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LUND UNIVERSITY
School of Economics and Management

Master programme in Economic Growth,

Innovation and Spatial Dynamics

The outcome of Brazilian innovation system development over time and its next steps to a knowledge-based economy.

Eduardo H. Ubiali Leite

egi13eub@student.lund.se

Abstract: This paper will provide different analysis over the Brazilian innovation system, on how it has developed over time, the key features in the system and the next steps in development. In order to better explain the evolution and to evaluate the system, the author will provide systematic, functional, economic, historic and international analysis, based on frameworks proposed by academics in the innovation systems field to create a complete and direct evaluation.

Key words: Economic growth, innovation system, innovation policy.

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1. Introduction

The development of humanity is an illustration of human innovation over time. In fact, the phases in human evolution are mainly based on the technology in which it was developed by humanity, this in time would have completely changed the way people interacted and grow as groups. This shows the entire dependency of humankind on the constant development of innovations in order to change or improve the way they live and achieve better quality of life, as well as social, technological and economic evolution.

Over time, not only technology, but also the economy has experienced an exponential evolution. Necessarily, there were incentives and governmental policies for the development of innovations in order to stimulate the economy growth, as well as jobs and market diversification. In addition, according to Schumpeter (1989), innovation would be a recurrent fuel of economic growth in an international scale, despite differences between countries.

To stimulate the development of innovations in a country, an interaction between stakeholder from government, private and third sector is necessary to join efforts to build a strong innovation system. Innovations systems are interactions between actors, policies, regulations and activities. The success of an innovation system depends on several points in which will be better explained by this paper on the evaluation of the national innovation system installed in the Latin American country of Brazil.

This paper will be divided in parts in order to better explain the research question proposed. Initially, the conceptual framework as well as the previous study will be provided, giving support for chapter explaining research design going through results chapter and finally conclusion.

Results will be separated in several parts beginning at analysis of development over time in innovation systems and policies, then systematic analysis, followed by functionality analysis, economic and market, historical and social scenario and lastly international comparison. All parts of the results will use its individual framework proposed by the author or using other academics work as concepts for the given basis.

Conclusion will provide overall results analysis presenting key features and prospective suggestions for the national system of innovation in the country.

1.1. Research Question

What is the outcome of Brazilian innovation system development over time and what are the next steps?

1.2. Research Objectives

- Analyse milestones in Brazilian innovation policy and system;
- Provide systematic, functional, economic, historical and international analysis on Brazilian innovation system;
- Identify flaws, successes and prospective scenario for innovation policies and system.

1.3. Hypothesis

This paper defends the hypothesis that Brazil's innovation policies and system, despite significant development in recent years, has not reached an acceptable level, and is still very far from the models used in the developed nations.

1.4. Research Purpose

In this context, it is very relevant to understand the different growth trends in developing and developed countries.

The research will focus on Brazil, one of the fastest growing nations in the world. In this sense, the Brazilian economy is a clear example of a country that is in search of an economic growth in comparison to already developed nations that have much more effective government policies regarding the development of innovations.

Concluding, it is possible to say that this research will try to illustrate the key features of Brazilian innovation system framework, making it clearer successful and failed actions by government and stakeholders in the pursuit of an efficient innovation system in the country may allow this nation to achieve economic growth in shorter or longer period as a consequence of the search for innovation in all aspects of society and to become a knowledge-based economy and thus providing a sense of the historic, economic and international scenario.

2. Conceptual Framework

2.1. Economic Growth and Innovation

For Link and Siegel (2003), the world economy has suffered a large number of oscillations in economic growth and decline over the history of humanity. As claimed by Grossman (1993), economic growth is demonstrated by the growth in investments, growth of job opportunities, opening of new markets and raise in standards of living for the general population. The

Sollow old growth theory explains that the growth is driven by the increase of demand and offer in markets, thus creating opportunities in businesses. A great example proposed by Abramowitz (1956) is the recovery of the United States in a post second world war period, when the world demand for goods and services grew after the destruction of nations by the war as well as the increase of demand in the domestic market with the beginning of the 'American way of life' culture of high consumerism, exponential production and commercialization of goods in a competitive market.

According to Romeo (1990), economic growth has changed to a more complex format, called 'the new growth theory'. In this context, economic growth would be very much dependent on the development of technology and knowledge in different sectors of the economy, which would mean competitive advantage over market players. Schumpeter (1934) supports that innovation is a key factor in economic growth, defending that new technologies substitute old ones, meaning that companies are driven out of the market if they resist changing.

Schumpeter (1949) describes innovation as a promoter of social economic growth through innovation in research and development (R&D). Innovations may take place in products, processes, businesses, source of supply and merges and divestments. Innovations must be either radical or incremental.

Innovations are repressed by the uncertainty from organizations that feel unprotected in reference to their new technologies. Romer (1986) concludes that spillovers may be a result of actual plagiarism, mobility of labour, international trade, networking and general-purpose technologies (innovations that have relation to the improvement of quality of life, thus making full monopoly over goods impossible).

2.2. Innovation Policy

As stated by Edquist (2001:2), "*Innovation policy is public action that influences technical change and other kinds of innovations... Innovation policy includes elements of R&D policy, technology policy, infrastructure policy and education policy…The term innovation policy arouses associations to change, flexibility, dynamism and the future: Innovation policy should serve as midwife"*.

2.3. Innovation Systems (IS)

According to Johnson (2001), it can be pointed out that 'systems of innovation' is not a formal theory, in the sense of providing propositions with respect to established and stable relations between well-defined quantitative variables.

The principal requirements for a successful innovation system are:

a) Stakeholders: private companies, governmental institutions, non-governmental organizations, research centres, technological infrastructure, investment agencies, universities and human resources;

b) Policies: Public Policies for Innovation, Legal Framework and Systematic Financial Resources;

c) Social-economic context: Entrepreneurial culture, focus on the vocations of the region, governance and interaction among actors, flows of knowledge and information; cultural, political and social streams.

Edquist (1997b:14) defined a system of innovation as *"all important economic, social, political, organizational, and other factors that influence the development, diffusion, and use of innovations" which* is very similar to the definition provided by Johnson & Jacobsson, (2001a).

Ingelstam (2002) in the other hand adds to this definition by stating that systems are a set of components and the relations between them is a common effort. Systems always have a purpose, even if spontaneous or artificially created. Finally, systems must have boundaries or should be easily separated from the outside world as one's perspective.

To better understand this framework, Chaminade & Edquist (2006:17) describe the 10 main activities in the system of innovation in four macro levels. These key features are related to the processes, demand, provision and support services. These are of great importance to the innovation system due to the necessity of development in activities as follows:

a) *Provision of knowledge inputs to the innovation process:*

- Development of continuous Research and Development (R&D);
- Competence-building focus on human capital.

b) *Provision of markets – demand-side factors*:

- creation of new markets;
- Quality and standardization.

c) *Provision of constituents for IS*:

- Development of institutional focus on new fields, entrepreneurship and diversity, agencies etc.;

- *Provision (creation, change, abolition) of institutions* (laws, programmes, regulation, procedures etc.);
- Networking market interaction and constant learning.

d) *Support services for innovation firms*:

- Incubating activities;
- Financing to innovation;
- Knowledge flow and market information.

What these explanations show is that the innovation system is a key facilitator in the development of innovation and the generation of economic growth in nations. Without this framework, agents would be acting individually in no organized actions in order to reach the same goal, which would constitute system failure.

2.3.1. Classification of innovation systems

There are many types of classification of innovation systems, usually taking into account the way it is delineated, such as: geographic and sectorial.

Moreover, 'sectorally' delimited systems of innovation only include part of a regional, national or international system. The limits for this classification are specific technological fields (generic technologies) or product areas. They can be, but not necessarily, restricted to one sector of production. Both 'technological systems' (Carlsson and Stankiewicz, 1995) and 'sectorial innovation systems' (Breschi and Malerba, 1997) belong to this category.

According to Johnson (2001), geographically defined innovation systems may be local, regional, national and supranational. This type of delimitation presumes that the area in question has a reasonable degree of 'coherence' or 'inward orientation' with regard to innovation processes.

In the opinion of Lemos (2000), Innovation Systems can be national, regional or local, and seen as a network of institutions in the public and private sectors whose activities and interactions generate, adopt, import, modify and diffuse new technologies and innovation as well as generate knowledge, these are crucial aspects.

When the concept 'national system of innovation' first appeared in the literature in the 1980s (Freeman, 1987; Lundvall, 1985) it reflected new developments in innovation research. The most fundamental new insight of innovation studies in the eighties was that innovation is an

interactive process where agents and organisations communicate, co-operate and establish long-term relationships.

The geographic concept is so important that Lundvall et al (2002:221) said:

> "The concept is rather broad so although it can be translated into manuals for studies of concrete national systems of innovation, it is not in its present form easily integrated into any theoretical discourse. The pragmatic and flexible character of the concept may be seen as a great advantage since it makes it useful for practical purposes. At the same time we believe that efforts should be made to give the concept a stronger theoretical foundation through additional work in the neo-Schumpeterian and evolutionary economic tradition to make the concept of national innovation systems better suited as a tool for theoretical economic analysis".

However, it is not obvious how territorially defined systems of innovation should be defined in practice and it may be very difficult to give empirical meaning to the notions of 'coherence' and 'inward orientation'.

Whether a system of innovation should be spatially or sectorally delimited – or both – depends on the object of study. All the approaches may be helpful for different purposes or objects of study. Generally, the different classifications complement rather than exclude each other.

This narrow approach is not so different from the 'triple helix' concept were universities, government and business are seen as the three important poles in a dynamic interaction (Etzkowitz & Leydesdorff, 2000).

The Freeman and the 'Aalborg-version' of the national innovation system-approach (Freeman 1987; Freeman & Lundvall 1988) aims at understanding 'the innovation system in the broad sense'. The definition of 'innovation' is broader. Innovation is seen as a continuous cumulative process involving not only radical and incremental innovation but also the diffusion, absorption and use of innovation.

The SI approach employs historical and evolutionary perspectives. Processes of innovation develop over time and involve the influence of many factors and feedback processes and they are often path dependent. Because of this evolutionary perspective, illustrative and instrumentally useful comparisons between different innovation systems can be made, while it is obvious that an 'optimal' system of innovation cannot be specified.

The approach emphasizes interdependence and non-linearity. This is based on the understanding that firms normally do not innovate in isolation but interact more or less closely with other organizations, through complex relations that are often characterized by

reciprocity and feedback mechanisms in several loops. This interaction occurs in the context of institutions - e.g. laws, rules, regulations, norms and cultural habits. In fact, the central role of institutions is emphasized in practically all specifications of the concept of innovation systems.

2.4. Technological Intensity

To analyse the data on the manufacturing order it is necessary to aggregate the 32 sectors, that make it up, into four groups proportional to their technological intensity (high, medium-high, medium-low, and low).

For this purpose, it is used the classification of Organisation for Economic Co-operation and Development-OECD (2005), which includes the sectors of manufacturing industry in four main groups of technology intensity:

- High technological intensity: aerospace, pharmaceuticals, computers, electronics, telecommunications and instruments;
- Medium-high technological intensity: electrical equipment, motor vehicles, chemicals (excluding the pharmaceutical industry), and rail transportation, machinery and equipment;
- Medium-low technological intensity: shipbuilding, rubber and plastic products, coke, refined petroleum products, nuclear fuel, other non-metallic products, basic metals and metal products; and
- Low technological intensity: other sectors and recycling, wood, pulp and paper, publishing and printing, food, beverages, tobacco, textiles and clothing, leather and footwear.

2.5. Previous Research

The paper will be based on the concepts of Edquist, Etzkowitz, Leydesdorff, Freeman, Lundvall, Andersen, Johnson, Johnson et al, Nelson, Fagerberg and others regarding theory on Innovation Policies and Systems.

The research will use the innovation system failure framework developed by Woolthuis et al (2005:610), the authors describe what would contextualize Innovation Policy systematic failure would mean in each of the following phases in order to analyse, justify and evaluate innovation policies effectiveness:

1. *Infrastructural failures (in Smith, 1999; in Edquist et al., 1998).* Physical and scientific infrastructure (IT, telecom, and roads).

2. Transition failures (in Smith, 1999) inability to adapt to change in the innovative process.

3. Lock-in/path dependency failures (in Smith, 1999) inability to overcome or complete innovation change.

4. Hard institutional failure being failures in the framework of regulation and the general legal system (in Smith, 1999). These institutions are specifically created or designed (in Edquist et al., 1998) for which reason in Johnson and Gregersen (1994) refer to them as formal institutions (agencies, policies, legal frameworks).

5. Soft institutional failure: being failures in the social institutions such as political culture and social values (in Smith, 1999; in Carlsson & Jacobsson, 1997). These institutions evolve spontaneously (in Edquist et al., 1998) for which reason in Johnson and Gregersen (1994) refer to them as informal institutions.

6. Strong network failures (in Carlsson & Jacobsson, 1997) inability to oversee individual interests and beneficial integration with other actors.

7. Weak network failures (Carlsson & Jacobsson, 1997) inability to learn from the integration in innovative systems. *Malerba (1997) refers to the same phenomenon as dynamic complementarities' failure.*

8. *Capabilities' failure: in Smith (1999) and Malerba (1997)* lack of knowledge, abilities and aptitudes to integrate the SI.

2.6. Contribution to Future Studies

By proposing an analysis based on the previous stated frameworks, this research will contribute to future studies by providing a realistic scenario about national innovation policies and system in Brazil by using the frameworks proposed by different academics in the field.

Governments and stakeholders may use this study in the innovation system as a reference for future decision and the development of actions to improve their role in the national system.

This may be used to analyse innovation systems and policies as well as provide a framework for the development of criteria for evaluation. A similar analysis could be replicated in other developing nations, specially the BRICS and Latin American countries.

