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Knowledge Bases and Regional Development: an application of the "SAS Model" to the Brazilian Economy

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Abstract

The subject of the analysis is the structure and the evolution of the ideal-types of "knowledge base" defined from data about employment according to the SAS Model at the level of the Brazilian territorial units. Specifically, the analysis seeks to identify the absolute and relative relevance of these knowledge bases in different territorial units as well as the evolution of these characteristics over a period of twelve years, in order to identify reinforcing or re-specialization patterns. The analysis also includes an attempt to analyze the connections between the characteristic of the educational infrastructure and the distribution of employment in Knowledge Bases. A conclusive section summarizes some policy implications generated from the analysis.

Key-words: SAS Model; Knowledge Bases; Territorial Concentration of Employment; Territorial Redistribution of Employment; Territorial Concentration of Tertiary Education

Introduction

It is widely accepted that the world economy is in a transition to a new era with a dynamics increasingly related to the production and use of knowledge (Freeman, 1995; Lundvall, 1998). These changes have been associated with terminologies such as "knowledge economy", "information age" or "learning economy". According to Lastres and Cassiolato (2005), what counts in the knowledge-based economy is the creativity and ability to search and make use of the new technologies and knowledge, through learning processes. In this context, the ability to build new skills through interactive learning mechanisms is fundamental for achieving competitive advantage at the organizational level (Foss, 1999; Dyer and Singh, 1998).

The concept of "knowledge base" has been increasingly used as an analytical tool by the literature of evolutionary economics and evolutionary geography. This approach has pointed the importance of connecting the characteristics of the knowledge generation and the identification of critical dimensions of the process of regional development. Specifically, the analysis developed incorporate the distinction between three ideal-types of territorial knowledge bases, Synthetic (engineering based), Analytical (science based) and Symbolic (artistic based), forming the so-called SAS model, which are applied to the discussion of the Brazilian regional reality.

In the last decade, public policies in Brazil have been redirected to the reduction of social inequalities. These inequalities are also reflected in an interregional dimension, due to the presence of regions that historically concentrated more wealth and have better social indicators (South and Southeast) while there are other less dynamic regions with highest levels of poverty, most notably the Northeast. Within this scope, S,T&I policies have been formatted in order to contribute to the reduction of regional inequality, expanding the number of scientific and technological institutions, technical schools and universities and increasing the funding for research and innovation activities in less favored regions. In this scenario, it is worth asking whether this expansion has, in fact, being effective in terms of the promotion of changes in the knowledge base of less structured regional innovation systems.

Considering the logic of polarization that traditionally has benefitted the more prosperous regions of the country, and the relative lack of productive factors, skills, brains and knowledge in less developed regions, it is important to evaluate the effects of those policies on the structure and evolution of regional

innovation systems located in peripheral regions of the Brazilian economy. To develop this analysis, the concept of the "knowledge bases" elaborated in the "SAS Model" can be particularly useful. The measurement of these knowledge bases in different regions of Brazil follow a methodology based on employment data, as proposed by Martin (2012). Through this analysis, we use traditional indicators widely used in the field of economic geography to analyze the evolution of knowledge bases in Brazilian regions between 2003 and 2015.

The main subject of the analysis is the structure and the evolution of the ideal-types of "knowledge bases" defined according to the SAS Model at the level of the Brazilian territorial units. Specifically, the analysis seeks to identify the absolute and relative relevance of these knowledge bases in each territorial unit as well as the evolution of these characteristics over a period of twelve years, in order to identify reinforcing or re-specialization patterns. The analysis comprises three levels of territorial units: geo-economic regions, Federative States (including the Federal District) and Geographical "Mesoregions". The five geo-economic regions comprise 27 federative states divided into 76 mesoregions. The complexity and heterogeneity of the Brazilian territorial structure justify the use of such analytical procedures. At the level of those units, their structure of occupations was approached through the SAS model. The analysis covers the period 2003-2015, comprising information about formal employment extracted from the Brazilian Annual Social Information Survey (RAIS). As a result, we try to evaluate the distribution of the employment among different territorial units throughout the period investigated, considering the distinction between the three types of "knowledge bases", articulating this evolution to the socio-economic dynamism of the territory and identifying potential implications in the fields of regional development policies. Specifically, we investigate if the expansion of technical schools and universities in less favored regions has been effective to reduce territorial inequalities, articulating areas of tertiary education with the "knowledge bases" proposed in the SAS Model.

The article comprises four blocks, as follows. The first section presents an analytical framework that tries to summarize the main aspects of the SAS Model. The second section presents the methodology of the analysis, based on the manipulation of data about regional distribution of the occupations disaggregated according to the categories of the SAS Model, defining indexes of territorial concentration and territorial redistribution. The third section presents an attempt to analyze the connections between the characteristic of the educational infrastructure and the distribution of employment in knowledge bases. A conclusive section summarizes some policy implications generated from the analysis.

1 - Analytical Framework

From a Schumpeterian perspective, innovation may be characterized as a diverse and multi-faceted activity, involving different sources of novelty (as well as different sources of knowledge) and multiple applications, with a with a broad impact on economic development.. The concept of 'system of innovation' introduced in the 1980s has the ambition to point out the interdependence and interaction between technical and institutional change in the process of economic development. In this perspective, innovations can only really be understood within a systemic and dynamic framework; the innovation performance of an economy (nation, region, sector) thus depends not only on how its individual firms and organizations perform, but also on how they cope with change and interact with each other and with the financial and public sector.

Different innovation system approaches might be identified in the evolutionary literature. The Regional Systems of Innovation (RSI) concept therefore rests on the relationship between technology, innovation and industrial location (D'Allura, Galvagno, and Mocciaro, 2012). The RSI approach highlights the regional dimension of the production and the exploitation of new knowledge, thereby helping to explain regional differences in innovation capacity and economic strength. RSIs usually consist of a set of interacting private, semi-private and public organizations, interacting within an institutional

framework. This framework stress the generation, exploitation and dissemination of knowledge and thus supports innovative activities on a regional level (Asheim, Coenen, and Svensson-Henning, 2003; Cooke, 2004; Doloreux, 2002).

Bell and Albu (1999) develop an analysis of the elements that strengthen the integration of capabilities in the knowledge systems, stressing the differences between elements that increase knowledge-using capabilities and elements that increase knowledge-changing capabilities. At the local level, they mention the mobility of skilled labor, the improvement of operational skills and the knowledge diffusion of specialized machinery or production-related services. The territorial proximity between agents inserted in a similar social, cultural and institutional context enhances cooperative practices that reinforce learning gains (Johnson and Lundvall, 1994). According to this perspective, the presence of multiple ties among local actors performs a critical role to strengthen competence-building processes in industrial agglomerations. The establishment of those ties may provide the necessary conditions to promote localized learning processes and to consolidate innovative paths based on incremental innovations. On the other hand, in order to avoid the danger of a geographical 'lock-in' related to the exhaustion of learning processes, the agglomerations might also retain capabilities to break productive practices and to change technological paths (Cooke and Morgan, 1998). Christopherson, Michiel and Tyler (2010) associate these processes with a kind of "regional resilience", defined as the capacity of a territory to overcome short-term or long-term economic adversity, which would be provided by a strong regional system of innovation (Clark et al., 2010; Howells, 1999) and by the effective creation of a "learning region" (Archibugi and Lundvall, 2001).

In an evolutionary perspective, the discussion about the relevance of the generation of knowledge in the development process may be associated with the construction of taxonomies that seek to identify functional categories for the analytical characterization of different innovative systems. According to Martin (2012a), at least three types of taxonomies of knowledge can be found in the literature of innovation systems: (1) the dichotomy between tacit and codified knowledge (Polanyi, 1967; Nelson and Winter, 1982); (2) the distinction of knowledge by the way it is acquired, in terms of know-what, know-why, etc. (Lundvall and Johnson, 1994) and (3) an alternative conceptualization that emphasizes the interactions that occur within innovation networks (Laestadius (2000); Asheim and Coenen (2005a); Asheim and Coenen (2005b); Asheim and Gertler (2005)). These categorizations seek to articulate analytically the concepts of knowledge and learning, incorporating the characterization of flows and stocks of knowledge within the theories of innovation systems.

The knowledge taxonomy developed by Laestedius (2000) and improved by Björn Asheim and Coenen (2005) comprises the notions of sector activity and spatial proximity, including new elements in the analysis. Among these elements, we can mention the rationality of knowledge creation; how it is developed and used; the criteria for the success of knowledge products; the strategies to convert knowledge in innovation and to promote industrial competitiveness and the interrelations between the actors involved in the processes of creation, transmission and absorption of knowledge (Asheim et al, 2011). According to Asheim and Coenen (2005), Asheim and Gertler (2005), Asheim et al (2011) and Martin (2012), the territorial knowledge base could be classified into three ideal-types: Synthetic (engineering based), Analytical (science based) and Symbolic (artistic based), forming the so-called SAS model. The profile of the knowledge base of a Regional Innovation System could therefore be characterized by the predominant type of the knowledge employed in economic activities in the region.

The SAS taxonomy defines three modes of learning and approaches to generation and application of knowledge relevant for innovation and economic development: "theoretically understanding", "instrumentally solving problems" and "culturally creating meanings". This taxonomy refers to different types of "learning modes" and to the specific character of the knowledge resulting from this learning (Manniche, 2012). Asheim et al., 2011, summarize the main characteristics of the three knowledge bases. "Analytical" knowledge comprises the theoretically understanding and explaining features of the natural

and social world, constituting the traditional core attribute of universities, research institutions and R&D departments of companies. The analytical knowledge involves cognitive, rational processes and application of scientific principles, methods and formal models, often documented in scientific papers, reports, files, patents, educational lessons, etc. The knowledge resulting is to a large extent codified, mobile and transferable across space, being documented in the scientific literature. "Synthetic" knowledge refers to instrumentally construct context-specific knowledge, oriented to practical solutions to specific human problems, being articulated to novel combinations of existing knowledge rather than creation of new knowledge, being generated from firm-internal learning by doing or learning by interaction in the context of markets and networks often involving customers, suppliers, institutions for applied research, etc. Thus, synthetic knowledge is to a large extent tacit and practice-related but it usually also has a codified element that allows mobility across geographical space and sector borders, which involves technical forms of engineering, human resource management, organizational change, etc. "Symbolic" knowledge processes deal with the creation and communication of cultural meanings and symbols, being evaluated on the basis of socio-culturally embedded perceptions of "meaning", taking the form of open-ended, creative and artistic thinking, performance and interaction that permits to combine or re-interpret established conventions in new ways. This symbolic knowledge is mainly (but not exclusively) tacit, being linked to specific socio-cultural contexts and difficult to transfer directly in geographical space, involving expertise within art, design, marketing and communication, as well as temporary, project-based forms of work organization, involving informal interaction with end-consumers and buzzing in non-commercial, civic, daily-life contextual settings (street cultures, public events, etc.). The different "knowledge bases" defined in SAS Model comprise specific forms of interaction, with academic, professional, cultural and social networks playing different roles for creation and diffusion of knowledge in the territory. Table 1 summarizes the main features of the differentiated knowledge bases.

Table 1- Main features of the SAS knowledge bases model

Knowledge Base	Analytical	Synthetic	Symbolic
Purpose of knowledge creation	Theoretically understanding natural or social systems, confirming or rejecting dominant scientific laws or defining new ones	Designing or constructing instrumental solutions to specific human problems	Creating socio-cultural meanings and interpretations of artefacts and their use
Approaches to reasoning	Deductive processes based on formal, abstract models, generalization and codification	Inductive processes commencing with observation of specific instances and problem-solving needs	Creative processes based on open-ended, divergent thinking, going beyond conformity and conventions, and usually involving personalized commitment of participants
Typical target of innovation	Improvement of cognitive/theoretical models for products, processes or organizations	Change of functional attributes of products, processes or organizations	Change of aesthetic, semiotic, value-laden features of products, processes or organizations
Typical learning method	Learning by searching and researching. Interaction in epistemic communities	Learning by doing and by interacting with customers and suppliers. Face-to-face interaction in communities of practice	Learning by interacting with consumers and by buzzing within professional creative communities
Type of knowledge created	Mainly codified, highly abstract and universal knowledge	Mainly tacit, context-specific practical knowledge but important codified component	Strongly tacit, context-specific, semiotic content
Institutional context of learning/knowledge sourcing	Science and education systems. Firm R&D	Market and supply-chain networks. Firm R&D	Firm sources. Consumer/connoisseur cultures. Creative business service. Policy discourses
Geographical context of learning/ knowledge sourcing	Mainly global	Mainly regional and national	Mainly local/regional but importance of global cultural trends
Typical management challenge	When do we need further understanding of a topic and when can we proceed to practical test and application?	How to avoid lock-ins in out-dated technological paradigms?	How to capture subjective values of organizational stakeholders and consumers and how to align the business accordingly?

