Local production and innovation systems in the state of São Paulo, Brazil

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Abstract

This paper applies a specific methodology to locate and geographically delimit local production and innovation systems in the state of São Paulo, Brazil. The source of data is RAIS - *Relação Anual de Informações Sociais*, elaborated by the Brazilian Ministry of Labor. This database provides detailed information on employment and number of plants for four-digit manufacturing industries at micro-region level. Locational Gini coefficients are calculated to determine which manufacturing industries are mostly spatially concentrated in the state. Once these spatially concentrated industries are identified, location quotients at micro-region level are applied to locate and geographically delimit industrial clusters, to determine local production specialization, and to assess to what extent cluster production is vertically integrated. Finally, filter variables are used to select relevant clusters or local production and innovation systems for case studies based on suggested guidelines. The paper emphasizes that case studies are essential for assessing other important cluster characteristics such as horizontal linkages and qualitative information and for designing cluster policies in a case-by-case approach.

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Abstract

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Introduction

This paper suggests a specific method to determine the location and to assess the production structure of industrial clusters, with an application to the state of São Paulo (SP), the most industrialized region in Brazil. Such method comprises the elaboration of indicators of (1) spatial concentration of manufacturing industries and (2) specialization of production structures at regional/local levels. It was devised as a preliminary step, and an essential one, in a broader methodology which includes case studies to cover cluster characteristics not usually found in industry statistics.

This methodology is particularly important in a country such as Brazil, characterized by her continental size, diversity of economic activities, and different regional specialization of production structures. In this context a great number of clusters or local production/innovation (LPI) systems have emerged. Some are well known and internationally competitive like the EMBRAER aircraft cluster of São José dos Campos, the telecommunications equipment industry of Campinas and several others in traditional industries such as shoe, furniture, ceramics, textile and clothing (Tironi, 2001). Other LPI systems all over the country, however, are less known and/or have not been studied yet.

Several public and private institutions are presently planning to survey industrial clusters or LPI systems in the country in order to gather information that enables them to design policies and joint actions to support cluster competitiveness. We expect our methodology to contribute to that effort.

The paper is organized as follows. Section 1 describes the database used for elaborating the quantitative indicators; section 2 explains the methodology of the same indicators, and section 3 shows briefly an illustrative application of the methodology to one branch of manufacturing industry in the state of SP. The final section presents some concluding remarks.

1. *RAIS* database: qualities and limitations

The indicators of spatial concentration and local specialization elaborated in this paper were calculated from data available in *RAIS - Relação Anual de Informações Sociais*, annually produced by the Brazilian Ministry of Labor. This database provides information on employment, number of plants and other details about manufacturing industries at four-digit level and micro-regions[1] and their respective municipalities. This breakdown of data and information is exactly the major quality of *RAIS* data for regional studies in Brazil. It makes possible the analysis of economic activities at four-digit levels, which means almost at product level, and at local (municipalities) or micro-regions levels. The uniformity of the data along time and among sectors is another quality, allowing comparisons among different distributions of economic activities at different times.

However, *RAIS* database also has some limitations that must be taken into account for their possible consequences on aggregate data for industrial studies at regional level. First, employment data include only formal contractual jobs. This is an important limitation when informal labor is extensively employed, which is common in Brazil in several manufacturing industries as well as in services. Second, the firms themselves are responsible for the classification of their economic activities, which may imply distortions in the sense that firms with a diversified production structure have the option to declare all their data in the activity they consider more relevant. Third, a firm with several plants may declare all its data in one plant, usually where the head office is located, which could, to some extent, distort information on the firm location. However, this and the previous problem are lessened in industrial clusters, where there are usually an agglomeration of

firms in the same industry and a high degree of firm specialization. Fourth, firms inform their data voluntarily, which may cause distortions in the analysis of small firms and less developed regions due to the high number of firms which do not inform.

Albeit important, these limitations do not impair the use of *RAIS* data for the purpose of regional studies. In fact they have been widely used for estimating changes in the regional distribution of economic activities and for case studies of clusters or LPI systems. For our purposes, *RAIS* data are consistent enough for the elaboration of spatial concentration and local specialization indicators. These indicators make possible to locate the cluster spatially, to determine its geographical limits, and to assess the extent of vertical linkages within the cluster. Horizontal linkages and other qualitative characteristics can only be assessed by field research in case studies.

