the municipality that in Brazil is also usually called "city". It is more or less consistent with the county definition although we believe that one level up, called in Brazil micro-regions, is even more consistent with the US/UK county concept in terms of size but it is tricky to compare this historically different geographical classifications. There is still a third definition between the micro-region and the State called meso-region. This classification might be compared to the metropolitan area definition in the US although, once again, we have to be careful in such comparisons.

Figure 3 compares the distribution of the raw concentration index for these 4 geographies, i.e. municipality, micro-region, meso-region and an idiosyncratic division as follows. For the 9 states that have one metropolitan area that can be split by PNAD¹⁰, the state will be split between the state and the metropolitan area; for the remaining 17 states and the DF the unit will be the state (DF) itself. So, we end up with 36 units per year. The distribution is more and more biased (towards low values of G) when we move to more disaggregated geography. This is surprising since we would expect more variance moving down in the scale of analysis. For instance, a (non-sense) indicator for the whole

⁸ 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" (pg 890). This difference is relevant since it allows for more precise comparison between industries with different number of plants. In practice the variation of the G index represent the bulk of the variation of 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 - pg 195). Given the difficulties involved in estimating the Herfindahl-Hirshman index we will concentrate on the G index in this paper.

⁹ We would like to thank the department of statistics of the Brazilian Minister of Labor (MTE) that kindly furnished plant-level data for this analysis.

¹⁰ Those are the metropolitan areas presented in the previous sections that re consistent with the 1967 definition.

country will be necessarily zero for all industries. In any case, the indices are going down as we move to more disaggregate geographical units.

<Figure 3 around here>

On Table 7 we show the concentration index dynamics for the industries considered before using micro-regions as the unit of analysis. We believe that this is the geographical unit that makes more sense for such analysis¹¹. The trends are very similar to the trends observed for any other geographical division¹². As expected the indices with more disaggregated geography are lower. Once again the main question is how much lower. In this case we can notice that difference is very small. Since there are around 500 micro-regions and 36 states/metropolis, we would expect a much larger difference. For instance, Ellison and Glaeser (1997) find that the median E-G index is 0.005 at the county level compared to 0.023 at the state level, a four times difference consistent with the difference between the number of units. The ratio between the indices for Brazil is 0.8 so typically the effect of spillovers is such that about 80% of the excess tendency of plants to locate in the same state/metropolitan area involves plants' locating in the same micro-region. In other words, in Brazil spillover effects seem to vanish at the micro-region level while this is not the case for the US.

<Table 7 around here>

From 1996 to 2005 concentration was increasing in average. However this was not the case in manufacturing. For this group of industries concentration start falling from 2000 on. All industries were reducing concentration in the second half of the 2000s. Actually, mid-tech industries were de-concentrating during the whole period of analysis. Low-tech has a more erroneous path decreasing concentration in the second half of the 1990s, increasing it again in the 2000s and then decreasing again at a very fast rate in the end of the period. Services were getting more and more concentrated up to 2005 when they start de-concentrating as well.

We also check the correlation between the indices along the years in Table 8. The correlation is slightly larger than the one observed for the state/metropolis division and also consistent comparing different periods. It is however considerably bellow the correlation observed in the US where it is possible to observe a 0.9 correlation after 20 years. We believe that using micro-regions and plant-level 5-digits data our results might be comparable to Ellison and Glaser estimates. The two continental countries of the Americas are not qualitative different but there are still some differences in levels to be explored.

¹¹ We make a small variation in the micro-region separating São Paulo City from the ABCD that are officially in the same micro-region.

¹² Results available upon request.

<Table 8 around here>

We interpret the differences between concentration indices in Brazil and in the US as suggesting that there is more volatility in Brazilian industry location than in the US. This is somehow expected since developing countries are still not as stabilized as developed countries. It is worth noticing that the de-concentration observed for the metropolitan areas (not shown in the paper) is not reproduced for the country as a whole except for the very final period (2005-2009). It means that the preferred location of industries may not be the large metropolitan areas anymore. But industries are probably not moving to remote locations originally with a very low activity (otherwise we would have notice a much lower correlation between indices along time). They are probably moving to locations that are not so large but still (originally) concentrated in some industries. We have some anecdotic evidence that part of the firms leaving SPMA have moved to medium cities in the very state of São Paulo that would be compatible with the evidence we have.

