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Brazil and its National System of Innovation (Nis): Perspectives and Challenges

O Brasil e seu Sistema Nacional de Inovação (Sni): Perspectivas e Desafios

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ABSTRACT

Based on the evolutionary approach, in this paper we deal with the growing importance of National Innovation Systems (NIS) for socioeconomic development, focusing on the Brazilian case. For this, initially we discuss the connections between NIS and socioeconomic development. Next, we discuss a set of reports and official statistics that indicate the current reality of the Brazilian innovation system. In this perspective, we analyze the challenges and perspectives for Brazil in the face of the economy and society of the 21st century, which are increasingly complex and globalized. It is considered that, despite the advances since the 1990s, the Brazilian innovation system lacks adjustments to effectively and efficiently contribute to the Brazilian socioeconomic development.

Keywords: Brazil. Innovation Systems. Socioeconomic. Development. Evolutionary Approach.

RESUMO

Com base na abordagem evolucionária, neste artigo tratamos da crescente importância dos Sistemas Nacionais de Inovação para o desenvolvimento socioeconômico, com foco no caso brasileiro. Para isso, inicialmente discutimos as conexões entre o sistema nacional de inovação e o desenvolvimento socioeconômico. A seguir, discutimos um conjunto de relatórios e estatísticas oficiais que indicam a realidade atual do sistema de inovação brasileiro. Nessa perspectiva, analisamos os desafios e as perspectivas do Brasil diante da economia e da sociedade do século XXI, cada vez mais complexas e globalizadas. Considera-se que, apesar dos avanços desde a década de 1990, o sistema brasileiro de inovação carece de ajustes que contribuam de forma efetiva e eficiente para o desenvolvimento socioeconômico brasileiro.

Palavras-chave: Brasil. Sistemas de inovação. Socioeconômico. Desenvolvimento. Abordagem Evolucionária.

1 INTRODUÇÃO

An expressive socioeconomic development is improbable without innovation, especially in the beginning of this 21st century. The international technological vanguard is a *sine qua non* condition to reach and remain among those with real possibilities of a vigorous socioeconomic dynamic. To do so, creating an effective and efficient NIS is practically a must.

In this vein, we aim in this study to examine the growing importance of NIS for socioeconomic development, focusing on the Brazilian case. The basic questions that will be discussed are the following: i) what are the main connections between NIS and socioeconomic development? ii) what do the official reports and statistics on the current reality of the Brazilian innovation system points out? iii) in this perspective, what are the main challenges and opportunities presented for Brazil in this complex and globalized context of the 21st century?

Methodologically, a theoretical reading of a heterodox nature is adopted, more specifically the evolutionary approach on Economics (*a là* Nelson & Winter, 1982). For the literature review, secondary bibliographic sources from researchers dedicated to the object of study were used. It supports and is supported by conceptual, statistical and analytical studies of official institutions addressing the theme. Some of them are the Organization for Economic Cooperation and Development (OECD), Atlas of Economic Complexity (AEC), World Bank (WB), United Nations Educational, Scientific and Cultural Organization (UNESCO), Instituto Brasileiro de Geografia e Estatística (IBGE) and Ministério da Ciência, Tecnologia e Inovação (BRASIL/MCTI/Encti).

This article is structured in three sections, together with this introduction and the final considerations. In the second section we present some of the main relationships between NIS and socioeconomic development, showing – in addition to the definitions of some concepts that will permeate the study – how both interact and feedback. In the third, we interpret official documents and statistics of formal institutions, in order to overview the innovation system in Brazil. The previous sections will provide theoretical insums for the fourth, in which the contemporary challenges and opportunities for the country are analyzed.