Source: Manniche (2012). The classification was adapted from Asheim et al. (2011), Gertler (2008), Asheim and Hansen (2009) and Manniche and Testa (2010)

From this classification, we can also advance in the understanding of how the support offered by the regional innovation system is effective in each context (Asheim and Conen, 2005a). Simultaneously, the understanding of the predominant features of the knowledge bases in a regional economy and its influence on other elements such as the innovative level, interactive practices, territorial dynamism and institutional complexity - especially for a RSI associated with peripheral regions - facilitates the evaluation of strengths and weaknesses of those SRIs. This aspect might be articulate to the discussion of the role of the public policies from a systemic approach of innovative activities.

2 - Methodology

In the empirical study, we chose to follow the methodology proposed by Martin (2012). The author uses data about formal employment to calculate a location quotient (QL) - widely used in regional economic studies - that permit comparisons at different territorial scales. This analysis would be based on the argument that the distinctive knowledge retained by the local labor force constitutes a key variable for measuring the knowledge base of a region. It is assumed, therefore, that knowledge is something intrinsic to the human mind, with the data about those skills - such as occupational profiles - providing a relevant instrument (even if inaccurate) to map the knowledge base in a region. Furthermore, the methodology incorporates a criterion related to the occupational structure of employment, using data extracted from the Brazilian Annual Social Information Survey (RAIS), performed by the Ministry of Labor and Employment. Specifically, the data comprises the distribution of the employment according to an occupation structure defined by the Brazilian Classification of Occupations (CBO), which is compatible with the International Standard Classification of Occupation (ISCO). Regional data based on those analytical cuts will be used to perform comparative analyzes of the characteristics of the knowledge bases between regions and sectors.

The attempt to consider data about employment as a crucial variable to map the knowledge bases is not original and is compatible with some interpretations developed both by the theory of human capital as by the approach of the theory of resource-based firm. Indeed, "*we argue that occupation statistics are most suitable for capturing the knowledge base of an economic system. Occupation data reflect the set of activities or tasks that employees are paid to perform, and thereby the type of knowledge they actually apply at their place of work*". (Martin, 2012, pp. 10) While the data about employment permit to capture the productive structure of a region, information about the capabilities reveal the type of activity performed by the workforce. The use of those data to show how the knowledge is incorporated into the qualifications of the workforce can minimize the biases caused by the characteristics of each type of knowledge. This methodology tries to articulate data about employment by occupational criterion with the empirical observation of the characteristics of occupations. In this sense, an analytical knowledge base will have a higher proportion of workers with skills in typically scientific fields, while a synthetic knowledge base will have a higher proportion of engineers and a symbolic knowledge base will have a larger share of its workforce involved in artistic and creative activities.

The relationship between the knowledge bases and their most characteristics occupations will be approached based on the analysis of Asheim and Hansen (2009), taking as reference the International Standard Classification of Occupation (ISCO), which was adapted to correspond to the Swedish classification of occupations, whose acronym is SSYK. Thus, the analysis to be developed will involve an effort to translate the occupational categories of SSYK to the categories of ISCO and, finally, from the categories of ISCO to the current version of Brazilian Classification of Occupation (CBO). Specifically, different groups of professional occupations were identified for each group of knowledge base - Analytical (science based), Synthetic (engineering based),) and Symbolic (artistic based).

Based on the grouping of the selected occupational categories in each knowledge base, the analysis seek to measure these bases through the calculus of a Location Quotient (QL) defined to those

groups of occupations, in order to verify if the knowledge base of a region is predominantly analytical, synthetic or symbolic, compared with other regions. In the analysis developed by Martin (2012), the QL is define by the relation (i/e)/(Ei/ E) where:

(i) = number of jobs in the knowledge base i in the region selected;
(e) = total number of jobs in the selected region;
(Ei) = number of jobs in the knowledge base i in the economy of reference (Brazil)
(E) = number of jobs in the reference economy.

The analysis seeks to identify the absolute and relative relevance of ideal-types of knowledge bases in Brazilian territorial units as well as the evolution of these characteristics over a period of twelve years, in order to identify reinforcing or re-specialization patterns. The empirical analysis will be performed for the five great geo-economic regions, the twenty-seven federative states (including the Federal District) and the correspondent 137 geographical "mesoregions". The analysis covers the period 2003-2015, being based on information on formal employment (distributed by sectors and occupational categories) extracted from the Brazilian Annual Social Information Survey (RAIS), provided by the Brazilian Ministry of Labor and Employment. It should be noted that the criterion used to identify professional occupations associated with the different knowledge bases have been adapted to take into account the classification of economic activities provided by this databases. The predominance of a knowledge base is defined with reference to the national average ratio between the number of professionals in a group and the overall employed labor force in the region. The analysis of those measures permits to evaluate how the skills that make up the knowledge base are distributed in the territory (at the level of mesoregions).

As a result, we intend to discuss the territorial distribution of the Brazilian mesoregions according to the distinction between the three types of knowledge bases throughout the period investigated. In this sense, other evidences might be captured from the analysis. Considering that the coefficient of location will be measured in different periods in time, the analysis can capture a process of regional structural change. It is also possible to consider some traditional indicators of regional concentration. One of these indicators, the Herfindhal-Hirschman Index (HHI) captures the general regional concentration of employment to each one of knowledge bases, as well as to the whole employment of the country along the three years surveyed (2003, 2009 and 2015). This index is calculated from the calculated from the sum of the square of the participation of each territorial unit consider in the analysis. The index has a higher value when all employments belong to a restricted number of regions and tends to zero when the those employments are more territorial dispersed. To capture these changes we can also consider a "redistribution coefficient" that helps to analyze the change of the spatial distribution of a knowledge base within the various regions along certain period of time (2003-2015). Since public investment has changed significantly in the last decade in favor of the less developed regions in the country, this coefficient can be applied to discuss this trend. It also helps to evaluate whether changes in terms of public policies are effective in terms of promoting changes in knowledge bases that accelerate the reduction of regional inequalities.

3 - Data Analysis

3.1 - Distribution of Employment by "knowledge bases"

Tables 2 provide a general view about the regional distribution of the employment according to the occupations identified for the different "knowledge bases" in the years surveyed among the economic regions and the federative states. The analysis comprise the distribution of the employment among the different "knowledge bases" for the years 2003, 2009 and 2014 and the growth of the employment among this "knowledge bases" between 2003-2014. The total employment reaches 48.060.807 jobs in 2015,

corresponding to a growth of 62,7% between 2003-2015. To the whole country, the employment of the Analytical Base reaches 4.095.830 jobs in 2015, corresponding to a growth of 77,5% between 2003-2015; the employment of the Synthetic Base reaches 9.140.444 jobs in 2015, corresponding to a growth of 66,4% between 2003-2015; and the employment of the Symbolic Base reaches 3.476.504 jobs in 2015, corresponding to a growth of 87,4% between 2003-2015.

In the year 2015, 49,2% of the employment in the "Analytical Base" was concentrated in the Southeast, 20,6% in the Northeast, 15,6% in the South, 8,3% in the Midwest and 6,3% in the North. Between 2003-2015, the growth was more impressive in North (129,3%), followed by the Northeast (104,6%), Midwest (87,6%), Southeast (66,3%) and South (64,0%). In terms of the Federative States the employment in this occupational group was more concentrated in the states of São Paulo (26,2%), Rio de Janeiro (11,6%), Minas Gerais (9,5%), Paraná (6,5%), Rio Grande do Sul (5,5%) and Bahia (5,1%). Between 2003 and 2015, the growth was more impressive in the states of Roraima, Maranhão, Piauí, Rondônia, Pará, Amapá and Mato Grosso do Sul. Concerning the Location Quotient (QL), in 2015, this index presented a vale greater than 1.25 for the states of Tocantins, Piauí, Roraima, Maranhão, Paraíba, Amazonas and Rio de Janeiro. On the other hand, this index presented a value less than 0.75 for the states of Amapá, Rondônia and Mato Grosso. Between 2003-2015, the growth of the index was more impressive for the states of Roraima, Piauí, Maranhão, Rondônia, Mato Grosso do Sul and Espírito Santo.

Concerning the "Synthetic Base" we can observe that, in the year 2015, 51,4% of the employment was concentrated in the Southeast, 22,3% in the South, 15,0% in the Northeast, 6,7% in the Midwest and 4,6% in the North. Between 2003-2015, the growth was more impressive in Midwest (99,4%), followed by the North (87,0%), Northeast (77,1%), South (63,3%) and the Southeast (60,0%). In terms of the Federative States the employment in this occupational group was more concentrated in the states of São Paulo (30,7%), Minas Gerais (10,6%), Rio de Janeiro (8,1%), Paraná (7,8%), Rio Grande do Sul (7,6%), - Santa Catarina (6,9%), Bahia (3,9%) and Ceará (3,2%). Between 2003 and 2015, the growth was more impressive in the states of Roraima, Mato Grosso, Pará, Amazonas, Maranhão, Mato Grosso do Sul, Goiás and Sergipe.

Concerning the "Symbolic Base" we can observe that, in the year 2015, 51,7% of the employment in this occupational group was concentrated in the Southeast, 19,8% in the South, 15,3% in the Northeast, 8,9% in the Midwest and 4,3% in the North. Between 2003-2015, the growth was more impressive in Midwest (139,0%), followed by the Northeast (110,1%), Southeast (94,5%), North (90,4%) and South (46,6%). In terms of the Federative States the employment in this occupational group was more concentrated in the states of São Paulo (29,7%), Rio de Janeiro (10,2%), Minas Gerais (9,9%), Paraná (7,1%), Rio Grande do Sul (6,9%), - Santa Catarina (5,8%), Bahia (4,2%) and Goiás (3,3%). Between 2003-2015, the growth was more impressive in the states of Roraima, Distrito Federal, Amapá, Piauí, Acre, Rio de Janeiro, Bahia, Alagoas, Mato Grosso and Goiás.

Table 2 - Distribution of Employment in Group of Occupations Related to the Knowledge Bases of the SAS Model - 2003, 2009 and 2015

	Analytical (%)				Synthetic (%)				Symbolic (%)				Total (%)			
	2003	2009	2015	Var % (*)	2003	2009	2015	Var % (*)	2003	2009	2015	Var % (*)	2003	2009	2015	Var % (*)
Midwest	**7,8**	**7,6**	**8,3**	**87,6**	**5,6**	**6,0**	**6,7**	**99,4**	**7,0**	**7,8**	**8,9**	**139,0**	**8,2**	**8,3**	**8,8**	**74,3**
50 - Mato Grosso Sul	1,0	1,2	1,3	139,1	0,9	1,0	1,2	119,4	1,6	1,4	1,5	76,4	1,2	1,3	1,3	76,8
51 - Mato Grosso	1,0	1,2	1,2	103,4	1,1	1,2	1,5	129,0	1,5	2,0	1,8	127,0	1,4	1,5	1,7	93,4
52 - Goiás	2,9	2,5	2,7	65,5	2,4	2,6	2,9	98,6	2,8	3,3	3,3	122.0	2,8	2,9	3,1	81,5
53 - Distrito Federal	3,0	2,8	3,1	86,7	1,2	1,2	1,1	57,8	1,1	1,2	2,2	292,1	2,7	2,6	2,6	56,0
Northeast	**17,9**	**20,5**	**20,6**	**104,6**	**14,1**	**14,6**	**15,0**	**77,1**	**13,6**	**14,9**	**15,3**	**110,1**	**17,2**	**18,0**	**18,5**	**74,7**
21 - Maranhão	1,1	1,6	2,0	227,3	0,8	0,9	1,1	122,7	0,8	1,0	0,9	106,0	1,2	1,4	1,5	107,3
22 - Piauí	1,0	1,7	1,8	210,3	0,6	0,5	0,6	68,8	0,5	0,6	0,7	177,5	0,8	0,9	1,0	86,5
23 - Ceará	2,8	3,3	3,3	110,1	3,1	3,1	3,2	70,3	3,0	2,8	2,9	81,7	2,8	3,0	3,2	87,0
24 - Rio Grande Norte	1,1	1,3	1,2	98,7	1,1	1,1	1,0	63,2	1,0	1,0	1,2	117,8	1,3	1,3	1,3	56,9
25 - Paraíba	1,6	1,8	1,8	98,6	1,0	0,9	1,0	78,6	1,1	1,1	1,1	93,1	1,3	1,3	1,4	73,8
26 - Pernambuco	3,1	3,2	3,4	96,8	2,6	2,5	2,8	84,9	2,7	3,5	2,8	99,8	3,3	3,4	3,5	73,6
27 - Alagoas	0,9	0,9	1,0	108,3	0,7	0,7	0,7	76,1	0,6	0,7	0,8	131,9	1,1	1,1	1,1	61,3
28 - Sergipe	1,4	1,3	1,0	25,8	0,6	0,7	0,7	92,4	0,7	0,6	0,7	88,9	0,8	0,8	0,8	65,2
29 - Bahia	5,0	5,3	5,1	82,3	3,8	4,1	3,9	70,4	3,3	3,7	4,2	139,1	4,7	4,9	4,8	67,6
Nortth	**4,9**	**5,2**	**6,3**	**129,3**	**4,1**	**4,6**	**4,6**	**87,0**	**4,2**	**4,7**	**4,3**	**90,4**	**4,7**	**5,3**	**5,7**	**97,5**

