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INSTITUTIONS AND SUSTAINABLE DEVELOPMENT

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Abstract

This article analyses recent efforts to create a different institutional framework in Pará State, Brazilian Amazon to promote sustainable development. The region is economically peripheral to capitalism. Historically, Amazon river delta has been used as source of raw materials since XVII century, but only from the 1970's, when roads were built, is been massively occupied by frontier activities like timber, mining, cattle and more recently soya beans. The economy is driven by primary activities and low technological intensive sectors (OECD indicators), not presenting diversity in its production matrix. It is an export based economy on mining (63%) of its exports and agribusiness (17%). Has two large regional hubs (Manaus and Belem) that offer better infra-structure, are trade connections and present more agglomeration effects (Lemos, 2007) however, it is not attractive to capital and technology intensive activities, and highly educated people. The region presents the lowest social, economic and R&D indicators of the whole country. Its MDG indicators (UNDP) are closer to Somalia than to São Paulo the heart of a macro cephalic country. The region suffers of, what can be called a natural-resources and green curse. Para state government, knowing its limitations in terms of competitive advantages is trying to overpass the mass-production paradigm implementing three thematic science and technology parks on: energy, biotechnology and IT; agrarian and mining sciences; fisheries and forest, in order to add-value to State vocation activities and connected 2 million people in 2000km of optic-fiber high speed internet to take from isolation peripheral areas. Although, the starting point to promote regional innovation, based on knowledge shared among economic agents is quite low as the absorptive capacity of the society is also low, there is a common belief that learning and knowledge-based economies do not exclusively occur in high technologically-intensive economies and can promote better use of natural resources. Asymmetrical interdependency among regions is contributing to maintain this lag. More recently, state government has been attentively inducing different institutional arrangements and investing in strategic research areas to promote a more sustainable development model. We discuss convergence on different Brazilian regions to evaluate the effect of the policies.

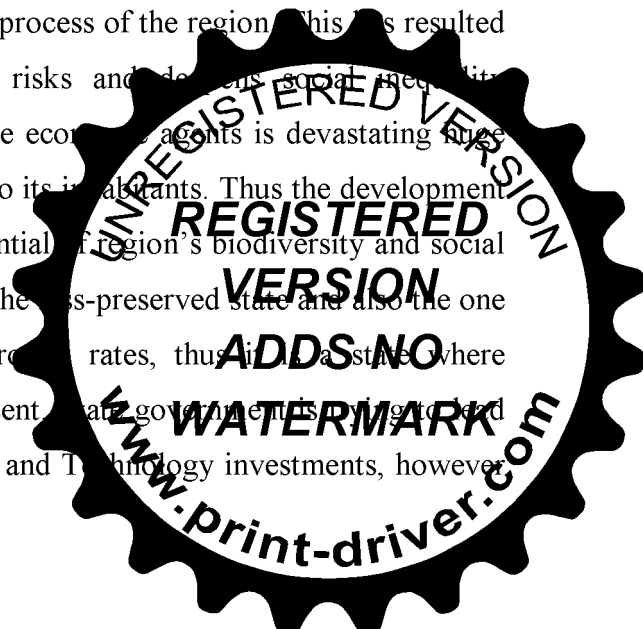


1. Introduction

This paper analyses recent efforts to implement a regional innovation system in Pará State, Brazilian Eastern Amazon. The region is socially and economically characterized as peripheral in a sense that when compared to other regions it is not attractive to capital and technology intensive activities (Krugman, 1992) and falls back. Exceptions to this scenario are economic activities that exploit natural resources such as mining, metallurgy, timber and agribusiness, although the technology used by these private is lagging behind other natural resource exploitation areas within Brazil. State economy is, thus, driven by primary and low technological intensive sectors (by OECD Indicators, 2008).

Amazon covers 60% of Brazil but accounts for only 8.2% of its total population and 6,7% of its GDP, presents the lowest socio-economic indicators of the country, the lowest population density rate. At the same time that it preserves more than 80% of its primary forests also deforests it at a highest rate in the world (around 27.000km²/year). Amazon is at the center of all discussions regarding sustainable development, climate change, gas emissions, poverty if its people. At the three levels of analysis: local, regional and international, development is expected to occur, and should be modern – that is, allying economic efficiency with social equality with special attention to the natural environment (ALIER, 1994; SACHS, 1993). Thus it is expected that public policies take this into account.

