**Policy design and implementation towards national systems of innovation – some evidence from the Brazilian case**

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## 1 – Introduction

This work is based on the dissertation: "National Innovation Systems: policy formulation in the OECD and Brazil", approved by the Pos-Graduate Program in Economics at the Federal University of Espírito Santo – Brazil. However, the focus of this paper is on the current constitution of the Brazilian National Innovation System (BNIS).

The theoretical approach with respect to national innovation systems used here follows the contributions of the Aalborg school. They emphasize the importance of government action in encouraging the interaction between agents, and learning-by-interaction as a way of decoding tacit knowledge. Learning processes arising from the interaction between agents is a basic component of the incentive and the creation of innovation in a systemic and broader level. They also put emphasis on processes of policy learning, which over time would lead governmental to refute innovative mechanisms that block associations.

Bearing that in mind, the paper analysis the Brazialian n.s.i. Brazil, as it is known, has had its process of industrialization and promotion of technical progress, encouraged from the 1930s with the process of import substitution. And since that time formed an important institutional/organizational structure that has permeated its policy of S,T&I. But that, as will be shown below, has had some difficulties promoting interactive and comprehensive systemic associations in scope to the country's socio-economic formation as a whole.

This article is organized in five sections. This introduction; the theoretical basis of national innovation systems; the section in which an analisis is made of the current Brazilian national innovation system; the fourth section on success stories exist in the Brazilian national innovation system; and the final considerations.

## 2 - Theoretical Contribution: National Innovation Systems

According to Lundvall (2005), from the 1980s begin to appear different studies that put a central role in promoting innovation as a way of developing the nations. Such works that

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[2]The author thanks comments and suggestions made by Prof. Arlindo Villaschi, under whose supervision her master's dissertation was written.

were developed in parallel in different parts of Europe give rise to the concept of national innovation system.

For Lundvall et. al. (2003), despite differences in approaches to NIS, which are often the result of own experience and origin of the analysts, there is common ground between them. The congruence is established: i) acceptance that countries, regions and sectors have idiosyncrasies, the stabilization of the production, trade and knowledge, which are modified over the time through learning, ii) existence of knowledge tacit, not easily transmitted between countries, regions and sectors, iii) argue that: *"The relationships may be seen as carriers of knowledge and interaction as processes where new knowledge is produced and learnt. […] Perhaps the most basic characteristic of the innovation system approach is that it is 'interactionist'"* (LUNDVALL *et. al.*, 2003, p. 5).

For Lundvall et. al. (2003) the perspective of national systems of innovation is: holistic, interdisciplinary, historical, evolutionary, emphasizes the interdependence and nonlinearity. It is an ample vision that tries to include all of the determinants of innovation, including non-economic factors (social and political) using the perspectives from other disciplines in the social sciences. It is historical and evolutionary, because the processes of innovations are developed and modified over time, and influences their trajectories, and it is interdependent and non-linear because the firms do not innovate in isolation, they interact with other firms, with development institutions, with universities, with government policies.

Another concept shown in the approach of national innovation systems is the institutional learning, highlighted by Johnson (1992). In this perspective, the nations should develop the ability to refute habits and rules that prevent innovation. Through interaction over time can be seen cultures that stimulate the technical change, these should be encouraged by the nation, while the opposite should be avoided. Then connects to the intrinsic learning in innovative processes, with the institutional context in favor of NIS approach, which is now characterized by: *"[...] a 'national system of innovation' simply means all interrelated, institutional and structural factors in a nation, which generate, select, and diffuse innovation."* (*Ibid*., p. 39).

The approach of national innovation systems is essentially systemic, interactive, based on capabilities and learning processes. A view that emphasizes cultural and institutional aspects and therefore, it considers it essential to the role of the nation state. Because the notion of institution is eminently national, regions and sectors are not autonomous in institutional terms, are subjugated to the institutions at the national level.

Other important contributions on the study of national innovation systems, but applied in cases of developing countries, are the contributions of Viotti (2002), which deals with the importance of innovation diffusion and the formation of national systems of learning. And Arocena and Sutz (2000, 2004) in their emphasis on capabilities and training of interactive learning processes.