3. Research Design

3.1. Study Area

The country to be studied will be Brazil. It is the world's fifth largest economy, in land area (8,511,965.00 SqKm), as well as in population (201,032,714 inhabitants). This Portuguese speaking country has found, after the international financial crises, a scenario in which its economic model would not be very affected, as it has in some European nations. It has a GDP of US$2,170 trillion. Despite its intense industrial activities, the development of innovations is still considered weak compared to more knowledge-based economies. Its technological intensity classifies mostly in low, medium-low and medium-high technology intense activities.

3.2. Selection of Method

The study will be conducted on literature review on innovation policies and innovation systems. Collected data will be integrated to findings from interviews to reach analysis and results.

3.3. Primary Data Collection

Primary data will be collected from organizations and government official websites (OECD, United Nations, World international Development Bank, Ministry of Science and Technology, FINEP, etc.), previous studies from academics, and interviews.

3.4. Interviews/Secondary Data Collection

Interviews with *five* academics, specialists and policy makers on their opinion regarding the development of the Brazilian innovations system through videoconference on Skype. The data resulted from the interviews will be used to reach results in support of primary data collection.

Interview questions and information on interviewed participants may be seen in Annex 1 and 2 in the end of the paper. All data from interviews will be integrated in results/conclusion.

3.5. Data Analysis

Data will be collected and analysed by using software MS WORD (writing and development), MS EXCELL (analysis) and MS POWERPOINT (presentation). SKYPE will be used as videoconference software to conduct interviews with specialists located in Brazil.

4. Analysis of Development of Innovation Policy

4.1. Phase 1: Institutions Period

Brazil had the birth of its key actors in the Innovation system on the second half of the 20th century progressively:

1951: CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico - National Counsel of Technological and Scientific Development) and **CAPES** (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior), organizations that incentive R&D, mainly in educational institutions, as well as coordinate distributions of salaries and scholarships for researches and student. They were created to develop higher education in the country in the beginning of the **presidential era of Getúlio Vargas**.

The president would be in power for many years to follow as a sort of *'Father of the people'*. As the milestones of this rule are the workers' rights, social benefits, as well as market close in the 1930s, which would retard Brazilian innovation with the low amount of international products imported.

1952: BNDES (Banco Nacional do Desenvolvimento - The Brazilian Development Bank), a state bank focussed in the social-economic development of the country. At its creation, the bank's main focus was in giving financial incentives to the industry and agriculture; notwithstanding, presently it gives large support for the expansion and adaptation to innovations in all sectors including social causes. This period would see many developments in infrastructure, with the mentality of developing the country in just five what it should be in 50 years created by President Juscelino Kubitcheck, which attracted multinationals that were not obliged to develop research in the country, giving continuity to the culture of exploration in the nation.

1964: The year of the **beginning of the military dictatorship** in Brazil, it would last until 1985 with the first open elections. For their intellectual nature, the military party had a good strategic plan for the development in Brazil in the fields of research and technology as it will be seen in the following dates and creation of institutions. The period known as the **'Economic Miracle'** is the time when there were an exceptional economic growth between 1968 and 1973, when the Brazilian development raised from 9.8% to 14%. However, this period would have high inflation rates, great income concentration and became the most

violent and strict periods in Brazilian history, which would forever change the culture and the way people think in this country.

1967: FINEP (Financiadora de Estudos e Projetos), a public company that provides financial incentives to researchers, companies, research centres and others which search for development in R&D. FINEP provides many different lines of financial support, including refundable and non-refundable, in areas such as sustainability, industrial growth, health, agriculture and many more. Nowadays, plays a major role in providing incentives related to the national innovation policies.

1969: FNDCT (Fundo Nacional de Desenvolvimento Científico e Tecnológico - National Science and Technology Development Fund) -Decree-Law nº 719, de 31.07.1969 -adapted by Law nº 11.540, de 12.11.2007)

The FNDCT were created to provide solid and permanent investments in scientific and technological research in Brazil. With this initiative, Brazilian innovation has been integrated into a new scenario, mobilizing additional sources, in different sectors, that were committed to financing new challenges.

The resources available in FNDCT are from public and private companies that contribute to the government, representing new sources of investment in innovation. This Fund not only facilitates the technological development to production activities, but also collaborates with the chain connected, directly or indirectly, to knowledge with industry.

FNDCT is administered by the Managing Committees coordinated by MCTI (Ministério da Ciência, Tecnologia e Inovação - Ministry of Science, Technology and Innovation), with the participation of regulatory agencies, the scientific community and the private sector. These committees define the annual investment plan, outline new guidelines, oversee the investment of funds, monitor and evaluate the performance of funded research. The financial incentives in the other hand are operationalized by FINEP.

The key sectors to funded are the Aeronautical, Agribusiness, Amazon Development, Fund to the Department of Transportation Waterways and Shipping, Biotechnology, Energy, Space Research, Water Resources, Information Technology, Infrastructure, Minerals, Oil and Natural Gas, Health, Land Transport, University-Industry Interaction; and Telecommunications.

1973: **EMBRAPA** (Empresa Brasileira de Pesquisa Agropecuária), a state company that focuses on the agribusiness by developing new techniques and products for the national and international markets. In the following years, this company would have played a key role in the development of Brazilian rural areas, which began from this period to use excellent techniques, products and services in their niche of production.

1985: **MCTI** (Ministry of Science, Technology and Innovation), as a request for higher support in the development of new technologies, the creation of the MCTI came mostly as a demand from research institutions such as EMBRAPA, which, despite the support of government funds, still hopped for better government policies for the increase of innovation in the country and actually expanding as companies entered the international market.

Despite having a strong industrial infrastructure since the turn of the 20th century, the national government always focused a lot of its efforts and policies towards the effective production of goods and the expansion of infrastructure to support this high growth rate demanded by the domestic market. In this sense, the policies for Innovation have developed rather distant from the actual industrial policies, concentrated mostly on the spread of academic publications with low support to industries.

An example given by Lee et al (2005), states which nations had different growth models from Brazil, had much sooner integration of industrial policies and innovations policies. I.e. Korea reached this point by late 1980s and, since then, has developed numerous policies and incentives due to this integration. Brazil, on the other hand, has only reached this point by the beginning of the years 2000s, when finally both sides would enjoy full integration and so focus on innovation as a competitive advantage driven by social-economic development.

The end of the 1980s in Brazil was a period of hard economic failure, where inflation would grow daily in surprising dimensions, purchasing power was unstable and the economy had low perspectives on development.

It was only by the 1990s in the government of Fernando Collor, a rather controversial impeachment character, that Brazil would again see market opening to innovations from overseas. Nevertheless, in this period, certifications and quality standards were prioritized in the productive structure, leaving R&D to a secondary focus.

After the economic politics of President Fernando Henrique Cardoso, the *Real (R$)* were implemented as a more stable and efficient currency thus generating high developments that the country lived after the 1990s.

Finally, Brazil could see itself as a nation that had more to offer than just being a provider of raw materials, low technology-intensity products and cheap labour force. The government had taken an important step towards achieving a knowledge-based economy, and different policies had to be integrated in order to meet this goal. That being said, no longer would policies regarding R&D and the industry be seen as separated, following in the years 2000s the international trend, which had already been installed in developed nations.

4.2. Phase 2: Age of Regulations and Incentives

After the development and the stabilization of the economy by Fernando Henrique Cardoso, in 2003, Luís Inácio Lula da Silva was the first labourer to become President, having a large support from the population as a consequence of the growth of the Labour Party in recent years. Lula would bring a period of high economic growth and development on innovation policies and the straightening of the innovation system as it will be better explained in the following points.

4.2.1. Innovation Law 10.973 – 02.12.2004

The main policy for innovation, the Innovation Law of 2004, was the biggest milestone for agents in the national innovation system context. Never have the government developed such a strategic and regulatory piece of official document to stimulate the growth of innovation as a weapon to conquer economic stability and technological development in the country.

This law was the turning point in national innovation history and opened a range of possibilities, obligations and hope to a sector that had been waiting for such development in the Brazilian economy. Within the largest needs were funding, partnerships and training to improve the labour force.

For this all to become true, the Ministry of Science and Technology would need support from stronger and better-established ministries, mainly from the Ministries of Development, Industry and International Trade (MDIC). Together they would discuss options to integrate policies to achieve the goals not only for the innovation sector, but also to solve social-economic problems through innovation.

MCTI would have the goal of (MCTI, 2014):

- Increase the national expenditure on R&D from 1.19% of GDP to 1.80% in 2014.
- Raise business expenditure on R&D from 0.56% to 0.90% of GDP in 2014.

- Focus on Research, Development and Technological Innovation; raise business expenditure in R&D from 0.56% to 0.90% of GDP in 2014; as well as to bring intensification on Productive Innovation.

The Law establishes measures and incentive to innovation, science, research and technology on the production context, with a view on training, domestic technological autonomy and the industrial development of the country.

By means of the rule, the state recognizes that innovation generates wealth; however, it comes with risk in the activity. Consequently, the state must stimulate and promote it, sharing the risks with the private sector. In addition, it aims at bringing constant culture changing to companies investing in R&D, thus, ensuring the survival and the competitiveness of enterprises.

As important as the generation of knowledge is to allow society and business to benefit from it, and so, improving the quality of life from innovative products and processes.

As stated by the Innovation Law (2004), the main strategies to be developed by the different stakeholders in the innovation context would be:

a) To promote partnerships and strategic alliances: This is known as the Triple Helix Model, conceptualized by Etzkowitz & Leydesdorff (1996), where the following stakeholders would participate as such:

- Government (MCTI, MDIC, FINEP, CNPq, BNDES): creates policies, mobilizes stakeholders, promotes development as well as human and financial supports;
- Businesses: generate innovations, jobs and wealth;
- Universities and research centres: provide training and generate knowledge.

b) To develop R&D Institutions to stimulate expansion of the sector in different regions by:

- Encouraging projects aimed at creating incubators and technology parks;
- Sharing laboratories, facilities, infrastructure and human resources with Small and Medium Enterprises (SMEs) in incubation activities and larger companies;
- Celebrating technology transfer and contracts licensing of its proprietary patent;
- Providing specialized consulting services;
- Encouraging employees' participation in projects in partnership with public and private institutions.

c) To encourage ‘Researcher / Creator’, they may:

- Obtain financial gain result of services rendered, regardless of pay source;
- Receive as an incentive to innovation, scholarship directly of supporting institution or sponsoring agency;
- Provide cooperation on R&D with other advantages additional to earnings.

d) To establish the role and responsibilities of the Centre for Technological Innovation (NIT-Núcleos de Inovação Tecnológica):

- Manage innovation policy of R&D rate, analyse, promote and ensure the maintenance of institutional policy of protection of creations;
- Celebrate technology transfer and contracts patent licensing;
- Provide specialized consulting services activities within the productive sector;
- Encourage employee participation in projects focusing on innovation;
- Promote training of employees regarding culture of innovation and knowledge protection etc.;
- Support the Independent Inventor;
- Develop and monitor the budget of these activities.

e) To provide incentives for the development of innovation in private sector by:

- Directing concession to companies through public notices, financial resources (subvention) human, material or infrastructure;
- Supporting for carrying out R&D activities involving technological risk.

f) To give differential treatment to encouraging the technology-based SMEs:

- Having the support of incubators;
- Using of laboratories, equipment, instruments and materials, facilities of R&D;
- Receiving economic Grants (non-repayable funds) via FINEP / FNDCT by simplified procedure;
- Promoting actions to stimulate innovation in SMEs by the development agencies, including technological extension by R&Ds;
- Ensuring favoured treatment in the application of the Law.

4.2.2. Goodwill Law - Lei do Bem: Law 11.196, 21.11.2005

After the creation of the Innovation Law in 2004, the Goodwill Law came as a regulatory milestone to the incentives proposed by the previous law. Both came to substitute the PDTI (IT Plan). The new incentives proved are far more comprehensive and its application more direct than PDTI was, and so bringing a greater recovery for companies of their investments in research and development. All these incentives would be regulated by prior approval from the MCTI to benefit specific projects.

One of the reasons why the new law was created was to encourage private investment in R&D development. In 2006, in its first year of validity, the law benefited only 130 companies, between the top 1,000 companies in Brazil that have revenues above US$ 156.4 million.

As a vision, the law was designed to increase the level of Brazilian industrial competitiveness. For this, the tax incentives were regulated for legal entities that developed research in technological development and innovation. This also includes the new design of products, improvement of innovative industrial processes, and enhancing in adding features to the product or new functionalities or processes.

The Law supports all companies registered in Brazil, both of national and multinational capital. It supports universities, research centres, consultancy companies as well as small businesses and many more.

The key features of the Goodwill Law:

- Human resources development for R&D;
- Increase team of ‘researchers’ from one year to another;
- Out-sourcing activities to Universities, Research Institutions, Micro and Small Enterprises for execution of R&D;
- Installation of laboratory facilities and acquisition of equipment for use in R&D;
- Protection of Intellectual Property (patents) in the country and abroad;
- Licensing of technologies in the country.

According to the Article 2 of the Goodwill Law (2005), for purposes of the Decree, technological research and development of technological innovation activities are: Basic directed research, applied (incremental), experimental development, basic industrial technology and technological support services.

According to the explanation provided by ALLAGI (2014) about the law of Income Tax of Corporations, regarding the benefits and eligibility in which companies would be subjected while developing activities for the research and development of innovations, would profit by the following tax incentives:

a) deduction for purposes of calculating net income, corresponding to the sum of expenditures made during the period of investigation on technological research and development of technological innovation classified as operating expenses;

b) Reduction of 50% of tax on equipment, machinery and instruments, as well as accessories parts and tools accompanying the goods for R&D;

c) Accelerated depreciation, without prejudice to the normal depreciation of machinery, equipment, apparatus and instruments, for use in innovation development for purposes of calculating the income tax;

d) 10% credit the income tax withheld at source on amounts paid, remitted or credited to beneficiaries resident or domiciled abroad, as royalties, technical and scientific assistance and specialized services provided in technology transfer.

e) Reduction to 0 (zero) the rate of income withholding tax on remittances abroad intended for the registration and maintenance of trademarks and patents.