However, the institutional environment has been quite conservative to date, and has been a major obstacle to sustainable development. Agents and sectors with a development view based on commodities' trading and the metal-mechanic capitalist paradigm are those that receive incentives and conduct the modernization process of the region. This has resulted in a dynamic that presents serious environmental risks and deepens social inequalities (COSTA, 2005). The homogeneity imposed by private economic agents is devastating huge areas of forest without promoting equal development to its inhabitants. Thus the development model needs to be re-interpreted, considering the potential of region's biodiversity and social heterogeneity of its peoples. Among Amazon, Pará is the less-preserved state and also the one that has the highest immigration and population growth rates, thus it is a state where environmental and urban-rural conflicts are more present. State government is trying to lead the process through a new approach based on Science and Technology investments, however



the depart point is well below Brazilian means and the convergence efforts are just beginning. In Brazil 95% of R&D investments are public but follow the concentration ration of industrial activities and major centers, like São Paulo. Thus, public policies towards Science and Technology (S&T) and Research and Development (R&D), sources of knowledge production (universities, research institutes, and other intermediary organizations and institutions providing government and private innovation services) and firm interaction with public sector have asymmetrical interdependency within Brazil. Core states such as São Paulo and Rio de Janeiro receive more resources, attract more innovative firms, high qualified employees and researchers, and thus profit more from agglomeration advantages. As those effects are absent in the periphery, state (local) governments may play a central role in inducing S&T processes. As the *red queen effect*³ seems to apply (Van Valen, 1973) it is not clear, how to evaluate and forecast the real effects on development of this process. Nevertheless, theory and empirical data on other regions show that the *invisible hand* left alone is not helping any region to escape its peripheral condition.

2. Economic context of Pará

Pará covers an area of 1,248,000 square kilometers, comprising 16.7 percent of Brazil's total area and 26 percent of the Amazon Region. Located in the country's North Region, the state of Pará is the second-largest state in Brazil. Pará's population is 6.79 million spread throughout 143 municipalities.

Map 1: Pará State with main municipalities, technological parks and fiber optic lines.

³ The term is taken from the Red Queen's race in Lewis Carroll's *Through the Looking Glass*, where Alice is running as fast as she cans but still not enough to stay steady in wonderland.



Pará has one of the lowest population densities in Brazil: only six inhabitants per square kilometer. In contrast, the most populous state of the federation, São Paulo, has a population density of 163 individuals per square kilometer. This population consists mainly of young people. In 2005, 54.6 percent of its population was under 24 years of age. In the same year, 66.8 percent was aged below 39. Those older than 60, accounted for only 6.4 percent. About 19.5 percent of those living in Pará were not born in the state. This illustrates the impact of migration flows, mostly from the country's Northeast Region, the poorest in the country. Regarding appliances, 80 percent of households in Pará have television sets, 70.9 percent have refrigerators, 11 percent have freezers, and only 13.2 percent have washing machines. Just 7.5 percent of homes have personal computers and only 10.9 percent of the population had accessed the internet in the three months prior to this 2005 survey. In Pará, 25.5 percent of the population has a mobile telephone line.

The state of Pará has a young workforce. In 2005, the state's labor pool totaled three million people, 45 percent of whom were less than 30 years old. The average education of Pará's labor pool is very low. Only 24 percent of Pará's workforce had graduated from secondary education in 2005. The average education of adult workers (older than 18) was only 6.4 years of schooling.

Although labor employed in manufacturing still accounts for a relatively small proportion of the overall workforce in the state, it is highly productive. According to the 2004 Annual Industrial Survey, the state of Pará ranked sixth in terms of value added per worker, with productivity about 15 percent above the national average, due to its major type of production, capital intensive mining and processing activities.

Tropical forests cover 73 percent of Pará's territory. They hold a capital of natural resources and are known for their immense biodiversity. The forest offers huge potential for tapping genetic material and active ingredients, which are essential and invaluable components for the advancement of science, particularly biotechnology. The business possibilities are vast and diverse and include production of pharmaceuticals, phyto-therapeutics, and cosmetic products, as well as industrial oils and resins, to name a few. This potential, however, is not being leveraged locally. There are no important pharmaceutical or cosmetics laboratories installed nor basic research conducted, except for poorly prepared university laboratories. The only use of non-timber products is by traditional peoples who have tacit knowledge of their properties. It is easy to find several plants, roots and seeds in local markets that can be



used for medical purposes. Timber is exported with no value added, as furniture is made only for local consumption with no design or finishing concerns, thus difficult to sell to middle and high class consumers or export to other regions.