5. Lessons for São Paulo

In this section we attempt to summarize what we learn from the exercises done in previous sections applying the knowledge towards a possible industrial policy for SPMA. We learn that the increase in jobs in service industries has happened basically in high-skilled services. Personal services proportion has increased in most regions but this was not absorbing a considerable share of the reduction in manufacturing jobs. Furthermore, the increase in the proportion of high-skilled jobs was not connected to the financial industry. Instead, business services were compensating for the losses in manufacturing jobs.

The most notable case are educational and health services that currently represent 7.7% of all jobs in São Paulo City. These two industries represented 6.5% of the jobs in 1996. It is also interesting to notice that other financial services such as Real Estate have not reduced its share in the period. The increase in productivity in this industry was concentrated in more typical financial industries, mainly in banking. Anyway it would be more precise to define SPMA as the capital of business services than as the capital of financial services despite the concentration of main facilities (such as the stock market) in the central city.

Another particular detail is that SPMA was very concentrated in mid-tech manufacturing. This is evidently connected to the auto industry classified as mid-tech. By 1991 ABCD had 39% of its jobs in this type of industry (most of it in assemblers and auto-parts). This is still the main type of manufacturing in SPMA but its relevance is far from what it used to be. It is also interesting to notice that São Paulo City in the period analyzed has never had any lead on high-tech industries. This is different from other large metropolitan areas in developing countries concentrating in high-tech industries.

When we looked at the SPMA we could notice the process of reducing jobs in manufacturing that was happening everywhere in the country but with much more

intensity in the originally manufacturing city. SPMA is not a manufacturing place anymore. Looking at micro-regions inside the metropolitan area, however, we can notice that the process of de-manufacturing is indeed happening in most cities, but it is still far from a complete vocational change. The ABCD, for instance, has still one third of its formal jobs in manufacturing. In any case, it is clear that large cities are not the favorite place for manufacturing location as observed in the 1970s.

One of the reasons why large cities are not so attractive to manufacturing anymore might be connected to the spread of high-school graduates in the country. Mid-tech manufacturing demands a labor force with high-school level. This was rare in the country some 40 years ago. This is not the case anymore. The proportion of high-school graduates in the median cities is similar to the proportion observed in 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 City could be more aggressive in attracting high-skill industries. These industries are looking for high skilled labor force that is still not available in intermediate cities. The large concentration of health services in São Paulo 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 are still quite concentrated in SPMA. This is also an industry that would deserve more attention when building an strategy for the city to remain a center of activity. The de-manufacturing period seem to be phasing out. In the second half of the 2000s the share of industries was very stable. Ignoring manufacturing consequently may not be the best strategy.

It is true that SPMA assumed the leadership in high-skilled services, the most dynamic industry in the 1990s and 2000s. However, this was not lead by the financial sector. Despite the fact that the financial industry generates a very large value added and consequently contributes to a considerable share in tax revenues, concentrating efforts in this industry seems risky. It is an industry that is reducing its share and this process does not seem to be stabilizing as we noticed for manufacturing. Furthermore, this industry is not very volatile sticking to its original location close to the main clients and to other firms in the same industry. In other words the industry does not seem to need many incentives to stay in the SPMA.

The results also suggest that Brazil is more volatile than the US or France and those two developed countries seem to be more volatile than Germany. This observation is not surprising given the characteristic of each country. Also, concentration indices are less correlated in Brazil than in the US. This lack of stability in Brazil represents a risk for any industrial policy. However, SPMA was very resilient in the period, and this was not observed for Rio de Janeiro, for instance. In any case, in such a volatile environment it is important to be more active not counting on the historic resiliency. Some metropolitan areas such as Belo Horizonte have been improving education at a faster pace and with more quality if we consider the results of standardized tests in each region.