2. Spatial concentration and local specialization indicators

The elaboration of indicators of spatial concentration and local specialization of economic activities is an old practice and has been an important object of study in regional economics since the seminal contributions by the pioneers of Regional Science. Two of the most widely used are the location quotient and the localization curve (Isard, 1960; Haddad, 1989). Recently, with the increasing interest on studies about the relationship between the geographical proximity of firms and their ability to compete and innovate, a variation of the localization curve was introduced – the locational Gini coefficient. We refer, in this paper, to two of the most important contributions in this field, by Krugman (1991) and Audretsch & Feldman (1996).

The statistical work developed in this paper is derived from those authors' contributions. They calculated locational Gini coefficients to measure spatial concentration in U. S. three-digit industries (Krugman) and to assess the relationship between the geographic concentration of innovative activities and the location of U. S. four-digit industries (Audretsch & Feldman). We have developed a similar methodology to calculate locational Gini coefficients for Brazilian four-digit industries, with a further step: our source of data allows the identification of vertical linkages in production structures at micro-region level.

On the basis of *RAIS* data, locational Gini coefficients were calculated to determine which manufacturing industries are mostly spatially concentrated. Once these spatially

concentrated industries are identified, location quotients at micro-regions level are applied to locate and geographically delimit industrial clusters, to determine local production specialization, and to assess to what extent cluster production is vertically integrated. Finally, filter variables such as the local industry share of the total national (or state) employment in the same industry and the absolute number of jobs and plants in the local industry are applied to select relevant LPI systems leaving aside, for example, "agglomerations" characterized by one (or few) large local firm(s) in small places.

Step-by-step, our methodology for *RAIS* employment data at micro-region and four-digit industry levels runs as follows. First, we calculate the ratio between the share of the industry in total micro-region employment and the share of the total industry employment in national (or state) manufacturing. This ratio is the location quotient (Isard, 1960), in our case at micro-region and four-digit industry levels. When the value of the quotient is over unity, it indicates that the micro-region has a higher concentration of employment in the industry comparatively to the overall geographic distribution of employment in the same industry. In this sense it also indicates a possible local production specialization. Per se, however, the location quotient has some limitations. For example, small or undeveloped micro-regions may present a high location quotient for an industry just because of the presence of a single plant. Or a highly developed and diversified micro-region, like metropolitan areas, may show very low location quotients despite the presence of many plants of the same industry. Additionally, regional differences in production technology and productivity affect employment figures. We shall keep these limitations in mind.

The second step is to calculate the locational Gini coefficients for employment at four-digit industry level. This is done for each industry by (1) ranking the micro-regions according to their location quotients, and (2) going down the rank and adding cumulatively the share of the industry in the total micro-region employment and the share of the industry in the total manufacturing employment. This produces a locational Gini curve which compares to the 45 degree line that characterizes an industry in which employment is evenly distributed in space. Thus, in the words of Audretsch & Feldman (1996: 633) with reference to locational Gini coefficients for production, "An industry which is not geographically concentrated more than is reflected by the overall distribution of

manufacturing would have a coefficient of 0. The closer the industry coefficient is to 1, the more geographically concentrated the industry would be."

The third step is, for each geographically concentrated four-digit industry, to rank the micro-regions with higher location quotients. This makes it possible to locate the micro-regions where the industry is concentrated, and to geographically delimit the industry cluster. Once the micro-regions are identified, a cross-section of four-digit industries by micro-regions indicates which related industries are also located in each micro-region, thus giving a proxy for the local production structure.

Finally, filter variables are used to refine the selection of relevant clusters or LPI systems. For example, the filters may be adjusted to select only those clusters or local systems that share at least 5 percent of total employment in the respective industry and have 20 or more plants and at least 5,000 jobs.

Thus altogether the Gini coefficients, the location quotients and the filter variables make it possible to identify, locate, and geographically delimit relevant industrial clusters. Additionally, they make it possible to assess to what extent the local system is vertically integrated. These findings are essential for guiding field research and, afterwards, for designing policy measures focussing local production and innovation systems.

However, as mentioned above, this quantitative methodology gives no indication of other structural and qualitative characteristics of the local system. These characteristics can only be assessed by case studies. Once a cluster or LPI system is selected as a case study, our methodology proceeds by carrying out field research in two levels. First, at firm level, after characterizing the firm (date of establishment, size, main products and markets), we seek information on distribution, product differentiation (quality, trademark, design, services), R&D activities, sources of information for product development and design, horizontal linkages, localization of main suppliers, interactions with suppliers, sources of financing. Second, at system level, we look for information on: the geographical extension of the system, infrastructure and logistics in relation to markets for products and inputs, population, history and initial conditions, evolution, institutional organization (supporting institutions, firm associations, worker unions), local production structure (extent of vertical integration, specialization, industrial organization, firm-size distribution, markets,

governance structure), dissemination of local knowledge (learning processes, spillovers, spin-offs), social/cultural/political contexts.