Pará has various types of soil, and its climate favors a variety of tropical crops. The state is rich in mineral resources, from iron ore to precious stones, including manganese, copper, nickel, and bauxite. But again, these mineral resources are exploited using low technology: jewels are not produced in the state and except for primary aluminum (electric power intensive) and pig-iron (charcoal intensive) there is no verticalization of mining products. Natural resources are exploited through mining, farming and cattle, products mostly exported in their natural state, with no further transformation.

In 2004, the GDP of Pará amounted to 12.3 billion Euros, and had real growth of 6.61% from 2003 to 2004, industry contributing 8.76% and mining 5.46% of said growth. *Per capita* GDP growth increased 3.87%. Industry represents 36%, agribusiness 23%, and commerce and services 41% of added value GDP. In 2004, farming and ranching accounted for 22 percent of the State's revenue, while at the national level it accounted for 9.5% as industry accounted for (18.6%) ten percent less than the national average (29.1%) (see Table 1).

Table 1: Pará GDP by sector

Industry	Pará	Brazil
Farming and ranching	22.8%	9.5%
Mining	3.5%	4.6
Manufacturing	18.6%	29.1
Utilities	4.3%	3.5%
Construction	9.9%	6.7%
Retail	5.9%	6.7%
Lodging and food	0.4%	1.3%
Transport	2.1%	1.9%
Communication	1.7%	2.2%
Financial	2.4%	2.2%
Rent	6.3%	9.1%
Public administration	18.0%	11.1%
Health and education	2.2%	1.1%
Other services	1.4%	1.4%
Domestic services	0.4%	0.5%
Total	100%	100%

Source: IBGE, 2004

Almost all economic sectors in the state of Pará enjoyed average annual growth rates above those of the Brazilian economy. Farming and cattle-ranching activities, as



well as manufacturing, had average annual growth rates of 4.83 percent and 3.07 percent, respectively, and contributed most to the state's economic growth.

Between 1985 and 2004, when the state of Pará's economy grew at an annual rate of 4.12 percent, these two activities accounted for 27 percent and 14 percent of this growth, respectively. In spite of the great importance of primary economic activities in the state of Pará, manufacturing, especially processing of mineral resources has been gaining ground since 2000 and is becoming an important contributor to the state's total output.

Within Brazil, Pará is the eighth state in exports, presenting US\$ 6.7 billion in 2006 year, and growth of 39.52% compared to 2005. It is currently responsible for 4.88% of total Brazilian exports. Its trade balance is positive with an increase of 37.70% from 2005 to 2006. Despite this positive performance, the range of exports is based mainly in low technological intensity primary products (mining and timber). Imports are mainly equipment and machinery for mining and chemical inputs to primary metallurgy (aluminum). In 2005, seven of the ten main export products were mineral and three were forest products. We are talking about 87.2% of export value and there was an increase in 2006, raising this to 89.8% in 2006. As the demand for primary products is increasing worldwide, we may expect that this value will increase as well.

From total exports of US\$6.7 billion, industry accounts for only 53.6% and natural resources for 46.4%. As equipment and logistics material to export are not developed here we may say that there is low technological incorporation in these exports. As for industrial products, using the OECD (2003) STAN indicators database, we found that in 2006, 71.31% of its exports were low-middle technological intensity industry and 27.29 low technology intensity industry (see table 2).



Table 2: Pará State exports of industrial sector per technological intensity, 2005-2006, US\$ Million FOB

Sectors	2006			2005		
	Value	Participation%		Value	Participation%	
		Total	Industrial Products		Total	Industrial Products
Total	6707603218	100.00	-	4807643832	100.00	-
Industrial Products (*)	3593917165	53.58	100.00	2417704462	50.29	100.00
High Technology Industry	3527	0.00	0.00	50338	0.00	0.00
Medium-High Technology Industry	50490861	0.75	1.40	40382341	0.84	1.67
Medium-Low Technology Industry	2562695363	38.21	71.31	1555813860	32.36	64.35
Low Technology Industry	980727414	14.62	27.29	821457923	17.09	33.98
Non industrial Products (**)	3113686053	46.42	-	2389939370	49.71	-

(*)OECD Classification, Directorate for Science, Technology and Industry, STAN Indicators, 2003.

(**) Agribusiness, fishing, mineral and forest exploitation

Source: SECEX/MDIC by DIDE/SEDECT, 2006.