Some de-concentration is expected and actually it is highly desirable. There is no reason to resist to such movement. The main question is how to maintain the share in industries that are more convenient to the welfare of São Paulo residents. For decades industrial policies attempted to move some activity to the poor states in the northeast. The de-concentration however has not gone in this direction and it does not seem to be connected to the regional policy adopted by the Federal Government. There is a need for a modern industrial policy not the old-fashioned subsidies that seem to be more deleterious than doing any good for the lagged regions. São Paulo Metropolitan Area may come up with a new policy that will keep its position as the center of production of the country but not in detriment of the other regions but rather spreading development all around the country.

References

- Davis and Haltiwanger (1998) "Measuring Gross Worker and Job Flows." In *Labor Statistics Measurement Issues*, ed. Haltiwanger, J. C. M. E. Manser and R. H. Topel, 77-119. Chicago: University of Chicago Press.
- Dumais, G., G. Ellison and E. Glaeser (2002) "Geographic Concentration as a Dynamic Process." *Review of Economics and Statistics*, 84(2): 193-204
- Duranton, G. (2007) "Urban Evolutions: The Fast, the Slow, and the Still" *The American Economic Review*, Vol. 97, No. 1: 197-221.
- Ellison, G. and E. Glaeser (1997) "Geographic Concentration in U.S. Manufacturing Industries: A Dartboard Approach". *The Journal of Political Economy*, Vol. 105(5): 889-927.
- Enright, M. (1990) *Geographic Concentration and Industrial Organization*. Ph.D. dissertation, Harvard Univ.
- Findeisen, S. and J. Sudekum (2008) "Industry churning and the evolution of cities: Evidence for Germany". *Journal of Urban Economics*, 64: 326-339.
- Florence, P.S. (1948) *Investment, Location and Size of Plant: A Realistic Inquiry into the Structure of British and American Industries*. Cambridge: Cambridge Univ. Press.
- Fuchs, V. (1962) *Changes in the Location of Manufacturing in the United States Since 1929*. New Haven, Conn.: Yale Univ. Press
- Henderson, J.V. (1974) "The Sizes and Types of Cities". *American Economic Review*, 64.
- Hirshman, A. (1958) *The Strategy of Economic Development*, New Haven: Yale University Press.
- Jacobs, J. (1969) *The Economy of Cities*. New York: Random House
- Krugman, P. (1991) "Increasing Returns and Economic Geography." *Journal of Political Economy* 99: 483-99.

Myrdal, G. (1947) *Economic Theory and Underdeveloped Regions*. London: Duckworth

Table 1: Share of employment in manufacturing and services for selected metropolitan areas in Brazil (1977-2009)

| Metropolitan Area | Manufacturing | | | Services | | |
|-------------------|---------------|-----|-----|----------|-----|-----|
| | 77 | 93 | 09 | 77 | 93 | 09 |
| Belem | 17% | 14% | 13% | 39% | 31% | 31% |
| Belo Horizonte | 23% | 23% | 17% | 38% | 32% | 38% |
| Brasília (DF) | 9% | 10% | 6% | 44% | 35% | 42% |
| Curitiba | 25% | 22% | 20% | 35% | 30% | 37% |
| Fortaleza | 24% | 24% | 21% | 33% | 25% | 31% |
| Porto Alegre | 31% | 30% | 24% | 35% | 29% | 34% |
| Recife | 22% | 17% | 12% | 36% | 32% | 35% |
| Rio de Janeiro | 24% | 19% | 14% | 39% | 35% | 42% |
| Salvador | 22% | 14% | 12% | 36% | 35% | 37% |
| São Paulo | 42% | 30% | 22% | 32% | 31% | 39% |

Source: Pesquisa Nacional por Amostra de Domicílios (IBGE)