11 - Rondônia	0,3	0,5	0,5	179,6	1,0	1,1	0,5	-9,2	0,6	0,7	0,7	91,3	0,6	0,7	0,7	95,5
12 - Acre	0,4	0,3	0,3	40,3	0,1	0,1	0,1	83,0	0,1	0,2	0,2	165,7	0,2	0,3	0,3	98,6
13 - Amazonas	1,5	1,1	1,6	93,6	1,0	1,2	1,4	124	1,0	1,1	1,0	79,1	1,1	1,2	1,3	92.0
14 - Roraima	0,1	0,2	0,3	916,6	0,1	0,1	0,1	151,5	0,1	0,2	0,2	329,9	0,1	0,2	0,2	248,3
15 - Pará	1,6	1,9	2,3	148,9	1,5	1,6	2,0	125,6	1,8	1,9	1,7	71,2	1,9	2,1	2,3	96,6
16 - Amapá	0,1	0,2	0,2	146,9	0,1	0,1	0,1	79,9	0,1	0,2	0,2	254	0,2	0,3	0,3	93,7
17 - Tocantins	0,9	0,9	1,1	122	0,3	0,3	0,3	84,6	0,4	0,4	0,4	93,0	0,5	0,6	0,6	87,9
Southeast	**52,5**	**50,7**	**49,2**	**66,3**	**53,5**	**53,6**	**51,4**	**60,0**	**49,8**	**48,2**	**51,7**	**94,5**	**52,1**	**51,2**	**49,7**	**55,2**
31 - Minas Gerais	12,7	11,7	9,5	32,1	10,8	11,2	10,6	62,6	9,9	9,6	9,9	87,6	10,6	10,6	10,0	53,6
32 - Espírito Santo	1,6	1,8	1,9	116,0	2,1	2,1	2,0	64,4	1,6	1,6	1,9	113,8	1,9	2,0	1,9	63,6
33 - Rio de Janeiro	10,8	10,0	11,6	90,6	8,6	8,3	8,1	56,9	7,3	6,5	10,2	163,6	10,0	9,3	9,3	51,1
35 - São Paulo	27,4	27,2	26,2	69,7	32,0	31,9	30,7	59,6	31,0	30,5	29,7	79,5	29,6	29,3	28,5	56,6
South	**16,8**	**15,9**	**15,6**	**64,0**	**22,8**	**21,2**	**22,3**	**63,3**	**25,4**	**24,4**	**19,8**	**46,6**	**17,8**	**17,2**	**17,3**	**58,5**
41 - Paraná	6,3	6,7	6,5	83,8	7,3	7,0	7,8	76,9	8,6	9,1	7,1	55,1	6,4	6,4	6,5	65,2
42 - Santa Catarina	4,0	3,7	3,5	55,2	6,3	6,3	6,9	82,3	7,3	7,3	5,8	47,6	4,4	4,5	4,6	71,3
43 - Rio Grande do Sul	6,5	5,6	5,5	50,3	9,1	7,9	7,6	39,1	9,4	7,9	6,9	37,9	7,0	6,3	6,3	44,5
Total geral (1.000)	**2.307**	**3.259**	**4.096**	**77,5**	**5.492**	**7.115**	**9.140**	**66,4**	**1.855**	**2.811**	**3.477**	**87,4**	**29.545**	**41.208**	**48.061**	**62,7**

(*) Variation refers to absolute values of employment between 2003 and 2015
Source: Brazilian Annual Social Information Survey (RAIS)

3.2 - Territorial Concentration and Territorial Redistribution of Employment in Knowledge Bases

In order to capture the evolution of the territorial distribution of the employment among the different "knowledge bases" defined in terms of occupational structure, two different indexes were constructed. First, a Herfindhal-Hirschman Index (HHI) permits to capture the regional concentration of employment to different knowledge bases, as well as to the whole employment of the country along the three years surveyed (2003, 2009 and 2015). This index is calculated from the sum of the square of the participation of each territorial unit consider in the analysis, for the different knowledge bases. The index has a higher value when all employments belong to a restricted number of regions and tends to zero when the employments are more territorial dispersed. This index was calculated for three different territorial levels: the five great geo-economic regions, the twenty-seven federative states (including the Federal District) and the correspondent 137 geographical "mesoregions". To capture these changes, we also considered a “Redistribution Coefficient” that measures the changes of the spatial distribution of employment in a "knowledge base" within the territory along certain period. This index is obtained from the sum of the modulus of the difference among the share of each territorial unit between two periods in time (2003 and 2013).

Table 3 presents information about the evolution of the territorial concentration measured by an HHI index for the different "knowledge bases" and for the whole set of occupations for the years 2003 and 2005 calculated for the three different territorial levels considered in the analysis. Concerning the more aggregated level of the five great geo-economic regions, we can observe a reduction of the index for the Analytical and Synthetic bases between 2003 and 2015, reflecting a movement similar to that observed to the Total Employment, while the index remained relatively stable for the Symbolic base. In terms of the territorial level of the federative states, the index was reduced further to the Analytical base, followed by a less pronounced reduction for the Symbolic and Synthetic bases, both with an evolution very similar to the Total Employment. Concerning the more fragmented territorial level of the "mesoregions", the index reduced more sharply to the Analytical base, followed by a less pronounced reduction for the Symbolic base, reflecting the general trend observed to the Total Employment, contrasting with a small increase of the index observed for the Symbolic base.

Table 3 - HHI Territorial Concentration Index Calculated to Group of Occupations Related to the Knowledge Bases of the SAS Model - Brazilian Geo-economic regions, Federative States and Geographical "Mesoregions" - 2003, 2009 and 2015

	Analytical			Synthetic			Symbolic			Total		
	2003	2015	Var	2003	2015	Var	2003	2015	Var	2003	2015	Var
Regions	34,5%	32,0%	-7,3%	36,3%	34,3%	-5,3%	33,8%	34,0%	0,6%	34,2%	32,2%	-5,7%
Federative States	12,1%	10,9%	-9,5%	14,4%	13,5%	-6,7%	13,8%	12,9%	-6,9%	12,7%	11,9%	-6,7%
Mesoregions	5,2%	4,4%	-16,0%	4,4%	3,7%	-14,4%	4,2%	4,4%	5,5%	4,9%	4,3%	-11,7%

Source: Brazilian Annual Social Information Survey (RAIS)

The trends captured by the analysis of the HHI index reflect only partially the redistribution of the Employment among different territorial units. Considering the potential impacts of public policies that have tried to stimulated the growth of the employment in less development regions, we can observe the evolution of a "Redistribution Coefficient" calculated by the sum of the modulus of the difference among the share of each territorial unit between the years 2003 and 2013 for the different "knowledge bases". The general movement of this coefficient is presented in Table 4 for the three different territorial levels considered in the analysis. The coefficient tends to be higher to the Analytical and Symbolic bases, followed by a small value for the Synthetic base and by an even lower value for the Total Employment. We can also observe that the growth of the "Redistribution Coefficient" tends to be more intense when we pass subsequently through the various territorial levels - geo-economic regions federative states and geographical "mesoregions".

Table 4 - Redistribution Coefficient Calculated to Group of Occupations Related to the Knowledge Bases of the SAS Model - Brazilian Geo-economic regions, Federative States and Geographical "Mesoregions" - 2003 - 2015

	Analytical	Synthetic	Symbolic	Total
Regions	9,2%	7,1%	11,1%	5,7%
Federative States	13,3%	8,1%	14,4%	6,6%
Mesoregions	17,2%	11,0%	19,1%	7,7%

Source: Brazilian Annual Social Information Survey (RAIS)

In order to verify if the movement of the "Redistribution Coefficient" effectively benefits the less development regions, it is possible to identify the location of the territorial units that contribute positively to the evolution of index among the period surveyed for the different "knowledge bases" considered in the analysis. Table 5 illustrates this aspect. Considering a simple mean of the contribution of the geo-economic regions and federative states for the different "knowledge bases", we can observe that this contribution to the coefficient is greater for the Northeast (with high values in Maranhão, Bahia, Piauí and Pernambuco), Midwest (with high values in the Distrito Federal and Mato Grosso) and North (with high values in Pará). The contribution of these regions tends also to be higher when we compare the simple mean of the different "knowledge bases" and their contribution to the "Redistribution Coefficient" of the Total Employment. The contribution of the Northeast tends to be higher for the Analytical and Symbolic bases, while the contribution of the Midwest tends to be higher for the Symbolic and Analytical bases and the contribution of the North tends to be higher for the Analytical base. Concerning the more developed regions, they contribute negatively to the evolution of "Redistribution Coefficient" among the period surveyed for the different "knowledge bases". In the case of Southeast, this negative contribution is lower when we compare the simple mean of the different "knowledge bases" with its contribution to the "Redistribution Coefficient" of the Total Employment, but the contrary occurs in the case of the South. Despite this general trend, we can observe a positive contribution of some federative states in some areas, such as Espírito Santo and Rio de Janeiro in Analytical and Symbolic bases, Paraná in Analytical and Synthetic bases and Santa Catarina in Synthetic base.

Table 5 - Contribution of Different Territorial Units (Geo-economic regions and Federative States) to the Redistribution Coefficient Calculated to Group of Occupations Related to the Knowledge Bases of the SAS Model - 2003 - 2015

	Analytical Base	Synthetic Base	Symbolic Base	Simple Mean of Knowledge Bases	Total Employment
Midwest	**0,44%**	**1,11%**	**1,92%**	**1,16%**	**0,58%**
50 - Mato Grosso do Sul	0,34%	0,28%	-0,09%	0,18%	0,11%

51 - Mato Grosso	0,15%	0,42%	0,32%	0,30%	0,26%
52 - Goiás	-0,20%	0,47%	0,52%	0,26%	0,32%
53 - Distrito Federal	0,15%	-0,06%	1,17%	0,42%	-0,11%
Northeast	**2,73%**	**0,90%**	**1,65%**	**1,76%**	**1,27%**
21 - Maranhão	0,93%	0,27%	0,08%	0,43%	0,32%
22 - Piauí	0,75%	0,01%	0,22%	0,33%	0,12%
23 - Ceará	0,51%	0,07%	-0,09%	0,16%	0,42%
24 - Rio Grande do Norte	0,13%	-0,02%	0,17%	0,09%	-0,05%
25 - Paraíba	0,19%	0,07%	0,03%	0,10%	0,09%
26 - Pernambuco	0,34%	0,28%	0,18%	0,26%	0,22%
27 - Alagoas	0,15%	0,04%	0,14%	0,11%	-0,01%
28 - Sergipe	-0,40%	0,09%	0,01%	-0,10%	0,01%
29 - Bahia	0,14%	0,09%	0,91%	0,38%	0,14%
North	**1,43%**	**0,50%**	**0,07%**	**0,67%**	**1,00%**
11 - Rondônia	0,20%	-0,45%	0,01%	-0,08%	0,13%
12 - Acre	-0,08%	0,01%	0,06%	0,00%	0,05%
13 - Amazonas	0,13%	0,35%	-0,04%	0,15%	0,19%
14 - Roraima	0,25%	0,03%	0,09%	0,13%	0,11%
15 - Pará	0,66%	0,52%	-0,16%	0,34%	0,40%
16 - Amapá	0,05%	0,01%	0,09%	0,05%	0,04%
17 - Tocantins	0,21%	0,03%	0,01%	0,09%	0,08%
Southeast	**-3,32%**	**-2,08%**	**1,89%**	**-1,17%**	**-2,40%**
31 - Minas Gerais	-3,26%	-0,25%	0,01%	-1,17%	-0,59%
32 - Espírito Santo	0,35%	-0,03%	0,23%	0,18%	0,01%
33 - Rio de Janeiro	0,80%	-0,49%	2,96%	1,09%	-0,71%
35 - São Paulo	-1,20%	-1,31%	-1,31%	-1,27%	-1,11%
South	**-1,28%**	**-0,43%**	**-5,53%**	**-2,41%**	**-0,45%**
41 - Paraná	0,22%	0,46%	-1,48%	-0,27%	0,10%
42 - Santa Catarina	-0,50%	0,60%	-1,55%	-0,48%	0,23%
43 - Rio Grande do Sul	-1,00%	-1,50%	-2,49%	-1,66%	-0,79%

