

Systems of Innovation and Development*

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1 - Introduction

This paper explores the advantages of the approach on system of innovation - SI - in terms of a better understanding of how knowledge is created, acquired, used and flows in productive structures, giving special emphasis to the case of the less developed countries.

The paper starts by discussing the transformations in the pattern of accumulation, during the turn of the millennium, leading to the diffusion of the so-called *knowledge era*. The main threats and opportunities of the knowledge economy are summarized in item 2. A central point in this discussion is that the increasing knowledge content and the bigger weight of intangibles in the economy are urging the development of new approaches, theories and instruments. There is a need to understand, measure and evaluate the nature and potential impacts of these changes in order to design the necessary policies to cope with them. The item ends up by focusing on the challenges posed to the less developed countries, such as the new forms of economic and social polarization and exclusion and development divisions.

The usefulness of the approach on system of innovation is explored in item 3. The discussion develops the argument that it represents an important analytical tool for understanding the processes of creation, use and diffusion of knowledge. Among the main advantages of this concept are a broader understanding of the role and characteristics of innovation and the importance of taking into consideration social, political and institutional contexts, as well as micro, meso and macro-economic relationships. In item 4, this discussion focuses on the specific advantages for the less developed countries. The experience in applying the approach of systems of innovation in Brazil is then presented in item 5, where the concepts, research agenda and results achieved by RedeSist in its attempt at analyzing local systems are discussed. Finally, in item 6 the main weaknesses and advantages of the approach on SI are summarized.

2 - Knowledge economy: threats and opportunities

Information and knowledge have always been important in human history. The notion of 'Knowledge Economy' relates to the observation that, since the post-war period, the economy has increasingly relied on knowledge-based activities. There are at least two usual lines of reasoning for this: (i) the proportion of labour that handles tangible goods has become smaller than the proportion engaged in the production, distribution and processing of knowledge; (ii) the share of codified knowledge in the value of goods and services is significantly increasing.

In the core of this process are the new possibilities offered by the development of information and communications technologies (ICTs), which have accelerated and deepened both the codification of knowledge and the spread of information. The conversion of different types of codified knowledge and information into digital formats offers the possibility of reducing the exponential dependency on matter. This trend towards the relative and absolute reduction of material components in the production of new goods and services is illustrated, for instance, by the case of *software*, which can be developed, produced, bought, distributed, consumed and discharged without ever assuming a physical form.

It is important to note the pervasiveness of these processes. In fact, its consequences are not confined to the high-tech sectors. The increase in the use of knowledge and innovation is radically transforming all economic activities, regardless of their being new or more traditional. Among other things, this reveals the inadequacies of the traditional classification of economic sectors in capturing situations where industries are constantly changing and where market structures are becoming increasingly fluid.

New forms of production, commercialization, management and interaction have been developed and there are new means of acquiring knowledge and information, as well as developing skills and capabilities. There are also new types of organizations (virtual) and new means of payments. Beyond the so-called *electronic money*, is the fact that individuals increasingly can consume goods and services without using any kind of money. One example here is the alleged *Internet free-access*. Of course users of such services are not only dispensing attention to the advertisements displayed during the consumption of the services;² but also providing valuable information (about their consumption profile, address, etc.), as well as working to produce part of the services consumed.³ Therefore, it is not the case of a free service. Its price is not at all irrelevant and its form is complex and at still difficult to perceive. It is this invisibility that allows claiming that the acquisition of such services is free. Other examples would reinforce this same argument that virtuality and novelty are important elements contributing to make it difficult to capture the most relevant features of the present pattern of accumulation.

The need of new theoretical, methodological and analytical frameworks

In previous works we have argued that the lack of a better understanding of the nature and consequences of the changes of the turn of the millennium, has led to a number of misinterpretations and mystification. The main points discussed led to the following conclusions:

- the speeding up of globalization, financierization, privatization and de-regulation are seen as correlated processes that characterize the new pattern of accumulation;
- the direction and pace of these changes - far from being neutral or natural - reflect very specific political interests;
- the main reason for the adaptation crisis refers precisely to the delay in better understanding of its specificities and in designing appropriate policies and regulation systems to cope with and orient them;
- even if some important specific features and trends of this new accumulation pattern are still 'invisible' and seem non-controllable, this should not be taken as a permanent obstacle;
- the lack of an adequate framework to capture and deal with the new configurations has fuelled the adoption and diffusion of neo-liberal theses and recipes in very uncritical ways;
- the main policies adopted in Brazil and other Latin American countries, in the 1990s, reflect among other things, also a very poor understanding of the nature of the present transformations of the world economy.⁴

All this leads to the first argument of this paper: that the present transformations of the world economic system – bigger weight of intangibles in the economy, accelerated increase of the knowledge content of activities, goods and services, rapid (and uneven) diffusion of ICT, acceleration of globalization (mainly in its financial dimension) and competition; etc. – are challenging economic approaches developed to deal with a different context, in providing sufficient conditions to measure, evaluate and explain the main sources, dynamics and characteristics of the new pattern, as well as its impacts on different economies and societies. At the same time that these changes expose even more the limitations of orthodox concepts, theories and correlated indicators

² In some countries this has been used extensively and for decades in radio and television transmission, as well as different sorts of newspaper, magazine and other printed material.

³ For details see, for instance, Lastres and Albagli, 1999.

⁴ Cassiolato and Lastres, 2000, Lastres, Cassiolato and Maciel, 2003.

and statistics systems, they also require the development of new approaches, theories and instruments to deal with them.⁵

The Development Perspective

In many senses, the development of the new pattern of accumulation can be seen as a response to the restrictions imposed by the energy and material-intensive mass-production (and highly polluting) Fordist paradigm of the 1950s and 1960s. However, at the same time, it also presents new challenges for firms, sectors, countries, regions and people, particularly those in the less developed countries. It is recognized that - together with the opportunities offered by the increasing diffusion of the ICTs, new forms of economic and social polarization (and exclusion) can be created. These are linked to digital illiteracy, as well as to unequal access to the opportunities to generate, acquire, use and renew knowledge basis and skills. In this sense, some alerts should be stressed. Firstly, the threats of the *digital divide*, *learning divide* and the new forms of *development divides*.⁶ Secondly the possible impacts on the cohesion and the longevity of national and local systems of innovation in countries not belonging to the Triad nor possessing developed science and technology systems with a capacity for autonomous self-reproduction.⁷

It is important to stress that, while former patterns of accumulation relied more directly on tangible resources, which are randomly disperse in the world, the new ICT paradigm emphasizes even more the importance of knowledge. This has important consequences for the less developed countries. Mainly, because the appropriation of physical and intangible resources and goods cannot be placed on equal bases. Knowledge and information are typical cases of non-rival use, since they may be utilized repeatedly and concurrently by many people, without being depleted. Differently from energy and materials, these are resources that are - more than abundant - inexhaustible. Their consumption does not destroy them; and when they are sold, transferred or given, this does not mean that they are lost. On the contrary, one can accumulate even more knowledge by using it.

Despite this, and as pointed out, for instance, by David and Foray (2002) ‘individuals and firms today are striving to create artificial scarcities – by achieving legally sanctioned monopolies of the use of information – in fields where abundance naturally prevails, thus giving rise to an enormous amount of waste’ (p.14). However, even more important are the consequences in terms of further exclusion and development division. Attempts to create scarcity of knowledge are associated to efforts by organizations and individuals to control and use it as an instrument of power. The implications of this process for the consolidation of a new form of geo-politics have to be taken into account.

3 - The usefulness of the approach on system of innovation

The interest that the approach on system of innovation - SI has attracted relates mainly to the belief that it represents an important analytical tool for better understanding the processes of creation, use and diffusion of knowledge, in what concerns its economic use.⁸ It is worth emphasizing that underlying the system of innovation approach is a:

- resurgence of the interest in historical and national development trajectories and in the role of technical change;

⁵ Dosi, 1996, Lastres and Ferraz, 1999.

⁶ Reinforcing their arguments about the digital, learning and development divides, Arocena and Sutz, 2003 for instance emphasize the need to take into account both the opportunity to learn and the opportunity to apply creatively what has been learnt. In this sense they note that ‘*educational policies, even if fundamental, are not enough if people are not allowed to deploy its creativity, enhanced by formal training, into problem solving activities*’(p. 310).