Pará's primary sector export vocation is undergoing a transformation through a strategy led by the State government. Science and Technology has entered the political agenda, the first step taken was towards filling the communication gap among institutions in such a huge area. The strategy is information dissemination; digital era spreading inland into the forest and connecting isolated cities. Access to and dissemination of information – accelerated by information technologies - are believed to be the core to social change, technological progress and economic development (OECD, 1996). In a belief in the positive effects of agglomeration, three technological parks have been established in three different areas of the State. The State government is aware of its peripheral condition (Krugman, 1991) and has recently established the development strategy of the build-up of a regional innovation system in the belief that one way of catching-up with other regions is through improving human capital and science and making technology investments.

3. RIS – Regional Innovation System

A regional innovation system has been recognized in literature (Lundvall, 1992) as playing an important role in economic development policy. The rise in popularity of the concept of regional innovation systems has been partly driven by the increased intensity of international competition in a globalized economy, the apparent shortcomings of traditional regional development policies, and the need for



emergence of successful clusters of firms and industries in many regions around the world (Porter, 1998).

One result has been the rediscovery by many academics of the importance of the regional scale and the importance of specific and regional resources in stimulating innovation capability and competitiveness of firms and regions (Cassiolato *et al.*, 2003; Cooke and Morgan, 1998; Lawson, 1999, Florida, 1995). Thus, it is argued that firm-specific competencies and learning processes can lead to regional competitive advantages if they are based on localized capabilities such as specialized resources, skills, institutions and share of common social and cultural values (Lawson, 1999). In Pará, the departure point for promoting a regional innovation system based on knowledge sharing among economic agents is very low as agents are disperse and have low horizontal networking.

As a developing region and having this fabulous source of natural resources, its role in world trade has mainly been to supply primary products to advanced economies and because of this relation does not benefits from technological or knowledge spillovers. The information technology is diminishing distances and leading to better organization of the production chain, but in Para it is not propels knowledge sharing amongst actors.

However, arguing that an economy based on learning and knowledge does not exclusively occur in a high technological intensive economy, and believing that the institutional mechanisms of learning, interaction and dissemination play a distinctive role, State government is investing in mechanisms for inducing innovation, improving networking activities: connecting isolated cities over optical fiber; creating technological parks in order to promote firms and research institutions agglomeration; providing a supportive environment to innovative actors; implementing S&T scholarships and financing S&T projects; creating institutions that will analyse data to have a continuous flow of information regarding a variety of social economic and innovation indicators.

Structural barriers to innovation are present in the region as a result of several modernizing policies implemented in the past by the central government in Brazilian strategic energy and mining projects (Monteiro, 2005). They become barriers because they were based on a linear model of innovation, science and technology (S&T) that worsened the region's peripheral status (Krugman, 1991). Capital intensive projects to exploit (and primary industrialize) mineral resources and integrate the Amazon with



the rest of the country via national roads, did indeed create some development in the industry and agribusiness sector but did not promote innovation or incorporation of technology: technology and equipment was bought in and not developed locally and investments did not target human capital formation, relegating the region to a peripheral status. The state government is now trying to break this path-dependency and choose to prioritize investments in S&T. However, the path as we can see in figure 2 will take a long way to catch-up.