Source: Brazilian Annual Social Information Survey (RAIS)

We can expand the analysis for the different "mesoregions" of the country. Table 6 presents the distribution of mesoregions that contribute positively to the evolution of the Redistribution Coefficient in the period 2003-2015. Considering the different knowledge bases separately or the mean of the contribution of the mesoregions, we can observe that most of the mesoregions of the less developing regions contributes positively to the evolution of the Redistribution Coefficient. In fact, considering the mean of the contribution for the three knowledge bases, we can observe that 75,0% of the mesoregions contributes positively in the North, 73,3% in the Midwest and 71,4% in the Northeast, contrasting with the lower percentage observed in the Southeast (43,2% of the mesoregions) and in the South (21,7%). However, among the twenty mesoregions with a greater contribution to the mean of the three knowledge bases, seven was located in the Southeast (Central Espírito-santense, Metropolitana do Rio de Janeiro, Baixadas, Norte Fluminense, Campinas and Vale do Paraíba Paulista), six in the Midest (Centro Norte de Mato Grosso do Sul, Norte Mato-grossense, Sul Goiano and Distrito Federal), five in the Northeast (Norte Maranhense, Centro-Norte Piauiense, Metropolitana de Fortaleza, Metropolitana de Recife and Sul Baiano), three in the North (Centro Amazonense, Norte de Roraima and Sudeste Paraense) and two in the south (Oeste Paranaense and Sudoeste Paranaense). The Table 7 illustrates this aspect, presenting the list of the twenty mesoregions with greater contribution for the mean of the Redistribution Coefficient and for the three correspondent knowledge bases.

Table 6 - Number of mesoregions with positive contribution to the Redistribution Coefficient Calculated to Group of Occupations Related to the Knowledge Bases of the SAS Model - 2003 - 2015

Region/ Federative State	Number of Mesoregions	Number of mesoregions with positive contribution to the Redistribution Coefficient					Percentage of mesoregions with positive contribution to the Redistribution Coefficient (%)					Mean of the Vale of the contribution of the mesoregions to the Redistribution Coefficient (%)				
		Analytical	Synthetic	Symbolic	Mean	Total	Analytical	Synthetic	Symbolic	Mean	Total	Analytical	Synthetic	Symbolic	Mean	Total
Midwest	**15**	**11**	**13**	**11**	**11**	**13**	**73,3**	**86,7**	**73,3**	**73,3**	**86,7**	**0,03**	**0,07**	**0,13**	**0,08**	**0,04**
50 - Mato Grosso do Sul	4	4	4	2	3	3	100,0	100,0	50,0	75,0	75,0	0,08	0,07	-0,02	0,04	0,03
51 - Mato Grosso	5	4	5	4	4	5	80,0	100,0	80,0	80,0	100,0	0,03	0,08	0,06	0,06	0,05
52 - Goiás	5	2	4	4	3	5	40,0	80,0	80,0	60,0	100,0	-0,04	0,09	0,10	0,05	0,06
53 - Distrito Federal	1	1		1	1		100,0	0,0	100,0	100,0	0,0	0,15	-0,06	1,17	0,42	-0,11
Northeast	**42**	**33**	**27**	**18**	**30**	**31**	**78,6**	**64,3**	**42,9**	**71,4**	**73,8**	**0,06**	**0,02**	**0,04**	**0,04**	**0,03**
21 - Maranhão	5	5	4	2	5	5	100,0	80,0	40,0	100,0	100,0	0,19	0,05	0,02	0,09	0,06

22 - Piauí	5	5	3	3	4	5	100,0	60,0	60,0	80,0	100,0	0,16	0,00	0,04	0,07	0,03
23 - Ceará	6	5	3	1	4	5	83,3	50,0	16,7	66,7	83,3	0,08	0,01	-0,01	0,03	0,07
24 - Rio Grande do Norte	4	3	1	1	2	2	75,0	25,0	25,0	50,0	50,0	0,03	-0,01	0,04	0,02	-0,01
25 - Paraíba	4	4	3	2	2	2	100,0	75,0	50,0	50,0	50,0	0,05	0,02	0,01	0,02	0,02
26 - Pernambuco	5	2	4	2	3	4	40,0	80,0	40,0	60,0	80,0	0,07	0,06	0,04	0,05	0,04
27 - Alagoas	3	3	1	1	3	1	100,0	33,3	33,3	100,0	33,3	0,05	0,01	0,05	0,04	0,00
28 - Sergipe	3		3	1	1	2	0,0	100,0	33,3	33,3	66,7	-0,13	0,03	0,00	-0,03	0,00
29 - Bahia	7	6	5	5	6	5	85,7	71,4	71,4	85,7	71,4	0,02	0,01	0,13	0,05	0,02
Nortth	**20**	**17**	**12**	**8**	**15**	**19**	**85,0**	**60,0**	**40,0**	**75,0**	**95,0**	**0,07**	**0,03**	**0,00**	**0,03**	**0,05**
11 - Rondônia	2	2	1	1	1	2	100,0	50,0	50,0	50,0	100,0	0,10	-0,23	0,01	-0,04	0,06
12 - Acre	2	1	1	2	1	2	50,0	50,0	100,0	50,0	100,0	-0,04	0,01	0,03	0,00	0,03
13 - Amazonas	4	3	1		3	4	75,0	25,0	0,0	75,0	100,0	0,03	0,09	-0,01	0,04	0,05
14 - Roraima	2	2	2	1	2	2	100,0	100,0	50,0	100,0	100,0	0,13	0,01	0,05	0,06	0,05
15 - Pará	6	6	5	2	5	6	100,0	83,3	33,3	83,3	100,0	0,11	0,09	-0,03	0,06	0,07
16 - Amapá	2	1	1	1	1	1	50,0	50,0	50,0	50,0	50,0	0,03	0,00	0,05	0,03	0,02
17 - Tocantins	2	2	1	1	2	2	100,0	50,0	50,0	100,0	100,0	0,11	0,02	0,01	0,04	0,04
Southeast	**37**	**20**	**15**	**18**	**16**	**11**	**54,1**	**40,5**	**48,6**	**43,2**	**29,7**	**-0,09**	**-0,06**	**0,05**	**-0,03**	**-0,06**
31 - Minas Gerais	12	6	4	8	5	3	50,0	33,3	66,7	41,7	25,0	-0,27	-0,02	0,00	-0,10	-0,05
32 - Espírito Santo	4	4	2	2	2	2	100,0	50,0	50,0	50,0	50,0	0,09	-0,01	0,06	0,05	0,00
33 - Rio de Janeiro	6	3	2	4	4	2	50,0	33,3	66,7	66,7	33,3	0,13	-0,08	0,49	0,18	-0,12
35 - São Paulo	15	7	7	4	5	4	46,7	46,7	26,7	33,3	26,7	-0,08	-0,09	-0,09	-0,08	-0,07
South	**23**	**9**	**16**	**5**	**5**	**8**	**39,1**	**69,6**	**21,7**	**21,7**	**34,8**	**-0,06**	**-0,02**	**-0,24**	**-0,10**	**-0,02**
41 - Paraná	10	4	7	4	4	4	40,0	70,0	40,0	40,0	40,0	0,02	0,05	-0,15	-0,03	0,01
42 - Santa Catarina	6	3	6	1	1	4	50,0	100,0	16,7	16,7	66,7	-0,08	0,10	-0,26	-0,08	0,04
43 - Rio Grande do Sul	7	2	3				28,6	42,9	0,0	0,0	0,0	-0,14	-0,21	-0,36	-0,24	-0,11
TOTAL	**137**	**90**	**83**	**60**	**77**	**82**	**65,7%**	**60,6**	**43,8**	**56,2**	**59,9**					

Source: Brazilian Annual Social Information Survey (RAIS)

Table 7 - List of Twenty Mesoregions with Greater Contribution for Redistribution Coefficient Calculated to Group of Occupations Related to the Knowledge Bases of the SAS Model - 2003 - 2015.

Analytical Base		Synthetic Base		Symbolic Base		Mean of the contribution of the Knowledge Base	
Norte de Roraima	North	Centro Amazonense	North	Norte Maranhense	Northeast	Centro Amazonense	North
Sudeste Paraense	North	Sudeste Paraense	North	Centro-Norte Piauiense	Northeast	Norte de Roraima	North
Nordeste Paraense	North	Norte Maranhense	Northeast	Metropolitana de Fortaleza	Northeast	Sudeste Paraense	North
Oriental do Tocantins	North	Metropolitana de Fortaleza	Northeast	Leste Potiguar	Northeast	Norte Maranhense	Northeast
Norte Maranhense	Northeast	Metropolitana de Recife	Northeast	Metropolitana de Recife	Northeast	Centro-Norte Piauiense	Northeast
Leste Maranhense	Northeast	Centro Norte Baiano	Northeast	Leste Alagoano	Northeast	Metropolitana de Fortaleza	Northeast
Centro-Norte Piauiense	Northeast	Triângulo Mineiro/	Southeast	Metropolitana de Salvador	Northeast	Metropolitana de Recife	Northeast
Norte Cearense	Northeast	Norte Fluminense	Southeast	Sul Baiano	Northeast	Sul Baiano	Northeast
Metropolitana de Recife	Northeast	Macro Metropolitana Paulista	Southeast	Central Espírito-santense	Southeast	Central Espírito-santense	Southeast
Centro Sul Baiano	Northeast	São José do Rio Preto	Southeast	Metropolitana do Rio de Janeiro	Southeast	Metropolitana do Rio de Janeiro	Southeast
Sul Baiano	Northeast	Centro Oriental Paranaense	South	Baixadas	Southeast	Baixadas	Southeast
Norte de Minas	Southeast	Sudoeste Paranaense	South	Norte Fluminense	Southeast	Norte Fluminense	Southeast
Central Espírito-santense	Southeast	Oeste Catarinense	South	Vale do Paraíba Paulista	Southeast	Campinas	Southeast
Metropolitana do Rio de Janeiro	Southeast	Norte Catarinense	South	Oeste Paranaense	South	Vale do Paraíba Paulista	Southeast
Campinas	Southeast	Sudoeste de M.Grosso do Sul	Midwest	Sudoeste Paranaense	South	Oeste Paranaense	South
Macro Metropolitana Paulista	Southeast	Leste de Mato Grosso do Sul	Midwest	Grande Florianópolis	South	Sudoeste Paranaense	South
Metropolitana de Curitiba	South	Norte Mato-grossense	Midwest	Norte Mato-grossense	Midwest	Centro Norte de Mato Grosso do Sul	Midwest
Norte Catarinense	South	Sudeste Mato-grossense	Midwest	Centro Goiano	Midwest	Norte Mato-grossense	Midwest
Centro Norte de Mato Grosso do Sul	Midwest	Centro Goiano	Midwest	Sul Goiano	Midwest	Sul Goiano	Midwest
Distrito Federal	Midwest	Sul Goiano	Midwest	Distrito Federal	Midwest	Distrito Federal	Midwest

Source: Brazilian Annual Social Information Survey (RAIS)

4 - Educational Infrastructure and the Distribution of Employment in Knowledge Bases

In the last decade, public policies in Brazil have been increasingly directed to the reduction of interregional inequalities, associated with to the presence of regions that historically concentrated more wealth and have better social indicators (South and Southeast) while there are other less dynamic regions with highest levels of poverty, most notably the Northeast and North. Within the broad scope of the S,T&I policies formatted to reduce regional inequality, one specific instrument activated was the expansion of technical schools and universities in less favored regions. In this scenario, it is worth asking whether this expansion has, in fact, being effective in terms of the promotion of changes in the knowledge base of less structured regional innovation systems.