4.2.3. Rouanet Research Law: (Law 11.487, 06- 2007)

The law amended the Law 11.196/2005 (Goodwill Law) to insert an article that allows businesses to use tax incentives for innovation also for projects conducted by universities and research institutes. The mechanism of access to incentives aims to invite universities to submit research projects they consider to be of interest to companies. In return, firms may exclude spending on income taxation and the tax basis of the Social Contribution on Net Profits (CSL).

The new rule states that companies are entitled to incentives if they invest in projects previously approved by a standing committee composed of representatives of the MCTI, the MDIC and MEC (Ministry of Education).

According to MCTI (2014), R&D institutes are defined as public entities whose institutional mission, among others, performs basic or applied research activities of a scientific or

technological nature. In this context, the Federal Institutions of Higher Education (IFES), acting as R&D institute, assumes an important role, accounting and expanding the role of public administration in the field of scientific and technological research.

One sees the encouraging partnership between the public and the private in order to achieve goals that would be difficult to be achieved if these spheres were separated, as once was believed to be the best. Nevertheless, there is explicit provision in the Act to enable R&D institutions to share with partner companies, their laboratories, equipment, materials and other facilities, aimed at implementation of activities related to innovation and technological development.

4.2.4. PACTI-Action Plan on Science, Technology and Innovation 2007-2010

It is an important tool for guiding the actions of state to the extent that outlines programs and directs the allocation of resources in a systemic and strategic approach. To enable these actions, the Plan provides investments of US$ 41.2 billion by 2010, coming from the federal budget, which, in many programs are accompanied by state, and municipal investments, and compensation offered by companies mainly benefited by the projects.

Conceived as part of the overall Government National Programme, PAC (Growth Accelerator Program) mobilizes and coordinates skills and actions throughout the Federal Government in cooperation with state, county and municipal governments and other actors. Their goals are ambitious. Fulfil them demand strong institutional commitment. The quality of interaction between the actors of the National Innovation System is therefore the determining variable in the success of the Plan, requiring coordinated action and shared management.

The introduction of the Plan as an instrument of state policy in the Brazilian scenario of innovation brought advances with regard to the evolution of the levels of investment in R&D as the improvement of instruments to encourage and support the activities of area.

The PACTI has four strategic priorities, guided by National Innovation Policy:

I - Expansion and Consolidation of the National System of Science, Technology and Innovation (ST&I):

1. Institutional Consolidation of the National System of S, T & I;
2. Formation of Human Resources for S, T & I;
3. Infrastructure and Promotion of Scientific and Technological Research.

II - Promotion of Technological Innovation in Enterprises:

1. Supporting Technological Innovation in Enterprises;
2. Technologies for Innovation in Enterprises;
3. Incentive Creation and Consolidation in Technology Intensive Companies.

III - Research, Development and Innovation in Strategic Areas:

1. Carrier Areas of Future: Biotechnology and Nanotechnology;
2. Technologies of Information and Communication;
3. Inputs for Health;
4. Bio fuels;
5. Electricity, Hydrogen and Renewable Energies;
6. Petroleum, Gas and Coal;
7. Agribusiness;
8. Biodiversity and Natural Resources;
9. The Amazon and Semi-Arid;
10. Meteorology and Climate Change;
11. Space Program;
12. Nuclear Program;
13. The National Defence and Public Safety;

IV – Innovation for Social Development:

1. Popularization of innovation and Improvements Teaching;
2. Technologies for Social Development

4.2.5. SIBRATEC-Brazilian Science, Technology and Innovation System

SIBRATEC, Decree 6.259/2007, is one of the main instruments used by Brazilian Government to integrate the scientific and technological community and innovative enterprises. It integrates with Action Plan on Science, Technology and Innovation for National Development (PACTI 2007-2010), by setting actions to create a favourable environment to technological innovation in enterprises.

a) The key Strategic Priorities are:

- Expand and Consolidate the National Innovation System: Expand, integrate, modernize and consolidate;

- Promote Technological Innovation in Enterprises: Boost promotion actions to create a favourable environment for innovation in enterprises and strengthen Brazil's Industrial, Technological and Trade Policies;
- RD&I in Strategic Areas: Strengthen research and innovation in areas of strategic importance to Brazil's sovereignty;
- Innovation for Social Development: Promote and strengthen science in schools, including the dissemination of technologies aimed at social inclusion and development.

b) Objectives: To provide conditions to enterprises to increase their current levels of innovation. It means higher aggregated value to enterprises results, more productivity, more competitiveness and a greater insertion of Brazil in the global market.

c) Organization: three types of networks, named components: Innovation Centres; Technological Services and Technology Extension.

d) Governance:

- Innovation Centres:

This component aims at generating and transforming scientific and technological knowledge into products, processes and prototypes with commercial viability (radical or incremental innovation).

Innovation Centres are composed by development units or groups that belong to technological research institutes, research centres or universities, with experience in interacting with companies.

It is desirable that the participant institutions should have an Intellectual Property Policy.

- Technological Services:

This component intends to support the infrastructure for calibration, tests, analyses and conformity assessment services, as well as standardization and technical regulation activities, to meet enterprises needs, associated to complying to technical requirements for market access.

- Technology extension:

This component provides access of small and medium enterprises to the State Networks of Technology Extension aiming at solving gaps in technology management, projects, development, production and commercialization of goods and services. This arrangement is constituted by institutions specialized in technology extension. The sectors serviced by the Networks are chosen by the State, aiming at the reinforcement of local productive systems.

e) Source of Financial Resources:

After the years 2000s, Brazil managed to have significant improvement in its structure that supported innovation in the country. Much more R&D was being done in comparison to previous decades. In spite of that, Brazil remains a country with low innovation rates in comparison to other countries, as well as has focused its efforts on very specific areas of research.

As a response, the government analysed areas that were in need of higher incentives, thus pointed out the following areas to be taken as priorities by the Larger Brazil Plan: R&D; Pharmaceuticals and Health Complex; Oil and Gas; Defence Industrial Complex; Aerospace complex; Nuclear energy; Biotechnology; Nanotechnology; Green Economy (renewable and biodiversity); Climate change; Oceans and coastal areas; Assistive Technologies;

4.2.6. ENCTI-National Strategy for Science, Technology and Innovation 2012-2015

According to MCTI (2014), the National Strategy for Science, technology and innovation, ENCTi 2012-2015, is a guide for:

a) Sustainable development: R&D as a column to the structure of sustainable development in Brazil.

b) Facing challenges:

- Reduction of the scientific and technological gap that still separates Brazil from more developed nations;
- Expansion and consolidation of Brazil's leadership in natural knowledge economy;
- Broadening the bases for environmental sustainability and developing of a low carbon economy;
- Consolidation of new international insertion of Brazil;
- Overcoming poverty and reducing social and regional inequalities.

c) Strengthening the structure that supports Innovations policies in Brazil:

- Promotion of innovation;
- Training of human resources;
- Strengthening research infrastructure and scientific and technological.

d) Improvement support mechanisms of innovation policy:

- Improvement of the regulatory framework for fostering innovation
- Improvement and expansion of the financing structure of the scientific and technological development
- Strengthening the Innovation National System.

4.2.7. National Code of Science, Technology and Innovation Law Project

As stated in the presentation given by professor L. A. Elias, Executive Secretary, MCTI (2011):

a) The main instruments and current programs are:

- Loans with low interest for innovation (FINEP and BNDES);
- Participation in risk capital funds (FINEP and BNDES);
- Shareholding in innovative companies (BNDES);
- Tax incentives (Computer Law and Good Law);
- Economic support for innovation (National Notices; PAPPE; PRIME);
- National program of incubators and technology parks;
- Government procurement (Law 12,349/2010).

b) Preliminary provisions: Broadens the scope of the Law of Innovation considering all entities operating in SIBRATEC.

c) Stimulating the construction of specialized and cooperative environments innovation.

d) Stimulating participation in public institutes of science and technology - processes innovation.

e) Stimulating innovation in enterprises - modifies the concept of enterprises by including non-profit entities (social-enterprises).

f) Encouraging independent inventor.

g) Development of stronger investment funds.

h) Human Resources training - expands the treatment of issues relating to education and training.

i) Promotion of development and incentive of research in biodiversity.

j) Stimulating imports and exports of technology.

Why the change of the legal framework?

The changes in framework are due to the depletion of conventional strategies to stimulate economic and social development that Brazil faces. In this context, priority is the recovery momentum of the national research and the creation of appropriate technological solutions to our economic and social challenges.

There is a growing importance of innovation to the productive sector, which requires an expansion of the scope of the constitutional norm, reaching science, technology and innovation in order to support the coordinated actions between academia and industry. As an effect of demand for innovation, loses sense of envisioned before the separation between basic science and technological research, as several lines of *'pure'* research have the potential to unfold in new solutions to the productive sector. Aims to create a National System of ST&I that can coordinate the actions of public and private entities and encourage their collaboration.

4.3. Integrated Policies

4.3.1. Educational Policies

In the opinion of Lundvall 2007, education is the basis for an innovative society. That being said, Brazil, like many other countries, in the past decades have developed policies to oppose the low levels in general education, and even more specific in higher education.

The Ministry of Education (ME), presents figure on less than 10% of the Brazilian population have higher educational training. As it was previously stated in this paper, to pave their way to a more developed society and bring innovation as a permanent culture, the national government had to adapt its policies applied to the Ministry of Education, in order to

integrate with policies from other ministries and help the nation achieve their common objectives of social-economic development.

The Ministry of Education currently works in different policies to raise education efficiency in the country. However, the programmes are also related to the development of science, technology and innovation.

The Brazilian government maintains projects that facilitate student access to higher education and teachers and help improve the quality of education of federal institutions.

FIES (1999): The objective of the Student Fund of Higher Education (FIES) is to fund the higher education of undergraduate students who are unable to afford the costs of their education. To apply for the FIES, students must be enrolled in private institutions, registered in the program and positive assessment in the evaluation processes of the Ministry of Education - MEC.

PROUNI (2004): The University for All Program (ProUni) was created to provide full and partial scholarships for studies to students of undergraduate and sequential specific training courses, always in private institutions of higher education. Those institutions that join the program receives tax exemption.

IES Program (2003) - MEC and BNDES (2014) The Ministry of Education and the National Bank for Economic and Social Development (BNDES) signed a joint action protocol that will enable the provision of funding to public and private higher educational institutions, which have good academic performance. Among the items that can be funded are infrastructure improvement works; domestically manufactured machinery and equipment that are accredited by BNDES; books, domestic and imported, for formation of the collection of libraries; national educational software, aimed at improving the administrative and financial management, import of equipment that do not present similar projects in national and financial restructuring industry.

PRONATEC (2011)- Law No. 12.513/2011 (National Program for Access to Technical and Employment): The program aims to expand and democratize, internalize the provision of vocational and technological education for Brazilian students. In addition, it will expand professional opportunities for labour force.

Science without Frontiers (2011): The program seeks to promote the consolidation, expansion and internationalization of science and technology, innovation and competitiveness through the Brazilian exchange and international mobility. The project involves giving up to 101 thousand scholarships over four years to promote exchanges, so that undergraduate and postgraduate do internship abroad in order to keep in touch with competitive educational systems in relation to technology and innovation. Moreover, seeks to attract researchers from abroad who want to settle in Brazil or establish partnerships with Brazilian researchers in priority areas defined in the program, and create opportunity for researchers from companies for specialized training abroad.

The key modes of scholarships are Doctors degree partially overseas, doctor's degree in Brazil, PhDs, Bachelor partially overseas, Development of innovations overseas, Attraction of foreign talents and Special Guest researchers. The key areas covered are the technological fields, such as IT, Renewable resources, etc.

4.3.2. Market Innovation Policies

a) Company Innovation Plan - Plano Inova Empresa (2013)

The program has its aim on stimulating investments in innovation to raise productivity and competitiveness in the Brazilian economy through expansion of the level of investment, greater support for projects of technological risk, strengthening relationships between companies and the public R&D sector and on defining strategic areas by targeting fostering innovation business plans and decentralization of credit and subsidy for medium and small businesses.

The new model for fostering innovation are articulated programs of various public institutions; Coordinated use of instruments: loans, grants, equity and non-refundable; Integrated Management (Innovation Room) for all kinds of participation in the program; Reduction time and administrative simplification.

The project calls for a total investment of US$ 32.9 billion, with 28.5 billion invested by the federal government and 4.4 billion by partner institutions such as National Petroleum Agency (ANP), The Brazilian Electricity Regulatory Agency (ANEEL), Brazilian Micro and Small Business Support Service (SEBRAE) and Brazilian Telecommunications Agency (ANATEL).

The key sectors to be fomented by the programme are Agricultural Chain; Energy; Oil and Gas; Health Complex; Aerospace and Defence Complex; ICT; Social and Environmental

Sustainability; Incremental Innovation; Product and Process Engineering; Decentralization; Small and medium Enterprises and Infrastructure for Innovation.

b) Bigger IT Program-Programa TI Maior (2012-2015)

The Strategic Program for Software and IT Services part of the National Strategy for Science, Technology and Innovation, ENCTI - 2012/2015, and articulates with other existing policies in the fields of defence, economic growth, health, agriculture, IT, industry and telecommunications.

