Local Production and Innovation Systems in Brazil: A Balance of 20 years

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1 - Introduction

In a contribution to the launching of Globelics (Lastres and Cassiolato 2003) we explored the main reasons for establishing and participating in such a global research network, highlighting the development perspective. That paper took up the discussion on the need and usefulness of the concept of system of innovation, focusing particularly the case of Latin American countries and Brazil. We also argued, that the transformations of the world economic system – in particular the acceleration of financial globalization, social inequality and the uneven diffusion of new technologies were challenging traditional approaches that are developed to deal with different contexts and urging the development of new concepts, theories and instrument.

The lack of a better understanding of the nature of the present transformations has given space for a number of contradictory interpretations. In particular, the perception that besides the globalization trends and their companions, such as the uneven spread of the benefits of the ICT revolution, the transformations of the world economy were paradoxically been accompanied by localization forces, have led, in the 1990s to the setting up and use of a variety of conceptual approaches aiming at analyzing the new forms of organizing economic activities and relationships among firms and other organizations at local level. Most of these have focused on group of agents and their interactions, recognized as an important source of economic growth. Different concepts were revisited and developed. Examples include the focus on industrial districts, clusters, *milieu innovateur*, as well as on system of innovation - SI. All these approaches have stressed the importance of the spatial dimension, proximity and interactions among firms to explain the specificities of their performance under globalization.

In 1997, a research network, RedeSist (Research Network on Local Innovation and Production Systems) was formally set up at UFRJ, in Brazil, aiming at investigating and understanding local processes of learning and capability accumulation, as well as putting forward propositions for their mobilization At the top of the research agenda was the analysis of how the changes brought by globalization were affecting the evolution trajectory of local Brazilian productive systems; and how these systems were managing to survive and eventually

develop in increasingly complex global and national environments.

One of the first accomplishments of the research network was the formulation of a conceptual and methodological framework capable of dealing with the specificities associated to local production and innovation. The concept of Local Production and Innovation Systems (or LIPS) has been widely used both by the network researchers and other scholars in Brazil and different parts of the world. Also, since the beginning of the millennium it has been formally adopted by Brazilian policy makers, at federal, state and local levels, to design and implement decentralized industrial and innovation policies.[1]

A recent comprehensive survey of the literature on local production and innovation (Torre and Zimmermann 2015) has singled out the LIPS approach developed by RedeSist as "one of the most relevant analytical proposals developed for understanding the phenomena of production development and which has had a remarkable success in both academic literature and in public policy" (p. 25). In an analysis of Latin American industrial policies, Peres (2011) pointed out that LIPS based policy in Brazil is "the main news and the most relevant industrial policy initiative in Latin America in recent decades" (Peres 2011, p. 3). Mazzucato and Penna (2016, p. 71) also singled out its importance as "those productive structures that have been left out of major… programs are targeted through the LIPS policy" and, as they concentrate on "activities, which tend to be more dispersed throughout the national territory, including less dynamic regions" they constitute a starting point for promoting the decentralization of production".

The paper reviews some of the most important achievements both in analytical and normative terms revealed by the set of studies undergone by RedeSist scholars and is organized as follows. Item 2 will briefly present the main different conceptual frameworks that have been used to analyze transformations of productive activities at local level. It does not intend to comprehensively cover this growing body of academic literature that has acquired the attention of both academics and policy makers, but just to stress the reasons that, in our opinion, stimulate a search for an alternative using the systems of innovation (SI) perspective. Item 3 will explain RedeSist's focusing device of LIPS, a combination of the SI framework with the contributions of the Latin American Structuralist school (LASA), and the main methodological tools we devised in attempt to better capture collective local processes of learning and capacity building taking into account other processes that occur at different layers; regional, national and global. Item 4 will summarize some of the most important achievements of this endeavor and the conclusion will speculate on the challenges faced by Brazilian

[1] Lastres and Cassiolato (2005) and Cassiolato et al. (2014) give a detailed account of RedeSist's framework. For its policy utilization see Cassiolato, Lastres and Lastres (2003) and Cassiolato and Lastres (2005).

production structures given our own learning and taking into account the profound political, economic and social changes that are occurring in Brazil since the overthrown in 2016 of the legitimate elected government of President Rousseff by a parliamentary *coup d'etat*.

2 – Trying to understand the local dynamics of production and innovation transformations: a brief review of the conceptual debate

The diffusion of information technologies has provided the technical means for articulating organizations, individuals and geographically distant entities in real time. With the acceleration of globalization, however, contrary to a global homogeneous world without frontiers, there is in fact a deepening of differences between the countries and regions of the planet, to the detriment of those on the periphery of the global power system. While there is acceleration in some dimensions of the globalization process, there is also a reassessment of the spatial dimension, and particularly of local space, as the importance of differentiation between places is emphasized. Dialectically, globalization unfolds in parallel with localization.

The recognition of the importance of the territorial dimension of globalization ignited a renewal of academic interest about local processes of economic and social transformation. In other works we give a more detailed account of such discussion.[2] Here we just stress some specificities of the conceptual frameworks that arguably have been more influential in analytical and normative terms.