⁷ Chesnais and Sauviat, 2003.

⁸ See Lundvall, 1992; Freeman, 1995a; Edquist, 1997 and 2002; Lundvall et al., 2002.

- characterization of innovation and learning in a broader context and as interactive processes with multiple sources;
- emphasis on the importance and complementarity between incremental and radical, technical and organizational innovations as well as their different sources (internal and external to firms and national boundaries);
- re-conceptualization of the firm as organizations embedded within specific socio-economic-political environments, reflecting historical and cultural trajectories;
- focus on the localized (and national) nature of the generation, assimilation and diffusion of innovation, as opposed to the simplistic idea of a supposed techno-globalism;
- observance of the systemic nature of innovation and the need of taking into account the productive, financial, social, institutional and political spheres, as well as micro, meso and macro dimensions.

These features of the concept, which help further understanding of the dynamics of the innovation process as well as guiding policies for its promotion in any country, are developed in Lastres, Cassiolato and Maciel, 2003. Here, we highlight those that are of particular relevance for the less developed countries and regions perspective.

A broader understanding of the role and characteristics of innovation

As particularly emphasized by Mytelka and Farinelli, 2003, the innovation system approach breaks ranks with the traditional view of innovation as a process of radical change at the frontier of an industry; and recognizes that innovation extends beyond formal research and development (R&D). This broader understanding of innovation emphasizes the importance of also taking into account continuous improvement in product design and quality and changes in organization, management and marketing routines, among others. Innovation is then understood as the process by which organizations master and implement the design, management and production of goods and services that are new to them, irrespective of whether or not they are new to their competitors — domestic or foreign. This understanding helps to avoid an overemphasis on R&D in the innovation process, encouraging policy-makers to take a broader perspective on the opportunities for learning and innovation in SMEs and in traditional industries (while also stressing the importance of investing in the development of the so-called new technologies that work as innovation diffusers, e.g. ICTs). Such a definition is particularly important for the analysis of innovation in less developed countries, and that is one of the reasons why this broader approach on innovation orients the research agenda of *RedeSist*.⁹

Importance of social, political and institutional contexts

By emphasizing particular historical, political and national trajectories, the system of innovation approach allows taking into account the specific geopolitical context of the different national systems. It is in this sense that the national system of innovation approach reinforces the thesis that the generation of innovation is localized and bound to national and regional frontiers, contrasting with the idea of a supposed free global flow of knowledge. Since a significant portion of knowledge

⁹ For details see www.ie.ufjf.br/redesist. The recognition of these advantages does not impede from appreciating the alerts made by Chesnais and Sauviat, 2003, about the links of the global finance dominated regime and this broader concept of innovation and innovation-related investments - which stresses mainly 'the marketing of new (or apparently new) products' – as well as the possible consequences to long-term education and R&D investment, and particularly on the fundamental research base.

on which the innovation process is based is tacit, cumulative and endogenous capabilities are required for the efficient absorption of knowledge, in order to adapt, modify, use and, then, generate, new knowledge.

The relevance of considering micro, meso and macro-economic relationship

Another important advantage of the national system of innovation - NSI - approach is that it stresses the need to take into consideration its micro, meso and macro dimensions, as well as their linkages. In this line, Coutinho, 2003, criticizes neo-classical theories, which reduce the macro dimension to a mere sum of the microeconomic short run outcomes and adds that '*the specific characteristics of macroeconomic systems contain and condition the microeconomic decisions that form the standards of financing, corporate governance, international trade, competition and technical change.*' (p. 311). Therefore, he emphasizes the importance of capturing and understanding the new macroeconomic international and national contexts, as well as the constraints these contexts impose on development and innovation policies. This point, which is fundamental for the analysis of the less developed countries (LDCs), will be elaborated below. It is mainly here that the approach on SI comprises the arguments that one has to take into consideration questions such as power and specific geopolitical and economic contexts to properly understand the systems of innovations of these countries.

4 - Systems of innovation and development

The system of innovation approach has been criticized for the absence of formalization. However, it could be argued that the development of this approach did not intend to create a theory in itself but rather to provide a useful framework for analyzing innovation dynamics.¹⁰ Additionally, it does not put innovation and learning processes into a strait-jacket model developed according to the specific experience of one (or a few) advanced countries, which could hardly be reproduced even in other economies in the North, not to mention the South. Therefore, what is seen by some as a disadvantage is here considered as the main element in providing a flexible and useful analytical framework.