These case studies information on local structure and qualitative characteristics, together with the quantitative indicators, offer a secure basis for cluster policies aiming at specific problems and at promoting production growth, employment, technological upgrading, exports, and other objectives which are relevant in a case-by-case approach.

3. An illustrative application of the methodology to SP manufacturing data

The *RAIS* (2000) industrial employment statistics for the state of SP are distributed in 63 geographic micro-regions and 268 four-digit industries. We have calculated locational Gini coefficients for 267 industries (one of the industries had nil employment in 2000) and 63 micro-regions. The descriptive statistics are given in Table 1 below.

Table 1. Locational Gini for employment in four-digit industries and micro-regions of SP - Descriptive statistics

Statistics	
N-sample	16821
Mean	0.6303
Std. Deviation	0.1789
Variance	0.0320
Range	0.7781
Minimum	0.2018
Maximum	0.9799

Source: Authors elaboration

The results show a wide range of Gini coefficients varying from 0.2 to 0.98, with a mean of 0.63. Since we are interested in determining which industries are mostly concentrated geographically, we proceeded by discharging industries with a Gini coefficient under the mean. This is just a selective criterion. Statistically a Gini over 0.5 indicates that the industry is geographically concentrated.

Thus, for Gini coefficients on 0.63 and over we have selected 119 four-digit industries. However, in many of the selected industries regional concentration comes hand-in-hand with industrial concentration and do not configure geographic agglomerations which could be characterized as industrial clusters. This is the case of such oligopolistic industries as aircraft building, oil refinery, petrochemicals, basic chemicals, cement, glass, steel, wheat milling, sugar refinery, and so on.

In order to focus on industrial clusters or LPI systems we have applied, at micro-regions level, filter variables related to the local four-digit industry share of total employment in the same industry in the state, the number of jobs and the number of plants in the local industry. Such filter variables can obviously be more or less rigorous depending on one's objectives. Table 2 illustrates all possibilities.

Table 2. Possible number of selected industries resulting from different combinations of filter variables

No. of plants	Location Quotient	Micro-region share of total employment in the Industry (4-digit)				
		...	≥ 5%	≥ 10%	≥ 20%	≥ 40%
...	Higher than 1	913	404	257	144	71
	Higher than 2	663	356	237	129	58
	Higher than 5	378	258	187	108	53
≥ 10	Higher than 1	109	75	54	39	15
	Higher than 2	83	62	44	30	8
	Higher than 5	50	43	32	21	7
≥ 20	Higher than 1	57	44	29	21	11
	Higher than 2	44	34	21	14	6
	Higher than 5	28	26	16	10	5
≥ 50	Higher than 1	22	18	12	8	3
	Higher than 2	16	14	9	6	2
	Higher than 5	14	13	9	6	2

Source: Authors elaboration.

To illustrate the application of the methodology for industries with Gini coefficients on or over the mean and aiming at focussing on clusters or LPI systems in micro-regions of the state of SP, we have fixed the following minimum limits for the filter variables:

- Location quotient for employment in the micro-region industry ≥ 1;
- Share of micro-region in total industry employment in the state ≥ 5%;
- Number of plants in the micro-region industry ≥ 20.

Again, those are selective criteria chosen with specific objectives. Table 2 above show that there are many other possibilities. We are aware of the fact that our choices have relevant analytical consequences. For instance, to work with a minimum of 20 plants in the local industry may imply that production systems like those characterized as "core-ring with lead firm" (Storper & Harrison, 1991) are excluded. This means, in the case of SP

state, that the important local production and innovation system built around EMBRAER plant will not be selected. Certainly many other important exclusions could be identified and commented upon. However, filter variables can be combined in a way to become more inclusive. Besides, our objective in this section is only to illustrate the application of the methodology.

As a result a new substratum of 44 four-digit industries, distributed in 20 micro-regions of the state, was selected. The full list of industries and respective micro-regions where they are located can be seen in Table 3.