In the area of economic geography it is worth mentioning:

(i) the pioneering work on Italian agglomerations based on the Marshallian notion of industrial district (Becatini 1990, Brusco 1990) that emphasizes the role of external economies (scale economies external to the firm but internal to the 'district') and industrial atmosphere (conventions, rules, etc.);

(ii) the Californian School (Lawson, 1997, Markusen 1996, Storper, 1989, Pyke and Sengerberger 1992) that stresses the role of institutions and considers the region as a nexus of traded, (aiming at reducing transactions costs), and untraded (including technological spillovers and conventions to develop, communicate and interpret knowledge) interdependences

In France, the concept of milieu innovateur (Camagni, 1991), which attempts to unbundle the conditions under which the environment stimulates innovation activities by local firms and the notion of 'systèmes productifs locaux', which also

[2] For a more detailed conceptual discussion see (Lastres and Cassiolato 2005). See also Cassiolato and Lastres, 1999 and 2000. Lopez and Lugones, 1999, provide a similar evaluation from a Latin American perspective. For a critique of some of these theoretical frameworks, particularly the cluster approach see Martin and Sunley (2003)

departs from the Marshallian concept while emphasizing territorial development (Courlet, 2000) have been extremely influential both in the academy and in policy circles.[3]

But arguably it was the "cluster" literature that has attracted more attention, especially in policy circles. The recognition in the business literature (Porter, 1998) that competitive advantages in the global economy derive also from a constellation of local factors sustaining the success of leading firms led to the analysis of how proximity and clustering, not only of suppliers firms but also competitors, constitute factors triggering local dynamism.[4]

It is necessary to recognize that, together with the IS perspective, all these approaches have stressed the importance of the spatial dimension, proximity and some sort of interactions among firms to explain their successful performance and competitiveness. Elsewhere (Lastres and Cassiolato, 2005) we argued that, even though some other points of - at least partial - convergence can be found[5], notable differentiations between all these approaches and the SI perspective remain.

Among these differences it is possible to single out the specific connotations of key central tenets of each theoretical approach, such as development and innovation.[6] Besides these differences in the weight and in the understanding of their main elements, a main distinction between the SI perspective and the approaches that stress the notion of agglomerations persist, deriving from their conceptual basis.

Most important is that using the SI frame of reference, by definition, implies focusing on all types of production and innovation structures and not only on those that are structured and specialized agglomerations that can be identified by traditional indicators and that are normally associated with the notions of clusters, industrial districts, etc.[7] For this reason, we argue that the SI represents a broader concept with wider applicability to different countries and productive activities.

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[3] For details see also Datar (2004).

[4] In the cluster literature see also Krugman (1995) that incorporates in the mainstream agenda the idea of increasing returns due to agglomeration and underlines the importance of geographical factors in competitiveness and Schmitz (1995, 2003) work on development that departs from a definition of clusters as sectoral and spatial concentration of firms and stresses cluster up-grading.

[5] They are related to the recognition that (i) non-economic agents apart from firms are important elements of any local system; (ii) the specificities of the environment are also critical to their survival and development; (iii) the focus on local activities can never ignore the global dimension (Lastres and Cassiolato, 2005, p.5) .

[6] For the differences on the notion of development see Cassiolato and Lastres (2008). Erber (2012) provides a very detailed analysis of how different schools of though comprehend and define innovation leading to what he calls an illusionary consensus with very harmful results in analytical and policy dimensions.

[7] For a detailed critique of the neoclassical use of traditional secondary indicators to "identify" local patterns of specialization and define what is (or is not) a "cluster" including the use and abuse of LQ (locational quocients) see Cassiolato and Stallivieri (2012) and Lastres and Cassiolato (2005).

There are significant implications, for analytical and in policy purposes, deriving from these qualifications. In normative terms, our main argument here is that policies adopting the SI approach can be broader than cluster or industrial districts' policies. As the notion of cluster and industrial districts automatically emphasize structured and specialized agglomerations, its use for policy ends leaves aside others that may also require policy support. As a matter of fact, emerging and less structured systems are frequently very important in LDCs. Of course, policies for industrial and technological development in these countries cannot ignore these cases. In analytical terms we devised, from the SI perspective, the notion of LIPS that will be briefly explained in the next item

3 – From Systems of Innovation to Local Innovation and Production Systems: RedeSist's contribution

We have argued elsewhere (Cassiolato and Lastres 2005; 2008) that the SI perspective has strong connecting points with the Latin American development thinking as for both visions development processes are characterized by profound structural changes resulting from technological discontinuities that affect, and are also affected by social, political and institutional structure of each nation. Also, development is also seen as a systemic process, unique and specific, with both theory and the policy recommendations being highly dependent on each particular context (Furtado, 1974, 1983).

There are several other intersections between the SI perspective and the Latin American Structuralism (Cassiolato et all 2005; Cassiolato and Lastres (2008). Here it is worth pointing out that from the specific point of view of LDCs, the usefulness of an analytical approach that combines both perspectives is that its central building blocks allow for their specificities to be taken into account: the broader understanding of innovation; focus on social, economic and political agents and contexts; systemic approach, observance of micro, meso and macro relationships, etc.

In the first place, is the emphasis of the approach on the importance of accumulating capabilities and knowledge for the sustainable competitiveness and not the so-called traditional comparative advantages, which Fajnzylber (1988) called 'spurious competitiveness': low price products based on low labor cost and on the intense use of natural resources without a long-term perspective and on the manipulation of exchange rates. Secondly, and most important, the SI approach allows taking into consideration that the evolution of any national (or regional) economic system depends, to a large extent, on its place in the hierarchy and power structure of the world economy.

Seeking to apply the IS framework to the Brazilian reality and combining it with the Latin American development thinking the research effort of RedeSist led to the development and consolidation of the conceptual and analytical framework of Local Innovation and Production Systems (Cassiolato, Lastres, and Maciel 2003). In a similar vain to the SI tradition, we argue that the LIPSs is a focusing

device and not a more or less structured construct. Systems of Innovation are rather a looking glass, an instrument to analyze production and innovation structures that is much more appropriate than, for instance, sectors and production or value chains

LIPSs represents essentially a frame of reference, from which it is possible to better capture and understand processes of generation, dissemination and use of knowledge and the dynamics of production and innovation. Hence, it provides a more appropriate tool to understand and guide the technological and productive development (Cassiolato and Lastres 1999, 2003).

The approach covers and focus on the set of economic, political and social actors and their interactions, including: firms producing goods and services; suppliers of raw materials, equipment and other inputs; distributors and traders; workers and consumers; organizations geared towards capacity building and training of human resources, information, research, development and engineering; support, regulation and financing; cooperatives, associations, trade unions and other representative bodies and policy design and implementation. Such systemic vision encompasses all activities and actors that explicitly and implicitly affect innovation and productive activities, in different territorial layers: local, regional, national and global.