This acknowledgement does not imply denying the value and contribution of theories and concepts that were developed in the North through the observation and analysis of processes occurring in the developed world. It is quite the opposite. It is recognized that such ideas are relevant for the analysis of the less developed countries. However, one should note that development can not be understood as if the economic history of all countries follows a common "development path", each country at its time and with different speeds. On the other hand it is important to recognize that the economies of developed countries are not defined exclusively by their internal structures and processes or by qualitative or quantitative factors, but also and mostly by their dominating position in the world system. In this sense, it is important not to forget that the evolution of a national (or regional) economic system depends, to a large extent, on its place in the hierarchy and power structure of the world capitalist system. It also does not deny the importance of elements of economic theory that help the analysis of innovation systems. The development of new models and quantitative tools adequate to the system of innovation approach represents significant efforts for setting up concepts, methodologies and indicators to deal with the processes of knowledge generation, acquisition and diffusion. Models of communication and networking are also helpful in getting a better understanding of how processes of interactive learning and diffusion take place.

¹⁰ For details of the background and some of the most important efforts made in terms of developing this concept see: Freeman, 1988, 1995, 2003; Lundvall et al., 2002; Edquist, 1997, 2002; Cassiolato and Lastres, 1999; Johnson and Lundvall, 2003, Arocena and Sutz, 2003.

From the specific point of view of less developed countries (LDCs) the usefulness of this approach resides precisely in the fact that its central building blocks – broader understanding of innovation; focus on social, economic and political agents and contexts; systemic approach, observance of micro, meso and macro relationships, etc. – allow for their specificities to be taken into account. Of particular relevance is also the emphasis on the importance of accumulating capabilities and knowledge for the sustainable competitiveness of these countries and not traditional advantages such as low labour cost and natural resources, which Fajnzylber (1988) called ‘spurious competitiveness’.

As already stressed, it is very important to take into account the problems related to the instability and vulnerability of the macroeconomic, political, institutional and financial environments, which have been a marked characteristic of less developed countries. As pointed out by a number of Latin American and Caribbean authors, problems such as hyperinflation, high external debt and high interest rates are common significant constraints to technological (and productive) development in these countries.¹¹ One main argument here is that macroeconomic contexts in less developed countries are of much greater importance than specific innovation policies. That is why they are called ‘implicit’ technology policies.¹² As stressed by Coutinho, 2003, (i) interest rates and exchange rate policies impact directly on the core of microeconomic business calculus; (ii) economies that are subject to high interest rates, as a result of their macroeconomic systems, place additional penalties on companies operating within them. And, what is worse, ‘if in addition to high levels of basic interest rates, the economy in question is classified as a country with a high exchange rate risk (*country risk*) its business sector is penalized even more heavily’ (p. 312). The point is that, under a more globalized regime, the degrees of freedom to maneuver in determining interest rate/exchange rate policy depend even more on the foreign exchange position of the economies, both in terms of stocks (position as a creditor/debtor nation) and flows (surplus/deficit in the current account).

Understanding innovation as a localized, context specific and socially determined process has important advantages for LDCs. It allows, for instance, the demystifying of ideas about the possibilities of generating, acquiring and diffusing technologies in less developed countries. It also makes clear that acquisition of technology abroad is not a substitute for local efforts. On the contrary, one needs a lot of knowledge to be able to interpret information, select, buy (or copy), transform and internalize technologies. It is worth noting that specially in a *knowledge era*, it seems at least naïve to think that in the any firm would be willing to ‘transfer’ (or to share) precisely its main strategic competitive asset. In this sense, ideas that technology is becoming a global commodity run totally against the trends observed nowadays, with the pressures to privatize and control knowledge, as discussed above.

It is worth emphasizing that it is not by chance that the approach on national system of innovation was developed in the 1980s, at the same time that the idea of a new global economy and society was spreading. The main principles of this concept also contribute to deny the hypothesis that in the “*new economy*”, technologies would become global, local and national attributes would disappear and the role of policies - in general, and government policies, in particular - would have no relevance.