The Key actions proposed are:

1. Support the Informatics (No. 8.248/91) and the Goodwill (No. 11.196/06) Laws for the generation of start-ups;

2. Develop scenarios of special tax regimes for export of software and services, like most

3. Propose tools of tax incentives for venture capitalists, including angel investment in IT, which has distinct market dynamics, rapid and exit strategies very particular investment in relation to other economic sectors;

4. Evaluate the models of procurement of Information Technology, seeking to balance the minimization of costs for government and generate benefit for the sector;

5. Improve legislation on outsourcing and subcontracting of work in the sector;

6. Studying aspects of Brazilian and international laws regarding intellectual property (IP) software, relying on comparative law analysis, assessment of the economic impact of legal architectures of IP barriers to innovation for small businesses, impact on value creation from the Brazilian market, among other topics;

7. examine the possibility of rapid implementation mechanisms (fast track) for the attraction and establishment in Brazil of skilled international human resources;

8. Supporting the implementation of a law protecting personal data.

Macro goals 2011-2022:

- Grow Brazil from 7th to 5th in the World IT Ranking;
- Raise 8 times the amount of exports by sector, reaching US$20 billion in 2022;
- Nearly double the participation of IT sector from 4.4% to 6% of National GDP.

Strategic Program:

- Social economic development;
- Positioning Brazil in the international arena;
- Generate innovation and entrepreneurship;
- Developing competitiveness;
- Incentive for research, technological development and innovation.

5. Results

5.1. Systematic Analysis

In this chapter will be using the frameworks proposed by Woolthuis et al (2005) on innovation policy systematic failure framework and Chaminade and Edquist (2006), Edquist's 10 activities/functions/factors influencing innovation (2005).

With these frameworks, it will be simpler to use their key concepts to analyse the efficiency of Brazilian innovation policies and the overall system. The chapter will be separated in Innovation System analysis, functional analysis, Economic and market analysis, Historical Influence, and international comparison.

5.1.1. Infrastructural Failures

Infrastructure for the development of innovation in Brazil is still developing. In most aspects, research infrastructure is small and concentrated in some regions of the country. Although there are policies to support development, infrastructure is still provided on demand, making it difficult to plan and stimulate innovations in a framework of complexity and poor infrastructure.

Brazil invests 1.19% of GDP in R&D. Much lower than a country in a similar economic stage such as Korea, which invests 3.44% of GDP in the technological development (MCTI, 2014).

On one hand, in developed countries such as the Unites States and Germany, investments made by private companies are much higher than those made by the government. This could

be related to the higher stage in development regarding the achievement of a knowledge-based economy. On the other hand, in Brazil, the private sector still sees investments in R&D as risky and not vital to the future of companies in the Brazilian market context. As an example, it can be seen that while Brazil companies invests only 0.55% of its revenue in R&D, Koreans invests 2.8%. This shows that innovation is still not seen as priority to Brazilian companies in comparison to Asian and European nations.

Although the investments in innovation in Brazil continue to grow, and remains higher than other BRICS nations such as India and South Africa, it is still insignificant compared to China, which has a very strong sense of investment in R&D related activities, while Brazil is characterized by relations mostly linked to market and organizational innovations (OECD. (2013b).

On the authority of the OECD. (2013b), the share of expenditure in R&D in the total GDP remains low compared to developed nations, however in the other hand is larger than its Latin American neighbours and some BRICS nations. This is clearly shown by the much smaller number of researchers composing the total employed labour force.

The innovation expenditure in 2008 in Brazil was 1.08% of GDP according to OECD. The country scored below OECD medium but remained higher than the others Latin American countries.

5.1.2. Institutional Failures

According to Lundval (1998:5), "*Institutions understood as norms, habits and rules are deeply ingrained in society and they play a major role in determining how people relate to each other and how they learn and use their knowledge*". Johnson and Edquist (1997a), completes this definition by stating that the main objectives of institutions in the innovation systems are to provide accurate information about market and agents, enforce property rights and to regulate the market.

If we point out the theory of Acemoglu et al (2003), regarding the institutions being the root of causes in economic development, institutions definitely play a key role in innovation systems.

The framework given by Woolthuis et al (2005), regarding hard institutional failures as being part of the systematic, regulatory, policy-making and bureaucratic side of institutions. The other side are the soft institutional failures, regarding culture and other social factors.

5.1.3.Hard Institutional Failures

Based on interviews and research, Brazil does not present a large number of hard institutional failures. There is a range of government institutions and policies framework that cover all aspects of the innovation system.

The burden of bureaucracy and attachment to formalism, which often make programs for R&D are not managed objectively in terms of results to be obtained, but with a focus on bureaucratic and operational requirements. An approach that has shown inadequate to the dynamics of the sector, which requires rapid responses, quickly takes the results from the laboratory to the market, and incompatible with the very nature of the activity of R&D (Informe ABIPTI-Interview Claudio Violato, 2014).

Agents: There are a range of government institutions as well as private and third-sectors institutions linked to the national innovation system, which all play important roles in the development of policies and the overall innovation system. These institutions have good financial situation, supported by the federal government and grants. In this sense Brazil show failures in institutional failures, since has solid and important agents integrated to the national system of innovation.

Regulatory framework integration: According to OECD (2012), not much has changed in Brazilian innovation policy since the Innovation Law. However, there have been many measures to promote coordination between institutions from national, state and municipal level. These agents would also have to interact with banks, private businesses, industry and labour unions.

The current situation of innovation policies in Brazil is actually raising awareness of the importance of innovation for the country's competitiveness, development, progress and well-being of society, creating a more favourable environment for the establishment of policies aimed at the intensification of activities for innovation in the country. Over the past 30 to 40 years, there was a very large scientific and technological maturity in Brazil, with the structuring of large programs of R&D and training of personnel, who have built expertise in various areas of research.

In the last two decades, Brazil has created a set of important policies to support innovations, such as sector funds, Law of Innovation and subsidy mechanisms, which mobilize resources for technological development and innovation instruments.

In agreement with the view from Innovation Policy Platform: Brazil OECD (2014), the ENCTI would become the key innovation strategic policy by providing strategies to bring Brazil to a global level in innovation; development and strengthen internationalization and partnerships; to bring a sustainable conscience about the development technologies for a greener economy; and brought more awareness about innovation regional disparities in the country.

The National Code of Innovation new legal framework for the sector will lead to new incentives for innovative activity in the country, increasing the level of public and private investment in innovation, which will result in increasing the competitiveness for Brazil. The approval of PEC 290 will enable the construction of a new environment for innovation in the country, stimulating research and the creation of appropriate technological solutions to the needs of Brazilian society, and the integration of technology research institutions and innovative companies in a national system, combining efforts towards national development. Due to its approval, it will be-able to establish clear and simple rules for the use of government resources for R&D, in particular sectorial funds.

Despite having policies overlapping one another in a few points, Brazil has a very good policy framework that foresees all aspects of the national innovation system. That being said Brazil does not have many hard institutional failures.

5.1.4. Soft Institutional Failures

In comparison to the framework proposed by Lundvall (1998) the Brazilian innovation system shows lack of trust and rationality with high relations between the agents. In interviews, the topic regarding the existent and even common rivalry between leaders of institutions since there is high competitiveness and ego conflicts in the government sector specially.

5.1.5. Innovation Culture

There is high importance in the study conducted on the perception of the domestic population in relation to the benefits from scientific research as illustrated by the graphic bellow. It can be seen that Brazil is the country that had most positive feedbacks, being compared to the USA, China and Korea. This shows that the population will probably support the creation of new government policies for innovation in the country.

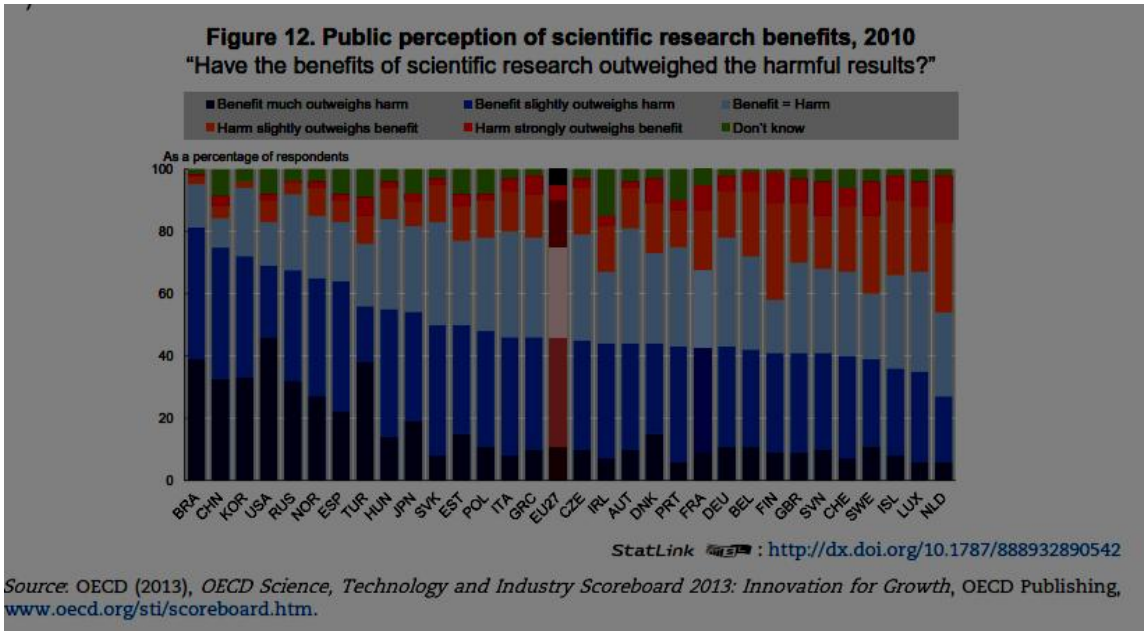

Figure 1 - Public perception of scientific research benefits, 2010 (OECD, 2013)

A low point mentioned by the OECD. (2013b) is the fact that even unwilling, the government is favouring incentives to larger, better established and more successful companies, thus generating an unstable competitive scenario from which already have been aggravated over the nation's history. The support available to smaller and younger enterprises remains inaccessible to some victims that do not possess knowledge and resources to reach these incentives and government direct support. Although there are few institutions that have scientific culture inside companies in Brazil, there is growing number of membership of companies to the Goodwill Law, which went from 130 registrations in 2006 to 635 in 2009, while the number of beneficiaries went 130-542. This shows a possible shift to a stronger innovation culture.

There are great challenges, since Brazil has yet to really strengthen a culture focused on innovation, especially in the business sector, where investments in this direction are still very shy.

5.1.6. Interaction Failures

According to the framework it is analysed regarding the concepts of Strong Network failure by Carlson and Jacobson (1997), despite evolving the innovation system and bringing results to the sector in Brazil as partners, there is a lack of integration between the key players in the innovation system. Regarding the hierarchy of institutions and stakeholders, it is evident that

efforts are wrongly directed. The exchange of information is low, and treated as a need to know basis, preventing the flow of knowledge and results creating lock-in.

The concept of Myopia due to internal orientation developed by and Nooteboom (2002) is evident, since most stakeholders in Brazil focus their efforts in internal activities, inhabiting institutions to interact with other institutions, this is a very strong culture in Brazilian government over the years, recently been receiving changes in previous governments in search of efficiency.

As pointed byte framework of Woolthuis et al. (2005), it is observed a high level of dependency between smaller and bigger partners. Due to the infrastructure of government funding system in Brazil, larger stakeholders outsource projects to smaller institutions, they being public or private, in order to provide results though specific integrative actions. Although decentralization is seen as a good thing in this sense, smaller stakeholders become very much dependent of others to even keep their existence. This is specially seen in the third sector, where associations and institutes are tied to government project funding.

In the context of interaction between universities and businesses the interaction between university and company is fully impaired if the company has a team of R&D. The mechanism is not bad from the point of view of the university, but their effectiveness is almost nil. A company that already does R&D will not want to collaborate their activities, putting own resources and could manage directly into the hands of third parties. Firms that do R&D, have no interest in these partnerships; if they use the mechanism, be the incentive, and not to increase their ability to innovate.

5.1.7. Capabilities Failures

Brazil does not present a lack of knowledge in its institutions; all have good expertise in what they do best. Especially the government organisms are very aligned with the policies of innovation. Nevertheless, some capabilities have still to be developed. Some institutions, despite their size lack flexibility in adaption to a new scenario, as well as resources to promote actions to generate results. Instead of joining efforts with other stakeholders to supply the demand for certain fields, many institutions aim the focus in self-growth and institutional independence. Losing focus of common goals and minimize learning potentials.

According to Innovation Policy Platform: Brazil OECD (2014), the federal and state governments must adapt to better integrate their innovation policies, in or to provide better services for society in relation to services and provide information to agents of innovation in all regions of the country.

5.1.8. Transition Problems

The Brazilian economy has seen over its history many different scenarios. Brazilians are known to make the best of things and hope for better times, which recently have come in a very much-developed economy. In the innovation system context, it is not very different. The efforts of many are now having results and the system is developing in reasonable steps. Nevertheless, the innovation system still has issues with transition from a peripheral region to a more developed scenario.

In a couple of interviews, it was pointed out that Brazil does not has bad policies and strategic plans, the problem lays with the inefficiency in pointing these efforts to the actual execution of activities to reach goal.

5.1.9. Overall Systematic Analysis

The systematic analysis for the Brazilian innovation system framework is rather negative.

As it was pointed out, innovation policies and institutions are not the issue in the low development of the system. The poor investment in innovation and the negative culture towards institutional integration are to be blamed by the systematic failures of the overall framework.

There is remaining lack of efforts in the development of capabilities that will provide better integration between agents in the scenario. Stakeholders are currently trying to develop these mechanisms, but there is a resistance over change regarding systematic integration with agents and policies to achieve desirable objectives.