2 NIS AND SOCIOECONOMIC DEVELOPMENT: MAIN CONNECTIONS

The first writings on the NIS date back to the 19th century, stemming from the studies of Friedrich List ([1841] 1885), that addressed systemic interactions between countries and within them. The fundamental idea was that of a system, such as a continuous process between different institutions, in which the author investigated the trajectory of the United States and England. This theme was resumed in the late 1980s, inspired by the rapid technological changes that are still ongoing. For the expression NIS there are several non-consensual definitions, among which four stands out:

- i) the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies (FREEMAN, 1987, p. 1);
- ii) all parts and aspects of the economic structure and the institutional set-up affecting learning as well as searching and exploring (LUNDVALL, 1992, p. 12);
- iii) a set of institutions whose interactions determine the innovative performance [...] of national firms (NELSON, 1993, p. 4);
- iv) all important economic, social, political, organisational, institutional and other factors that influence the development, diffusion and use of innovations (EDQUIST, 1997, p. 14).

From these definitions, noted that NIS encompass the flow of information and technology between institutions, people and companies, essential for the innovative process at the national level. They result from a complex set of relationships among the various actors of the system, especially government research institutes, companies and universities.

The innovation system conception assumes that each case is unique and should be analyzed in its context and according to its specificities, with which its critics – especially those of economic orthodoxy – judge it methodologically diffuse. This criticism advances on the systemic and endogenous view of public policies, since the government is seen in this approach as an active agent – coordinating public policies – and not as a market failure.

It is also considered the “concept of global public goods and the notion of knowledge as a global public good” elaborated by Stiglitz (1999, p. 15). It understanding the NIS as something that can efficiently and effectively contribute to reflection and action as instruments that should be oriented not only to economic growth, but to the promotion of the socioeconomic development of international and national communities. Equitable use and production of global knowledge directly require a collective initiative. The international

community faces a challenge, that is, to make our current system of voluntary and cooperative governance turn to the collective interests of all.

Associated with this conception of knowledge as a public good is the role of innovation for the socioeconomic development of countries. For Fagerberg, Srholec & Verspagen (2010), innovation is seen as carried out by highly skilled R&D intensive hubs located in the world's leading centers of excellence. From this perspective, innovation is an exclusive activity of advanced countries. However, there is another way of looking at innovation that goes far beyond this high-tech image. In a broader perspective, innovation – such as trying new or improved products, processes or ways to do things – is just one aspect of most socioeconomic activities. Thus, innovation should be perceived as a relevant practice for all existing communities.

From this discussion emerges another, which, in turn, unfolds in two others: the importance and implications of NIS for the socioeconomic development agenda. Given the complexity of the innovation process, attempts to integrate it into a system have – in developing countries – emphasized its implementation via formal institutions, oriented to the adaptation and absorption of established practices.

Nevertheless, other aspects have been neglected in these countries, such as an agenda focused on the learning process. It is an essential part of the innovation process and, consequently, the learning process is carved by practical experiences and the economic structure in which it is perpetuated. Uniquely in emerging developing countries, learning is linked to the natural capabilities needed to transform and modify knowledge to meet and adapt local conditions and context (OECD, 2010).

Another aspect of the relations between NIS and socioeconomic development is the structural change – in full course – of the productive paradigm, that is, the transition from essentially industrial economies to the predominance of service economies as a majority portion of gross domestic product (GDP). This is particularly critical when it comes to the accelerated internationalization of services. This occurs in progressive competitive global dynamic, where technology allows virtually barrier-free entry and exit from markets (including labor). There is no economy or society immune to this, which imposes socioeconomic challenges and opportunities, particularly over developing ones (PHILLIPE and LÉO, 2010).

The robotization of procedures continues to evolve; software today can do as never before tasks that were previously done by people. If the aim is increasing competitiveness and existing as companies, it requires changes in the organization, such as methods and ways of

relating to the customers (and citizens, in the case of the State). Thus, it can be seen as a threat, but it also offers many opportunities.

In this vein, it is important to consider the social issues involving the theme of innovation (and NIS). According to Kline & Rosenberg (1986), social issues matter: the increase in technique is an historical labor saver, which leads to debates nowadays about socio-technical systems and social technology. Therefore, it is necessary to look at the innovation process as a change in the system as a whole, which encompasses the market environment, stock of previous technical knowledge, product life cycle, in addition to the various social contexts in which it is inserted.