One important argument here is that there is not one unique ‘model’ to be imperatively followed, and that no culture has a monopoly on the factors for successful socio-economic development. Each case must be studied according to its peculiarities, its characteristics, and the international context – with its limitations and opportunities – in order to evaluate what should be its own, specific, strategies and mode of development. These are some of the reasons why the use of concepts and parameters such as “*benchmarks*” and “*best practices*” have been criticized.

¹¹ See, among others, Girvan, 1997; Villaschi 1993; Katz, 1999; Cassiolato and Lastres, 1999.

¹² See Cassiolato 1992 and Sagasti 1978.

National and local conditions may lead to completely different paths and to a growing diversity instead of the standardization and convergence suggested by the more radical theses about the influence of globalization on national and sub-national systems. As emphasized, for instance, by Celso Furtado, *'globalization is very far from conducting to the adoption of uniform policies. The mirage of a world behaving under the same rules dictated by a super IMF exists only in the imagination of some people. The disparities among economies are due not only to economic factors but, most importantly to diversity in cultural matrices and historical particularities'* (1998:74).

As already stressed, the *knowledge era* does not result from any neutral, natural or uncontrollable progressive force. Both the upsurge and diffusion of the new techno-economic paradigm and the acceleration of the globalization process result from (and reflect) political and institutional changes which have characterized the environment of the most developed countries in the second half of the XX century. These changes have also oriented processes of deregulation, privatization and liberalization worldwide, supposedly associated to increasing needs of greater competitiveness, within an ideological framework that accepted no alternative.

As pointed out by Humbert *'the present neo-liberal promotion of globalization is a clear call for dismantling all barriers so that the nation-state territorial production apparatus of any country becomes open to any actors of the global system'*. This author also recalls and discusses the slogan *'join the global train immediately or you're finished!'* and the reactions it has provoked.¹³ Arocena and Sutz, 2003, further develop this issue, discussing the consequences for development of this hegemonic and globalized thought; exploring the challenges of avoiding both the *'integration'* and *'apocalypse'* visions; and pointing to the need to escape from this trap. They also discuss the reasons why *'Southern frameworks of thought'* developed in the 50s and 60s (*'ECLA structuralism'* and *'dependency theory'*) have not been replaced by a new holistic view, noting that *'perhaps, as hegemonic thinking would claim, because there is no need for 'regional' frameworks of thought any more. Alternatively, it is possible to claim that they are indeed needed but that hegemonic thinking makes it very difficult to build them'*.

All these points (and their further elaboration) were considered by the group of researchers who decided to start, in the beginning of the 1990s, an effort to analyze systems of innovation in Brazil. Adding up to the challenge of dealing with such level of complexity, there were the difficulties associated with that period, when the neo-liberal thesis was very fashionable leaving almost no room for concerns with national productive, innovative or policy implications efforts.

5 – Systems of innovation in Brazil: experience of RedeSist

In 1997, a research network – RedeSist – was formally set up in Brazil aiming at investigating and understanding local processes of learning and capability accumulation and putting forward propositions for their mobilization.¹⁴ The system of innovation approach was used to base the research. The aim was to target the systemic aspects that affected productive and innovative competence building systems. Of course this goes beyond the traditional sectoral view since it includes all activities and agents that interact – in real or potential terms – in a particular cognitive space. It became also clear that a particular system would function differently and require different types of support if located in the South, North or any other part of the country. Additionally, as the definition of innovation is often not very precise, we decided to target the main productive Brazilian systems and then focus on its innovation system. Therefore, our first step was to try to derive from

¹³ About these issues see also Fiori, 1995; Furtado, 1998.

¹⁴ The first research grant obtained after years of applications came from the National Council for the Development of Science and Technology and from the Organization of the American States. The latter allowed us to formalize cooperation also with colleagues from Uruguay and Argentina.

the SI approach an operational tool. As a result the concept of *local productive and innovative systems and arrangements* (LPISA) was developed.