According to the original conception of this approach, wherever there is the production of any good or service there will always be a system around it, involving related actors and activities, from the purchase of raw materials, machinery and other inputs to the commercialization of final products. Such systems will vary from those more rudimentary ones to those more complex and articulated that really function systemically. In this perspective, for instance the number of LIPSs existing in any country is as big as its historically determined productive capacity allows for. Both from the analytically and policy perspectives, it is not enough to develop indicators and maps to identify the amount of existing systems and their different configurations and degrees of development. Similarly, because they are based on the recognition of the specificities of the different systems, the policies for their promotion are incompatible with generic models and templates using benchmark and best practice ideas.

Our basic argument is that to better understand the dynamics of a given system – and propose ways to promote it – it is necessary, not only deeply understand its particularities, but also its weight and role inside the knowledge and production chains and sectors that they are part of at the national and international level. Specific contexts, cognitive and regulatory systems, as well as forms of interaction and learning are recognized as fundamental for generating and diffusing knowledge. It is also clear that a particular system functions differently and requires different types of support if located in different parts of the country.

A distinctive feature of this frame of reference is that it takes as a unit of analysis a set of agents, collectively, going beyond the focus on individual organizations (companies), sectors or productive chains, establishing a close relationship

between the territory[8] and the economic activities.

The next methodological step was to derive an operational tool. In fact, one of the main criticisms of the SI perspective refers to the difficulty to apply the framework for an effective analysis of the reality of production and innovation. In a detailed analysis of all Globelics papers presented in the first nine conferences, we showed that: (i) 56% of them do not use the Innovation System framework in their analysis; (ii) most of those (46%) who quote the innovation systems perspective do not advance in using the approach in a systematic way (Cassiolato et all 2012). There have been very few successive attempts to deal with this complexity, such as the Disko project (Lundvall et all 1999), as it necessarily involves gathering information about innovation processes of interactive and tacit nature not easily quantifiable and absent in traditional statistics and data.

There are several factors that have contributed to hamper the initiatives to capture and analyze collective and interactive processes of generation and diffusion of knowledge[9] and it is not surprising that attempts to map and measure interacting sources and flows of knowledge are still very incipient worldwide[10]. The knowledge base is complex and heterogeneous, as well as its sources, means of acquisition, use and dissemination. The importance of each one varies from one activity to another and even in similar activities the specificities of the different territories make it impossible to characterize them in a homogeneous and standardized way. There are diverse sources, variable, systemic and non-linear forms from and through which knowledge is developed, acquired, used, and disseminated. These different sources and forms are complementary and often simultaneous. Therefore, in attempting to measure and evaluate processes of generation and use of knowledge, learning and capacity building, both productive and innovative, a first fundamental challenge refers to the importance of treating firms and other organizations and social actors in an aggregate way, focusing on their interactions.

Recognizing that knowledge is neither neutral nor autonomous, it is fundamental to consider the context in which it is generated, acquired and diffused, as well as who holds it, uses it and disseminates it, including individuals and institutions. This is why the evaluation of the specificities - personal, organizational, institutional and other characteristics of the environment itself - is considered important in the analysis of the processes of generation and use of knowledge, training, learning and innovation.

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[8] The concept of territory used by RedeSist covers its different dimensions such as: physical; economic; social; environmental; political; simbolic (including affective, cultural and identity bonds of the individual or social group); and cognitive (related to the conditions for the generation, use and diffusion of knowledge). For details see RedeSist (2008).

[9] See Cassiolato e Lastres (2008) for details. For example, the distinction between tacit and codified knowledge is particularly essential from the point of view of measurement possibilities. Codified knowledge is easier to measure than tacit, practical knowledge and know-how. Thus, pioneering initiatives provide heterogeneous and difficult to compare indicators (Cassiolato and Stallivieri 2010).

[10] Cassiolato and Stalivieri (2010) discuss the few international attempts such as the Disko Project of the Aalborg University, Denmark, the Blue Sky I and Blue Sky 2 proposals of the Statistical Office of Canada and the British initiatives of NESTA.

The methodology developed by RedeSist[11] attempts to tackle such complex issues and is essentially based on collecting information and data that are not included in traditional statistics but need to be collected directly from actors related to a local productive system. In a nutshell, the methodological tool set comprises three main building blocks: (i) the characterization of the local system; (ii) tools for information gathering during fieldwork; and (iii) a guideline for the LIPS analysis and a research report. These steps are briefly presented in Annex 1.

4 - Using LIPS methodology

Among the main transformations in the world economy that occurred in the last 20 years, the rise of China stands with prominence. Its double-digit rate of growth for most of the period (which pulled most of the developing world) and its entrance in all important international arrangements, notably the WTO, have changed significantly the global economic, social and geopolitical scenario. From a policy perespective, globalization has been accompanied by an almost global consensual about the importance of knowledge and innovation and the consequent need for their promotion by public and private policies.[12]

The deepening of globalization in the same period, however, brought some disturbing social and economic results, with modern capitalist economies facing 'secular stagnation': very slow or near zero growth, low investment in technology and thus low income and employment growth. Taking the case of US, Gordon (2014) suggests that the world economy is faltering not because population growth slows as the original proponent of secular stagnation, Alvin Hansen, argued in the late 1930s, but because the productivity of labor has been faltering and actually will not grow fast enough in the near future. In a 'supply-side' version of the secular stagnation thesis[13], Gordon reasons that the major capitalist economies have run out of innovation and technology to boost productivity and even the IT revolution of the last 20 years did not raise productivity growth in the whole economy, compared to other technological revolutions of the 19th and 20th centuries.[14]

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[11] A detailed presentation of the methodology in english is found in Matos et al (2015).