Considering the distinction between different "knowledge bases" previously discussed, it is possible to evaluate how the territorial distribution of the employment among those bases would be connected to the territorial distribution of the enrollment in tertiary education in the correspondent knowledge areas. In order to evaluated this connection, the analysis consider data about the territorial distribution of the enrollment in tertiary education provided by the Census of Higher Education for the year 2015 prepared by the Ministry of Education. For each one of the different "knowledge bases", a group of "knowledge areas" related to the enrollment in tertiary education was identified[1]. The analysis also considers the territorial distribution of the enrollment in secondary professional education provided by the Ministry of Education.

Initially, we can compare the territorial concentration of the employment in each one of "knowledge bases" with the territorial concentration of the tertiary education in the correspondent "knowledge areas" and with the secondary professional education for the year 2015. This comparison is illustrated by the Table 8, which presents the HHI territorial concentration index for the employments in "knowledge bases" defined in terms of occupational criteria and for the enrollment in the knowledge areas, calculated for the three different territorial levels: the geo-economic regions, the federative states and the correspondent geographical "mesoregions". The data indicate that the territorial concentration indexes were lower in the case of the Analytical knowledge high education areas compared to the Analytical knowledge base. The indexes seem to be similar when we compare the Synthetic knowledge high education areas to the Synthetic knowledge base. On the other hand, the indexes were higher in the case of the Symbolic knowledge high education areas compared to the Symbolic knowledge base. We can also observe that the indexes calculated for the secondary professional education were expressively lower that those calculated for the different "knowledge bases". Considering these trends, we can suggest that the potential of mobilization of a decentralized educational infrastructure in order to reducing interregional inequalities tend to be higher in the case of the Analytical Base. Furthermore, this potential seems also to be more effective in the case of the secondary professional education

[1] Specifically, the analysis comprises a distinction between groups of enrollment tertiary education in Analytical Areas, Synthetic Areas and Symbolic Areas. In the case of Analytical Areas, the analysis includes tertiary enrollment in a group of Natural sciences and mathematics (Biology and biochemistry, Computer science, Environmental Sciences, Physical sciences, Statistic, Physics, Mathematics and Chemistry) and in a group of Medical Sciences (Nursing, Pharmacy, Pharmacology, Medicine and Odontology). In the case of Synthetic Areas, the analysis includes tertiary enrollment in a group of Engineering Sciences (Electricity and energy, Electronics and automation, Civil and construction engineering, Mechanical engineering, Metallurgy, Manufacturing, Materials, Mining, Food processing. Chemical engineering, Shipbuilding and aeronautics). In the case of Symbolic Areas, the analysis includes tertiary enrollment in a group of Humanities and Arts Sciences (Arts, Craft, Fine Arts, Design, Styling, Philosophy and ethics, History and archeology, Literature, Music and Performing Arts, Religion and theology, Audiovisual and Media).

Table 8- HHI Territorial Concentration Index Calculated to Group of Occupations and to Groups of Enrollment in Tertiary and Secondary Education - Brazilian Geo-economic regions, Federative States and Geographical "Mesoregions" - 2015

	Knowledge Bases (employment)				Knowledge Areas (tertiary and professional education)			
	Occupations – Analytical Base	Occupations - Synthetic Base	Occupations – Symbolic base	Occupations - Total	Higher Education - Analytical Area	Higher Education - Synthetic Area	Higher Education - Symbolic Area	Secondary Professional Education
Regions	32,0%	34,3%	34,0%	34,2%	29,5%	37,2%	37,4%	29,6%
Federative States	10,9%	13,5%	12,9%	12,7%	9,6%	13,5%	14,9%	9,0%
Mesoregions	4,4%	3,7%	4,4%	4,9%	3,7%	4,0%	9,3%	2,8%

Source: Brazilian Annual Social Information Survey (RAIS) and the Census of Higher Education

We can also compare the values of the Location Quotient (QL) calculated both to "knowledge bases" and to the "knowledge high education areas". The Table 9 supports this analysis. In terms of the Analytical knowledge high education areas, the QL index is greater for the Northeast, where this index tend also to be superior to the index calculated for the Analytical knowledge base. In terms of the Synthetic knowledge high education areas, the QL index is greater for the Southeast, where this index tend also to be superior to the index calculated for the Synthetic knowledge base. Concerning the Symbolic knowledge high education areas, the QL index is greater for the South, where this index tend also to be superior to the index calculated for the Symbolic knowledge base. Finally, in terms of the Professional Education, the QL index is also greater for the South and the Northeast, where this index tend also to be superior to the index calculated for the Mean of the different knowledge areas.

Table 9- Location Quotient (QL) Calculated to Group of Occupations and to Areas of Enrollment in Tertiary and Secondary Education - Brazilian Geo-economic regions and Federative States - 2015

	Analytical			Synthetic			Symbolic			Professional Education		
	QL in Higher Education - Analytical Areas (1)	QL Analytical Base (2)	Comparison - Analytical (1)/(2)	Higher Education - Synthetic Areas (3)	QL- Synthetic Base (4)	Comparison Synthetic (3)/(4)	Higher Education - Symbolic Areas (5)	QL- Symbolic Base (6)	Comparison Symbolic (5)/(6)	QL - Professional Education (7)	Mean of QL in Knowledge base (8)	Comparison (7)/(8)
Midwest	**0,98**	**0,95**	**1,03**	**0,83**	**0,76**	**1,09**	**0,59**	**1,01**	**0,58**	**0,83**	**0,91**	**0,91**
50 - Mato Grosso do Sul	0,89	0,97	0,92	0,96	0,87	1,10	0,34	1,09	0,31	1,33	0,98	1,36
51 - Mato Grosso	0,94	0,71	1,32	0,87	0,93	0,94	0,21	1,11	0,19	0,69	0,91	0,76
52 - Goiás	0,93	0,86	1,08	0,89	0,92	0,97	0,63	1,06	0,59	0,66	0,95	0,69
53 - Distrito Federal	1,11	1,19	0,93	0,66	0,42	1,57	0,93	0,85	1,09	0,99	0,82	1,21
Northeast	**1,23**	**1,11**	**1,11**	**0,71**	**0,81**	**0,88**	**0,70**	**0,82**	**0,85**	**1,01**	**0,92**	**1,10**
21 - Maranhão	1,07	1,35	0,79	0,66	0,70	0,94	0,37	0,60	0,62	0,56	0,88	0,64
22 - Piauí	1,25	1,84	0,68	0,36	0,60	0,60	0,51	0,71	0,72	1,73	1,05	1,65
23 - Ceará	1,31	1,02	1,28	0,65	0,99	0,66	0,95	0,91	1,04	1,03	0,97	1,06
24 - Rio Grande do Norte	1,48	0,94	1,57	0,68	0,83	0,82	0,53	0,96	0,55	1,39	0,91	1,53
25 - Paraíba	1,40	1,30	1,08	0,72	0,74	0,97	0,76	0,78	0,97	0,90	0,94	0,96
26 - Pernambuco	1,01	0,99	1,02	0,68	0,82	0,83	0,70	0,82	0,85	1,28	0,87	1,47
27 - Alagoas	1,21	0,96	1,26	0,72	0,65	1,11	0,44	0,71	0,62	0,94	0,77	1,22
28 - Sergipe	1,33	1,17	1,14	0,90	0,83	1,08	0,59	0,78	0,76	0,71	0,93	0,76
29 - Bahia	1,20	1,06	1,13	0,86	0,82	1,05	0,81	0,88	0,92	0,89	0,92	0,97
Nortth	**1,04**	**1,12**	**0,93**	**0,67**	**0,80**	**0,84**	**0,55**	**0,76**	**0,72**	**0,67**	**0,89**	**0,75**
11 - Rondônia	1,31	0,73	1,79	0,53	0,73	0,73	0,06	0,88	0,07	0,77	0,78	0,99
12 - Acre	1,38	1,10	1,25	0,44	0,48	0,92	0,55	0,71	0,77	0,71	0,76	0,93
13 - Amazonas	1,03	1,27	0,81	0,89	1,07	0,83	0,60	0,75	0,80	0,77	1,03	0,75
14 - Roraima	0,87	1,52	0,57	0,25	0,44	0,57	0,60	0,83	0,72	0,84	0,93	0,90
15 - Pará	0,88	0,99	0,89	0,63	0,85	0,74	0,74	0,72	1,03	0,53	0,85	0,62
16 - Amapá	1,10	0,73	1,51	0,50	0,46	1,09	0,87	0,77	1,13	0,88	0,66	1,33
17 - Tocantins	1,08	1,87	0,58	0,75	0,57	1,32	0,12	0,76	0,16	0,82	1,07	0,77
Southeast	**0,94**	**0,99**	**0,95**	**1,19**	**1,03**	**1,16**	**1,18**	**1,04**	**1,13**	**1,03**	**1,02**	**1,01**
31 - Minas Gerais	0,94	0,94	1,00	1,46	1,05	1,39	0,83	0,99	0,84	0,92	1,00	0,92
32 - Espírito Santo	0,89	1,01	0,88	1,23	1,06	1,16	1,09	0,96	1,14	1,50	1,01	1,49
33 - Rio de Janeiro	0,99	1,25	0,79	1,05	0,88	1,19	1,42	1,11	1,28	1,30	1,08	1,20
35 - São Paulo	0,93	0,92	1,01	1,13	1,08	1,05	1,24	1,04	1,19	0,96	1,01	0,95
South	**0,85**	**0,90**	**0,94**	**1,06**	**1,29**	**0,82**	**1,33**	**1,14**	**1,17**	**1,22**	**1,11**	**1,10**

41 - Paraná	0,83	1,01	0,82	1,03	1,20	0,86	1,23	1,10	1,12	1,09	1,10	0,99
42 - Santa Catarina	0,79	0,76	1,04	1,30	1,50	0,87	1,42	1,25	1,14	1,09	1,17	0,93
43 - Rio Grande do Sul	0,91	0,88	1,03	0,97	1,22	0,80	1,38	1,11	1,24	1,45	1,07	1,36

Source: Brazilian Annual Social Information Survey (RAIS) and the Census of Higher Education

We can expand the analysis for the different "mesoregions" of the country. The Table 10 presents the list of the twenty mesoregions with greater value attributed to the QL calculated for the three "knowledge high education areas" related to the tertiary education (Analytical, Synthetic and Symbolic) and to the secondary professional education. Among the 80 mesoregions with a high value of the QL index calculated for those dimensions, 32 was located in the Southeast, 26 in the Northeast, 17 in the South, 3 in the North and 2 in the Midwest. Therefore, these evidences suggest that the effective impact of educational policies based on the expansion of the tertiary education and secondary professional education to the reduction of regional inequalities - reflected in the occupational structure defined by the SAS Model - is still restricted, particularly in the cases of Synthetic and Symbolic knowledge areas.

Table 10 - List of the Twenty Mesoregions with Higher Location Quotient (QL) Calculated to Groups of Enrollment in Tertiary and Secondary Education - 2015.