5.2. Functional Analysis

According to Wieczorek & Hekkert (2012:77), "*functional analysis focuses on the processes that are important for innovation systems to perform well. The processes are categorised as functions of innovation systems and they clarify the dynamics of the systems*". This being said, there is a high importance in analysing the context in which the Brazilian innovation system is framework.

The concept developed by Tödtling, M Trippl (2005) regarding the problem areas in regional innovation systems (RIS), the author points out the 3 different regional innovation systems: peripheral region (developing), old industrial regions (lock-in, stagnated) and fragmented metropolitan region (well developed).

The concept from Johnson (2001) regarding the *six functionalities of innovations systems* will be analysed. Also, Hekkert (2007) and Bergek et al. (2008); regarding system functional

analysis as a way to evaluate the innovation system as it is in terms of its specific functionalities which would classify the framework as efficient.

5.2.1. Firms and Regional Clusters

Brazil qualifies as a peripheral region in the sense that there are not many clusters developed. Mostly as a result of spontaneous phenomena in each region. These usually focus on one activity and their service related businesses. Some sectors such as petroleum and gas as well as ethanol production are very developed clusters and industries in some regions of the country, nevertheless the perspective of Brazil as a fragmented metropolitan region remains only in the absence of knowledge-based clusters in national level.

5.2.2. Entrepreneurship, Private Sector Growth and Competitiveness

According to IPEA (2011), 51% of the activities related to exportation in Brazil are related to primary commodities and only 25% related to high and medium technological intensity. This is still a very low percentage of total production. For a country to develop into a knowledge-based economy, its production must have very intense technology purposes.

As an example of this problem, as stated by PINTEC Results-IBGE (2011), in Brazil, during the period 2009-2011, there were 14.37% of enterprises introducing new products for themselves and 3.66% of the total that have introduced new products for the domestic market. In 2008, nationally, the rates were, respectively, 19.93% and 4.10%. In this case, it can be seen that the rate of innovation of local firms were also higher than the national average in the triennium 2006-2008 and 2009-2011.

PINTEC Results-IBGE (2011)also point out that in terms of selected industrial activities, the manufacturing segment of machinery and equipment obtained the highest rate of product innovation and process with 82.25% of the surveyed companies in this sector, which was also a leader in product innovation (61.96%), the new product for the company (48.55%) and new product for the domestic market (37.32%). This shows how certain sectors have a much higher technology intensity creating a type of discrepancy with other sectors.

This can be a great problem in promoting competitiveness, since the Law 11,487 is focused on companies that collect income taxes using the system's actual profit. This system is only large companies, and these usually already develop R&D. These companies have little interest in using the mechanism. If the law is intended to increase the quality of the interaction between university and company, most likely will not fulfil its purpose.

Despite many problems regarding the non-equality between stakeholders, entrepreneurship based on innovation is still to be stimulated in the country as a measure to intensify high technological intense firms.

5.2.3. Innovation Activities

The low levels of R&D in the country qualify Brazil as a peripheral region for not stimulating as much development as it has on some fields previously discussed. The research that is developed is mainly linked to incremental and process innovation. As previously stated, much of the innovations in the country never even see income as a result of efforts.

5.2.4. Knowledge Generation and Diffusion

a) universities/research organisations:

The higher education sector is within the areas that have larger growth over the past years. Nevertheless still attracts low investments especially in infrastructure and research. Although there are more patents and publications being registered, international co-operations and movement of researchers remain small, despite of investments made thorough CNPQ and FINEP for the financial incentive of researchers from Brazilian institutions. In addition OECD. (2013b) concludes that the international cooperation and movement of research is not just low, but also brings insignificant scientific results.

As for the Innovation Policy Platform: BRAZIL OECD (2014), Brazil must develop support for innovation building efficient institutions for education and R&D, due to importance of education to the development of innovation. OECD provides negative data. (2013b), which informs that the total investment in education in Brazil is still very low of total GDP (1%), while its neighbour Chile invest almost 2.5% and Canada almost 3%.

Although there are many negative points regarding research organizations and universities, there has been a great development both in number of students in all levels. The policies of education such as PROUNI, FIES, PRONATEC improvement of the educational systems and teachers in general; as well as the financial incentives being directed to higher education and government grants.

In this context, Brazil qualifies as an old industrial region in the number and quality of universities. The ones considered to be high quality have are mainly orientated to traditional technologies. There is not much partnership between companies and universities to develop innovation. According to Polanyi (1997) it is important that there is a certain partnership

between universities and private sector in order to provide practical learning for students, since the master-apprentice relationship teaches as much as the academic side of education.

b) education/training:

According to MCTI (2014), despite a slow growth in academic graduates over the last 20 years, in 2011, almost 55.000 masters and doctors students graduated in Brazil. A 324% increase in comparison to 1998, which graduated 17.000 academics in public and private educational facilities. This number is still very small in comparison to developed countries that have achieved the knowledge-based economy context. In this sense, it can be argued that the development of thinkers is vital for an economy to grow from a low technological intensity scenario to a very high intensity context. This can mainly be related to the low incentives to innovation in Brazil.

Professionals in Brazil still prefer to focus on more practical bachelor's degree that for instance would guarantee their participation in the labour market rather quickly in comparison to the academic career choice, which would take a longer dedication, without guarantee of financial and career progression in a short time, as they would have with bachelor's degree in the private sector.

Academics that insist in pursuing their vocation having to become frustrated by low opportunities of jobs in different sectors, mainly focussed on the public universities career or pursue international careers that have higher demand for highly skilled labour, thus, generating a knowledge flow and brain drainage to these nations, leaving Brazil with even less innovator and thinkers.

As a peripheral region, Brazil focuses its educational efforts on the efficiency of the low and medium level qualifications and training. Although there are traditional and well-established vocational school, and developed educational policies such as PRONATEC, FIES and PROUNI, the participation of higher education graduated in the overall market is still around 10%.

5.2.5. Knowledge Transfer/Diffusion

As previously stated, in Brazil there is a very difficult reality for the developed of knowledge and technology into actual commercialization. The innovations created despite having high demand in the domestic market still shows low influence on total GDP.

Technological diffusion understand the process in which a technological innovation is adopted by the market after being developed. The main objective of dissemination is to

exchange innovations that can contribute to increased efficiency and effectiveness of the means of production that are being used at that moment. Any dissemination, as an impact of technology occur differently among different economic agents benefit.

Technological transfer is the process by which an invention or intellectual property resulting from academic research is licensed or transferred through the use rights for a for-profit entity and consequently marketed.

Despite not in the same level as international upper levels knowledge flows in other countries, according to Innovation Policy Platform: BRAZIL OECD (2014), Brazil has developed many support mechanisms to encourage exchange of ideas such as incubation, provision of facilities for independent researchers, incentive on joint projects, establishment of start-ups and financial support reaching in 2007 US$ 204 million. Most programs incentive knowledge flows between universities and R&D related companies. SEBRAE, the public company to incentive entrepreneurship in the country, plays a strong role in developing technological intense enterprises.

The Innovation Law (2004) has opened many doors for the development of knowledge flows, by helping creating innovative companies with the support of incubators, facilities and partnerships to make possible the shift to a more integrated knowledge system. Resources from SIBRATEC and other government policies have directed funding to these activities. These have already shown results. The key aim today is to bring higher interactivity between universities and the business sector. Only through this integration will the innovation system be fully efficient in knowledge diffusion.

5.2.6. Networks

Brazil classifies an old industrial region since the system still has not managed to break from technological or political lock-in. Although the networks are very well developed through policies and frameworks for the system of innovation, the relations between the actors is still developing. There is a need to improve integration between these, which would so make the innovation system more functional and so making possible the development of many actions regarding the evolution of the innovation system in the country.

5.2.7. Creation of Legitimacy and Protection on Innovation

The Patent law (Law 9.279/96), regulates the obligations and rights relating to industrial property, to ensure the inventor of a new product, the production process of industrial or utility model application, the ownership of his invention for a certain period, during which

any interested in making the invention for commercial purposes, you must obtain permission from the copyright and pay him royalties.

Spillovers have always been the main concern of innovators when investing in new technologies. Dedicating months and even years in projects to give knowledge to competitors has been a major concern of researchers all over the world.

In Brazil, the lack of incentives for the development of new technologies reflected in 2010 the very low number of patents registered in the United States Patent Office with only 568 patents registered, not much more in relation to 1980 where there have been registered 53 patents. This is a minuscule amount for a country that seeks development through R&D. In South Korea on the same period, have been registered 26.040 patents (in 1980 registered only 33 patents), and in the United States 241.977. The company Toyota alone in 2009 registered more than 1.000 patents according to USPTO (2014). According to OECD. (2013b),the number of patents per capita in Brazil is an even worst problem, where it is lower than the other BRICS nation, showing the low culture of intellectual property in the country.

Once brought up these numbers it is easier to understand why Brazil has difficulties in emerging to a knowledge-based economy in comparison to more advanced nations in the world. Not only this is an intellectual property problem, but also it becomes clear that there are patents that are not being registered, missing out on possible revenues, or in some cases just archived in universities all over the country, never making the production chain, slowing the technology intense economy.

A good example is the “Copaíba”, it is a seed originated from Brazil used as a natural antibiotics and anti-inflammatory to treat urinary and lung infections, psoriasis, eczema and wounds. Brazil is the nation that has made most publications related to the seed (76 publication), almost *seven times* more than the second country that made any research on this, the USA (11). Nevertheless, Brazil has not made any patents registration in the last 10 years, however, the USA has made 17 and even Japan has made two. This demonstrates the lack of intellectual property culture in the country. (Núcleo de Informações Biotecnológicas-NIB/CBA, 2009)

5.2.8. Analysis

In the framework proposed by Tödtling, M Trippl (2005), it would be difficult to qualify Brazil as a specific type of regional innovation system. Like most countries in the BRICS, which find themselves in a context of shifting from underdeveloped economies to well

develop, Brazil is a country that has many traces of a peripheral regional system as well as old industrial region characteristics.

Overall, Brazil is a peripheral regional system, since it is still very premature in the sense of cooperation and actual use of actions. The country searches for possibilities of improving educational infrastructure as well as knowledge diffusion between agents. Nevertheless, it is possible to analyse a resistance against change by institutions in order to work better as one to achieve desirable goals.

In the other hand, Brazil shows many important characteristics that old industrial regions have. Although being a relatively young nation, the country benefited from the industrial revolution just like other countries in the world. This shows that Brazil has a relatively strong industrial revolution. The problem lieson the lock-in, which takes place in the Brazilian market, where innovations are rarely seen in the market, and the search for developments is still very shy compared to other nations.

To achieve an efficient functionality in the national innovation system, must adapt to integrate policies and stakeholders to pursue common goals as partners. Innovation can transform the country in a few decades if properly administrated.

5.3. Sector Economic and Market Analysis

There is a stagnation of innovation indicators in Brazil in relation to a set of factors that are related to the characteristics of the Brazilian productive sector, the existing research infrastructure in the country and with the tools to encourage the technological efforts of firms and their interaction with the universities and research centres, between others. Among these factors, it is highlighted a productive structure specialized in segments less technology-intensive, small scale production of Brazilian companies and the existence of few Brazilian companies of national capital in more technology-intensive sectors.

According to PINTEC-IBGE (2008), the Progressive Growth rate of innovation grew from 31.5% in 2000 to 38.1% in 2008. 22.3% of innovative companies used at least one instrument of government support while in the previous survey was 18.8%. The innovative effort is still concentrated on the acquisition of machinery, equipment and software. Companies with medium/high technological intensity recorded higher rates of innovation. E.g.: automotive industries (83.2%) and pharmaceutical industries (63.7%). There was an increase in the technological intensity of the high-technology sectors (whose R&D / RLV ratio increased from 1.89% to 2.28% between 2008 and 2011), medium-high (from 1.13% to 1.27%) and medium-low (from 0.62% to 0.78%).

On the other hand, the low-intensity segment technology R&D / NSR ratio fell from 0.26% to 0.22%. One can also observe that the sectors are medium to high tech ones that contribute most to total spending on R&D in the manufacturing industry in Brazil (0.37% to 0.75% in 2008 and 0.42% to 0.83% in 2011). Sectors of low technological intensity, in turn, although they represent about a third of the RLV together contributed only 0.08 percentage points (in 2008) or 0.07 percentage points in 2011 for the R&D / relationship RLV industry average processing (PINTEC Results- IBGE, 2011).

Despite the effects left by the international crisis, the economy in Brazil continues to grow slower, nevertheless, the number of companies being born remain larger than the ones dying. This shows the improvement of enterprise longevity in comparison to the previous years and even to other countries. According to the OECD - Entrepreneurship at a Glance (2013), all the OECD nations had a higher rate of enterprise death than births, apart from Korea, Luxembourg and mainly Brazil.

What can be seen in the recent period is a deepening of this specialization. Therefore, international commodity prices still high and a backdrop of slowdown in industry (sector accounts for over 70% of business R&D in the country) contributed to further specialization of the Brazilian economy in segments of low technological intensity. In this sense, there seems to be a problem of composition: despite the growth of the knowledge content in technology-intensive sectors, these sectors are losing ground in the Brazilian productive structure. In other words, the technological effort increases in important segments of the industry, but the share of these sectors in the economy decreases. This explains why the increase in R&D in the manufacturing industry has not translated into an expansion in the ratio R & D / GDP. As per the data of PINTEC Results-IBGE (2011), expenditures on internal R&D reached in 2011, US$ 19.95 billion currents, whereas spending on foreign acquisition of R&D reached US$ 4.29 billion to R$24.24 billion. When compared to GDP, this represents 0.59% versus 0.58%.