In the current economic and social stage, very globalized and complex, some of the main connections of NIS with socioeconomic development remain theoretically manifested, as well as the importance of the former in supporting the latter, as both interact and feed back into a cumulative circular process. This favors the adoption of a sustained development strategy that can effectively contribute to the improvement of living conditions in general, a thing certainly desired by all societies and that in Brazil in particular is still much to advance.

In order to conform a brief overview of the innovation system in Brazil and empirically attest its importance for national socioeconomic development, the following section will be dedicated to the presentation and interpretation of some statistical data and official documents of international and national institutions.

3 NOTES ON INNOVATION IN BRAZIL: TIMID ADVANCES

With regard to Brazil, a country with numerous historical obstacles to its socioeconomic development, it can be affirmed that its innovation system – which began to be implemented only in the 1980s – continues to present an intermediate level standard. His actions in this area – to be discussed in the next section – are of the type top-down without the recognition of their most promising and advantageous niches. This discussion is recurrent in the Brazilian academic literature.

Albuquerque (1996), for example, based on the definitions of NIS and the systematization of the data that have been already existing on science and technology (S&T) divided the standards into three distinct categories: i) those that allow advanced countries to maintain the international technological vanguard; ii) those that allow countries to aim the dissemination of innovations, since they absorb the advances generated in the previous

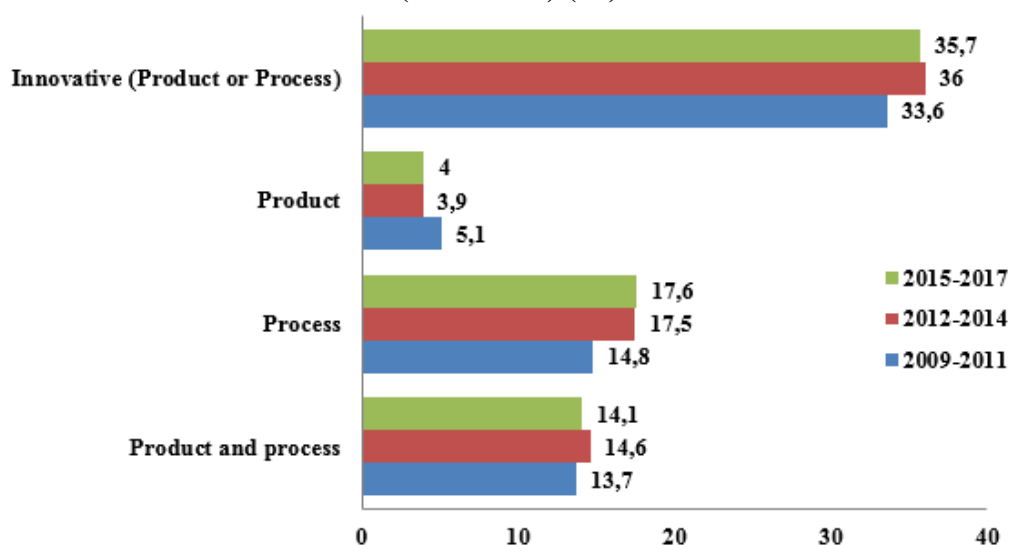
category; iii) those who have not completed, are immature and without a S&T structure suitable for the productive sector and that contributes little to the development of the country. Brazil, according to the data revealed by the author, fell into this last category, in a much lower standard than the mature NIS in that moment.

Despite almost thirty years of many initiatives for the implementation of a successful innovation system in Brazil, all this time was not enough to achieve success on such a journey. Brazil has consolidated institutions of the innovation system through measures very similar to those adopted in countries with innovation systems considered mature. However, it has not yet managed to create or make the existent interaction channels capable of providing legal certainty, encouraging interactions and giving dynamism to the components of the system (TURCHI; MORAIS, 2017).

UNESCO (2015, p. 10-11) also indicates that despite the advances of Brazil, it has not been able to align with the leading countries in research and development (R&D) investment (especially the public one). Public commitment to R&D has remained unchanged since 2008, although the private sector has increased slightly from its own effort. All companies in the research conducted in the triennium 2015-2017 reported a fall in innovation activity since 2011. What we can expect is that this trend will have effects on spending if the Brazilian economic slowdown persists.