Analytical high education Knowledge Areas		Synthetic high education Knowledge Areas		Symbolic high education Knowledge Areas		Secondary Professional Education	
Madeira-Guaporé	North	Sertão Sergipano	Northeast	Sudeste Paraense	North	Sudoeste Piauiense	Northeast
Vale do Acre	North	Borborema	Northeast	Agreste Pernambucano	Northeast	Sudeste Piauiense	Northeast
Agreste Potiguar	Northeast	Litoral Norte Espírito-santense	Southeast	Metropolitana de Fortaleza	Northeast	Leste Potiguar	Northeast
Centro-Sul Cearense	Northeast	Vale do Rio Doce	Southeast	Metropolitana de Salvador	Northeast	Metropolitana de Recife	Northeast
Jaguaribe	Northeast	Sul Fluminense	Southeast	Jequitinhonha	Southeast	Centro-Norte Piauiense	Northeast
Sertão Paraibano	Northeast	Vale do Paraíba Paulista	Southeast	Metropolitana de São Paulo	Southeast	Norte Piauiense	Northeast
Leste Potiguar	Northeast	Norte Fluminense	Southeast	Metropolitana do Rio de Janeiro	Southeast	Norte Fluminense	Southeast
Central Potiguar	Northeast	Araraquara	Southeast	Zona da Mata	Southeast	Litoral Norte ES	Southeast
Sul Cearense	Northeast	Macro Metropolitana Paulista	Southeast	Central Espírito-santense	Southeast	Sul Fluminense	Southeast
Mata Paraibana	Northeast	Oeste de Minas	Southeast	Metropode Belo Horizonte	Southeast	Central Espírito-santense	Southeast
Agreste Sergipano	Northeast	Metrop Belo Horizonte	Southeast	Metropolitana de Curitiba	South	Noroeste Fluminense	Southeast
Agreste Paraibano	Northeast	Campinas	Southeast	Grande Florianópolis	South	Sul Espírito-santense	Southeast
Leste Alagoano	Northeast	Piracicaba	Southeast	Vale do Itajaí	South	Baixadas	Southeast
Centro-Norte Piauiense	Northeast	Sul/Sudoeste de Minas	Southeast	Metropolitana de Porto Alegre	South	Sudeste Rio-grandense	South
Noroeste Cearense	Northeast	Araçatuba	Southeast	Nordeste Rio-grandense	South	Metropde Porto Alegre	South
Leste Sergipano	Northeast	Noroeste Fluminense	Southeast	Sudeste Rio-grandense	South	Centro Ocidental RS	South
Oeste Potiguar	Northeast	Norte de Minas	Southeast	Norte Catarinense	South	Centro Oriental Paranaense	South
Jequitinhonha	Southeast	Central Mineira	Southeast	Norte Central Paranaense	South	Norte Catarinense	South
Noroeste Fluminense	Southeast	Norte Catarinense	South	Noroeste Paranaense	South	Pantanais MS	Midwest
Vale do Mucuri	Southeast	Sul Catarinense	South	Centro Ocidental Rio-grandense	South	Centro Norte de MS	Midwest

Source: Census of Higher Education

We can also consider the impact of high education infrastructure to generate qualified people to be absorbed in the productive sector confronting the Location Quotient (QL) calculated to different high education areas with the Location Quotient calculated to different knowledge bases in terms of occupations at the level of the different "mesoregions". If the Location Quotient calculated to different high education areas is higher than the Location Quotient calculated to different knowledge bases, it can be suggested that tertiary education infrastructure has the potential to generate locally qualified personnel in the respective areas to be embraced by the productive sector. Table 11 illustrate this comparison to the mesoregions of the different geo-economic regions, articulating data of different high education areas with data of different knowledge bases. To the Analytical Base this potential tends to be higher (comprising 42,3% of the mesoregions), particularly in the cases of mesoregions located in the Midwest (60,0% of mesoregions) an in the Southeast (51,4% of the mesoregions). In the case of Synthetic Base, this potential is less intense (comprising 42,3% of the mesoregions), being higher to the Southeast (59,5% of the mesoregions). Finally, in the case of the Symbolic Base, this potential is even less intense (comprising 18,2% of the mesoregions), being higher to the South (39,1% of the mesoregions). Also considering theses trends, there are also evidences that the impact of educational policies based on the expansion of the tertiary education to the generation of qualified people able to be absorbed by productive

sector is still restricted in less developed regions of the country, especially in the Northeast and in the North.

Table 11- Comparison Between the Location Quotient (QL) calculated to different high education areas and the Location Quotient calculated to different knowledge bases to different "mesoregions" distributed by Brazilian Geo-economic regions - 2015

	Number of Mesoregions						Distribution of Mesoregions					
	No enrollment in high education areas (A)	Location Quotient (QL) of high education areas / Location Quotient (QL) of different knowledge bases < 1 (B)	1 < Location Quotient (QL) of high education areas / Location Quotient (QL) of different knowledge bases <1, 5 (C)	Location Quotient (QL) of high education areas / Location Quotient (QL) of different knowledge bases > 1,5 (D)	Location Quotient (QL) of high education areas / Location Quotient (QL) of different knowledge bases > 1,0 (C+D)	Total (A+B+C+D)	No enrollment in high education areas (A)	Location Quotient (QL) of high education areas / Location Quotient (QL) of different knowledge bases < 1 (B)	1 < Location Quotient (QL) of high education areas / Location Quotient (QL) of different knowledge bases <1, 5 (C)	Location Quotient (QL) of high education areas / Location Quotient (QL) of different knowledge bases > 1,5 (D)	Location Quotient (QL) of high education areas / Location Quotient (QL) of different knowledge bases > 1,0 (C+D)	Total (A+B+C+D)
Analytical high education areas/ Analytical Knowledge Base												
Midwest		6	9		9	15	0,0%	40,0%	60,0%	0,0%	60,0%	100,0%
Northeast	1	24	14	3	17	42	2,4%	57,1%	33,3%	7,1%	40,5%	100,0%
North		14	4	2	6	20	0,0%	70,0%	20,0%	10,0%	30,0%	100,0%
Southeast		18	17	2	19	37	0,0%	48,6%	45,9%	5,4%	51,4%	100,0%
South		16	7		7	23	0,0%	69,6%	30,4%	0,0%	30,4%	100,0%
TOTAL	**1**	**78**	**51**	**7**	**58**	**137**	**0,7%**	**56,9%**	**37,2%**	**5,1%**	**42,3%**	**100,0%**
Synthetic high education areas/ Synthetic Knowledge Base												
Midwest	2	9	2	2	4	15	13,3%	60,0%	13,3%	13,3%	26,7%	100,0%
Northeast	5	26	7	4	11	42	11,9%	61,9%	16,7%	9,5%	26,2%	100,0%
North	4	11	3	2	5	20	20,0%	55,0%	15,0%	10,0%	25,0%	100,0%
Southeast	1	14	16	6	22	37	2,7%	37,8%	43,2%	16,2%	59,5%	100,0%
South		17	6		6	23	0,0%	73,9%	26,1%	0,0%	26,1%	100,0%
TOTAL	**12**	**77**	**34**	**14**	**48**	**137**	**8,8%**	**56,2%**	**24,8%**	**10,2%**	**35,0%**	**100,0%**
Symbolic high education areas/ Symbolic Knowledge Base												
Midwest	8	6	1		1	15	53,3%	40,0%	6,7%	0,0%	6,7%	100,0%
Northeast	18	18	4	2	6	42	42,9%	42,9%	9,5%	4,8%	14,3%	100,0%
North	9	9	1	1	2	20	45,0%	45,0%	5,0%	5,0%	10,0%	100,0%
Southeast	9	21	4	3	7	37	24,3%	56,8%	10,8%	8,1%	18,9%	100,0%
South	5	9	3	6	9	23	21,7%	39,1%	13,0%	26,1%	39,1%	100,0%
TOTAL	**49**	**63**	**13**	**12**	**25**	**137**	**35,8%**	**46,0%**	**9,5%**	**8,8%**	**18,2%**	**100,0%**

Source: Brazilian Annual Social Information Survey (RAIS) and the Census of Higher Education

Another methodological issue comprises a comparison between indexes of "territorial association" calculated to the territorial distribution of groups of enrollment in tertiary education and to the territorial distribution of groups of occupations related to different knowledge bases. Specifically in the case of tertiary education, a distinction occurred between groups of enrollment in Analytical Areas, Synthetic Areas and Symbolic Areas. These indexes comprise the sum of the modulus of the difference among the share of each territorial unit between the distribution of different groups (occupations and secondary/ tertiary education enrollment). The spatial association is greater the smaller is the value of the index. The Table 12 present these data for three different territorial levels: geo-economic regions, federative states and the geographical "mesoregions". The indexes of "territorial association" between "knowledge areas" of tertiary education and the respective "knowledge bases" of occupations are market in "red". Other indexes of "territorial association" between the categories with expressive ("small") values are marked in "blue".

In the case of the Analytical Knowledge Base, the territorial distribution of occupations is strongly territorially associated with the Analytical "knowledge high education areas" at the level of the Geo-economic Regions. This association also occurs less intensely in the case of the Federative Sates and at the level Geographical "Mesoregions". The Synthetic Knowledge Base is strongly territorially associated with the Synthetic and Symbolic "knowledge high education areas" at the level of the Geo-economic Regions, as well as at the level of the Federative Sates, being also strongly territorially associated with tertiary enrollment in the Synthetic "knowledge high education area" at the level of the Geographical "Mesoregions". The Symbolic Knowledge Base is strongly territorially associated with the Symbolic and Synthetic "knowledge high education areas" at the level of the Geo-economic Regions and Federative Sates, but at the level of Geographical "Mesoregions" this association is high only to the Synthetic "knowledge high education area".

Table 12 - Indexes of "Territorial Association" Between Groups of Enrollment in Tertiary and Secondary Education and Group of Occupations related to Different Knowledge Bases - 2015

Geo-economic Regions (5)			
	Ocup. Analytical Base	Ocup. Synthetic Base	Ocup. Symbolic Base
Enrollment - Higher Education - Analytical Area	14,7%	32,7%	28,3%
Enrollment - Higher Education - Synthetic Area	15,2%	11,9%	9,3%
Enrollment - Higher Education - Symbolic Area	22,0%	7,7%	8,5%
Federative States (27)			
	Ocup. Analytical Base	Ocup. Synthetic Base	Ocup. Symbolic Base
Enrollment - Higher Education - Analytical Area	16,9%	33,5%	29,4%
Enrollment - Higher Education - Synthetic Area	24,2%	17,9%	15,9%
Enrollment - Higher Education - Symbolic Area	24,4%	19,1%	16,5%
Geographical Mesoregions (137)			
	Ocup. Analytical Base	Ocup. Synthetic Base	Ocup. Symbolic Base
Enrollment - Higher Education - Analytical Area	27,4%	44,0%	37,5%
Enrollment - Higher Education - Synthetic Area	34,0%	30,7%	30,8%
Enrollment - Higher Education - Symbolic Area	52,3%	61,1%	53,2%

Source: Brazilian Annual Social Information Survey (RAIS) and the Census of Higher Education

5 - Concluding Remarks

In the last decade, Brazil has tried to establish a comprehensive policy to reduce social and territorial inequalities. At the territorial level, these inequalities reflect the presence of regions that historically concentrated more wealth and have better social indicators (South and Southeast) while there are other less dynamic regions with highest levels of poverty, most notably the Northeast and the North. Public policies have tried to stimulated the growth of the employment in less development regions, in order to that accelerate the reduction of regional inequalities. The analysis carried in the study pointed the evolution of the of employments among different "knowledge bases" defined according to the SAS Model, conceived as a relevant aspect of the structure of Regional Innovation Systems (RIS). Concerning the main trends captured by the analysis, we observed that, between 2003 and 2015, there are evidences of a territorial de-concentration, particularly to the occupations related to the Analytical knowledge base. Concerning the evolution of a "Redistribution Coefficient", we observed high values for the Analytical and Symbolic bases, followed by a small value for the Synthetic base and by an even lower value for the Total Employment. Apparently, this redistribution has benefited the Northeast and the North regions, with the contribution of these regions being higher when we compare the different "knowledge bases" and their contribution to the "Redistribution Coefficient" of the Total Employment. The contribution of the Northeast tend to be higher for the Analytical and Symbolic bases, while the contribution of the Midwest is higher to the Symbolic and Analytical bases and the contribution of the North it is higher to the Analytical base.

Considering these trends, it is possible to suggest that there is an ongoing process of territorial de-concentration, based on the distinction between three "knowledge bases" proposed by the SAS Model. The analysis also suggests that the potential of a regional decentralization of competences promoted by the growth of the Educational Infrastructure in the direction of the "knowledge high education areas" articulated to the "knowledge bases" mentioned by the SAS Model is only partial, with the more developed regions remaining specialized in knowledge high education areas related to Synthetic and Symbolic areas. The evidences collected suggest that the potential of mobilization of a decentralized educational infrastructure in order to reduce interregional inequalities tend to be higher in the case of the Analytical Base. Furthermore, this potential seems also to be more effective in the case of the secondary professional education. In this sense, an evaluation of the recent Brazilian experience indicates that the impact of educational policies based on the expansion of the tertiary education to the reduction of regional inequalities - reflected in the occupational structure defined by the SAS Model - should be improved. To reduce these imbalances, the strengthening of territorial nucleons of institutions related to

the S&T infrastructure seem to be very important, reinforcing the relevance of comprehensive policies well-adapted to very diverse local realities. In this sense, a critical aim to the policies would be the improvement of the professional qualification of the workers, in order to amplify the possibilities of productive inclusion of the population. There is also a potential to spread the growth of skills and competences in creative activities strengthening the regional decentralization of the S&T infrastructure in those areas.