Table 2: Share of employment in services industries by skill for selected metropolitan areas in Brazil (1977-2009)

| Metropolitan Area | Type of Service | | | | | | | | |
|-------------------|-----------------|----|----|--------------|-----|-----|---------|------|------|
| | Personal | | | High Skilled | | | Finance | | |
| | 77 | 93 | 09 | 77 | 93 | 09 | 77 | 93 | 09 |
| Belem | 15% | 8% | 9% | 17% | 17% | 15% | 2.2% | 1.9% | 0.7% |
| Belo Horizonte | 15% | 7% | 8% | 17% | 18% | 21% | 2.3% | 2.2% | 1.2% |
| Brasília (DF) | 17% | 6% | 7% | 23% | 23% | 29% | 5.5% | 3.9% | 2.9% |
| Curitiba | 12% | 5% | 8% | 19% | 18% | 21% | 3.4% | 3.8% | 1.9% |
| Fortaleza | 15% | 7% | 7% | 12% | 12% | 18% | 1.5% | 1.5% | 0.8% |
| Porto Alegre | 12% | 5% | 7% | 17% | 18% | 20% | 3.3% | 2.7% | 1.3% |
| Recife | 16% | 9% | 7% | 14% | 17% | 21% | 1.8% | 1.7% | 1.1% |
| Rio de Janeiro | 14% | 7% | 9% | 18% | 21% | 23% | 3.3% | 2.3% | 1.3% |
| Salvador | 15% | 8% | 9% | 14% | 20% | 21% | 2.8% | 1.5% | 3.7% |
| São Paulo | 10% | 6% | 8% | 16% | 18% | 23% | 3.7% | 3.1% | 2.1% |

Source: Pesquisa Nacional por Amostra de Domicílios (IBGE)

Table 3: Share of employment in manufacturing industries by technological intensity for selected metropolitan areas in Brazil (1977-2009)

| Metropolitan Area | Manufacturing Technology | | | | | | | | |
|-------------------|--------------------------|------|------|----------|-----|-----|----------|-----|-----|
| | High Tech | | | Mid Tech | | | Low Tech | | |
| | 77 | 93 | 09 | 77 | 93 | 09 | 77 | 93 | 09 |
| Belem | 1.5% | 1.2% | 0.7% | 4% | 5% | 5% | 12% | 8% | 7% |
| Belo Horizonte | 2.1% | 2.1% | 1.6% | 13% | 10% | 9% | 9% | 10% | 7% |
| Brasília (DF) | 1.4% | 0.9% | 0.9% | 3% | 4% | 3% | 4% | 4% | 3% |
| Curitiba | 4.6% | 2.9% | 2.7% | 10% | 11% | 12% | 11% | 8% | 6% |
| Fortaleza | 1.6% | 1.0% | 1.1% | 6% | 6% | 5% | 17% | 17% | 15% |
| Porto Alegre | 3.7% | 2.6% | 2.3% | 12% | 10% | 10% | 15% | 18% | 12% |
| Recife | 2.6% | 1.3% | 1.4% | 7% | 8% | 6% | 13% | 8% | 5% |
| Rio de Janeiro | 4.2% | 2.6% | 1.3% | 9% | 8% | 7% | 11% | 9% | 6% |
| Salvador | 5.0% | 1.8% | 1.1% | 7% | 7% | 6% | 10% | 6% | 5% |
| São Paulo | 7.1% | 4.4% | 3.2% | 20% | 15% | 11% | 15% | 11% | 8% |

Source: Pesquisa Nacional por Amostra de Domicílios (IBGE)

Table 4: 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 |
| Belem | 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)

Table 5: 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 |
| Belem | 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) |
| | 6 | 16 | 8 |

Source: Pesquisa Nacional por Amostra de Domicílios (IBGE)

Table 6: Churning in Employment and in Industries for Selected Countries

Panel A: All Industries

| Country | Churn _c | Δ EMP _c | Churn _c /Δ EMP _c |
|---------|--------------------|--------------------|--|
| 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 | Churn _c | Δ EMP _c | Churn _c /Δ EMP _c |
|---------|--------------------|--------------------|--|
| Brasil | 24.23% | 11.00% | 2.20 |
| US | 9.81% | 4.82% | 2.04 |
| France | 12.24% | 6.62% | 1.85 |

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

Table 7: Raw Concentration in Brazil and Variation for Selected Industries Using Micro-Regions 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