According to Viotti (2002), developing countries should be evaluated in terms of national learning systems. *"The dynamic engine of late industrialization is, then, technological learning, rather than innovation."* (*Ibid.*, p. 658). In the analysis, the author suggests what matters for developing countries is the diffusion/absorption of innovation that takes a central role, instead of the innovation itself. *"The processes of technical change of industrializing economies are usually limited to the absorption and improvement of innovations produced in the industrialized countries."*(*Ibid.*, p. 657).

Other authors with important contributions about policies that converge with NIS are the Uruguaians Rodrigo Arocena and Judith Sutz. These authors concentrate efforts in implementing the NIS approach, and alternatives to this, in developing countries and in specific analysis for Latin America, in an approach that places key importance to the diffusion of innovation. And, therefore, use the expression of innovative circuits, comprising mainly the interaction between two types of agents in which one of them would have a problem and the other the potential ability to solve it, in a vision inspired by the National Innovation Systems approach.

Innovative circuits are more frequent in developed countries, in which conflicts of personal and politic interests tend to act less strongly on the cooperation between sets of agents. In this case, those circuits are usually successful, and the solutions arising in the interaction between agents diffuse and end up including and covering other actors. Thus form "interactive learning spaces". (Arocena and Sutz, 2004)

One the other hand in less developed countries usually the circuits that establish remain isolated, what makes innovation fail in its diffusion and not to form those interactive learning spaces. In contrast, developed countries are mostly rich in these types of space, which produces divisions of learning and it is linked with both capabilities as with opportunities (Ibid.).

For Arocena and Sutz (2000) learning is the term more convenient to be used for the study of innovation activities, because, it can more accurately convey the idea of acquiring

knowledge, whether formal or tacit, and to find solutions to different problems. Thus term "learning society" replacing "industrial society". In which: "*Learning societies, that is, societies where interactive learning spaces are easily created, are bound to have well-articulated relationships between universities, industry and government* [...]"(AROCENA and SUTZ, 2000. pg. 13).

**3 - The institutional dimension of the Brazilian national innovation system**

From this theoretical background can follow the analysis of how Brazil has historically been using, or not, policies that encourage innovative associations between agents.

In this analysis, it is clear that Brazil has historically relegated policies of innovative culture, because the policies that prevailed between 1930 and 1980 encouraged as a priority to industrialization, but most of the time without proper encouragement of interaction between firms and government spheres. And with regard to stimulating innovation has plans only in the early 1970s.

Jaguaribe (1987), highlights that it is only with the Strategic Development Plan (SDP), between 1968/70, which established a plan with specific strategy for the development of national science and technology. This was a program of scientific and technological capability, associated to an industrial strategy, which emphasized that the "process of substitution of importations" of industrial products was not enough to guarantee development. It was also necessary to promote a program of substitution of technology, in order to adapt imported technology and gradually develop internal technological capabilities (JAGUARIBE, 1987).

The First National Development Plan (I PND), between 1969-74, brought elements of continuity to the SDP, but it chose priority areas: nuclear energy, space research, oceanography, technology-intensive industries, infrastructure technology and agricultural research, in which companies, both public and private which were the central agents of the plan incorporated innovations through the transfer of foreign technology for national adaptation. The main source of funds came from credit lines offered by BNDE (National Bank for Economic Development), extending the benefit equally to domestic and foreign companies. So the innovations were brought by large multinational companies that dominated more dynamic sectors, but there was not internal generation of technologies, making it difficult the rooting of such culture in the agents, because there was not interaction between multinationals and local firms. (JAGUARIBE, 1987).

These segmented actions without integration between firms from different sectors and even less between local firms and multinationals, put the path of Brazilian industrialization against to the formation of a national innovation system. This policy option encrusted in the industry the dependence on imported goods or on property of multinational corporations, because it was not rooted in the local business community innovative and interactive culture.