Local productive systems are defined as productive agglomerations involving economic, political and social agents localized in the same area, performing related economic activities and presenting consistent articulation, interaction, co-operation and learning processes. It includes not only firms (producers of final goods and services, suppliers of inputs and equipment, service providers, etc.) and their different forms of representation and association, but also other public and private organizations specialized in educating and training human resources, R&D, engineering, promotion, financing, etc. We have also developed the approach on *local productive arrangements* to include productive agglomerations, in which there is no (or almost no) articulation among the agents.

Based on these concepts a compatible empirical methodology to gather information about the strengths and vulnerabilities of Brazilian productive, innovative and learning processes was developed.¹⁵ This methodological framework covers micro, meso and macro elements influencing the evolution of the arrangements. The methodology chosen was to approach the theme through the analysis of the productive and innovative capability of selected local systems; the competence structure, organizations, relations and incentives, which are more appropriate for mobilizing local innovative potentialities.

Also on the agenda was the issue of how transformations that occurred in the 90s have affected the evolution trajectory of local systems, particularly in what refers to their capacity to generate, absorb and diffuse innovations. Up to 38 case studies in different regions of Brazil, Argentina and Uruguay were produced, covering industries such as aerospace, biotechnology, automobile, textiles-clothing, leather-footwear and agro-industry.

The case studies aim mainly at:

- characterizing the local productive arrangements, their histories, main economic activities, products and services, agents and coordination structure, as well as their role and form of insertion in the international, national and local economies;
- discussing the conditions under which local learning, the accumulation of productive and innovation capabilities and effective use of these capacities occur;
- determining in what sense the type of governance, competition pattern and market structure influence the evolution of the arrangement;
- investigating to what degree the competitiveness of the arrangement is sustainable and dynamic regarding embeddedness, articulation with the local system of innovation and main competitive elements (product quality, value-added, productivity and labour);
- examining the influence of the macro-economic regime of the 1990s and of local and national, explicit and implicit policies to promote the evolution of the arrangements.

So far the work undertaken by RedeSist has produced, besides the development of the approach on local productive and innovative systems and arrangements:

- the development of a methodology for the empirical surveys, which includes questionnaires, sample and tabular plans;
- the elaboration of a glossary - GLPISA (GASPIL)

¹⁵ For details of this methodology, including the three types of questionnaires developed to base the field-work, see www.ie.ufjf.br/redesist. The results of the work developed by the research network are also available there.

- the conception of a data base and a geo-referenced system of information on local productive and innovative systems and arrangements - Sinal - www.sinal.redesist.ie.ufrj.br
- the analysis of 38 local productive and innovative systems and arrangements in different Brazilian regions (see map in Figure 1)
- the elaboration of a panel summarizing the different types, forms, location and dynamics of these arrangements, indicating strengths and weaknesses, as well as specific needs.

Advantages of the focus on Local Productive and Innovative Systems and Arrangements

We see important advantages on focusing on Local Productive and Innovative Systems and Arrangements – LPISA, as developed by RedeSist. In the first place because it represents a practical unit of investigation to deal with the complexity of the Brazilian system of innovation. Secondly because it targets the group of different agents - firms and other organizations dealing with education, training, R&D, promotion, financing, etc. - and connected economic activities that usually characterize any productive and innovative local system. Thirdly because it establishes a bridge between territory and economic activities, at the same time that it surpasses the restrictions imposed by the traditional focus on sectors, individual organizations and space (municipalities and micro-regions). Fourthly because it covers the space where the main processes of learning, capacity building and innovation take place and where tacit knowledge flows. Finally because it gives firms, promotion and financing agencies and other agents a broader view about these processes, helping to define strategies to foster them. One main argument here is that the focus on LPISA represents the space where policies to promote learning, innovation and competence building can be more effective.

However, we would stress that the focus on LPISA should not be seen as a priority for policies *per se* and that it is not a substitute for those policies that focus on sectors, productive chains, regions and individual organizations. It is rather a complement of these other foci. Our main argument is that it is a format that enhances the possibility of mobilizing industrial and technological development, by focusing on the group of agents that interact to produce goods and services and to innovate, as well as on their environment and their specific requirements. Of course the policies for the promotion of LPISA should not be implemented in isolation, but should represent the local action reflecting the priorities of national and regional development, standing for their instrumentation. In this sense it is worth emphasizing, on the one hand, the participation of the different local agents in the design and implementation of these policies; and, on the other hand, the need to articulate and co-ordinate these policies with national and regional development priorities.