[12] One could single out, for example, the setting up of the "Lisbon Strategy" in 2000 in Europe and the central place of innovation in policies in different countries such as the BRICS (Cassiolato and Vitorini 2009).

[13] There is a well known 'demand side' version of the secular stagnation thesis presented by Larry Summers (2015) that adopts the Keynesian perspective (he called it a permanent 'liquidity trap) that economies have got 'stuck', with interest rates near or at zero and still cannot return to normal growth.

[14] It is true that Gordon was criticised for underestimating the new technologies that will come into play in driving up productivity growth over the next few decades. In a reaction to the critics he points out that "there is no need to forecast that innovation in the future will falter, because the slowdown in the rate of productivity growth over the past 120 years already occurred more than four decades ago. His main argument is that the pace of innovation has actually been declined after 1972. For a critique of Gordon's thesis see, for example Brynjolfsson and McAfee (2015) who suggest that rise of robots and artificial intelligence will have an exponential effect in what has been called the 'second machine age' or 'Industry 4.0'.

As globalization deepened it has been accompanied by a growing instability with economic crises becoming more frequent and strong. Two factors are absolutely central to crisis and its persistence, both of them related to the financialization of the world economy. First, there is a profound hypertrophy of financial assets and markets: the relation of the world stock of financial assets to world GDP grew from 1.02 in 1980 to 3.74 in 2008 (Paulani 2009). The global derivatives market - non-existent in 1980 - was estimated at approximately US$ 390 trillion in 2009 (Mulgan 2015) and amounted to US$ 710 trillion in December 2013 (Bank of International Settlements 2014).

Secondly, a sharp inequality in income and wealth distribution has increased at the heart of the system, as demonstrated by Piketty (2013). His analysis suggests that high inequality is the main obstacle to growth and therefore is capitalism's most important problem today and the most important policy challenge of the 21st century. He shows that globalization, deregulation, the free market and the "financialization" of the economy all led to 19th century levels of income inequality and to a kind of "patrimonial capitalism," in which politics and economy are controlled by few. Inequality is not only expressive, but the rhythm of its increase has actually accelerated since the 2007-2008 crisis irrupted.

Increase in inequality has been accompanied by stagnation of the economy induced by austerity. At the same time significant increase in corporate profits and contraction of productive investments worldwide. In a situation of world deteriorating demand and excess production capacity, this divergence between corporate profitability and investment in the real economy is a very threatening characteristic of the global economy.

Exacerbated consumerism, an increase in non-rational exploration and use of resources, accelerated loss of biodiversity, high levels of air and water pollution, greenhouse effects and the generation of enormous quantities of waste pollutants have been brought to the fore, contributing to an unprecedented environmental crisis. Maharajh (2012), for instance, points out that the estimated annual environmental cost resulting from global human activity is the equivalent of 11 per cent of global gross domestic product (GDP).

The persistent low GDP growth and the impacts of climate change, have economic and social consequences with great differences from continent to continent, from country to country and everywhere between social classes. With respect to investment and trade, UNCTAD characterizes public policies, almost without exception, as "not addressing the rise of income inequality, the steady erosion of policy space along with the diminishing economic role of governments and the primacy of the financial sector of the economy, which are the root causes of the crisis of 2008".

WTO reports that for the first time since the end of the Second World War, trade has ceased to boost growth. In fact, not only is world trade lower than its pre-Crisis level, but it is also growing slower than GDP. The slowdown in economic

activity that has been characterizing the global economy has resulted in larger and more rapid declines in international trade. Since the global downturn, GVCs are seen as central to this collapse of world trade (Baldwin 2009).

In the last 20 years the Brazilian National System of Innovation evolved in this crisis environment at world level with some important positive changes, but also with very significant deficiencies. It is not the focus of this paper to detail these transformations, just to single out some of the more relevant ones.[15]

Among the weaknesses in its production structure that remains one could single out (Cassiolato, 2015): (i) firms have a very low propensity to innovate, with very low business expenditure on R&D (BERD) and, most important on training and educational qualifications; (ii) firms do not systematically engage in cooperation with other firms and research institutions.[16] Among the strengths it is also possible single out (Cassiolato 2015) (i) the performance of the agribusiness sector, thanks to "a greater systemic integration between economic agents, especially suppliers of machines and equipment and of inputs and fertilizers, with research institutes and with agricultural productive units" (Cassiolato, 2015, p. 276) and a well-structured national and regional system of agrarian research anchored by EMBRAPA, a public R&D agency; (ii) the dynamism of some of the Brazilian service sector: Brazil is one of the world leaders in bank automation (Cassiolato 1992) and the software industry (Cassiolato, 2015, p. 277); (iii) oil and aircraft industry: anchored by respectively the state-owned oil enterprise Petrobras and one of the three largest aircraft firms, EMBRAER these industries have shown world leadership in innovativeness and dynamism; (iv) Brazilian SMEs have also improved their technological capabilities as by specific policy initiatives have been implemented in the last 15 years.

It is worth mentioning that important social achievements were registered in Brazil from 2003 to 2014 as a result of government policies. The share of wages in GDP grew from 31.1%, in 2003, to 38%, in 2011 and the total number of workers with formal jobs grew from 29.5 million in 2003 to 47.5 million in 2012. The share of poor people in total population fell from 35,8% in 2003 to 15.9% in 2012 and the Gini coefficient improved from 0.583 in 2003 to 0.530 in 2012. Such positive results were accompanied by successful initiatives in educational policy that led to improvements in labor qualification. Finally a significant process of regional de-concentration was set into motion with the poorest regions of the North, Northeast and Centerwest increasing all socio-economic relevant indicators (Cassiolato et al 2015).

Brazil also re-introduced industrial policy in its agenda in 2003, with the

[15] A detailed account of the Brazilian National System of Innovation is found in Cassiolato et all (2014, 2015); Cassiolato (2015); Mazzucato and Penna (2016).