Table 3. Spatially concentrated industries and their micro-region localization in the state of São Paulo, 2000

Four-digit Industries	Micro-region	Location Quotient	Share of total employ-ment (%)	Employ-ment	No. of plants
Manufacture of grain mill products	São Paulo	1.9	67.3	2,391	27
Preparation and processing of other natural textile fibers	Campinas	3.0	25.2	718	21
Spinning of man-made textile fibers	Campinas	3.9	32.9	3,980	26
Weaving of textile cotton fibers	Campinas	5.7	48.8	2,787	34
Manufacture of textile products	Araraquara	29.0	31.7	2,560	204
	Campinas	2.6	22.3	1,795	47
Manufacture of knitting products	Campos do Jordão	188.2	7.3	170	22
	Amparo	38.1	22.9	535	106
	São Paulo	1.1	38.4	897	57
Tanning and dressing of leather	Franca	16.7	23.9	1,409	32
	Jaú	4.8	5.7	338	58
Manufacture of leather footwear	Franca	43.5	62.1	16,546	1,064
	Jaú	12.3	14.7	3,916	177
	Birigui	6.4	8.8	2,339	52
Manufacture of plastic footwear	Birigui	63.9	86.9	5,171	45
Manufacture of other material footwear	Birigui	42.8	58.2	5,185	108
	Jaú	6.4	7.7	683	30
Saw-milling and planning of wood	Capão Bonito	104.1	8.3	483	27
	Itapeva	101.4	27.6	1,597	80
	Bauru	6.8	7.3	421	27
Reproduction of records and tapes	São Paulo	2.8	100.0	946	26
Manufacture of plain and security glass	São Paulo	1.2	41.8	1,935	26
Manufacture of non-refractory ceramic goods for structural use in building construction	São João da Boa Vista	14.3	12.4	2,662	203
	Tatuí	11.3	9.6	2,066	54
	Jaú	7.2	8.6	1,836	71
	Limeira	4.9	10.3	2,210	32
	Sorocaba	2.0	8.5	1,826	100
Manufacture of non-refractory ceramic goods for several uses	Pirassununga	22.4	12.5	2,018	93
	Limeira	7.9	16.7	2,692	38
	Campinas	1.7	14.8	2,384	136

	Sorocaba	1.2	5.3	860	26
Manufacture of other iron and steel pipes	São Paulo	1.0	37.9	467	35
Manufature of machinery for agriculture, poultry and other animal products	Mogi Mirim	6.1	7.8	921	26
	Ribeirão Preto	3.6	6.2	726	26
	Limeira	2.7	5.7	676	30
Manufacture of machinery for apparel, leather and footwear industries	Franca	35.7	50.9	269	26
	São Paulo	1.2	45.3	239	21
Manufacture of alarms and signaling apparatus	São Paulo	1.8	66.0	1,310	48
Manufacture of metallic furniture	Votuporanga	26.1	9.6	830	55
	Mogi Mirim	8.8	11.2	972	36
	São José do Rio Preto	8.4	11.9	1,036	33
Stonecutting of precious and semi-precious stones, manufacture of jewelry	Limeira	13.0	27.5	1,254	104
	São José do Rio Preto	6.8	9.6	438	43
	São Paulo	1.3	48.2	2,201	211

Source: Authors elaboration from *RAIS* (2000) data.

A summary table was elaborated organizing the information in a reverse way, that is, by micro-regions and the number of four-digit industries which are located in each of them (Table 4). It can be seen that there are 9 micro-regions where more than one industry is concentrated. We have decided to look more closely at those with 3 or more industries since they have a better chance of constituting not only an agglomeration of firms of the same sector but also a vertically integrated production system. We have also decided to focus on 4 of those micro-regions, namely Franca, Birigui, Jaú and Limeira, leaving aside the two larger ones, Campinas and São Paulo, which are large metropolitan areas with a highly diversified industrial structure that would demand a lengthy examination.

Table 4. Number of industries located in each of the micro-regions, state of São Paulo, 2000

Micro-regions	**N° of industries**	**Micro-regions**	**N° of industries**
Votuporanga	1	São João da Boa Vista	1
São José do Rio Preto	2	Mogi Mirim	2
Franca	3	Campinas	5
Ribeirão Preto	1	Amparo	1
Birigui	3	Itapeva	1
Bauru	1	Tatuí	1
Jaú	4	Capão Bonito	1
Araraquara	1	Sorocaba	2
Limeira	4	Campos do Jordão	1
Pirassununga	1	São Paulo	8

Source: Authors elaboration from *RAIS* (2000) data.

For each of the four micro-regions a complete set of information derived from *RAIS* data was organized, including all four-digit industries located in the region and the respective locational quotient, share of total employment, number of jobs, and number of plants. In order to shorten the tables and focus the discussion, an additional criterion was applied: for each micro-region, only those industries with a share or 5% or more of the total employment were considered. The results can be seen in Tables 5 to 8.