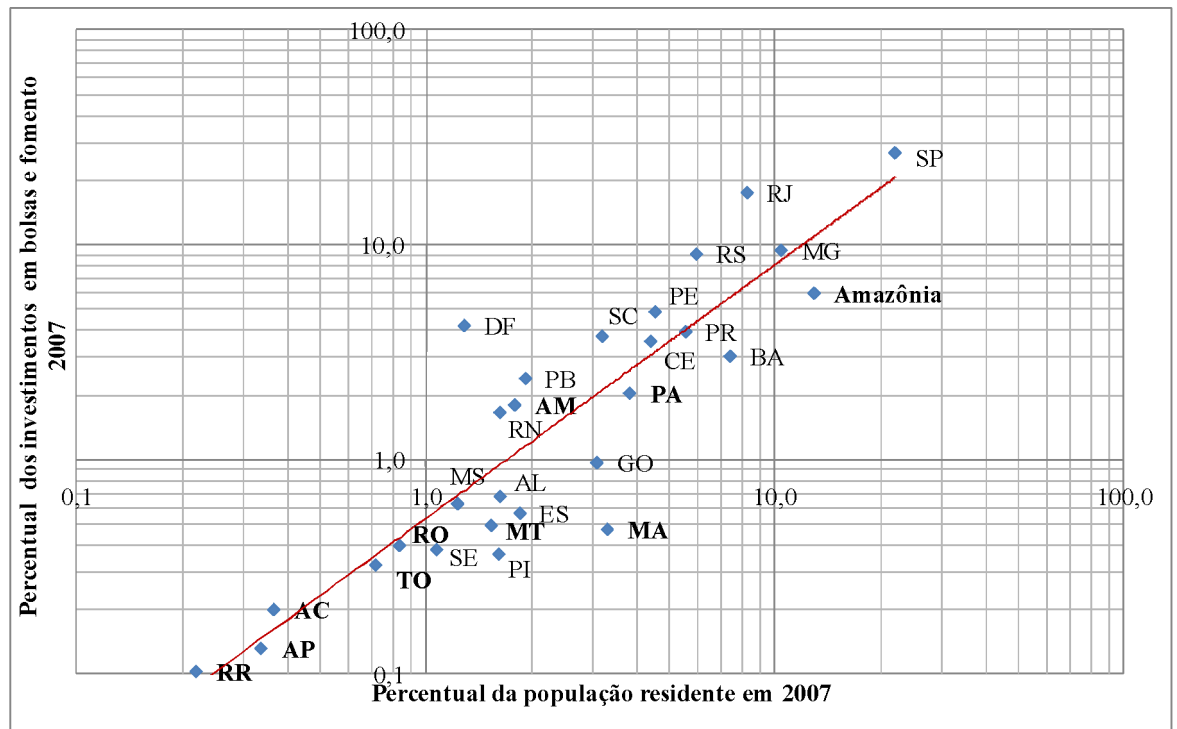


Figure 1- Figura 2 – Percent of public R&D investments to percentage of population in 2007.

Source: IBGE and CNPq (2010). PA stands for Pará State.

In developing regions, the three factors that facilitate innovation economy: *accumulativity* (territory path dependency), *specificity* (tacit knowledge) and *appropriability* (stability of the agglomeration), are difficult to find (Cassiolato, Lastres and Maciel, 2003). Another major problem is related to incorporation of technology, the rare cases of innovative activities, are mostly cases of imitation of other products or processes developed elsewhere, they are not breakthrough innovative products or processes. But even imitating organizations may stumble into a lack of capacity to comprehend the process or product they imitate. In fact, absorptive capacity is cumulative since it enhances the firm's ability to assimilate and exploit new knowledge and to evaluate the importance of new technological advances (Cohen and

Levinthal, 1990). A low level of absorptive capacity may hinder an organization's appreciation of emerging new technologies and opportunities and cause it to be more reactive. A high level of absorptive capacity will help organizations be more proactive and exploit emerging new technologies and market opportunities.

Given the internal difficulties of firms and low schooling level of workers and entrepreneurs in local agglomerations, accumulation of knowledge can be relevant, depending on the microeconomic behavior of firms, especially when they supply inputs or services to a company located in the same area. If they are located near each other, they can share different experiences of technology and management and acquire knowledge which would be impossible to develop internally (Bastos, 2001; Nelson e Winter, 1982; Dosi et al., 1988). However, as we said before, the gap between agents can be so deep in problem-solving and nature of goals, that sharing information is insufficient for knowledge acquisition (Dosi, 2001). Moreover, there are internal scale restrictions: huge distances, a sparsely populated state and low income of the great majority of urban inhabitants. External restrictions on S&T investments result in central areas continuously receiving more investments than peripheral areas. The southeast graduates 25 times more doctors than the Amazon region which contributes for only 1,1% of the doctors nationally and thus receives more research projects, register more patents concentrating more R&D activities.

Efforts to deepen technology are much greater in peripheral regions than central regions as the departure conditions and the capacity to incorporate technology are very low. On the other hand innovation costs can be lower to peripheral regions, they do not have the costs of introducing new products and imitation is always lower. Currently highly developed countries such as Japan, United States and developing countries as South Korea and China, successfully made use of imitation and reverse engineering techniques to catch-up with what were at the time centrally located.

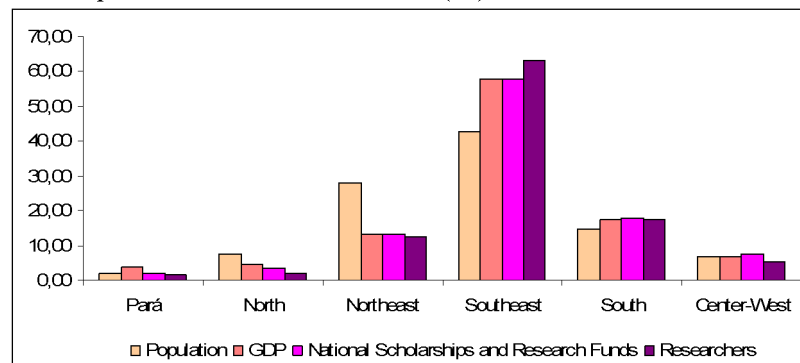
Regional innovation systems are viewed as a catalyzer of development, creating a culture of innovation so that regions may learn to be self-sustainable. Public and private sectors work hand in hand leading to a process of networking and partnership to perform joint actions. The greatest advantage of this system is that can be implemented in any region, as regional actors take part in the process and are the ones to establish their goals, action strategies and pace of innovation. Thus, regions lagging behind have a chance of establishing a policy to catch-up with others that are more advanced and increase the pace of their efforts. As richer regions usually invest in S&T at higher rates