There was an increase in R&D/RLV industry relationship, which increased from 0.73% in 2008 to 0.81% in 2011. If the analysis is restricted to the mining industry, this ratio goes from 0.15% to 0.42%, while limited to the processing industry analysis indicates an evolution of R&D/RLV from 0.75% to 0.83%. All these percentages show that between 2008 and 2011, the Brazilian industry increased its investment in R&D (PINTEC Results-IBGE, 2011).

Financial Incentives: According to the MCT, in 2006, 130 companies spent about US$ 2 billion in their R&D projects. This generated a real reduction of US$ 189 million in social

contribution and U.S. $ 525 million in income tax. If accounted for all tax incentives of Law, the real gain for these companies was around US$ 229 million in 2006. This is an example of how the financial incentives to these firms are efficient and can help develop more innovations over time. However, the number of companies is still very small compared to what it could be.

According to economist Robert Solow, by including tax incentives (tax cuts) and lines of credit from BNDES subsidized as a way of promoting innovation, the Larger Brazil Plan contains real measures of promoting Innovation over long periods; nevertheless, it does not bring much development in shorter periods.

The major criticism that makes the Goodwill Law unequal is the disregard to small companies that are framed in a simpler tax frame, which is regime based on deemed income. The stated reductions in tax can only be re-dear in tax system based on taxable income. In this sense, larger firms will always be more favourable to tax reductions and even reduce one third of their expenditures.

The milestone-regulation that enables the granting of a subsidy was established after the adoption of the Innovation Law and the Law of Good It is observed from the chart below that companies that had the highest number proposals contracted economic subsidies from 2006 to 2009 were the SMEs. PINTEC-IBGE (2008).

According to data provided by the OECD (2014), Brazil focus its support to the development of R&D in tax incentives rather than direct government funding. It is illustrated in the graph that Brazil provides small investments in comparison to Countries such as the USA, Russia, Korea and France.

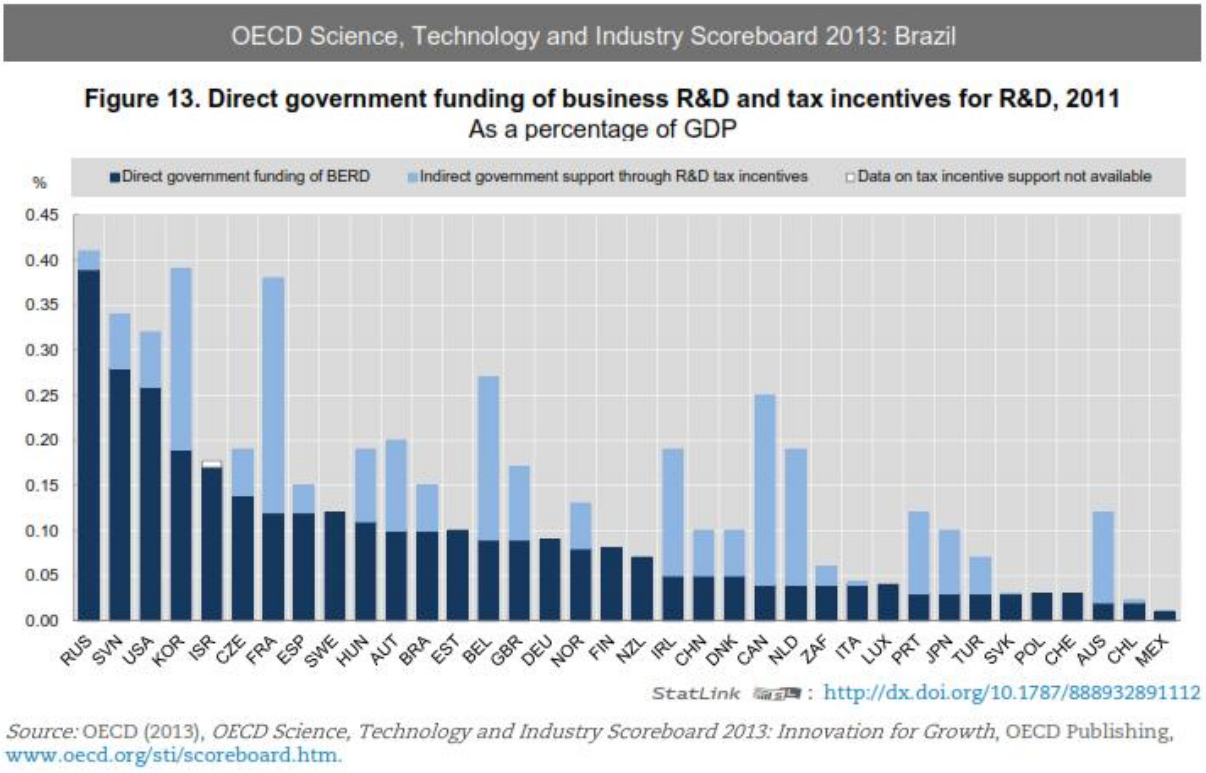

Figure 2 - Government funding for Innovation (OECD, 2013b)

5.4.Historical and Social Analysis

History itself is a factor that changes institutions and culture in general. That being said, it is important to point out how history has influenced the development of the national innovation system in the country.

As it has been previously pointed out, Brazil has shifted from many different economic philosophies over a little more than a century. The country shifter from monarchy, to a more totalitarian republic, later by dictatorship, following by right wing governments and finally most recently by the left-wing politics. Nevertheless, the country has always had a status of third world nation, and considered a mare spectator in the global scenario.

According to OECD (2014:8), *"challenging framework conditions and substantial social challenges, such as poverty, explain the generally weak STI performance"*, in countries such as Brazil, these factors would affect the development of policies by providing slow and costly regulations in the country. Bureaucracy and inefficiency is an inheritance from the colonial period.

The market closure by president Getulio Vargas despites having intentions to product national product acted as a form of protection against international innovation, prohibiting higher quality products from entering the country. This would affect the innovation culture in the

country since people would learn to relate better products with the ones made overseas. This issue would only be corrected in the 1990s, leaving Brazil outside of much of the technological development done in the world.

5.5.International Comparison and Analysis

Brazil is becoming a more important actor on the world stage, both from an economic standpoint, innovation, which provides more opportunities for international cooperation and increased presence of Brazilian technology in foreign markets. The economic momentum that the country lives opens a range of opportunities in overall economic development. Innovation is an important tool to generate economic growth. The country despite the international financial crises has found a scenario of growth trajectory, which does not seen to be changing in the past years. The country has important research institutions that focus in highly developed technologies such as deep-water oil extraction, done by institutions such as PETROBRAS, the public petroleum company in the country.

It was published in the Global Innovation Index (2013), where it analysed through the eyes of different variables how innovative countries were taking into consideration factors such as expenditure on R&D, development of human resources, patents registration and etc. As a result, it was observed that the top five most innovative countries were from Europe and North America on the following order: Switzerland, Sweden, United Kingdom, Holland and the United States. Despite this result had not caused much surprises, another familiar context is the fact that Brazil was held in the 64th place, behind countries economically weaker such as Uruguay (52th), Colombia (60th) and Russia (62th). This clearly demonstrates that Brazil still has a low culture of innovation in comparison to some smaller nations and very far behind in comparison to the developed nations of the northern hemisphere. OECD (2014) and ITIF (2012) both point out how Brazil is levelled in the lower-mid or lower tier in the Global Innovation Policy Index.

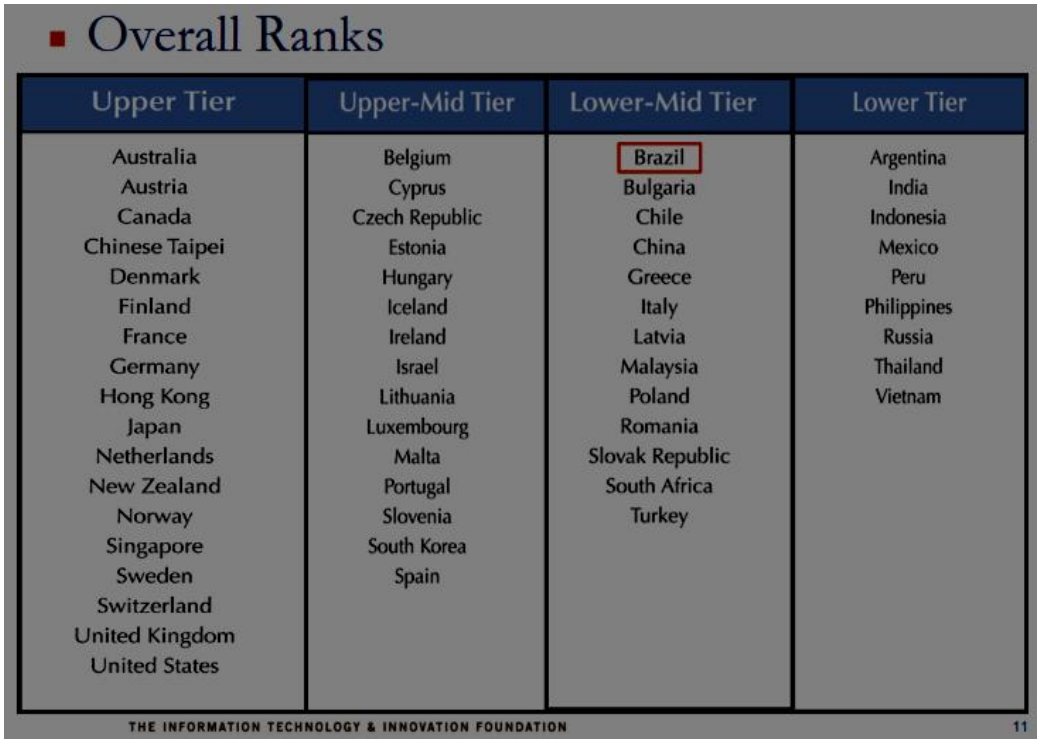

Figure 3 - Overall Ranks of Global Innovation Index (2013)

In reference to the data provided by PINTEC RESULTUS-IBGE (2011), between 2008 and 2011, the world went through a crisis that obviously had an impact on investments in innovation. As a result, countries like the United States and Spain showed a decrease of their business investments in R & D relative to GDP. In the first case, this ratio fell from 1.97% in 2008 to 1.83% in 2011, and the second, from 0.74% to 0.71% of GDP in the same period. In both cases, these reductions were observed after a three-year period (2005-2008) in which the corporate R & D / GDP relations had risen. There are, however, exceptions. Indeed, the Euro zone showed an upward trend of business expenditure on R&D/GDP in the three periods, and China managed to increase this ratio by almost 0.5 percentage points between 2005 and 2001, with emphasis on the period 2008-2011, in which this indicator increased from 1.08% to 1.39%. These data show that the relative stagnation of the Brazilian economic indicators, although consistent with what has been observed in more advanced countries tend to penalize it compared to an emerging country like China.

Although if the strong efforts to develop a strong innovation policy in the country over the years, these were unable to reverse the development trend. In the last decade, the country has built a relatively complete menu of innovation policies: tax incentives, subsidies, subsidized credit, among others. Despite this set of policies aiming in the right direction, it lacks key

elements, especially focus, prioritization and adequate resources. Initiatives try to overcome these limitations, but the results will only be observed in the future.

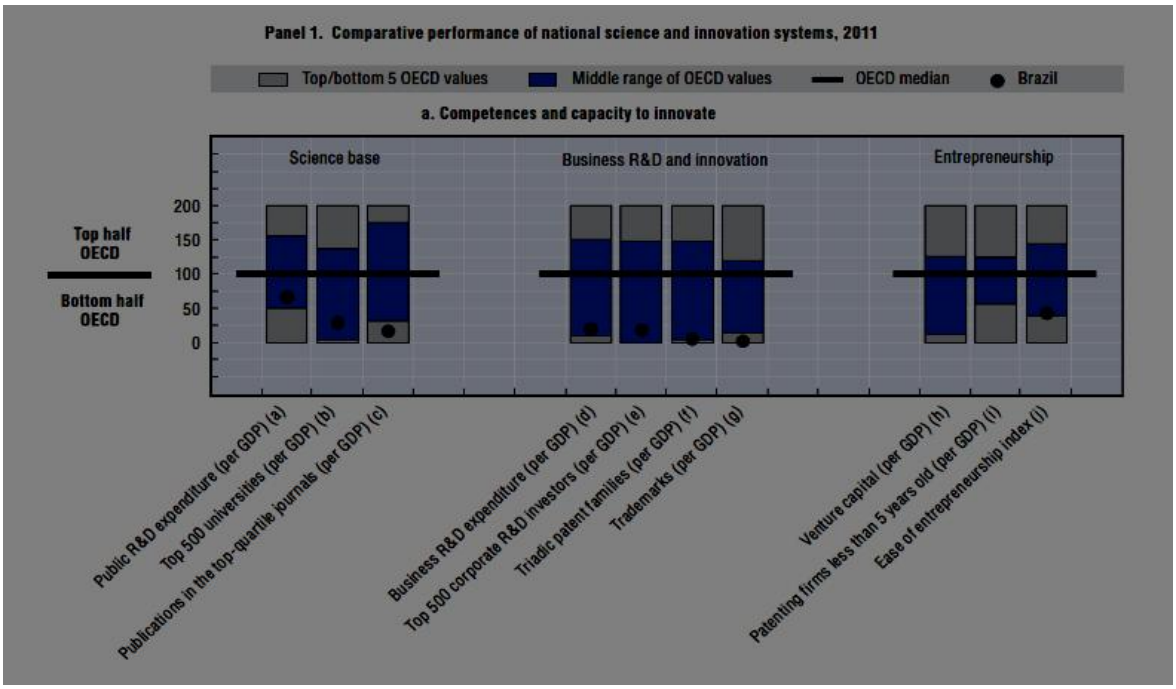

Figure 4 - Comparative performance of national science and innovations systems, 2011 (OECD 2014)

Regarding the development of articles and patents, Brazil is still a country that produced low number of innovations; OECD (2014) explains that Brazil still has a large dependency on international linkages to develop researches that are more complex. Around 27% scientific articles are published in co-authorship with foreigners and 17% of patents. This is a clear example of how Brazil still sees itself as a spectator in the world scenario. It is important that one sees themselves as important stakeholders and give the proper guidance to their capabilities.