The data for the micro-region of Franca are most revealing (Table 5). They show that the region is specialized in the manufacture of leather footwear, concentrating over 62% of the industry total employment in the state of SP and a large number of small firms in the business. This specialization was strong enough to attract related industries such as the manufacture of machinery and equipment for footwear manufacturing, tanning and dressing of leather, manufacture of inputs such as adhesives and sealant, rubber products, apparel accessories. It also motivated the local development of synergetic industries like the manufacture of travel bags and other leather goods. All these industries have a highly significant share of employment and concentrate locally a large number of plants and jobs. They configure very clearly a vertically integrated local production system. It is possible that agglomeration economies also acted in the attraction of other related activities, not shown in the data, in the areas of distribution, technological services, design and modeling, labor training. Marshallian external economies and spillover effects are probably behind the centripetal forces that attracted a whole production chain to the region.

Table 5. Micro-region of Franca, 2000

Four-digit industries	Location Quotient	Share of total employ-ment (%)	Employ-ment	N° of plants
Manufacture of leather footwear	43.55	62.1	16,546	1,064
Manufacture of machines and equipment for apparel, leather and footwear industries	35.73	50.9	269	26
Tanning and dressing of leather	16.75	23.9	1,409	32
Manufacture of other leather products	15.15	21.6	822	81
Manufacture of adhesives and sealant agents	7.77	11.1	243	4
Manufacture of rubber products	6.33	9.0	2,262	49

Manufacture of apparel accessories	5.93	9.5	457	10
Manufacture of bags, handbags, valises and other travel products, from leather and other material	3.49	5.0	177	13

Source: Authors elaboration from *RAIS* (2000) data.

The micro-region of Birigui is a similar case, although with a different pattern of specialization. The data in Table 6 show that the region is highly specialized in the manufacture of plastic footwear and tennis shoes and footwear from mixed materials, including plastics for soles, leather and textiles. The source of plastic materials is the petrochemical industry, and this certainly explains the fact the local production system is far less integrated locally than in the region of Franca. Local production could not reach the scale economies necessary to attract petrochemical plants, which are usually located near the source of raw material. However, the local production system has managed to attract related industries such as tanning and dressing of leather, manufacture of paper and cardboard products for packing shoes, and the manufacture of travel bags and other leather goods.

Table 6. Micro-region of Birigui. 2000

Four-digit industries	**Location Quotient**	**Share of total employ-ment (%)**	**Employ-ment**	**N° of plants**
Manufacture of plastic footwear	63.87	86.9	5,171	45
Manufacture of tennis shoes from mixed materials	55.24	75.2	3,848	17
Manufacture of footwear from other materials	42.78	58.2	5,185	108
Manufacture of paper and cardboard products	6.69	9.1	429	3
Manufacture of leather footwear	6.45	8.8	2,339	52
Tanning and dressing of leather	5.95	8.1	478	4
Manufacture of metallic furniture	5.49	7.5	649	6
Repairing of aircraft	4.91	6.7	57	4
Manufacture of wrapping paper	4.18	5.7	446	11
Manufacture of bags, handbags, valises and other travel products, from leather and other material	3.99	5.4	193	6

Source: Authors elaboration from *RAIS* (2000) data.

The data for the micro-region of Jaú (Table 7) also show an impressive concentration of firms in the manufacture of leather shoes. In this case, however, the location quotients and employment share of the local industries, although high, are smaller than those observed in the previous cases. This is explained by the fact that, being specialized in women's shoes, the region competes unfavorably with the so-called "super-cluster" of Vale dos Sinos, in the South of Brazil (Schmitz, 1999), also specialized in women's shoes. The region industrial structure is somewhat more diversified, but a certain degree of vertical integration in the manufacture of shoes is evident from the data. The local concentration of firms in the tanning and dressing of leather industry is significant, as well as in other related industries like manufacture of other leather products, and manufacture of paper and cardboard products.