poor regions must accelerate more to at least keep abreast, the so-called *red queen effect*,⁴ (Van Valen, 1973). For an evolutionary system, ongoing development is needed just in order to maintain its position in relation to the systems with which it is co-evolving.

As we can see from figure 1, the North region has a long way to go in order to catch-up with the Southeast region (the most highly developed in Brazil). National investments in S&T are much higher in the Southeast than in other regions. The region is home to important research laboratories and has both high technology industries such as aeronautics, the space center and pharmaceuticals, to low technology industries such as textiles.

Figure 1: Regional participation in total population, GDP, total national investments in research and scholarships and total of researchers (%)



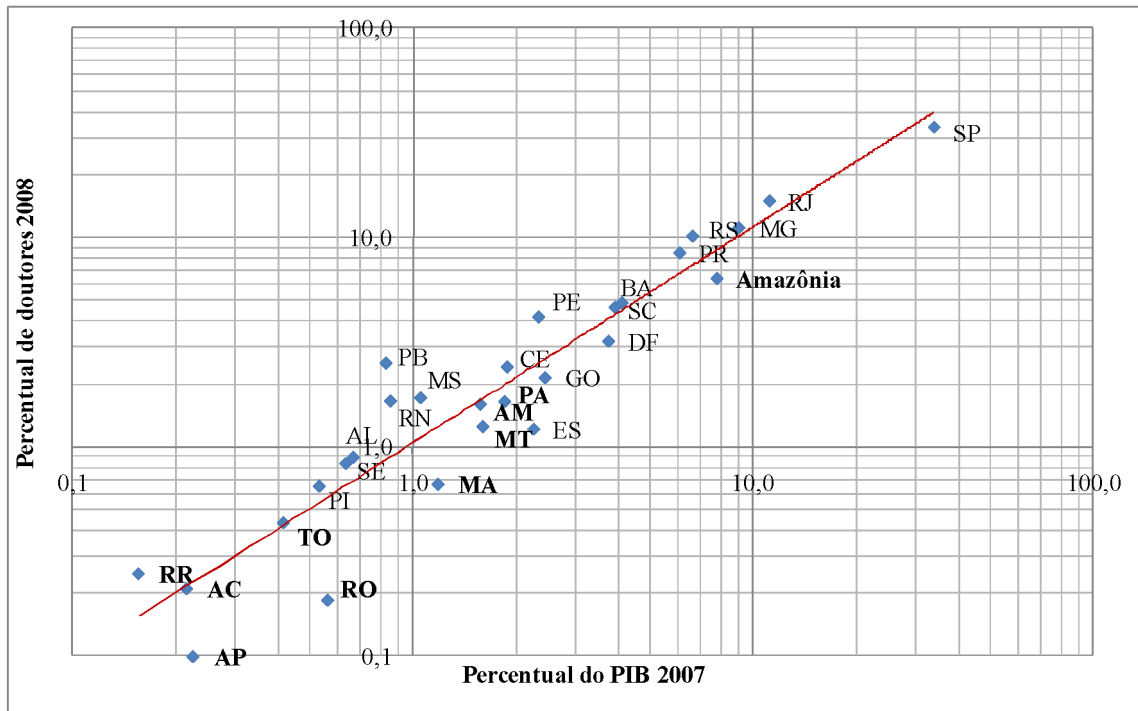
Source: CNPq (National Council for Scientific and Technological Development), 2006

Thus, if national funding institutions distort and maintain regional asymmetries, state and local governments, in cooperation with universities and other research institutions, along with the private sector need to define catch-up strategies, throughout investments and creative solutions to innovate and promote development.

Figure 4: Selected State investments in S&T related to GDP, State budget and number of PhDs, 2004

⁴ The term is taken from the Red Queen's race in Lewis Carroll's *Through the Looking Glass*, where Alice is running as fast as she can but still not enough to stay steady in wonderland.