This option is contrary to an interactive view, and it can also be seen on the analysis of the organizational structure of that time. In the 1970s was created the National System of Scientific and Technological Development (SNDCT), in which participated two hierarchical groupings: i) concentrated around the National Fund for Scientific and Technological Development (FNDCT), the core system, with financial functions (FINEP (Financier of Studies and Projects)/ FNDCT ), coordination and programming (CNPq), and representation of interests; ii) the structure of government, different ministries. The inter-relationship between the two hierarchical groups occurred only by the flow of financing and preparation of plans by the CNPq. But neither FINEP nor CNPq had specific control over the allocation of resources, which was responsibility of the specific spheres, ministries, not being controlled by SNDCT. (JAGUARIBE, 1987)

But within that structure less integrated some important cases are still observed, in which has exhibited relatively international success, in technological terms . It was during the II PND (1975-79), in which the adoption of industry and technology policy was considered essential to the competitiveness of the Brazilian economy and to build a modern industrial society. In its application, stand out mechanisms of market reserves, strengthening the capacity of R&D in telecommunications, institutional and financial support for activities in R&D, creation of research laboratories in enterprises and institutes of R&D and promotion of research in universities (VILLASCHI, 1996).

In those successful cases , it is clear that, as the approach of Arocena and Sutz (2000), the interactive spaces were isolated at the borders of these specific sectors. In these sectors there were interaction between firms, between enterprises and universities, with the government; but such stimulation did not expand beyond those sectors.

This success displayed primarily by policies of informatics and telecommunications, but that by the end of the 1970s saw their resource decrease, because the severe debt crisis that began giving theirs first signs.

According to Villaschi (1996) the year of 1979 defines the last government change under military regime, as well the change in schedule and economic debates in the country. From 1979 the economic debate let to be related to the industrialization and started to focus on subjects around inflation control, external debts and fiscal crisis of the state.

According to Villaschi (2005), until the 1990s Brazil had been inserting well in techno-economic paradigm that appeared, the ICT, considering that the information technology and telecommunications sectors showed relative success and through the country's political redemocratization it was expected a positive insertion in the new paradigm. But that, in fact, it did not happen, due to the negligible performance of investment in science and technology, as well as the economic liberalization process that did not bring itself enough productive foreign investment in the areas in which it was necessary. "Moreover, in the institutional domain, a strong belief in market forces by government officials led the country to adopt 'non-policy as policy'". (Villaschi, 2005, p. 4)

Moreover, in Brazil of the 1990s there was a malignant[3] macroeconomic regime, to scientific and technological development, by combining high interest rates, overvalued currency, weakening Brazilian industry (Coutinho, 2003).

In the 2000s, with economic stability there was room for further discussions aimed at the scientific and technological development of Brazil. Initially in one more organizational view than the approach of NIS. Emphasis of this, is that in the early 2000s the political vision of S&T has focused on restructuring actions of the MCT (Ministry of Science and Technology), the creation of sectorial funds, Pintec (survey on technological innovation), regulatory, and other devices that emphasize the importance of organizations consistent, rather than a systemic and interactive approach.

This paper emphasizes that the actions of MCT were more concerned with the vision of supply (especially resources and programs) and less concerned with the demands of society and with fostering more direct interaction between agents.

Among the changes that show the organizational issue was the installation of S&T sectorial funds, created in 1999 as instruments for funding research projects, development and innovation in Brazil.

[3] According to Coutinho (2003) macroeconomic regimes that combine high interest rates, overvalued exchange rates are considered malignant. This is because both prejudice domestic production, the more expensive credit, such as international competitiveness, discouraging exports and encouraging imports of foreign similar. On the other hand benign macroeconomic regimes are those that combine low interest rates, devalued currency, common in countries with strong international competitive position, Japan's case in much of the 1980s.

Currently there are 16 funds, 14 in specific sectors and 2 horizontal ones. Its resources come from royalties from exploitation of natural resources belonging to the Union, plots of industrialized products of certain sectors and CIDE (Contribution for Intervention in Economic Domain) incident on values that reward the use or acquisition of technological knowledge and/or transference of technology abroad, which are allocated in FNDCT and managed by FINEP[4]. (FINEP, 2011).

However, it should be stressed that in the case of sector funds it is noticed some elements of political/institutional learning. That is so because in 2004 was created the Committee to Coordinate Sectoral Funds (CCFS) in order to coordinate the sector funds and the two transversal actions, created from that moment. Transversal Actions CT-infra (it is the S,T&I infrastructure) and CT-Verde-amarelo (fostering university-industry interactions and innovation in small and medium enterprises), they use 50% of the resources of each other 14 sector funds, and should undertake activities that cover all these. It is a way to integrate actions and sectors, but at the same time put more resources available to areas considered strategic by the government.