[16] In other works (Cassiolato et all 2014, 2015), we discuss in detail the reasons for this low propensity to innovate that was not changed in the last 15 years even if government industrial policies attempted to tackle this issue. Among the main reasons we argued that most of the Brazilian industry is controlled by subsidiaries of multinational corporations, which would tend to carry out locally only activities to adapt products and services to local demand.

increase in innovation capabilities at its central tenet. Although in this area some limited and partial successes occurred most of policy mechanisms implemented proved to be irrelevant and insufficient to foster intended transformations. As we argued elsewhere, innovation policies focused on R&D and remained based on a linear view of the innovation process. The mechanisms used by policies were restricted essentially to R&D tax credits and economic subventions both aiming at reducing financial costs with no effect to firms' strategies towards innovation (Cassiolato et al 2014, 2015).

There has been one area, however where the systemic notion of production and innovation has been used. In fact, a significant item of the novel policies geared towards industrial transformation was the targeting of SMEs in a collective way In 2004, at the Ministry of Development, Industry, and Foreign Trade a Permanent Working Group for Local Productive Arrangements (GTP-APL) was set up as a forum of articulation of organizations – both public and private – that have any type of action towards LIPS.

Hence, since 2003, a systemic perspective on production and innovation based on the LIPSs framework with the explicit objective reducing regional and local inequalities in Brazil has been widely used in Brazil as public and private policy orientation for production, ST&I and development at federal, state and local level. Perhaps the most important contribution of this policy is that productive structures that historically have been left out of major industrial programs (as they refer to activities by small firms, most informal and "invisible" for traditional indicators) are those that are targeted through the LIPS policy.

It is possible to recognize that considerable amount knowledge has derived from the pragmatic use of the LIPS concept - both as a research and a policy instrument - as a result of almost 20 years of cooperative work, In fact during this period researchers in more than 20 Brazilian universities and in academics institutions of China, India, South Africa and Uruguay have provided knowledge and information on around 200 LIPS. All of these studies attempted to capture dynamic evolution of systems in a wide range of productive activities from more advanced (such as aircraft production) and traditional manufacturing (textiles and clothing) to agriculture and services.

Particularly relevant was the research on services LIPS, such as health (traditional medicine, indigenous population health care; primary health care provision, low cost medical equipment, for example) and cultural activities (audiovisual, music and festivities, such as Carnival) that are usually excluded from the innovation research and policy agendas, despite their extreme relevance for development (Matos et al. 2015, Matos and Britto 2011, Cassiolato et al. 2008). It has also been used in international comparative studies of Mercosur countries (Cassiolato and Lastres 1999; 2003) and BRICS countries (Cassiolato and Soares 2015). [17]

These studies have focused primarily on knowledge and learning processes for

[17] For the analysis of these 200 LIPS, questionnairies were applied to more than 3000 firms.

capacity building, and the link between innovation and development challenges. They stress that the specific territory in which production, learning, and innovation take place constitutes a key unit of analysis, as each territory or country faces specific challenges and takes a very specific development path. Further, they suggest that there is not necessarily a contradiction among economic, technological, and social/environmental goals and that a systemic perspective is essential to envisage the potential convergence of these goals and to guide policy action in that direction.

Below we present a summary of the main findings of the 20-year research effort by RedeSist taking into account the brief evaluation of the significant transformations that occurred in the world and the Brazilian economy in the same period. Besides the almost obvious confirmation of the specificity of experiences, the fact that each case is a different one even if we consider the same production activity brings a general conclusion is policy terms. Policies for their promotion are incompatible with benchmarks, best practices and "one size fits all" generic templates. In the words of Rao, 2006:

> "Political and culturally informed public action is not easy. The process requires paying close attention to context in shaping interventions both globally and locally. It therefore argues against the idea of ´best practice´ - that an intervention that worked wonders in one context would do the same in another. Good interventions are very difficult to design ex-ante. A cultural lens thus teaches us that public action, particularly when it is participatory, aspiration-building and aware of ´common-sense´, requires an element of experimentation and learning. Ironically the best practice may be the absence of a best practice."

In terms of knowledge creation and its use for policy purposes it is also possible to point out that progress achieved so-far includes: (i) deeper interaction among researches in Brazil (RedeSist), Latin America (Lalics), BRICS, Globelics, Indialics and other LICS networks; (ii) important processes of creating, using, improving and disseminating knowledge; (iii) intense interaction among researchers, policy-makers, entrepreneurs and other participants of the processes of using these approaches in the academic and policy spheres.

Other main contributions of this significant collective learning and accumulation of experiences in analytical and normative terms include:

A – LIPS and the Brazilian National System of Innovation

Even though a marked difference between LIPS occur there have been at least two facets of the Brazilian National System of Innovation affect them negatively in the same way irrespective of location and activity. The first one constitutes a recognition about one of the structural problem of the system that gradually, as pointed out above starts to be tacked, that is deficiency in capacity building In all analyzed cases we found that lack of local availability of qualified human resources was considered to be a main constraint to a more virtuous evolution of the LIPS.

Another general deficiency of the broad Brazilian National Innovation System

that harms LIPS is the financial system. Almost unanimously the more than 3000 firms interviewed in different parts of the Brazilian territory and in different time spams (from 2000 to 2015) pointed out that the very high interest rates charged by banks, the unavailability of financial mechanisms geared towards their needs (including working capital) forced then to depend upon other forms of financing including loans from relatives and even usurers.[18] This finding is consistent with one of the issues that have been stressed in Latin America since the 1970 and that has been put aside by the innovation literature: the fact that huge imperfections in the financial system and in the macro-economic contexts constitute malignant elements that jeopardize long run investments in real and intellectual capital. As stressed by the Latin American literature on technology and development, macroeconomic policies and structure in the region affects negatively industrial development and firms' strategies, rendering specific industrial and innovation policies irrelevant.[19] The risk of ignoring this perspective can lead also to the design of completely inoperative policies.