Bibliography

ALCOUFFE, A.; KEPHALIACOS, C. (1998) Regional innovation systems and global markets: the Midi-Pyrénées benchmark. In.: Braczyk, H. et al. (eds.) Regional Innovation Systems: the role of governances in a globalized world. UCL Press: Londres.

ARANCEGUI, M. N. (2009) Los sistemas regionales de innovación. Una revisión crítica. Ekonomiaz, a. 1, v. 70, País Basco, Espanha.

ARCHIBUGI, D.and LUNDVALL, B.-A eds." The Globalising Learning Economy. Oxford: Oxford University Press. 2001

ASHEIM, B. & HANSEN, H. (2009) Knowledge bases, talents, and contexts: On the usefulness of the creative class approach in Sweden, Economic Geography, 85(4), pp. 425–442.

ASHEIM, B. T., COENEN, L., and HENNING, M. (2003). Nordic SMEs and regional innovation systems. Department of Social and Economic Geography Lund University.

ASHEIM, B.T (2005b) Contextualising Regional Innovation systems in a Globalising Learning Economy: On Knowledge Bases and Institutional Frameworks. The Journal of Technology Transfer, v. 31, pp: 163-173.

ASHEIM, B.T.; BOSCHMA, R.; COOKE, P. (2011) Constructing regional advantage: Platform policies based on related variety and differentiated knowledge bases. *Regional Studies*, Taylor & Francis Journals, vol. 45, nº 7, pp. 893-904. Disponível em: < http:// econ.geo.uu.nl/boschma/artashboscooke2.pdf >

ASHEIM, B.T.; COENEN, L.(2005) Knowledge bases and regional innovation systems: Comparing Nordic clusters. Research Policy, v. 34, pp: 1173-1190.

ASHEIM, B.T.; COENEN, L.; VANG, J. (2007) Face-to-face, buzz, and knowledge bases: socioespatial implications for learning, innovation and innovation policy. Environment and Planning C: Government and Policy 25: 622-670.

ASHEIM, B.T.; GERTLER, M.S. (2005) The Geography of Innovation: Regional Innovation Systems. In: Fagerberg, J.; et al (eds). The Oxford Handbook of Innovation. Oxford: Oxford University Press, 291-317.

ASHEIM, B.T.; HANSEN (2009) Knowledge Bases, Talents and Contexts: On the Usefulness of the Creative Class Approach in Sweden. Economic Geography, vol. 85, nº 4, pp. 425-442.

ASHEIM, B.T.; ISAKSEN, A. (2002) Regional Innovation Systems: The Integration of Local 'Sticky' and Global 'Ubiquitous' Knowledge. Journal of Technology Transfer, v.27, pp. 77-86.

AUDRETSCH, D. B.; FELDMAM, M. P. Knowledge spillover and the geography of innovation. In: HENDERSON, Vernon; THISSE, Jaques-François (Ed.). Handbook of urban and regional economics. Amsterdam: Elsevier, v. 4, cap. 3. 2004

BATHELT, H.; MALMBERG, A. Y MASKELL, P. Cluster and knowledge: local buzz, global pipelines and the process of knowledge creation, Progress in Human Geography, 28 (1): 31-56, 2003.

BELL, M. and ALBU, M. "Knowledge Systems and Technological Dynamism in Industrial Clusters in Developing Countries" World Development Vol. 27, No. 9, pp. 1715-1734, 1999

BRACZYK, H.; COOKE, P.; HEIDENREICH, M. eds. (1998) Regional Innovation Systems: the role of governances in a globalized world. UCL Press: London, 1998.

CASSIOLATO, J. E.; LASTRES, H. M. M. (2005) Sistemas de inovação e desenvolvimento: as implicações de política. Revista São Paulo em Perspectiva.v19 nº1 p 34-45. São Paulo 2005

CASSIOLATO, J. E.; LASTRES, H. M. M. (2008). "Discussing innovation and development: converging points between the Latin American school and the innovation Systems perspective?" GlOBELICS 2008

CASSIOLATO, J.E.; MATOS, M.P.; LASTRES, H. e MARCELLINO, I. (2012) Innovation Systems and Development: the use of IS framework along the first ten years of the Globelics conference. 11st Globelics Conference, Hangzou, China.

CHAMINADE, C. and EDQUIST, C. (2010) Rationales for Public Policy Intervention in the Innovation Process: A Systems of Innovation Approach. In: S. Kuhlmann, P. Shapira & R. Smits eds. Innovation Policy Theory and Practice. Edward Elgar, Cheltenham, UK, pp. 83–97.

CHAMINADE, C. and EDQUIST, C. (2006) From theory to practice. The use of the systems of innovation approach in innovation policy, in Hage, J. and Meeus, M. (eds.), Innovation, Science and Institutional Change. A Research Handbook, Oxford University Press, 17pp.

CHRISTOPHERSON, S. MICHIE, J.; TYLER, P. "Regional resilience: theoretical and empirical perspectives", Cambridge Journal of Regions, Economy and Society, 3, 3–2, 2010

CLARK, J.; HUANG, H.I. and WALSH, J.P. . "A Typology of Innovation Districts: What it Means for Regional Resilience" Cambridge Journal of Regions, Economy and Society 3.1: 121-137. 2010

COOKE, P. (1998) Regional Innovation Systems: origin of the species. International Journal of Technological Learning, Innovation and Development. 1(3), 393-409.

COOKE, P. (1992) Regional innovation systems: competitive regulation in the new Europe. GeoForum, v.23: 365-382.

COOKE, P. (2001) Regional innovation systems, clusters, and the knowledge economy. Industrial and Corporate Change, a. 10, v. 4: 945-974.

COOKE, P. Regional innovation systems, clusters, and the knowledge economy, Industrial and Corporate Change, 10(4): 945-974, 2001

COOKE, P.. (2008) Introduction: origins of the concept. In.: Braczyk, H. et al. (eds.) Regional Innovation Systems: the role of governances in a globalized world. UCL Press: Londres.

COOKE, P.; MORGAN, K. The associational economy : firms, regions, and innovation. Oxford [Inglaterra]; New York: Oxford University Press. 1998

COOKE, P.; URANGA, M.; ETXEBARRIA, G. (1997) Regional Innovation Systems: Institutional and Organizational Dimensions. Research Policy, 26, 475–491.

D'ALLURA, G., GALVAGNO, M., and DESTRI, A. (2012). Regional Innovation Systems: A Literature Review. Business Systems Review, 1(1), 139–156.

D'ALLURA, G.; GALVANO, M.; LI DESTRI, A.(2012) Regional Innovation Systems: A Literature Review. Business Systems Review. N. 1. Vol. 1.

DE LA MOTHE, J.; PAQUET, G. Local and regional systems of innovation. Economics of science, technology, and innovation ; v. 14., Boston, Mass.: Kluwer Academic Publishers. 1998

DOLOREUX, D. (2002) 'What we should know about regional systems of innovation', Technology in Society, 24: 243–63.

DOLOREUX, D. (2002) What we shoud know about regional systems of innovation?. Technology and Society. V.24: 243-263.

DOLOREUX, D.; BITARD, P.; HOMMEN, L. (2004) Identifying Regional Innovation Systems in a Globalising Economy: A Plead for an Integrated View. II Globelics Conference, 2004. Beijing, China.

DOLOREUX, D.; PARTO, S. (2004) Regional Innovation Systems: A critical synthesis. United Nations University, Institute for New Technologies, Discussion Paper Series 17,

DYER, J. H. and SINGH, H. (1998). The relational view: cooperative strategy and sources of interorganizational competitive advantage. Academy of Management Review, 23(4), 660-679.

EDQUIST, C, Systems of Innovation – A Critical Review of The State of the Art. In J. Fagerberg, D. Mowery and R. Nelson Handbook of Innovation . Oxford: OxfordUniversity Press, 2004

EDQUIST, C. (1997) Systems of Innovation Technologies, Institutions and Organisations. Pinter, London, UK.

EDQUIST, C. and JOHNSON, B. (1997). "Institutions and organizations in systems of innovation", in Edquist, C. (ed.), Systems of innovation: Technologies, institutions and organizations. Pinter/Cassell Academic, London and Washington.

FLORIDA, R. (2002) The Rise of the creative class. Nova Iorque: Basic Books.

FLORIDA, R. (2005). Cities and the Creative Class. New York, NY: Routledge.

FLORIDA, R. (2006). The Flight of the Creative Class: The New Global Competition for Talent. New York, NY: Harper Business.

FOSS, N. "The Use of Knowledge in Firms", Journal of Institutional and Theoretical Economics 155(3), pp458-486, 1999

FREEMAN, C. (1995) 'The national system of innovation in historical perspective', Cambridge Journal of Economics, 19: 5–24.

GEORGHIOU, L. (2006) Innovation, Learning and Macro-Institutional Change: the limits of the market model as an organizing principle for research systems. In Innovation, Science, and Industrial Change: A research handbook, ed. Hage J and Meeus M, Oxford University Press.

GERTLER, M. (2008) Buzz without being there? Communities of practices in context, in: A. Amin& J. Roberts (Eds) Community, Economic Creativity and Organization, pp. 203–226 (Oxford: Oxford University Press).

GERTLER, M.; WOLFE, D.; GARKUT, D. (2000) No place like home? The embeddedness of innovation in a regional economy. Review of International Political Economy. 7(4). pp. 688-718.

HOLBROOK, A. ; SALAZAR, M. (2003) Regional Innovation Systems Within a Federation: Do National Policies Affect All Regions Equally. In: Knowledge and economics and social change: New challanges to innovation studies. Conference, Manchester, Inglaterra.

HOWELLS, J. Regional systems of innovation? In: Archibugi, D., et al. (Eds.), Innovation Policy in a Global Economy. Cambridge University Press, pp. 67–93. 1999

HOWKINS, J. (2001) The Creative Economy: how people make money from ideas. Penguin.

JOHNSON, B. (1992) Institutional Learning. in B. Lundvall (ed.), National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning. Pinter: London, pp. 23–44.

JOHNSON, B. and LUNDVALL, B."The Learning Economy", Journal of Industry Studies, Vol.1, no 2, 23-42. December, 1994

JOHNSON, B., EDQUIST, C., and LUNDVALL, B. - A. (2003). Economic Development and the National System of Innovation Approach. In First Globelics Conference. Rio de Janeiro.

JOHNSON, B.; LORENZ, E.; LUNDVALL, B. (2002) Why all this fuss about codified and tacit knowledge? Industrial and Corporate Change, vol. 11, nº 2, pp. 245-262.

KLEIN-WOOLTHUIS, R., LANKHUIZEN, M. and GILSING, V. (2005) 'A system failure framework for innovation policy design', Technovation, vol.25, pp.609-619.

LARANJA, M., URRAYA, E., FLANAGAN, K. (2008) Policies for science, technology and innovation: translating rationales into regional policies in a multi-level setting. Research Policy, Elsevier, vol 37, n. 5, pp. 823-835, Junho.

LUNDVALL, B. (2006) Knowledge Management in the Learning Economy. DRUID working paper, nº 06-6, Danish Research Unit for Industrial Dynamics, Dinamarca. Disponível em: < http://www.druid.dk/uploads/tx_picturedb/wp06-06.pdf >.

LUNDVALL, B. (Ed.) (1992) National Innovation Systems: Towards a Theory of Innovation and Interactive Learning. London: Pinter Publishers.

LUNDVALL, B., NIELSEN, P. (2012) Knowledge Management in the Learning Economy. 8th Globelics Academy Conference. Rio de Janeiro, Brasil. Disponível em: < http://www.redesist.ie.ufrj.br/ga2012/textos/Lundvall/Lecture%203_Knowledge%20management%20for%20PTF.pdf >.

LUNDVALL, B.. (2004) The Economics of Knowledge and Learning. In Christensen, J. L.; _____. (ed.) Product Inovation, Interactive Learning and Economic Performance (Research on Technological Innovation, Management and Policy, Volume 8), Emerald Group Publishing Limited, pp.21-42. Disponível em: < https://smartech. gatech.edu/bitstream/handle/1853/43152/BengtAkeLundvall_1.pdf >.

LUNDVALL, B.; JOHNSON, B.; ANDERSEN, E.S.; DALUM, B. (2001) National Systems of Production Innovation and Competence Building. Department of Business Studies, Aalborg University, Dinamarca.