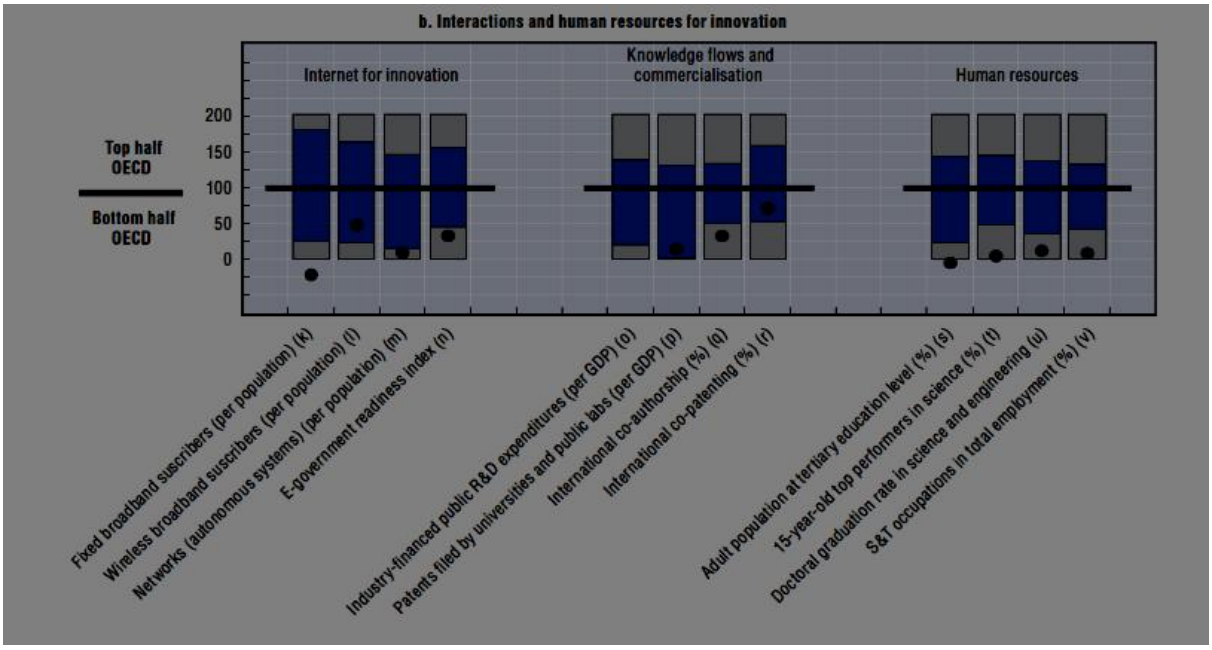

Figure 5 - Interactions and human resources for innovation (OECD, 2014)

5.5.1. Analysis

It is possible to affirm that although Brazil is in a very important period of economic growth, which will probably shift its history in the next decades, the country is still behind developed nations in many ways. In reference to the context of innovation policies and system, the country is to very far from policies and institutions developed to impulse innovation development. The key problem that Brazil faces in comparison to the global scenario is the lack of integration and investment in R&D in the country. The national infrastructure is still considered weak and education to elevate innovative thinking is not very strong as it is in the other countries. Concluding, it's possible to say that Brazil has much to develop to reach the level of international partners, nevertheless as it is pointed by Tödtling and Trippl (2005), not all frameworks are ideal for all innovation systems, thus, Brazil needs to adapt efficient frameworks to the national reality.

6.Discussion and Conclusions

The development of an innovation system is something rather complex and hard to evaluate and categorize all the aspects over a single framework. That is why the integration of different frameworks proposed by authors such as Woolthuis et al, Edquist, Smith, Carlsson & Jacobsson, Tödtling and Trippl, Chaminade, and Malerba is very important to the evaluation of an innovation policy and system. For Brazil, it could be no different, especially

because Brazil does not qualify itself as a single framework. BRICs are in a different stage than developed and undeveloped nations, their innovation systems are complex and, despite having many failures, it presents characteristics of very developed systems, which makes the analysis very hard to be done.

6.1. History and Culture

The importance of historical factors to the innovation system in Brazil is quite clear. Although there is a strong innovation culture in relation to the level of importance of innovation to the overall economy, Brazilians still are very conservative in relation to general changes, and so innovation is rather weak in the country. That being said, stakeholders must raise, through innovation policies, the self-steam of Brazilians regarding their capabilities of developing innovation.

This social structure in Brazil was developed because of government instability, underdevelopment and polarization of the international order that kept many nations outside the innovative knowledge flow between nations. In interviews it is pointed out how government measures that aimed to make the domestic market stronger, backfired, bringing the notion to people that imported products would always be better than national ones, this way of thinking is only recently beginning to change.

6.2. Education

As it was pointed out in different parts of this paper, the importance of education to the growth of innovation in a country is perhaps the most important factor in relation to the development of a strong innovation system.

Previous governments have forgotten the development of educational policies and the overall educational system in Brazil, which classifies Brazil as a very weak educational system within the international education index (39^{th}). These facts are very serious, and this is just an example of how Brazil has developed over the decades.

In order to fix these institutional and policy problems, it is important that stakeholders focus the development of more incentives to education through scholarships, grants and provide a support for the population to educate themselves. Having only 11% of its population with higher education is not acceptable for a country that aims to become a knowledge-based economy. It is necessary to have more professionals qualified in the technical and technological fields.

Although Brazil sees growth in the higher education sector, the accessibility and quality of education is still very distant from an international perspective. It is important that government and private investor create more institutions to promote education in high-standards. It is important that the creation of these institutions take place in less economical areas such as the southeast part of the country in order to generate development in poorer regions.

It is important to discuss that Brazil has, in the previous year, developed many important educational policies which are already bringing results such as PROUNI, FIES and Science Without Frontiers, nevertheless it is necessary the continuance of policy development in order to strengthen education in the country.

6.3. Businesses

According to IPEA (2011), Brazil must develop an innovative culture in order to be more competitive with other nations, especially in the private sector. Companies that innovate and differentiate their products and services profit more, employ more, remunerate well above average, have better qualified skilled labour, export 5 times more and with prices at least 30% higher than those exporters who do not innovate. IPEA (2011) also confirms this theory by stating that the companies with technological advantages make only 3.5% of the total national industry. Nevertheless, they are responsible for 43.4% of the total income from the national industry and for 49.2% of the whole industry transformation, employ 21% labour, are 2.6 times more productive, have an annual average salary 1.8 times bigger than the national average and, furthermore, are the ones that attract most investments.

In order to improve private sector participation in the national innovation system, stakeholders must focus on stimulating innovation in companies to generate wealth. Through the development of an innovative culture, actors will understand the importance of innovation to firms.

Another important factor to businesses is that Brazil needs to have a better representation regarding innovation that would be exported; Brazilian technologies are not very frequently seen in the overall market. This a problem, since if there is no visibility to Brazilian products revenue will be low and so innovations will no generate as much benefits to firms, as it should.

It is also very important to say that the solidification of the bridge between R&D and the generation of wealth is something that still has to be intensified in Brazil. The educational

sector should focus on researches that can lead to patents and wealth in firms. Patents and publications stored in academic offices will not make Brazil more innovative.

6.4. Market Development

Ediquist (1999) said that through various public actions, the functioning of markets can be improved or the state may create markets. This improvement is the objective of law and policies (anti-trust), increasing the level of competition. This might sometimes be achieved through de-regulation, i.e. getting rid of old or obsolete regulations. The creation of intellectual property rights using the institution of a patent law gives a temporary monopoly to the inventor. This makes selling and buying of technical knowledge easier.

6.5. Investments and Incentives

Although the present policies and tax incentives have increased the possibility of investments in R&D in the country, the amount of resources directed to these actions is still low. It is important to develop a stronger infrastructure and research centres that will help public and private sector to be more integrated to the overall innovation system. More grants should be available to develop independent projects.

Policies regarding investments in R&D to governments are seen as tools to develop the economic scenario presently and in the future. For companies the development of innovations is much related to the financial benefits provided. This being said it is important to point out that to benefit both the economy and firms, tax incentives, government grants and invests must be directed to companies. An important point to refer to is the necessity for equality between larger and smaller firms. Smaller firms in the innovation system do not receive these resources, but they generate most jobs in the country.

6.6. Policy and System Interaction

As it was previously stated, the innovation policy framework in Brazil is well developed by laws, strategic plans, and most recently a national code of innovation that will provide even more legal grounds for the development of innovation. In addition, the country does not lack strong institutions. These are very well established and efficient in the purpose.

The downturn in Brazilian innovation system is the lack of interaction between actors in the system. Although they are efficient in their individual activities, institutions have difficulty in aligning their strategic actions with other institutions. This creates a problem for the national innovation system, since without interaction, policies and actions proposed cannot be applied.

Since Brazil needs this integration to develop itself and so achieve the desirable economic change in the country, it needs to make changes to adapt to these changes. No longer, must a stakeholder or institution thinks of itself as an island in the innovation system context.

While there have been efforts in recent governments to establish this integration, it has failed so far. This is a cultural trait installed in Brazilian government sector, which needs to be changed. The ego of many institutional directors and politicians will never benefit the national innovation system. More efforts must be directed to this goal by either adaptation to a benchmarked framework from other nations or from induced culture change in public institutions. This is vital for the development of Brazil into a knowledge-based economy.

6.7. Final Conclusion

It is possible to affirm that, even though Brazil had a rather late innovation system development, it is still a country with large potential for development of innovations as a key factor to strengthen the economy.

Stakeholders are working to regain the lost time; however, more must be done for the system. New actions must be developed in the integration between agents, stimulation of R&D, support to businesses, solidification of educational system and many other factors previously integrated in the paper.

The future of Brazil as a knowledge-based economy is promising. Nevertheless, it is important to point out that the future is not a matter of fate; it is a matter of choice. Problems are evidence in the system, but how they will be dealt with is the key to the future of the Brazilian innovation system.

APPENDICES:

A) INTERVIEW PARTICIPANTS:

- **Edimilson Costa Filho:** Human Resource Coordinator at CNPQ and Programme Coordinator at Euro-American University.

- **Tomas Marcelo Leite:** Technical School Director in SENAI.

- **Hartur Setubal:** Science, technology and innovation advirsor at CGEE.

- **Felix Silva:** Specialist in innovation, former director in ABIPTI, consultant and and professional speaker.

- **Bianca Torreão:** Journalist with speciality in Science, technology and Innovation sector.

B) INTERVIEW QUESTIONS:

1. Describe what is to you the importance of a more innovative Brazil?

2. What are the milestones in the development of innovation policies in Brazil? (Laws, new institutions and policies)

3. What are the main difficulties that an agent in the innovation scenario face in the development of R&D in Brazil due to the established public policy? Could offer 3 points?

4. According to a survey on the interest of the Brazilian population on innovation in general, the OECD (2013b) concludes that the Brazilian people have a high interest in innovation and considers it a topic that should be further discussed. If the economy is shaped by cultural traits, why is Brazil delayed and underdeveloped in innovation?

5. Education is defined as a development tool in many social areas. In this context, how would you describe the effectiveness of education policies related to training of human resources for the development of research and technology to generate innovations in Brazil?

6. Structurally Micro and small businesses as well as independent researchers are the stakeholders less active in the innovation scenario. How do you analyze the incentives and targeted innovation policies to these agents? Is There an attempt to integrate the smaller and less fortunate?

7. What is your point of view on the difficulty in integrating the generation of innovation and wealth to socio-economic development? (Innovation → Company → Profit).

8. According to ITIF (2012) and IPEA (2009), Brazil classifies as a diffuser technology with the BRICS countries. In contrast it is leading in industries such as Oil and commercial jet technology, while classified as a consumer of technology in IT and telecommunications (same as Haiti and Paraguay). How would you compare the national innovation policies with the international scenario? Is there favouritism in certain fields or just spontaneous development in some industries?

9. What are the key changes for Brazil to develop better policies for innovation to generate socio-economic development? How do you see the coming decades in this context?

7. References

ABIPTI. (2014). Gestão *participativa será reforçada pelo novo presidente da ABIPTI*. Informe ABIPTI [ONLINE] Available at: http://www.abipti.org.br/cms_inf/index.php?option=com_content&view=article&id=723:gestao-participativa-sera-reforcada-pelo-novo-presidente-da-abipti&catid=35:entrevistado. [Accessed 09 August 2014].

Abramowitz, M. (1956), "Resource and Output Trends in the United States Since 1870", May.

Acemoglu, Johnson, Robinson, and Thaicharoen (2003) *Institutional Causes, Macroeconomic Symptoms: Volatility, Crises and Growth.* Journal of Monetary Economics, 50, January 2003: pp. 49-123.

ALLAGI - Open Innovation e as Leis de Inovação no Brasil - Blog ALLAGI. 2014. [ONLINE] Available at: http://www.allagi.com.br/pt/blog/entry/open-innovation-e-as-leis-de-inova-no-brasil. [Accessed 12 August 2014].

Atkinson and Robert., (2012). *The Global Innovation Policy Index and Brazilian Innovation*. ITIF.

Bergek, A., Jacobsson, S., Carlsson, B.; Lindmark, S. and Rickne, A., (2008), Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. Research Policy, 37 pp. 407-429.

BNDES. (2014). *Innovation Policy for Inclusive Growth: Technical Conference on Trends, Policies and Evaluation.* [ONLINE] Available at: http://www.bndes.gov.br/SiteBNDES/bndes/bndes_en/Institucional/Financial_Support/innovation_policy.html. [Accessed 09 August 2014].