In general terms, the above conclusion sides with the idea suggested by Chesnais and Sauviat (2003).that the predominance of the financial capital - with its preference for liquidity and focus in short run profits - effectively contributes to question investments of high risk, cost and maturity period, such as those in education, science, technology and innovation. In fact the trend to conform macroeconomic regimes increasingly dependent on the logic of financial capital hinders the possibility of implementing policies for these areas, even in the US and other advanced countries in Europe and elsewhere (Coutinho 2003).

B – LIPS and their insertion in production networks and value chains.

LIPS are by definition integrated into broader production structures organized upon regional, national, supra national and global spheres. Most of them are not isolated and self-contained. In this sense their transformation is also dependent upon external linkages – political, economic and social.

The intrinsic collective nature of production has acquired a transnational dimension with capitalism (Wallerstein, 1985) "as almost all commodity chains of any importance have traversed these state frontiers" (p. 31). In the present financial-dominated globalization, such characteristic of production has again gained a new momentum with a general agreement about the emergence of a pattern of global production characterized by dispersion of production with functional integration of economic activities (Dicken 2003, p. 12).

[18] Relevant efforts have been mobilized since 2003 to broaden the amount and diversity of financial instruments directed towards SMEs and collective actor within the context of LIPSs. But main challenges still remain such as the difficulty to tackle informal activities and the overall high cost of credit (Matos and Arroio 2012).

[19] Herrera (1971) called macroeconomic policies in Latin America 'implicit' industrial and technology policies. As a number of authors in the region have stressed, following Herrera's insight, hyperinflation, high real interest rates and imperfections of the financial system and of capital markets are significant constraints to technological (and productive) development in the region. See, among others, Katz, 1999; Cassiolato and Lastres, 1999 and 2004; Coutinho, 2000.

Besides the Systems of Innovation approach, other perspectives have attempted to understand and analyze these trends with the Global Value Chain (GVC) literature being the most influential in this debate.[20] Studies of Brazilian LIPS examined the connections between the local and external production structures and provide interesting insights to this discussion (Soares et. al 2015; Matos et al. 2015; Szapiro et al, 2016).

First they tend to show some of the limitations and problems faced by localities in the developing world that are absent in the GVC literature. For example in all cases where LIPS firms tried to connect to global value chains they got trapped in the vicious circle of mass production of low-cost standard products, based on the least skilled workers and most precarious working conditions of the value chain. Integration with the local economy diminished with negative implications: the exclusion of local suppliers and adverse effects on local industrial structure, low technological incorporation, and weak contribution to local capabilities and learning processes.

The information and knowledge that these firms received from external sources were given from export agents and/or the purchasing offices of large global buyers. The strategies of these firms have been based on passive learning of these sources and low wages. In the cases we analyzed where this passive learning occurred, lack of integration with local economy was also found, with negative implications such as the exclusion of local suppliers and other adverse effects on local industrial structure, low technological incorporation, and weak contribution to local capabilities and learning processes. In some cases, dramatic decrease in social indicators such as wages or local value-added is also mentioned.

[20] Besides the CVG approach one could single out international production networks (Borrus, Ernst and Haggard, 2000), global production systems (Milberg, 2008), and the French concept of filière developed in the late 1970s by French economists (Raikes et al., 2000. p.12). In other papers (Soares et al., 2015) we pointed out that the GVCs approach has at least three main weaknesses: a) it neglects the power dimension of GVCs - which is reduced in the GVC literature to the narrow concept of governanceand and in reality is about the power of large Transnational Corporations (TNCs) to organize the chain and maximize profits; b) it has a poor understanding of the conditions for "upgrading" - GVC literature tends to overestimate the role played by the structures and governances of the chains, neglecting the broadercontext conditions in which they operateand that decisively shape their successes and failures; c) it neglects the capital-labour dynamics in GVC - a critical gap of GVC literature is the lack of understanding of the determinants of value creation and appropriation along global chains. Lee (2016) also criticizes the GVC literature: it implicitly assumes that the leadership continue to remain in the hands of the multinational firms from the North; it takes a static or linear view of upgrading processes and governance modes; it does not pay enough attention on independent upgrading processes by the Southern firms (assumes a view that more insertion in GVC is always better).

In most cases where local systems were subjected to this logic of connection with GVCs, policies fostered by loans provided by international organizations led to a dramatic decrease in social indicators such as wages or local value-added. This was the case, for example of the timber and furniture production in Paragominas in the Amazon region (Costa and Andrade 2009, Matos et al. 2015).

There are few case studies where we were able to find upgrade with increase in technological capabilities, where some of LIPS firms pursued a more active learning strategy, breaking away with large foreign TNCs that command global value chains and targeted niche markets of higher added value and prices, initially national and then global. In these cases, the active learning processes includes reliance on both local and external sources of information and knowledge that include international competitors, foreign machinery manufacturers and international trade fairs which allowed them to engage in strategies that include the development of innovative capabilities in design and marketing aimed at premium markets, setting up new commercialization channels and brands.

The situation we found in Brazilian LIPS is similar to what was uncovered, in a much larger scale by Lee et all (2015) in the analysis of Korean SMEs which only were able to successfully upgrade functionally after they decided to make a structural break with large western transnational corporations by adopting their own path creation strategy.[21] Lee et al. (ibid.) showed also that these Korean firms faced enormous difficulties in their strategy as incumbents used several attacking mechanisms such as dumping, charging of predatory prices, IPR disputes, etc. According to the authors, the factors that made it possible were (i) Korean government policies not only to strength innovation systems (particularly those that supported capacity building), but most important those implicit policies that helped local enterprises to overcome the above mentioned barriers; (ii) local ownership of firms; and (iii) a strategy to make local firms independent from the established, dominated by western TNCs, global chains.