Another important change was the installation of Pintec (survey on technological innovation), which despite some problems, has captured important quantitative and qualitative information about innovation activities in Brazil. IBGE (the Brazilian Institute of Geography and Statistics) conducts the survey with support from FINEP.

The preparation of the questionnaire of Pintec is based on the Oslo Manual, OECD. Pintec constitutes, from its first edition in 2000, the main source of data on innovation in Brazil, allowing international comparisons mainly with OECD member countries participating of the CIS (Community Innovation Survey). The frequency of Pintec, is biannual, and is thus subdivided: 1) Pintec 2000 presents data on the period 1998-2000, 2) Pintec 2003, includes data from 2001 to 2003, 3) Pintec 2005, explores the period from 2003-2005, 4) and Pintec 2008 presents data from 2006 to 2008 (IBGE, 2010).

In the first half of the 2000s other changes occur, in more organizational perspective, that should not be unmerited because just inaugurated an era of concern about the incentive for innovation. There was a major challenge to break with more than 20 years tradition of no-policy for S&T, and the first plan that had such a mission was the Industrial, Technological and Foreign Trade Policy (PITCE) between 2004 and 2008.

[4] With the exception of FUNTTEL (Fund for the Technological Development of Telecommunications) which is managed by the Ministry of Communications.

Among the main results of this policy was the establishment of a regulatory framework with the promulgation of the Innovation Law (Law No. 10973 of 02 December 2004). According to Morais (2008), the Innovation Law establishes the criteria for interaction between research institutes/public universities with institutes/private companies in order to promote the development of scientific and technological research. And the establishment of the Good Law (Law No. 11196 of 21 November 2005, through which the tax incentives for the practice of R&D in private companies are regulated).

The PITCE was articulate on three levels: 1) Horizontal Lines of Actions – innovation and technological development, increasing the competitiveness of companies, external integration, encouraging exports of higher value-added, industrial modernization and in institutional\capacity environment and productive scale, dynamics of supply chains and clusters; 2) Strategic Options – semiconductors, software, capital goods, drugs and medicines; 3) Future Activities – biotechnology, nanotechnology, renewable energies and biomass. It is characterized differently of the actions undertaken so far by not showing the protectionism of years 1960/70/80 and the fragmentation of the 1990s. (ALVAREZ, 2006; MORAIS, 2008)

PITCE positive point was the fact that it elects strategic areas which is transversal,ie, that can potentially benefit many sectors.

On the other hand, Villaschi and Felipe (2008) highlights the PITCE difficulty of effecting:

> *However, the PICTE is facing difficulties in transforming the policy's guidelines into concrete results. The main difficulties are comprised in two pillars. The first refers to the already old problem of lack of coordination among the governmental institution that define the guidelines and finance the innovation programs and the private companies that implement and incur in the risks of the innovation process. The second is the absence of coordination between the objectives and results of the macroeconomic policy adopted and the objective of the policies that involve industry, commerce, technology and the SNIB* (VILLASCHI and FELIPE, 2008, p. 17).

FIESP (2005) points out that the PITCE priorities and objectives lacked of greater objectivity and achievement, and a lack of actions that act directly on the institutional aspects that hamper the development of SNIB as information asymmetry and low cooperation and association between small and medium enterprises.

The plan after PITCE was the Plan of Action on Science Technology and Innovation (PACTI), which ran between 2007 and 2010.

This plan had as priorities the strengthening of the interaction between the spheres of government actions S,T&I. It is connected directly to the Ministry of Science and

Technology, but interacts with other spheres of government, is part of PAC policy (Growth Acceleration Plan). And it interacts with the PDP (Production Development Policy).

Emphasis must be given the importance of designing such a plan, to share goals. Something totally in accordance with the propositions of the NIS approach, of integration between spheres of government. This policy can be seen as a change in Brazilian S,T&I policy, a maturity and a sign of presence of institutional learning. However, their results still seem somewhat detached from its wording, as will be seen below.