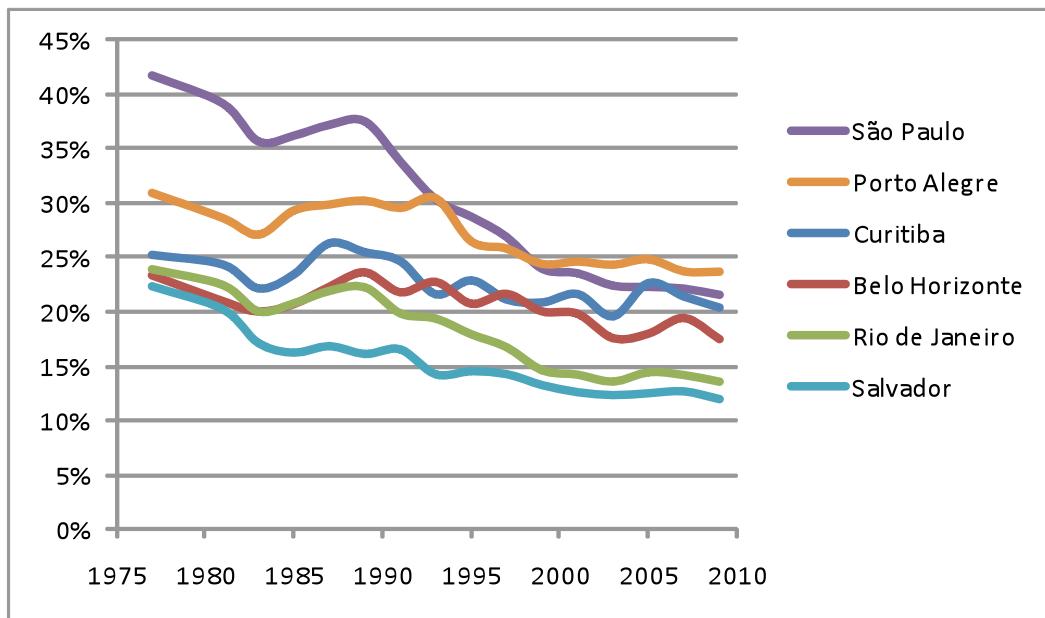
Source: Relação Anual de Informações Sociais (MTE)

Table 8: Raw Concentration Correlation Along Years in Brazil for Selected Industries Using Micro-Regions as the Unit of Analysis (1996-2009)

| | 1996 | 2001 | 2005 |
|------|--------|--------|--------|
| 2001 | 0.7796 | | |
| 2005 | | 0.9078 | |
| 2009 | 0.7606 | 0.8276 | 0.9187 |

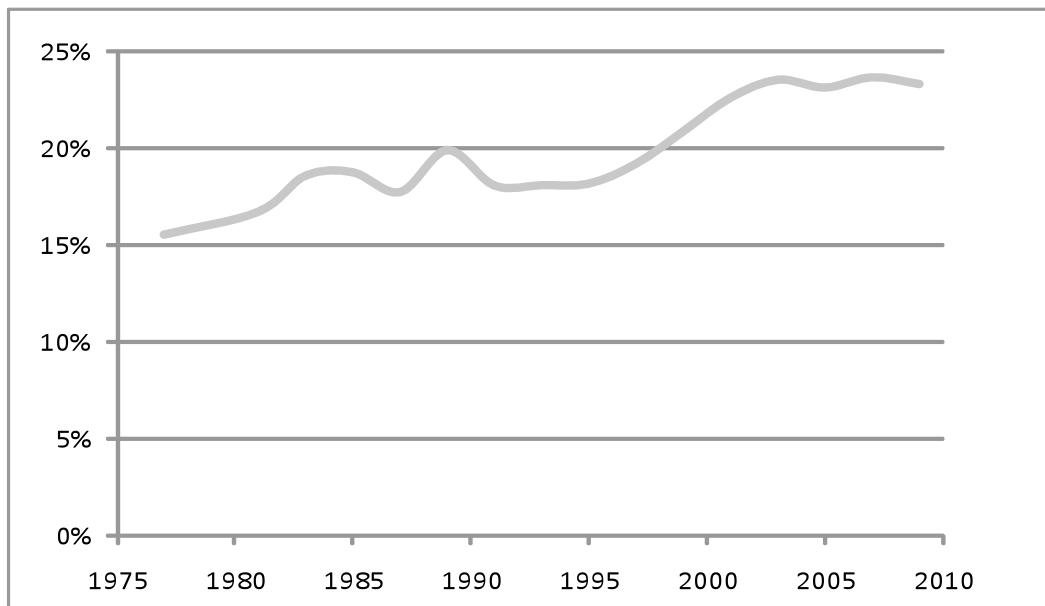
Source: Relação Anual de Informações Sociais (MTE)