The case studies of LIPS in Brazil also showed the limitations of the normative dimension of the GVC literature. Contrary to the policy recommendation of that framework, which include free trade policies aimed at reducing or even eliminating any kind of trade barrier in order to be more competitive in the world economy and get a better insertion in GVC (Dalle et al. 2013), the analysis of the Brazilian LIPS shows that policy makers should design industrial and innovation policies to foster the creation and dissemination of knowledge among the actors and to develop local productive and innovative capabilities. This policy implication goes in the opposite direction of the one diffused by the

[21] Fagerberg, J et all (2016) also suggest that increased participation in global value chains or trade more generally is not the potent driver of growth that international organizations such as the World Bank tend to assume. Kummritz (2015) finds that low-income countries do not benefit economically from participating in global value chains.

international organizations that make use of the GVCs approach (Szapiro et al, 2015).

5 - Conclusions: towards an update of a research and policy agenda

In the first place, we should point out that the use of the LIPS approach did not escape the criticisms of representing only a new label for old ideas, where the new 'way' of focusing on productive structures was often distorted by 'fashion' or 'vogue'.[22] Hence, the importances of understanding the processes that commonly make it difficult to use new research and policy references. These processes generally include factors such as: (i) submission to hegemonic approaches, usually of neoliberal order and created in (and for) the contexts of more developed countries; (ii) conservatism, which makes the new approaches subordinate to pre-existing rules, practices and hierarchical structures.

Second, there is an even more alarming conclusion: that regardless of the way the concept is understood - more or less close to a developmentalist or neoliberal view - the support for LIPSs was not implemented as planned, given conditions and rules imposed on the financing of development in the country. [23]

Hence, the relevance of evolving in the apprehension of the current obstacles to development, overcoming the lack of clarity about its new conditions and the distortions associated with what is conventionally called the 'colonization of knowledge' and 'cognitive injustice'. That is, the predominance of visions and models of knowledge elaborated in countries considered more advanced, which, besides inadequate to other contexts, produce exclusions and contribute to limit the possibility of creating alternatives.

In a common language it is as if we were obliged to use others spectacles, instead of those suited to our own conditions. In this line, it is argued that it is necessary to deepen the reflection on the opportunity to review the teaching, research and policy references in use and to progress in the elaboration of new and appropriate concepts and methodologies.

Considering that the understanding of the current transformations experienced in Brazil and in the world, in their financial, productive, technological and geopolitical dimensions, is a fundamental conditioning element to understand the limits and possibilities of the long-term development strategies, it is

[22] See Lastres and Cassiolato (2001); Cassiolato and Lastres, (2004) and Reinert and Reinert (2003), who warned that some attempts to use the focus on innovation systems at the international level, both in research and policy, were nothing more than 'thin icing on a solid neoclassical cake.' We consider this an example of how the international partnerships of RedeSist can contribute to broadening the understanding of our own challenges.

[23] For details see Lastres, Cassiolato and Arroio (2005; Apolinário and Silva (2010); and Lastres et al., (2016).

proposed to follow an agenda of teaching and research, with three blocks aimed at advancing the understanding of:

1 – The Geopolitical, Sociotechnical and Institutional Transformations in the World, aiming to discuss and advance the understanding of the processes of:

1.1 - Financialization, focusing on:

- ✓ its orientation and power structure; its agents and main effects; financial liberalization, instabilities and the multiplication of crises;
- ✓ the decoupling of productive and financial capital; the fictitious nature of international capital flows, which destabilizes growth, in addition to increasing the financial subordination of peripheral countries;
- ✓ the rentier and short-term logic and their impacts in macroeconomic regimes, production and innovation dynamics and LIPSs; implicit policies and development conventions; new modes of financing development;
- ✓ the global and systemic nature of the financial crisis that began in 2007/8 and its convergence with the requirements of changing the production paradigm and the pressures of financialization and sustainability;
- ✓ the opportunities presented by socially and environmentally sustainable LIPSs;
- ✓ the consequences of austerity measures on LIPSs; the dynamics of production, innovation and consumption; and the creation / destruction of jobs and of new and old inequalities;
- ✓ possible forms of new international geopolitical, financial and economic governance.

1.2 - Change in patterns of organization, production, consumption, financing and policy; in regional and territorial development; in the technological and knowledge generation matrices; in life styles and in the dynamics of cities, as well as in social relations of production, focusing on:

- ✓ new production and innovation standards; internet of things; human and sustainable cities;
- ✓ interests and questions of power in guiding these new patterns and their possible consequences: structural technological unemployment; the space and income of less skilled workers; the precariousness of working and living conditions; the strengthening of exclusions and inequalities;
- ✓ identification of possibilities and paths appropriate to the challenges and opportunities of the peripherical countries and their LIPSs;
- ✓ evaluation of existing experiences indicating new and sustainable ways of producing, marketing, consuming, working, socializing, remunerating, financing, etc.

- ✓ new forms of development and, generation, use and diffusion of knowledge;
- ✓ the requirements of new policies and the new formats and roles of the State.

2 – The Brazilian and Latin American situation, focusing on:

- ✓ processes of de-industrialization; 'regressive specialization', de-nationalization and escalation of imports and profit remittances abroad;
- ✓ the subordinate international productive integration and limited progress in reconfiguring the Latin American industrial structure;
- ✓ the increasing subordination, instability and economic-financial vulnerability of countries that do not have a strong currency, such as Latin Americans;
- ✓ the primacy of recessive austerity policies, malignant macroeconomic regimes, and the implicit policies and their impact, especially on poor LIPSs and communities;
- ✓ the importance of planning and implementing development strategies in the face of political and institutional fragility; the erosion of the economic, financial and political space of governments; fiscal constraints, governance crises, social pressures; the limitations on the exercise of policies and the risks to the State and public managers; the criminalization of development support.