In general we observe that all States invest a very low percentage of their GDP and state budget in S&T. Here States were selected that invest relatively higher rates in S&T. We can see that the South (Paraná) –Southeast (Minas Gerais, Rio de Janeiro, São Paulo) axis concentrates a higher number of PhDs but they also invest more in S&T. In general, although investments are increasing and the number of PhDs has doubled from 2000 to 2004, inequalities have been maintained. Public investments (national and state) in the S&T systems of peripheral states has resulted in a higher increase in the number of PhDs and research funds than in central states, even though said growth rates are insufficient to reach the same number of PhDs, and therefore benefits of agglomeration are lower in peripheral areas than in the central states.

To promote development and drive innovation, a regional innovation system methodology predicts that public sectors should interact with private firms. Universities are a key part of the science base, and therefore a key ‘framework condition’ for innovation. Regarding this interaction, firms that innovate and have demands for public infra-structure to develop internal R&D are sought. Findings showed that a great majority of firms do not perform R&D (from 5 to 10%), half of them do it continuously and demonstrate a low demand for universities as partners in their innovation efforts.

Table 4: Industrial firms, innovator firms, firms that perform R&D continuously, selected states, 2003

States	Industrial Firms	Innovator Firms	Firms that perform R&D	Firms that continuously perform R&D			
				Total	Firms that consider Universities as important sources of information	Firms that consider Universities as unimportant sources of information	% of Firms that consider Universities as important sources of information
São Paulo	29,650	9,209	2,212	1,173	306	867	26.05
Rio Grande do Sul	8,273	3,304	736	357	84	272	23.69
Santa Catarina	6,915	2,480	480	244	49	195	19.98
Minas Gerais	10,028	3,503	410	180	80	100	44.55
Rio de Janeiro	5,468	1,367	273	134	31	103	23.17
Paraná	7,057	2,607	354	121	19	103	15.33
Amazonas	530	203	51	38	16	22	42.66
Bahia	1,928	641	60	29	8	21	27.80
Pernambuco	1,674	485	39	26	11	14	44.54
Goiás	2,221	737	53	23	10	13	43.56
Ceará	1,785	603	27	15	8	7	54.03
Pará	1,106	378	46	15	9	6	59.58
Espírito Santo	1,776	645	51	12	4	7	37.27

Source: PINTEC, IBGE, 2005

In São Paulo nearly 30% of firms are considered innovators, some 10% perform R&D, and about 5% perform it continuously. For Pará, although we found lower rates for all categories, the major problem is in the absolute numbers, which are hugely different and here is where we lose the agglomeration effects. If only 15 firms perform R&D continuously, agglomeration effects are very weak and RIS inductors also need to motivate managers and entrepreneurs as to the importance of internal R&D, and of their role in implementing a culture of innovation. There is also a need to stimulate the demand for innovation, current innovation policy over-emphasizes supply. In emergent economies there a market lack in the incentives to invest in technological development. Multinational firms draw R&D investment and innovative activities in core countries and to emerging markets such as China. Local firms need to know that global markets consist of global customers, and innovators need intimate knowledge of their detailed requirements. And those smaller firms that supply the material giants may gain access to innovation through supply chain linkages.

4. The Regional Innovation System of Pará



The local state government is implementing its RIS due to belief in its role in regional development. Concerns over the environment and sustainable development are also present, as former development models have been devastating the forest and increasing social inequalities. The proto-capitalism installed in region based on the metal-mechanic paradigm has proven to be inadequate in addressing the new information-knowledge based capitalist paradigm. The networking role of the regional innovation system, bringing together diverse institutions and actors, should be able to overcome some of the state's structural weaknesses. We argue that innovation policy is greater than science and technology policy. Many areas of 'traditional economic policy' need to be aligned to promote innovation. The two major policy modalities for influencing the degree to which Pará integrates into innovation systems are: (a) innovation framework conditions, which influence the relative attractiveness of the State as a location for innovation-driven businesses in general; (b) specific targeted policies designed to address particular *market and/or 'system failures'* in specific processes of innovation.

As the starting point is structurally very low, there were several actions to consider in the conception and implementation of a state RIS that play a decisive role in innovation strategy: (a) training and maintaining researchers in applied science in the main production chains of the state; (b) building information technology infra-structure; and (c) building science and technology park infra-structure.

A Foundation⁵ was set up to provide financial support to S&T in coordinating and supporting applied research : distributing research funds to breakthrough research projects; providing graduate, post-graduate and junior researcher grants to maintain them in the state; supporting technical training in remote areas in Pará, etc.