This assertion is corroborated, for example, by the data provided by IBGE/PINTEC 2017 (2020), which shows that just over a third of Brazilian companies made some effort to innovate between 2015 and 2017 (figure 1), which is unsatisfactory for more robust advances in the sector.

Figure 1 - Participation in the number of companies that have implemented product or process innovations, by sectors of activities, according to the type of innovation - Brazil (2015-2017) (%)



Source: IBGE/PINTEC (2020, p. 2).

There is another disturbing fact contained in IBGE/PINTEC 2017 (2020). It concerns the fragility of innovative efforts, with a proportion of revenue dedicated to innovative investments (expenses) of only 1,65%. This is even worse if given the proportion that R&D spending in total spending on innovation. These limitations, the document concludes, observed in the scope of companies' innovations, are related to the limited amount they devote to R&D investments: only 10.91% of total spending on innovative activities.

With regard to public sector investment, the situation is even more serious. Federal government's objective set out in the proposal called the National Strategy for Science, Technology and Innovation 2016-2019 (BRASIL/MCTI/Encti, 2016) was to invest 2% of national GDP in R&D by 2019 – which would bring Brazil to an investment level closer to the OECD average of 2.4% in 2015 (OECD, 2016). It should be emphasized that until the last available data, in 2017, R&D investment in the country was only 1.27% (WB, 2020), well below the target to be achieved.

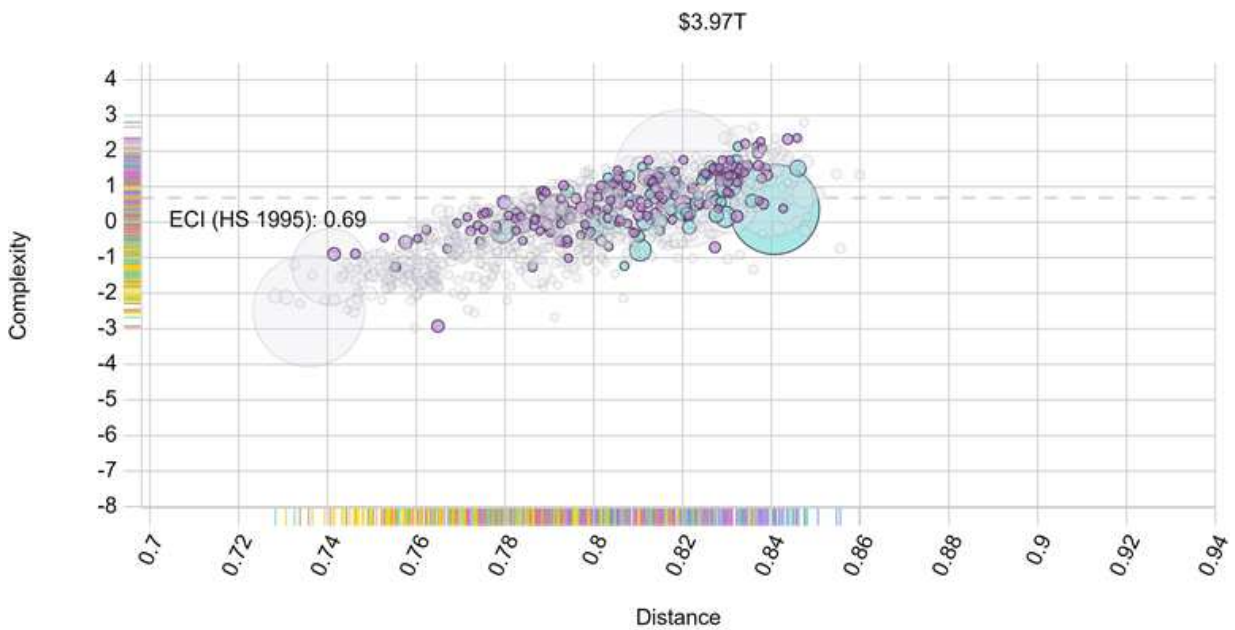
This structure reflects the positions that Brazil occupies in several rankings related to the NIS. Two examples are emblematic. First, the Global Innovation Index – a ranking of countries based on their capacity and success in the field of innovation. In a universe of 131 countries, in 2016 Brazil positioned itself in the 62th place (CORNELL UNIVERSITY,