3 - The Future of Brazilian Development, focusing on

- ✓ the need for a favorable macroeconomic regime (overcoming the trap of the tripod on which we have been stuck for decades) and ways of addressing the enormous inequality, social fragmentation, de-industrialization and coping with the ongoing global transformations;
- ✓ the possibilities of formulating a participatory and cohesive national project, based on a new socio-political pact for inclusive and sustainable development, with the capacity to guarantee its implementation;
- ✓ the role of the State and its agencies in supporting development and in coping with the effects of crises, democratization and renewal of the Brazilian State, and the resumption and modernization of participatory and territorialized planning;
- ✓ coordination of different actions and policies: macroeconomic, industrial and technological, regional, social, educational, cultural, etc. ;
- ✓ policies with a vision of the future and focused on the use of the Brazilian domestic market, favoring the development of productive and innovative capacities and LIPSs related to new forms of food production, health, education, housing, access to water, sanitation and energy, mobility and culture;

- ✓ new forms of procurement as one of the most effective mechanisms of industrial and technological, regional, territorial and LIPSs development;
- ✓ the opportunities to include in the productive and innovative Brazilian effort the agents, knowledge, regions and activities marginalized; and support production and innovation systems based on our environmental and socio-cultural diversity;
- ✓ modernization of the forms of exploitation and use of natural resources and regional socio-biodiversity, giving them sustainability and priority attention to the needs of local societies;
- ✓ the identification and evaluation of experiences indicating new paths for cohesive and sustainable development and of future bearers LIPSs;
- ✓ the overcoming of abstract, decontextualized, fragmented and inadequate visions, theories, concepts and of teaching, research and policy models, whose imposition blocks and prevents the formulation of alternatives.[24]

Finally, it is argued that coping with huge inequalities and other development challenges can provide an opportunity for consensus building and further development. Fundamentally, it should be pointed out the high relevance of the knowledge - pioneering and dense - already accumulated in Latin America, in Brazil and by RedeSist itself. It has to be accentuated the necessary contextualization of concepts, models and objectives of teaching and research activities, emphasizing those with greater capacity to recognize and mobilize the potential of Brazilian development and its vast territory. The generation and diffusion of adequate knowledge to deal with the specificities of development and its consequent transformation into instruments capable of breaking invisibilities and illuminating new development paths and the possible ways of treading them is a necessary task to be accomplished by local researchers and policy makers.

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[24] See Lastres, et al, 2016.

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ANNEX 1 – A Brief Description of LIPS Research Methodology

The LIPS analysis starts with the identification of the relevant actors of the system. It includes the complex network of productive agents of the main productive activities (suppliers, service providers, distributors in many interrelated productive chains) and the set of organizations related to representation and support, education, training and research, public and private policies. This is to say, the characterization of the specific local system to be analysed has to take into account all the agents that potentially - directly or indirectly - interact with the main productive activities.

This methodology is not circumscribed to formal productive activities, neither focus on specific industries. As the research experience based on the LIPS framework shows, it can be applied for the study of the most different productive segments and even for predominantly informal activities.
LIPS methodology emphasizes the importance of gathering original primary data for understanding local processes of systemic innovation, learning and capacity building. Secondary information, available from data gathering official agencies do not suffice for an examination and analysis of innovation systems. So there is a need to collect information directly from local actors, combining the secondary information that may be available with this primary information.
The tools used for field research in RedeSist´s studies consist of a questionnaire and different interview guides. The questionnaire is directed to the productive actors/agents who are at the core of the local system (see appendix 2). These actors can be formal enterprises, informal ones or individuals. The set of productive agents and other organizations to which this questionnaire and the interview guides would be applied should be defined in advance, according to what was proposed in the previous section.
The questionnaire is structured in five blocks of questions. The first aims to characterize the productive organization, with questions about segments, products, origin and structure of the capital, and characteristics of the employees. The second block poses questions about the economic performance of the enterprise/organization opver a time span (usually 5 years) such as turnover, sales and markets attended, as well as factors considered to be important for the competitive capacity of the enterprise. The third block poses the central questions for the analysis, investigating the innovative efforts, learning activities and cooperation with diverse agents and the impact of these interactive processes on the capabilities of the enterprise. The forth block investigates aspects related to the competitive advantages associatesdto the local environment, the articulation to the local productive structure, and the patterns of governance. The fifth block evaluates the existing and potential support and promotion policies.
As mentioned above, the field research tools also encompass three different interview guides (see appendix 3). The first is directed to organizations with functions of education, training and research such as technical schools, universities, technological centers and social organizations. The second interview guide is directed to organizations with representation functions such as associations and trade unions, as well as relevant social organizations. The third interview guide is directed to public and private organizations (including

international cooperation) with promotion and policy functions.

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The conjunction of information and data based on secondary sources and the results from field provide the material for the analysis of a LIPS that encompasses five dimensions that are relevant within this framework..

1- the national and international context in which the LIPSs is inserted (i) Analysis of the global and national competition pattern and technological regimes; (ii) Analysis of the economic, technological, institutional and geopolitical contexts, thus constituting a bridge between the local, national and global spheres.

2 - socio-economic characteristics of the territory in which the LIPS is embedded and how these characteristics influence the productive activities of the LIPS and, conversely, how theseactivities affect this territory, focusing particularly on the social dimension.

3- an analysis of the profile of the LIPS, that is its origin and development, the main actors of the LIPS, the main products, suppliers of inputs and equipment, patterns of commercialization, and characteristics of the consumer market, the promotion, regulation and financing activities, the knowledge infra-structure, embeddedness and forms of cooperation and what have been the influence of policies on the development of the LIPS, identifying the public or private organization that implemented it, the type, the scope, the level, and nature of those policies and whether they embrace a social perspective.

4 – an analysis of the processes through which productive and innovative capacity is generated, focusing on the formal and informal learning mechanisms, information sources and forms of productive and innovative capacity building, how knowledge is acquired, used and diffused, and whether scientific, traditional and popular knowledge are valued and used. The interactive learning among different productive actors (producer-supplier and producer-client interactions) and among these and education and research institutions are also discussed.

5 - the perspectives of policies for the promotion of the LIPS.