With its continental dimensions and poor infra-structure network, hinterland Pará is highly isolated. Thus it is very difficult to share information and services (health, education, security) as well as among private firms. We need a good information-sharing structure to create an environment favorable to incorporating technology and innovation in processes and products, enhancing competitive advantages of firms, facilitating agglomeration of companies and increasing access to national and international costumers and proceedings, electronic governance and enhancing human capital through more training and educational tools. Building an

⁵ Pará is one of the few states that did not have a government foundation to provide financial support to R&D and S&T.



entire new structure of information network would have been time-consuming and beyond the state budget. Therefore, the government is working together with a state-run hydropower plant⁶ company which had a huge under-utilized fiber-optic network in order to bring internet to quasi-isolated areas, especially during the rainy season when roads become impossible to use (see map1). In the regional center cities around the state, the government is investing in public and free LAN-houses (information access to the poorest), digital inclusion of hospitals, schools, public services, unions, industrial and commercial associations and so on.

On a different front, the state is also creating three thematic science and technology parks (the first to be built in the State), see map 1. Guamá STP in the capital, inside the federal university, working on energy, information and communication technology and biotechnology. Tocantins STP in the city of Marabá (southeast): mining technology and new materials, agribusiness research and forestry. Tapajós STP in the city of Santarém (west): mineral geology, tropical agriculture and forest products, fishing and fish farming.

As the science and technology policy of state government is in its initial phases it is difficult to foresee its effects on regional development in light of the limitations presented above, but we are positive that breaking away from the former path is highly likely to succeed at improving people's living conditions through the establishment of economic agents and institutions. Because the convergent efforts on policy and investments have only 3 years calculations for *β -convergence* gave insignificant results. As well those that measure by regression and *log-log* the influence of R&D investments on economic growth by a panel of 27 states 8 years observations.

Moreover, economic growth arrived in the region without the interdependence of local institutions and theory states that institutions are important to promote economic development (North, 1990). Thus, government is in the process of creating institutional arrangements to promote agglomeration effects that may spread a culture of innovation.

5. Concluding remarks

Concluding remarks are on the challenges of the current government in forging links of cooperation between firms, government, universities and other R&D institutions, for the

⁶ The current largest hydroelectric power plant in the world is located in China. Within a few years the largest will be in China.



creation of technological parks and promoting of regular encounters among innovation agents. As can be seen throughout this paper, the region is lagging far behind other regions within Brazil and thus other global innovative regions. The starting point is very low, thus, leaving the process to work through the market's *invisible hand* has lead the state to an economy based on exploitation of natural resources without any concern to its socio-economic development. Literature demonstrates that agglomeration effects are more than formal meetings between agents and that sharing the same space enables exchange of information among agents and may induce innovation (Dosi, 2001; Nelson and Winter, 1982). However, to incorporate and assimilate innovation and technological knowledge, agents must comprehend them and have absorptive capacity (Cohen and Levinthal, 1990, Bastos, 2001). Otherwise, the knowledge gap can be so wide that firms are unable to develop competitive capabilities. In peripheral areas with low cognitive structures within its agents, the state needs to furnish the initial impetus in order to develop endogenous innovation.

Brazilian central government development strategies “use” the state and the entire Amazon region, except for the Manaus industrial district, as an escape valve for its historical land conflicts (giving land to poor landless people) and its balance of payments, through the region's exports of natural resources. Again, except for Manaus, several industrialization policies adopted by central the government basically ignored the region: from Import Substitution Industrialization (ISI) policies and expansion of the role of the commodity futures exchange as a tool for development in the 1950's to a more recent neoliberal industrial policy. This fact, together with an absence of any regional industrial policy, has resulted in an absence of infra-structure investments as well as investments in education, science and technology. Major infra-structure investments: Barcarena industrial district to produce aluminum (60km from the state capital, Belém), railways and river ports are associated with mining and the Amazon export logistics, thus external to local needs. Pará plays an important role in the Brazilian trade balance and as source of hydroelectric power.

The State government is taking a different approach toward promoting science and technology, by building-up information sharing facilities, computer regional centers throughout the state over a high speed broadband network, and establishing three technological parks, decentralized from the state capital metropolitan area. Theory and empirical data have shown that building endogenous innovation structures in a peripheral region, as a catch up strategy towards the more developed regions, involves



greater efforts and leadership from state policy, as these regions are less attractive to private investments but regression models gave no significant results.



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