Breschi, S. and F. Malerba (1997). *Sectoral innovation systems: technological regimes, Schumpeterian dynamics, and spatial boundaries.* In Edquist, C. (ed.) 1997 Systems of Innovation: Technologies, Institutions and Organizations. London and Washington: Pinter/Cassell Academic.

Carlsson, B., Jacobsson, S., (1997). *In search of useful public policies: key lessons and issues for policy makers.* In: Carlsson, B., (Ed.), Technological Systems and Industrial Dynamics, Kluwer Academic Publishers, Dordrecht.

Carlsson, B., Jacobsson, S., Holmén M. and Rickne A. (2002), *Innovation systems: analytical and methodological issues*, Research Policy, Volume 31, Issue 2, February, pp. 233-245.

Carlsson, B., Stankiewicz, R., 1995. *On the Nature, Function and Composition of Technological Systems*, in: Carlsson, B. (Ed.), *Technological systems and economic performance: the case of factory automation*. Kluwer Academic Publishers, Dordrecht, pp. 21-56.

Chaminade, C., & Edquist, C. (2006). *From theory to practice: the use of the systems of innovation approach in innovation* policy. Innovation, Science and Institutional Change, Oxford University Press, Oxford.

Ciência Sem Fronteiras. (2014). *Início – Ciência Sem Fronteiras*. [ONLINE] Available at: http://www.cienciasemfronteiras.gov.br/. [Accessed 09 August 2014].

Coatsworth, J. (2008). *Inequality, Institutions and economic growth in Latin America*. Journal of Latin American Studies, pp. 40.

Costa Filho, E. (2014) Interviewed by Eduardo Ubiali Leite, Masters Thesis, August.

De Negri, J., Salerno, M. (2005). *Inovações, padrões tecnológicos e desempenho das firmas industriais brasileiras.* IPEA. Brasilia.

Dosi, G., & Nelson, R. (1994). *An introduction to evolutionary theories in economics*. Journal of evolutionary economics, 4(3), pp. 153-172.

Edquist, C. (2001). *Innovation policy–a systemic approach*. The Globalizing Learning Economy. Oxford University Press, Oxford, pp. 219-237.
Edquist, C. (editor) (1997b), *Systems of innovation: technologies, institutions and organizations*, Pinter Publishers/Cassell Academic, London.
Edquist, C. and B. Johnson (1997a), *Institutions and organisations in systems of innovation*, in C. Edquist (ed.) Systems of Innovation: Technologies, Institutions and Organizations. London and Washington: Pinter/Cassell Academic.
Edquist, C. and L. Hommen (1999), *Systems of innovation: theory and policy for the demand side*, in Technology in Society, 21, 1999, pp. 63-79.
Edquist, Charles, (1997c), *Systems of innovation approaches - their emergence and characteristics*, in Edquist, Charles. (ed.) Systems of Innovation - Technologies, Institutions and Organizations, Pinter Publishers/Cassell Academic, London.
Etzkowitz & Leydesdorff´s Concept. (1996) – Revista Inteligência Empresarial Nº 21/2004, CRIE, COPPE, UFRJ.
Etzkowitz, H. and Leydesdorff, L. (2000), *The dynamics of innovation: from national systems and 'Mode 2' to Triple Helix of university industry-government relations,* Research Policy, Vol. 29, No. 2, pp.. 109-123.
Fagerberg, J., Mowery, D. and Nelson, R. (2005). *The Oxford Handbook of Innovation*. New York: Oxford University Press.
Financial Times. (2013). *Brazil: innovation, research & development*. [ONLINE] Available at: http://www.ft.com/reports/brazil-innovation. [Accessed 09 August 2014].
Freeman, C. (1995). *The national system of innovation in historical perspective*, in Cambridge
Freeman, C. (1997), *The 'National System of Innovation' in historical perspective in technology, globalisation and economic performance*, edited by Archibugi D. and Michie, J. Cambridge, Cambridge University Press.
Freeman, C., (1987). *Technology Policy and Economic Performance*. Pinter Publishers, London.
Grossman, G. (1993). *Innovation and growth in the global economy*. MIT press.
Hekkert, M., Suurs, R., Negro, S., Kuhlmann, S., Smits, R., (2007), Functions of innovation systems: A new approach for analysing technological change, TFSC, 74, 413-32.
IMF (2003), *World Economic Outlook: Growth and Institutions*, April, Washington: International Monetary Fund.
Ingelstam, L., 2002. *System: atttänkaöversamhälleochteknik. Energimyndigheten, the Swedish energy agency*, Stockholm.
Innovation Policy Platform (2014). *Brazil - Innovation Policy Platform.* [ONLINE]. Available at: http://www.innovationpolicyplatform.org/content/brazil. [Accessed 09 August 2014].
IPEA. (2011). Fonte: Radar Nº 13, IPEA, 04/2011
Johnson, A. (1998). *Functions in Innovation System Approaches*, Mimeo, Department of Industrial Dynamics, Chalmers University of Technology, Göteborg.
Johnson, A. and Jacobsson, S. (2001a), *'The Emergence of a Growth Industry: A Comparative Analysis of the German, Dutch and Swedish Wind Turbine Industries'* paper presented at the Schumpeter Conference in Manchester 2000.
Johnson, A. and Jacobsson, S. (2001b). *Inducement and blocking mechanisms in the development of a new industry: the case of renewable energy technology in Sweden*, in: Coombs, R., Green, K., Richards, A. and Walsh, V. (eds): Technology and the Market: Demand, Users and Innovation, Edward Elgar, Cheltenham, p. 89-111.
Johnson, A., (2001). Functions in innovation systems approaches. In electronic paper at the proceeding of the Nelson and Winter conference, Aalborg.

Johnson, B., Edquist, C., & Lundvall, B. Å. (2004). *Economic development and the national system of innovation approach*. First Globelics Conference, Rio de Janeiro, November 3 – 6, 2003

Johnson, B. (1992), *'Institutional learning', in Lundvall* B.A (ed.), National Innovation Systems: Towards a Theory of Innovation and Interactive Learning, London: Pinter Publishers.

Lee, W In Kim & Nelson. (2005). "*Tecnologia, Aprendizado e Inovação*", pp. 369 (Ed. UNICAMP, C.H. Brito Cruz.

Leite. T (2014) Interviewed by Eduardo Ubiali Leite, Masters Thesis, August.

Lemos, C. (2000), "*Innovation and Industrial Policies for Small and Medium Enterprises in Brazil*". In Danish Research Unit on Industrial Dynamics (DRUID) Winter Conference, http:// www.business.auc.dk/druid/conferences, Hillerod, Denmark, 6 - 8, January

Link and Siegel, Technological Change and Economic Performance, Routledge (2003) (176 pp., [Ukpound] 65.00, ISBN 0415 271398)

Lundvall, B-Å (1998). *Why study national systems and national styles of innovation?*, in Technology Analysis & Strategic Management, Vol. 10, No. 4, pp.407–422.

Lundvall, B-Å (2003), *National innovation systems: History and Theory*, Contribution to be published in Elgar Companion to NeoSchumpeterian Economics, Cheltenham: Edward Elgar Publishing Limited.

Lundvall, B-Å (2007). National innovation systems—analytical concept and development tool. Industry and innovation, 14(1), pp. 95-119.

Lundvall, B-Å .et al (2002), *Innovation, Growth and Cohesion: The Danish Model*, Cheltenham: Edward Elgar Publishing Limited.

Lundvall, B-Å and Borras, S. (1998), *The Globalising Learning Economy: Implications for Innovation Policy*, DG XII-TSER, Bruxelles: The European Commission.

Lundvall, B-Å, Johnson, B., Andersen, E. and Dalum. B. (2002), *National systems of production, innovation and competence building*, Research Policy, Volume 31, Issue 2, February 2002.

Lundvall, B-Å. (1992), *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, London: Pinter Publishers.

MCTI (2014). Portal do Ministério da Ciência, Tecnologia e Inovação. Ministério da Ciência, Tecnologia e Inovação - MCTI. [ONLINE] Available at: http://www.mct.gov.br/index.php/content/view/740.html. [Accessed 09 August 2014].

Nelson, R and Rosenberg, N. (1993c), *Technical Innovation and National Systems*, Introductory. In: Nelson. R (ed), National systems of innovation: a comparative study, Oxford, Oxford University Press.

Nelson, R. (editor) (1993a), *National systems of innovation: a comparative study*, Oxford, Oxford University Press.

Nelson, R.R. (1993b), *A Retrospective*, concluding chapter in R.R. Nelson (ed.) National Innovation Systems: A Comparative Study, Oxford: Oxford University Press.

Nelson, R.R. and Nelson, K. (2002), *Technology, institutions and innovation systems*, Research Policy, Volume 31, Issue 2, February, p 265-272.

Norden (2014). *Nordisktsamarbete*. 2014. Startside — Nordisktsamarbete. [ONLINE] Available at: http://www.norden.org/. [Accessed 17 March 2014].

Nordic Innovation (2012). *Towards a new innovation policy for green growth and welfare in the Nordic Region* - Nordic Innovation publication 2012:02. Oslo.

Núcleo de Informações Biotecnológicas-NIB/CBA, 2009 "*Propriedade intellectual no Brasil*.

OECD (2012), "Reader's guide", in OECD Science, Technology and Industry Outlook 2012, OECD Publishing. http://dx.doi.org/10.1787/sti_outlook-2012-32-en

OECD. (2001a), *Innovative Clusters: Drivers of National Innovation Systems*, OECD, Paris.
OECD. (2001b), *Innovative Networks: co-operation in National Innovation Systems*, OECD, Paris.
OECD. (2002a), *Dynamising National Innovation Systems*, OECD, Paris.
OECD. (2002b), *Main Science and Technology Indicators*, Volume 2002/2, OECD, Paris.
OECD. (2005). Oslo manual: guidelines for collecting and interpreting innovation data. OECD, Paris
OECD. (2013a). *Entrepreneurship at a Glance*. OECD Publishing, http://www.oecd.org/industry/entrepreneurshipataglance.htm. [Accessed 09 August 2014].
OECD. (2013b). *Science, Technology and Industry Scoreboard*: Brazil *Highlights*. OECD. Paris
OECD. (2014). Innovation Policy Platform: Brazil. OECD. [ONLINE]. Available at: http://www.oecd.org. [Accessed 09 August 2014].
PINTEC. (2014) PINTEC. [ONLINE]. Available at: http://www.pintec.ibge.gov.br/. [Accessed 09 August 2014].
Polanyi, M. (1997). Tacit knowledge. Knowledge in organizations, 135-146.
Portal Inovação. (2014). Portal Inovação. [ONLINE] Available at: http://www.portalinovacao.mct.gov.br/pi/#/pi. [Accessed 09 August 2014].
Resende, S., (2014). *Innovation policy around the world: Brazil: challenges and achievements.* Issues in Science and Technology. [ONLINE] Available at: http://issues.org/26-3/rezende/. [Accessed 09 August 2014].
Romer, P. 1996. "Why, Indeed, in America? Theory, History, and the Origins of Modern Economic Growth," American Economic Review, American Economic Association, vol. 86(2), pages 202-06, May.
Sanz, L. (2009). *Science Parks: main concepts; building blocks; strategic models*. IN: IASP Pre-conference Seminar "Fundamentals of Science Park Management", IASP, Raleigh, NC, USA, June 2009.
Schumpeter, J. (1949). *Economic Theory and Entrepreneurial History, Change and the Entrepreneur*, p. 63-84, reprinted in Schumpeter, J. (1989) Essays on Entrepreneurs, Innovations, Business Cycles and the Evolution of Capitalism, edited by Clemence, V. New Brunswick, N.J.: Transaction Publishers, pp. 253- 231.
Schumpeter, J. (1989). Essays: On Entrepreneurs, Innovations, Business Cycles, and the Evolution of Capitalism. Transaction Publishers
Schumpeter, J. 1934 (2008), The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle
Setubal J. (2014) Interviewed by Eduardo Ubiali Leite, Master's Thesis, August.
Silva. F. (2014) Interviewed by Eduardo Ubiali Leite, Masters Thesis, August.
Solow, R. (1956). *A contribution to the theory of economic growth*. The quarterly journal of economics, pp. 65-94.
Szmrecsányi, T. (1999). *Sobre a formação da formação econômica do Brasil de Furtado*, C. Universidade Estadual de Campinas - UNICAMP, Campinas, Brazil.
The Global Innovation Index (2014) - *The Human Factor in Innovation*. [ONLINE] Available at: http://www.globalinnovationindex.org. [Accessed 09 August 2014].
Tödtling and Trippl (2005). *One size fits all? Towards a differentiated regional innovation policy approach*. Research policy 34 (8), pp. 1203-1219
Torreão. B. (2014) Interviewed by Eduardo Ubiali Leite, Master's Thesis, August.
UFMG - Universidade Federal de Minas Gerais. (2014). [ONLINE] Available at: https://www.ufmg.br/. [Accessed 09 August 2014].
UNICAMP (2014). *Inovação - notícias sobre inovação*. [ONLINE] Available at: http://www.inovacao.unicamp.br/. [Accessed 09 August 2014].

USPTO (2014). *USPTO Annual Reports*. [ONLINE] Available at: http://www.uspto.gov/about/stratplan/ar/index.jsp. [Accessed 09 August 2014].

Wieczorek and Hekkert (2012). *Systemic instruments for systemic innovation problems: a framework for policy makers and innovation scholars*. Science and Public Policy 39 (1), p. 74-87.

Woolthuis, R. et al. (2005). *A system failure framework for innovation policy design.* Technovation. 25, 609–619. The Netherlands.

World Bank (2002). *Building Institutions for Markets.* World Development Report 2002, New York: Oxford University Press.