The PACTI was established with four strategic priorities, in 21 lines of action. Its resources were thus distributed between different strategic priorities: 1) expansion and consolidation of SNCTI (National System of Science, Technology and Innovation), 22.7% of resources, 2) promotion of technological innovation in enterprises, 45.4%, 3) R,D&I in strategic areas 29.3%, and 4) S,I&T for social development, 2.6% of total resources, according to MCT (2007a). That is, the promotion of technological innovation of the firms was the priority of PACTI, receiving nearly half the resources for the plan. And it is precisely in this priority action that PACTI has greater interaction with the PDP, whose main points of action, as MCT (2010b), were: raising the innovation capacity of the productive sector and strengthening of micro and small enterprises.

Therefore, a major instrument is the SIBRATEC (Brazilian System of Technology), established in 2007 by Decree No. 6259 and whose mission is to create an environment favorable to technological innovation in enterprises, which is held by of innovation technology centers, and technological extension services in various sectors and regions of Brazil (MCT, 2010c).

Regarding programs is highlighted Prime (First Innovative Company), which came into operation in early 2009 and which supports the process of creating and developing innovative businesses through non-reimbursable funds to be contracted directly by hatcheries accredited by FINEP to companies selected by the program.

The main programs of subsidized credit in effect for PACTI are the “Inova Brasil”,that between 2007 and 2010 supported 213 projects in an amount of R$ 4.2 billion; and “Zero Interest”, both managed by FINEP, which finances between R$ 100,000 and R$ 900,000 in value up to 30% of gross operating revenues of micro and small innovative companies, in a repayment term of 100 months, with a refresh rate equal to the monthly monetary variation of IPCA plus 10% spread rate, which will not be charged to businesses who pay their

installments on time. Between 2007 and 2010 the “Zero Interest” picked 60 projects,a total of U.S. $ 33.1 million

Moreover, the government encouraged the states also to adopt their own laws to encourage innovation. According to the report of the MCT (2010b), in October 2010 fourteen states had enacted state innovation laws (Rio Grande do Sul, Santa Catarina, São Paulo, Rio de Janeiro, Minas Gerais, Espírito Santo, Goiás, Mato Grosso, Amazonas, Ceará, Pernambuco, Alagoas, Sergipe and Bahia). Two had laws in processing (Mato Grosso do Sul , Distrito Federal), and three states were preparing drafts of innovation law, in analyse phase by their respective legislatures (Pará, Maranhão and Paraná).

Also, between the results of PACTI stands out: the installation of the National Institutes of Science and Technology (INCTs), launched in 2008 by CNPq (and which have the strength to organize groups of R&D network, coordinated by institutions of excellence in research and training of human resources); restructuring and expanding the Institutes of Scientific and Technological Research of the MCT, which are engaged in scientific and technological research in strategic areas such as biotechnology, nanotechnology, environment and sources of energy, agriculture and health.

However, despite those important results, the Brazilians S,T&I plans still have important shortcomings.

Viotti (2008) notes that one of political difficulties of S,T &I in Brazil, is that it still has a strong academic bias, and has difficulties to operate in conjunction with private companies. It is observed that there is still a lack of synergy that hampers the achievement of established goals.

Traditional policies of S&T basically involve universities and public research institutions, while in the center of innovation policies are companies. Unlike teaching and research institutions, that have main goal the production of scientific papers and training of human resources, the companies produce and market goods and services and aim to profit. Either the differences in nature or the long tradition of institutionalized practice, public agencies have the facility to handle, support and encourage educational institutions and research, but much difficulty for doing something similar directly involving companies. Such difficulty has appeared in a remarkable way in efforts to implement the new policy instruments that are specifically aimed at promoting innovation, such as, for example, of economic subsidy and the use of direct ordering of products or innovative processes. Even

with advances in legislative matters, there are few public policies that guarantee and promote the access of innovative products in the market. (VIOTTI, 2008).

Specifically about the PACTI, a major criticism is that it brought high expectations with respect to possible increments in the levels of scientific and technological development in Brazil, but it did not change the methods for that to happen. The fact is in Brazil there still is a gap between what is a priority for its S,T &I policies and the financial resources allocated for it. (GRYNZPAN, 2008).

The current S,T&I Brazilian policy is the National Strategy of Science, Technology and Innovation (ENCTI) connected to the MCT and intertwines with the Plan Brazil Biggest from MDIC. The biggest challenge of such policies is to turn their goals, and the previous plans, the increased levels of innovation by firms into reality. Although the plans demonstrate that innovation are increasingly incrusted in the agenda of government action, and its stimulus for companies, the numbers still show that it has been accomplished in a very shy way.