LUNDVALL, B.; JOHNSON,B. (1994) The Learning Economy. Journal of Industry Studies, vol. 1, nº 2, pp. 23-42. Disponível em: < http://www.tandfonline.com/doi/abs/ 10.1080/.U4I4mdJDvIc >.

MANNICHE, J. & TESTA, S. (2010) Knowledge bases in worlds of production: The case of the food industry, *Industry and Innovation*, 17(3), pp. 263–284

MANNICHE, J. (2012) "Combinatorial Knowledge Dynamics: On the Usefulness of the Differentiated Knowledge Bases Model, *European Planning Studies* Vol. 20, No. 11, November 2012

MARTIN, R. (2012a) Measuring the knowledge base of regional innovtion systems in Sweden. Lund: CIRCLE Eletronic working paper series, Lund University, Suécia. Disponível em: < http://www4.lu.se/upload/CIRCLE/workingpapers/201203_Martin. pdf >.

MARTIN, R.. (2012b). Knowledge Bases and the Geography of Innovation. PhD. Thesis at the Meddelanden Fran Institutionen för Kulturgeografi och Ekonomisk Geografi Avhandlingar V, Lund University.

NIOSI, J. (2005) Canada's Regional Innovation System: The Science-Based Industries. Montreau, Canada. McGill-Queen's University Press.

RODRIK, D. (2010), 'Diagnostics before prescription', The Journal of Economic Perspectives, 24(3), 33–44.

SMITH, K., (2000) 'Innovation as a systemic phenomenon: Rethinking the role of policy, enterprise & innovation.' Management Studies, vol 1, pp. 73–102.

SMITS, R. and KUHLMANN, S. (2004), 'The rise of systemic instruments in innovation policy', International Journal of Foresight and Innovation Policy, 1(1/2), 4.

STORPER, M. (1997) The Regional World. Territorial Development in a Global Economy. Londres: The Guilford Press.

STORPER, M. The Regional World. Territorial Development in a Global Economy. Londres: The Guilford Press. 1997

TÖDTLING, F. ; TRIPPL, M. (2005) One size fits all? Towards a differentiated regional innovation policy approach, Research Policy, 34: 1203-1219.

URRAYA, E. (2008) What is evolutionary about regional systems of innovation¿ Implications for regional policy. Manchester Business School. Working paper nº 565. University of Manchester, Manchester, Inglaterra.

VAN MIERLO, B., LEEUWIS, C., SMITS, R. and KLEIN-WOOLTHUIS, R. (2010) 'Learning towards system innovation: Evaluating a system instrument', Technological Forecasting & Social Chang, vol.77, no. 2, pp. 318-334

VOSS, J.-P., SMITH, A. and GRIN, J. (2009) 'Designing long-term policy: rethinking transition management', Policy Sciences, 43: 275–302.

WOOLTHUIS, R. K., LANKHUIZEN, M., GILSING, V. (2005). A system failure framework for innovation policy design. – Technovation, Vol. 25, pp. 609-619

Annex – List of Occupation Selected in Different Knowledge Bases

Analytical
201 - PROFESSIONALS OF BIOTECHNOLOGY AND METROLOGY;
203 - RESEARCHERS;
211 - MATHEMATICAL, STATISTICAL AND RELATED;
212 - COMPUTER PROFESSIONALS;
213 - PHYSICAL, CHEMICAL AND RELATED;
221 - BIOLOGISTS AND AFFECTS;
222 - AGRONOMISTS AND SIMILARS;
223 - PROFESSIONALS OF MEDICINE, HEALTH AND SAFETY;
224 - PHYSICAL EDUCATION PROFESSIONALS
225 - PROFESSIONALS OF MEDICINE;
231 - TEACHERS OF HIGHER LEVEL IN CHILDREN'S EDUCATION AND FUNDAMENTAL EDUCATION
234 - TEACHERS OF HIGHER EDUCATION
251 - SOCIAL SCIENTISTS, PSYCHOLOGISTS AND AFFILIATES
320 - TECHNIQUES IN BIOLOGY;
322 - TECHNIQUES OF HUMAN HEALTH SCIENCE;
323 - ANIMAL HEALTH SCIENCE TECHNICIANS
325 - BIOCHEMISTRY AND BIOTECHNOLOGY TECHNIQUES;
395 - RESEARCH AND DEVELOPMENT SUPPORT TECHNICIANS
Synthetic
202 - ELETROMECHANIC PROFESSIONALS;
214 - ENGINEERS, ARCHITECTS AND AFFILIATES;
300 - MECHATRONIC AND ELECTROMECHANICAL TECHNICIANS;
301 - LABORATORY TECHNICIANS
311 - PHYSICAL AND CHEMICAL SCIENCES;
312 - CIVIL CONSTRUCTION, BUILDING AND INFRASTRUCTURE WORKS
313 - ELECTRONIC AND PHOTONIC TECHNICIANS;
314 - METALMECHANICAL TECHNICIANS;
316 - MINERALOGY AND GEOLOGY TECHNICIANS
317 - COMPUTER TECHNICIANS;
319 - OTHER TECHNICIANS OF MEDIUM LEVEL OF PHYSICAL, CHEMICAL, ENGINEERING AND AFFECTIVE SCIENCES
341 - TECHNICIANS IN AERIAL, MARITIME AND FLUVIAL NAVIGATION;
342 - TRANSPORTATION TECHNICIANS (LOGISTICS)
391 - MEDIUM LEVEL TECHNICIANS IN INDUSTRIAL OPERATIONS
710 - SUPERVISORS OF MINERAL EXTRACTION AND CIVIL CONSTRUCTION
711 - MINERAL EXTRACTION WORKERS
712 - MINING AND ORNAMENTAL WORKERS BENEFITING WORKERS
723 - THERMAL TREATMENT AND SURFACE WORKERS OF METALS AND COMPOSITES
724 - TUBULATION, METALLIC AND COMPOSITE STRUCTURES WORKERS
725 - MOUNTING MACHINES AND MECHANICAL APPLIANCES
730 - SUPERVISORS OF ELECTRICAL AND ELECTRONIC INSTALLATIONS AND INSTALLATIONS
731 - BUILDERS AND INSTALLERS OF ELETROELETRONIC EQUIPMENT IN GENERAL
741 - ASSEMBLIES AND ADJUSTERS OF PRECISION INSTRUMENTS
760 - SUPERVISORS IN THE TEXTILE, DRESSING, CLOTHING AND GRAPHIC INDUSTRY
761 - TEXTILE INDUSTRY WORKERS
762 - LEATHER AND SKIN CARE WORKERS
763 - CLOTHING WORKERS
764 - WORKERS OF THE CONFECTION OF CALCADOS
765 - WORKERS OF THE CONFECTION OF FABRIC AND LEATHER ARTS
770 - SUPERVISORS IN WOOD, FURNITURE AND VEHICLE CARPENTRY
772 - WORKERS OF THE PREPARATION OF MADEIRA
773 - WORKERS OF THE TRANSFORMATION OF WOOD AND FURNITURE MANUFACTURING
775 - WORKERS IN WOOD AND FURNITURE FINISHING
781 - ROBOT OPERATORS AND SPECIAL EQUIPMENT;
782 - VEHICLE DRIVERS AND LIFTING EQUIPMENT OPERATORS AND MOVING
783 - HANDLING WORKERS ON TRACKS AND MOVEMENT AND LOADS
784 - PACKAGING AND PRODUCTION FEEDERS
810 - PRODUCTION SUPERVISORS, IN CHEMICAL, PETROCHEMICAL AND AFFLIC INDUSTRIES;
811 - OPERATORS OF INSTALLATIONS IN CHEMICAL, PETROCHEMICAL AND AFFAIR INDUSTRIES
812 - WORKERS OF THE MUNICIPAL AND CHEMICAL EXPLOSIVES MANUFACTURING
813 - OPERATORS OF OTHER CHEMICAL, PETROCHEMICAL AND RELATED INSTALLATIONS
818 - LABORATORY UNIT OPERATING OPERATORS (TRANSVERSAL FOR ANY INDUSTRY OF PR
820 - PRODUCTION SUPERVISORS IN SIDERURGICAL INDUSTRIES
821 - OPERATORS OF INSTALLATIONS AND EQUIPMENT FOR PRODUCTION OF METALS AND ALLOYS - FIRST FUSE
822 - OPERATORS OF INSTALLATIONS AND EQUIPMENT FOR PRODUCTION OF METALS AND ALLOYS - SECOND FUSEO
823 - WORKERS OF INSTALLATIONS AND EQUIPMENT OF CONSTRUCTION MATERIAL, CERAMICS AND VID
830 - SUPERVISORS OF CELLULOSE AND PAPER MANUFACTURING
831 - PAPER PULP PREPARATION WORKERS
832 - PAPER MANUFACTURING WORKERS
833 - CONTAINERS FOR PAPER AND PAPER PRODUCTS
840 - SUPERVISORS OF FOOD, BEVERAGE AND SMOKE MANUFACTURING
841 - EQUIPMENT OPERATORS IN FOOD AND BEVERAGE PREPARATION
842 - OPERATORS IN SMOKE PREPARATION AND IN THE MANUFACTURE OF CIGARS AND CIGARETTES
860 - SUPERVISORS OF THE PRODUCTION OF UTILITIES
861 - OPERATORS IN THE GENERATION AND DISTRIBUTION OF ENERGY (HYDROELECTRIC POWER PLANTS, THERMELETRY
862 - UTILITIES OPERATORS
910 - SUPERVISORS IN MECHANICAL REPAIR AND MAINTENANCE SERVICES
911 - MECHANICS FOR MAINTENANCE OF INDUSTRIAL, COMMERCIAL AND RESIDENCIAL MACHINES AND EQUIPMENT
913 - MAINTENANCE MECHANICS OF HEAVY MACHINES AND AGRICULTURAL EQUIPMENT
915 - REPAIRING INSTRUMENTS AND PRECISION EQUIPMENT
950 - ELETROELETRONIC AND ELECTROMECHANIC MAINTENANCE SUPERVISORS
951 - ELECTRONIC ELECTRONICS OF INDUSTRIAL, COMMERCIAL AND RESIDENTIAL MAINTENANCE
954 - ELECTROMECHANICAL MAINTENANCE
991 - OTHER CONSERVATION AND MAINTENANCE WORKERS (EXCEPT ELEMENTARY WORKERS)
Symbolic
261 - COMMUNICATION AND INFORMATION PROFESSIONALS;
262 - PROFESSIONALS OF SPECTACLES AND ARTS;
271 - PROFESSIONALS IN GASTRONOMY AND FOOD SERVICES
318 - TECHNICAL AND MODELIST DESIGNS
371 - CULTURAL SERVICE TECHNICIANS
372 - TECHNICIANS IN PHOTOGRAPHIC CAMERA, CINEMA AND TELEVISION OPERATIONS
373 - OPERATING TECHNICIANS OF RADIO ISSUERS, TELEVISION SYSTEMS AND PRODUCERS OF
374 - TECHNICAL OPERATIONS OF SOUND, CENOGRAPHY AND PROJECTING APPLIANCES
375 - DECORATORS AND WINDOWS;
376 - ARTISTS OF POPULAR ARTS AND MODELS;
377 - ATHLETES, SPORTS AND AFFILIATES;
513 - WORKERS FOR HOTEL AND FOOD SERVICE
516 - WORKERS IN SLEEPING AND PERSONAL CARE SERVICES
740 - SUPERVISORS OF PRECISION MECHANICS AND MUSICAL INSTRUMENTS
742 - MOUNTING AND ADJUSTERS OF MUSICAL INSTRUMENTS
750 - SUPERVISORS OF JEWELRY, GLASS, CERAMICS AND AFINS
751 - JEWELERS AND GOLDEN JEWELERS;
752 - GLASSWARE, CERAMICS AND AFFILIATES
766 - GRAPHIC PRODUCTION WORKERS;
768 - ARTISAN WORKERS OF TEXTILE, CLOTHING AND GRAPHIC ACTIVITIES;

771 - MARCENEIROS A AFINS
776 - ARTISAN WORKERS OF WOOD AND FURNITURE;
791 - URBAN AND RURAL CRAFT WORKERS;
828 - ARTISAN WORKERS OF SIDERURGY AND CONSTRUCTION MATERIALS
848 - HANDICRAFT WORKERS IN AGROINDUSTRY, FOOD AND SMOKE INDUSTRY

Source: Brazilian Classification of Occupations (CBO)