Table 7. Micro-region of Jaú, 2000

Four-digit industries	Location Quotient	Share of total employ-ment (%)	Employ-ment	N° of plants
Spinning of cotton fibers	14.93	17.9	1,508	1
Manufacture of leather footwear	12.28	14.7	3,916	177
Manufacture of Sugar	11.92	14.3	4,154	8
Manufacture of radio and television receivers, sound or video recording or reproducing apparatus	9.48	11.3	485	2
Manufacture of other leather products	8.34	10.0	380	64
Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment	7.79	9.3	284	4
Manufacture of non-refractory ceramic goods for structural use in building construction	7.16	8.6	1,836	71
Manufacture of footwear from other materials	6.41	7.7	683	30
Manufacture of safety accessories for personal and industrial use	4.88	5.8	147	20
Tanning and dressing of leather	4.79	5.7	338	58
Production and processing of poultry and other small animals meat products	4.67	5.6	565	6
Manufacture of packaging cardboard products	4.56	5.5	713	7

Source: Authors elaboration from *RAIS* (2000) data.

The case of the micro-region of Limeira is somewhat fuzzy. The region is closer to the metropolitan areas of Campinas and São Paulo than the other ones and is characterized by an extremely diversified industrial structure, probably under the market influence of those metropolitan areas. The data in Table 8 offer strong evidence of this industrial diversification. However, the region contains at least three most significant industrial clusters, one in the manufacture of ceramic goods, another in the manufacture of machine-tools and other machinery, and the last one in the production of jewelry. The latter is the most impressive. It comprises not only the 104 plants under the heading of manufacture of jewelry but also the major part of the 86 firms in "other manufacturing", which the breakdown of data has shown to consist mostly of small manufacturers of golden-coated pieces and bijouterie. Other related industries could be in the manufacture of metal articles for domestic and personal uses, and in the machinery industry, but the data are insufficient in this case to figure out the extent of vertical linkages.

Table 8. Micro-region of Limeira, 2000

Four-digit industries	Location Quotient	Share of total employ-ment (%)	Employ-ment	N° of plants
Sugar milling and refining	36.47	76.8	915	1
Manufacture of cardboard and paperboard	22.78	48.0	1,104	5
Stonecutting of precious and semi-precious stones, manufacture of jewelry	13.04	27.5	1,254	104
Manufacture of parts and accessories for braking systems	10.34	21.8	1,429	7
Manufacture of non-refractory ceramic goods for several uses	7.94	16.7	2,692	38
Manufacture of other machinery for ore extraction and for building construction industry	7.48	15.8	393	2
Manufacture of dairy products	5.60	11.8	2,162	9
Manufacture of paper	5.02	10.6	1,582	8
Manufacture of non-refractory ceramic goods for structural use in building construction	4.90	10.3	2,210	32
Manufacture of metal articles for domestic and personal uses	4.59	9.7	487	25
Manufacture of machine-tools	4.49	9.5	794	21
Production of alcohol	4.20	8.8	652	2
Preparation of spices, gravies and seasonings	4.20	8.8	279	2

Manufacture of manioc flour and derivatives	3.62	7.6	42	6
Manufacture of non-motorized bicycles and tricycles	3.61	7.6	167	6
Production of fruit juice and vegetables	3.60	7.6	484	9
Manufacture of machinery for textile industry	3.46	7.3	157	5
Other manufacturing	3.13	6.6	1,460	86
Manufacture of wooden barrels and wooden packaging goods	3.04	6.4	252	8
Manufacture of machinery for transport and loading of cargo and people	2.95	6.2	498	7
Manufacture of metallic structures for buildings, bridges, communications towers, truss and others	2.94	6.2	365	13
Manufacture of machinery for agriculture and poultry farming	2.73	5.7	676	30
Preparation of rice and manufacture of rice products	2.51	5.3	71	13

Source: Authors elaboration from *RAIS* (2000) data.

Concluding remarks

The methodology applied above proved to be useful for identifying the location of industrial clusters in spatially concentrated industries. Despite the inherent limitations of *RAIS* (2000) data, the methodology also proved to be helpful for assessing local industrial structures and particularly for verifying the extent to which the cluster is vertically integrated. Additionally, location quotients together with other information give a hint on the cluster production specialization. However, specialization can only be confirmed by case studies, which are as well indispensable for assessing other important characteristics such as horizontal linkages and qualitative information. We have not presented any case study in this paper, but some general guidelines for field research were suggested. We have not made any policy recommendations either. We believe that cluster policies should not be considered as a panacea for regional problems and should not replace proper regional policies. Instead, they should be treated in a case-by-case approach supported by case studies. And our methodology offers a reasonable guide for selecting relevant clusters or local production/innovation systems.

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[1] A micro-region in Brazilian federation is a purely geographical unit, equivalent to a US county, comprising a number of municipalities. Usually the economically hegemonic and/or larger municipality centralizes and names the micro-region.