According to data from MCTI-CGIN and MTE-RAIS, the percentage of people employed in R&D activities in relation to total employment in Brazil was between 0.88 (2000) and 1.06 (2010). Expenditures in S,T&I in Brazil ,in percentage to GDP ranged from 1.30% in 2000 and 1.66% in 2010.

In spite of these indicators are not so efficient to evaluate a national innovation system, according to NIS approach, it is used here in order to give a rough idea to the reader of what is taking place in the country´s system of innovation. Moreover, according to the plans of S,T&I it can be seen that a major means to stimulate innovation is through financial resources, which through the data mentioned above does not seem to be as significant in relation to the Brazilian GDP in the period.

Data from MCTI-CGIN also shows that public and private spending have been very close (in 2010 the percentages are 0.9% of GDP to public expenditure and 0.77% for business expenses (joint ventures and private)). But such data are present much below those observed in most OECD countries, in which business expenses exceed largely the public spending on innovation.

However, it is noticed that is exactly one of the main goals of ENCTI (2011-15). And that chooses as a priority area the human resources training, primarily through the program “Science without Frontiers”, which is held in partnership with the Ministry of Education and the private sector. This program awards scholarships abroad (more than 100 000 in total), thus

becoming a form of exchange of Brazilian students the best education institutions in the world and bringing new knowledge to the technological development of Brazil. Besides, it forecasts the increasing of resources from BNDES for innovation, FINEP strengthening (transforming it into a "national bank of innovation", enhancing its budget) and of SIBRATEC, and the creation of EMBRAPII (Brazilian Enterprise of Research and Industrial Innovation). (MCTI, 2012).

The main form of entanglement of Plan Brazil Biggest and ENCTI is through the goal to increase the spending of companies in R&D relative to GDP, reaching the target of 0.9% in 2014. Thus the percentage of GDP invested in R&D in 2010, according to the MCTI, was 1.19% is expected to reach 1.9% in 2014, the percentage applied by the companies should rise from 0.56% to 0.90 % and the government's 0.63% to 0.90%. That is, the largest increase in investment in R & D must be performed by the companies, for what the EMBRAPII should play a key role.

> The Embrapii aims to contribute to greater institutional coordination between public and private sectors to complement the work of development agencies existing and ongoing actions. Its main objective is the expansion of links between universities, research centers and companies in the development of innovative technologies, with emphasis on the final stage of product development, activities such as scheduling, proof of concept and demonstration plant. Although joint initiative with the MCTI, the Embrapii should have a strong private sector participation, both in funding and in its management, ensuring that it is modern, lean, agile and shared among many actors,being transparent and flexible, as demanded by actions in the field of innovation. Such as the Brazilian Agricultural Research Corporation (Embrapa), the new company will have as main feature delineating of its programs for serving the demands of the associated sectors, since traditional companies that innovate until small start-ups based on knowledge-intensive or strong technological content. However, unlike the Embrapa, Embrapii does not constitute from the construction of their own laboratories, but will make intensive use of networks of institutes and research centers that already exist, with capillarity and proven competence in projects with companies (Own translation of MCTI, 2012, p. 101).

These plans show that the Brazilian government has not been totally silent about the issue of science, technology and innovation; on the contrary, the plans seem to be well founded. Furthermore, to pay a little more attention in discussions on the agenda both in Congress and on the government's agenda it is clear that this has been a recurring theme. But probably this is still little to what Brazil needs in order to achieve a position of greater international prominence.

It is important to realize that the plans include two policies that can be decisive for the future success of SNIB and are considered key components both for the Plan Brazil Biggest and ENCTI, i.e., Program Science without Frontiers and EMBRAPII. What brings on one hand qualifying human resources and incentives for graduates to enter the market beyond the

Higher Education and also start to integrate work teams of the companies, as already happens in most developed countries. On the other hand, establishing a funding agency for science and technology and research and development specifically for the industry, such as the EMBRAPA has been doing that for agriculture and is considered a reference.