6 – Final considerations

In order to summarize the discussion about the main weakness and advantages of the IS approach, we would agree with conclusions such as that of OECD, 2002, that the IS approach is not easy to implement. However, it has proved to be a very useful framework, capable of help understanding the processes of creation, use and diffusion of knowledge.

Another alleged weakness of the SI approach refers to the lack of rigor and formalism. As this paper has argued, we see its flexibility – together with its basic assumptions - as valuable attributes. It is clear that the innovation system approach was meant to be adapted to the situation of any country. It is thus flexible enough to comply with the specificities of the different cases that exist in both developed and underdeveloped countries. One observation here is that one has to be aware of the simplification of referring to countries in the North and in the South. It is well known that processes in different stages of development can be found in most countries, even those considered as more homogeneous. Of course, in all cases, there is a need to advance in the understanding of the formation, boundaries (local, national or supranational), strengths and vulnerabilities of innovation

systems, as well as the role of power relationships. However, this should be considered rather as a weakness of the research effort than of the concept.

A related weakness of the approach would include the understanding that it was created in the North as an ex-post concept and has not been applied to system building. From a different perspective, one can conjecture if such conclusion is not based on a supposition that there exists an ideal model of system of innovation to be pursued. From our point of view this is not the case. On the other hand, it can be argued that the SI approach was also developed to understand (i) the process of catching-up; and (ii) how national systems of innovations can benefit from the opportunities offered when appropriability regimes are low, which is mainly the case of the phases of changes of paradigms (Freeman, 1988, Perez, 1983).

One important argument of this paper is that the effort required to understand the new conditions for mobilizing development will certainly benefit from different contributions and approaches; particularly those capable of freeing themselves from the limits imposed by theories, concepts and indicators developed to understand completely different situations. Either in terms of social, economic and political conditions, or in terms of phases of economic accumulation. In this line it is important not to forget the alerts that author, as Reinert, 2000, make when discussing what he calls 'selective use, methodological schizophrenia and opportunistic ignorance' in the history of economic thought.

Contrarily to the 'no alternative' thesis, this paper has attempted to stress the need to understand the features of the present accumulation pattern and design new policies and regulation regimes to orient growth and development. It is recognized that policies targeting the learning issue are much more complicated when knowledge is seen as the main resource and learning the main process of development and cannot be taken in isolation from issues of economic, social and political power. Defining and implementing effective policies to cope with such a complex situation are not easy tasks. More importantly, general conditions for implementing policies significantly deteriorated in the 1990s. However, another argument here is that one main reason for the crisis of adaptation to the new patterns refers precisely to the delay in designing appropriate policies and instruments to cope with them. Hence the need of advancing towards an adequate understanding of the characteristics and impacts of the new pattern of accumulation and of designing and implementing policies, taking into account local, national and international conditions for development as well as the changes associated with new forms of governance at world level.

Therefore, the experience and the results obtained by RedeSist so far lead us to agree with the proposition of both Freeman, 1986, and Lundvall, 1985 that the development of the approach on system of innovation in the mid-1980s represents an important move in this direction. Its use has led to refinement of this analytical approach. Our main objective has not been to build new innovation systems. It has rather been to capture the particularities of those existing learning, innovation and competence building systems in order to be able to suggest the best forms to enhance them.

The research effort of RedeSist has also made clear the importance of adding to - instead of replacing - the tacit knowledge already accumulated by the groups of researchers working locally in charge of the analysis of LPISAs in different regions of Brazil. Our motto is: empirical research will always benefit from the knowledge already accumulated about the historical, economic, social and political environment of these LPISAs. This is considered as an important means of broadening the understanding of quite different contexts. Collaborating with local academic and research teams all over Brazil contributes to spread this approach, which has also a relevant operational value regarding policy making. This intelligentsia is seen as a relevant part of a system of innovation.

It is this sense that we believe that by discussing and comparing our experience in a wider research network, such as Globelics we will be contributing to the evolvement of the conceptual, methodological, analytical approaches and also theoretical insights on innovation and development research.

Map 1 Local productive and innovative arrangements analyzed by RedeSist in Brazil



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