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



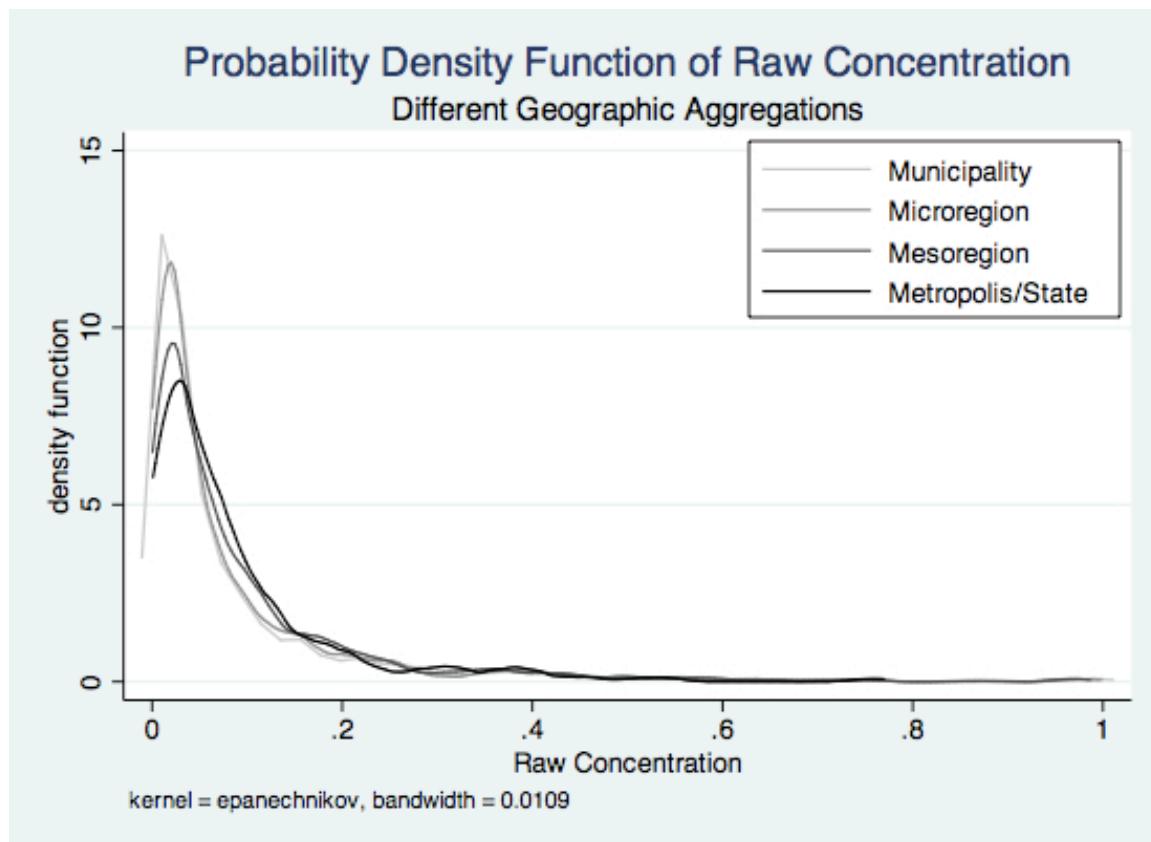
Source: Pesquisa Nacional por Amostra de Domicílios (IBGE)

Figure 2: Trends in the Share of High-Skilled Services in Total Employment in Selected Metropolitan Areas (1977-2009)



Source: Pesquisa Nacional por Amostra de Domicílios (IBGE)

Figure 3: Probability Density Function of Raw Concentration for Different Geographic Aggregations in Brazil (1996-2009)



Source: Relação Anual de Informações Sociais (MTE)