The goals, however, are slightly low compared internationally. For example, to increase the percentage of GDP invested in R & D from 1.19% to 1.9% can be considered a good goal, even considering that the country has a tendency to increase in the gross domestic product. And even if confronted with the OECD average between 2005 and 2008 was between 2 and 2.5%, it also seems reasonable, because a significant portion of these countries are suffering economic problems and this should negatively influence both the GDP and investment in R&D. But if a such comparison is made with countries that have gained prominence worldwide as NIS efficient and its insertion in markets with high technological level, the result is quite different.

Finland and Korea, have their percentage of GDP invested in R&D between 3.5 and 4% and 2.75 and 3.25% between 2005 and 2009, respectively. And considering that these nations tend to at least maintain or increase their investments because they are potential savings and they are not being so severely affected by the economic crisis European/world, Brazil with his timid 1.9% is still far from achieve similar scientific and technological development.

Thus, thinking of a national innovation system is a long-term policy, but to achieve relevant results worldwide it must be taken as a government priority.

**4 - The Business Dimension of the Brazilian National Innovation System**

In this section we recall some instances of success BNIS, including Embraer, private firms as Embraco, Weg and Aracruz-Fibria, and Embrapa.

For Lima et. al. (2005), the Brazilian aviation industry had the year of 1945 as a mark, from the implementation of the Space Technology Center (CTA). Soon after, in 1947, with the creation of the Aeronautics Technological Institute (ITA), the engineering school of the CTA, in 1954 was created the Office of Research and Development, strengthening the research and rooting of industry knowledge. To end this national effort was created in 1969 Embraer, which has been as a consolidated leading integrator of civil aircraft, occupying the fourth position worldwide, behind Boeing, Airbus and Bombardier.

Moreover, it is important to notice that Embraer was established in an integrated manner with a teaching center for aeronautical engineering and a technology center industry, which, despite having different spheres of governance, should benefit the greater uptake of technologies. ITA provides skilled labor, filling the gap that often delays the technological development of firms in other sectors.

But beyond the example of Embraer there are other important cases of companies that have achieved high level of technological development in sectors prioritized, both by national and local policies. So it also stands out examples of metal-mechanic sector from Santa Catharina state, Weg and Embraco, and paper pulp in the state of Espírito Santo, Aracruz Celulose.

According to Macedo and Campos (2002), the sector of metal-mechanic of Santa Catharina began to expand in the 1970s, and especially in the following decade while the national sector was stagnating, In Santa Catharina was noticed a major expansion of it. Such growth was the result of a series of investments made at 1970/80 and that prioritized the sector, since most of the features of BRDE (Regional Development Bank of Southern) and from BADESC (Development Bank of Santa Catharina state) was reversed for the industrial development of this sector. And although at the beginning of the 1990s showed a slight decrease, the process of opening the later years made such industrial complex reached even higher levels of development.

Among the companies in the metal-mechanical in Santa Catharina stands Embraco (hermetic compressors and condensing units) and Weg (electric motors), such that during the survey conducted by Macedo and Campos (2002) invested in 3% and 4% of its revenue in R&D, addition to emphasizing the interaction with clients, producing effective results through learning-by-interaction.

Similarly Aracruz Celulose (currently Fibria) constitutes the world's leading producer of bleached eucalyptus pulp (a basic input in the production of office papers, tissue papers, handkerchiefs, napkins, diapers absorbent and specialty papers). A company that invests in research, development and innovation and technological effort, which has a center of research and technology (CPT), with 80 employees (including master and PhDs) who devote themselves entirely to research and development (CAMPOS, 2010).

Thus Aracruz Celulose (Fibria) achieved important results that put places it as world leader in its segment, it has developed new techniques for propagation of eucalyptus clones,

innovative ways to control pests and diseases, and research for soil nutrition, eco-physiology, environmental preservation and biodiversity, and other innovations of process, involving communication and integration of different sectors of the company. Campos (2010) points out that since the 1970s the company has been developing their ability to learn: learning-by-using (in production facilities), learning-by-doing (forestry), or learning-by-interaction (partnerships with research institutes and national and international universities, and funding of thesis for master's and PhD).

Another success existing in the SNIB and highlighted in this article is the case of Embrapa (Brazilian Agricultural Research Corporation). This was established in 1973, aiming to institutionalize science and technology for agriculture. From their coordination in the National Agricultural Research System (SNPA), which also involved the State Agricultural Research Organizations (OEPAs), universities and other institutions. These, from the research and creation of appropriate technologies to geography and climate of different regions of Brazil, should increase the domestic availability of food and diversify the country's export (CAMPOS, 2011).

Embrapa is a system formed by administrative units/centers that are located in headquarters, in Brasilia, and research units and services/decentralized which are distributed in different regions of the country. The decentralized units are inserted in different regions and conduct agricultural research focused on the needs and idiosyncrasies of each one of these places. Each unit of Embrapa works the research directed toward a particular product and/or ecosystem. (EMBRAPA, 2011)

Embrapa has been producing important advances for Brazilian agriculture, placing Brazil as one of the potentials in the generation and supply of food in the world. And with its integrated structure and other related institutions focused on specific local market has been able to provide important innovations to the market that ensures increasing of productivity and quality of many products. It has been so in the breeding and introduction of new varieties more adapted to the Brazilian climate and geography, as well as guidance for the control of pests and diseases of plants and animals.

As reported by Embrapa (2008), in 2006 for every R$ 1.00 invested in agricultural research, the return for a society was of R$ 13,20. Among important results of this organization is placed, for example, a new bean variety “cowpea BRS new age”, which was developed to be planted by riverside communities of Rondonia and reaches five times more productive than the varieties that was obtained until then.

Embrapa has produced important results for practice and research in biotechnology in Brazil, which is sponsored by Embrapa Genetic Resources and Biotechnology in partnership with some units of research into products. Whose main line of activity is the development of transgenic plants with resistance to certain viruses that hamper its development. As an example, citing the beans resistant to the “golden mosaic virus bean”, the greatest impediment to development of the plant in South America, this was the first genetically modified product developed entirely by Brazilian public institutions. (MAPA, 2010)

Besides these are being developed important studies about transgenic for: drought resistance in products such as soybean, sugarcane and coffee; resistance in viruses: potato varieties, papaya and tomato; plants and animals that will be used as bio-factories for the production of medicines; handling webs of spiders found in Rain Forest, Amazon and cerrado to produce more resilient and flexible wires to be used by industry. There are also researches in genetic improvement to reduce disease, increase nutritional components and flavor for: banana, coffee, rice. Also the improvement genetic applied to eucalyptus, beef cattle and milk production has produced important results in terms of productivity and quality. (Ibid.)

**5 – Conclusions**

The main conclusions that can be drawn from this work is that the 2000s economic policy changes and becomes slightly more favorable to the installation of innovative environments. But it is mainly from 2007 that the concern to draw objectives on science, technology and innovation becomes more clear, from the release of the first Plan of Action in S,T&I formulated by the Ministry of Science and Technology. This plan, as its successor (ENCTI) show a greater concern about stimulus for companies to invest in R&D, so that they reach, higher percentages of spending on R&D *vis-à-vis* that of the public sector. But its results still show timid compared to other countries.

The plans go to a systemic vision, but the speech is even more sectorial, given the example of sector funds and how the resources are released. Despite the plans emphasize associations between the different spheres of government, there are no effective mechanisms requiring such association, or that promote among companies, to these promote mobility among these workers, for example. The policies focus too much on release of funds and compensation for companies that implement some kind of investment in R&D, which are neither so high nor supplies the demand of enterprises, and less on stimulus trainning to the association between firms and other forms of stimulus rooting capacity.

But there are important exceptions, Embraer, for example, from its association with the CTA/ITA has produced results which places it among the first companies worldwide in aircraft construction, a sector that requires high technological content. Also, Embrapa produces important results in new varieties, techniques and products, which has placed the Brazilian agribusiness as featured in the world, so because it worries to do research and projects that create products adapted to different regions, increasing productivity and quality of agricultural products, as well as the telecommunications sector, especially in the 1970/80 produced important technologies adapted to Brazilian reality and geography. Other important result are found in Petrobras, some firms and sectors and clusters that exhibit technological success, as well as projects and universities and research centers.

But the nation as a whole has not developed technologically nor rooted capabilities that encourage learning and innovation. It is not common to all of Brazilian society prioritize associations to produce new goods and services tailored to different realities. Public policies historically have not placed this issue as a priority. Therefore, we can say that Brazil has important sectoral systems of innovations, as well as regional, but its national innovation system is still functioning poorly.

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