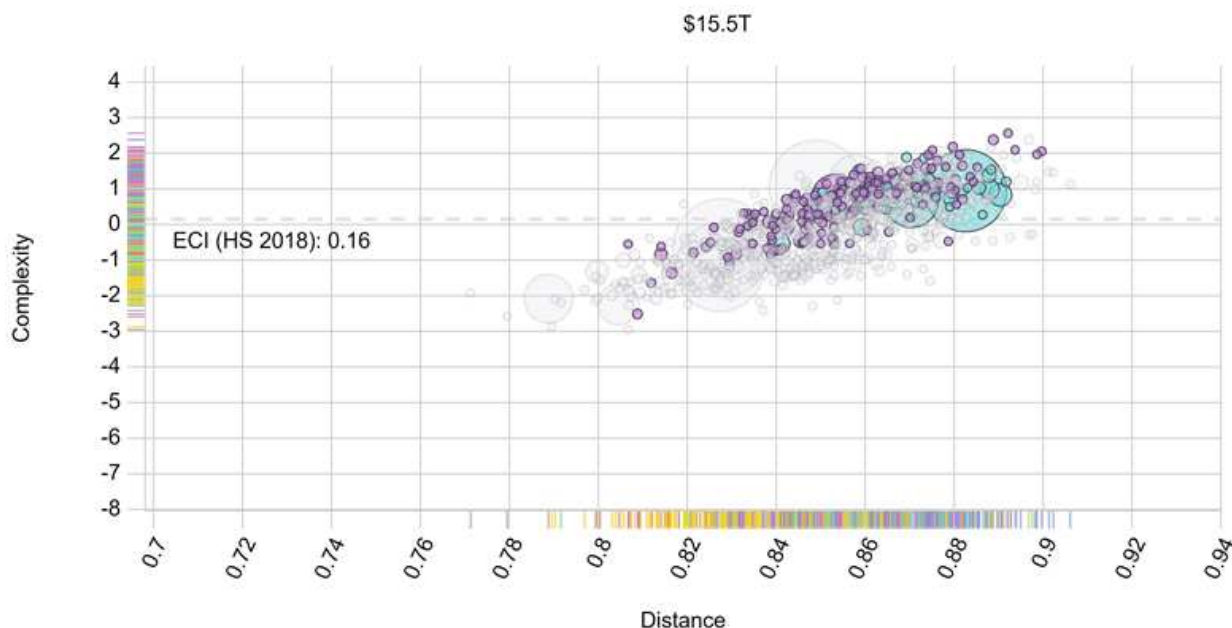
INSEAD & WIPO, 2020). Second, The Global Competitiveness Report 2019 (GCR) (WEF, 2019), in which the country appears in the 71st position in a ranking from 141 countries.

Also noted in this timid evolution of Brazil’s innovation system is the information gathered by the Atlas of Economic Complexity (2018). Considering that the products made in a society can be used as a measure of knowledge, the economic complexity of a country is calculated based on the variety of exports produced in comparison with the number of countries capable of producing them. From this derives the Economic Complexity Index (ECI), which concerns a specific overall given economy.

In the comparison between 1995 and 2018 – the first and last data available by the Atlas, figures 2 and 3 shows which products are viable for export from Brazil and, more specifically, the country’s diversification opportunities based on what it currently exports.

**Figures 2 and 3 - Opportunities for diversification of Brazil based on what it exports
Brazil - (1995 and 2018) (ECI)**





Source: Atlas of Economic Complexity (2018). **Note:** The purple color denotes the chemicals and plastics, while the light blue color refers to the electronics. Both, in the authors' view, are the two aspects analyzed by the Atlas that have the most relationship with NIS.

Figures 2 and 3 let evident the timid advances in absolute terms of Brazil and its setback when compared to other countries. For example, in a universe of 122 nations, in 1995 Brazil was in the position twenty-nine (with ECI of 0.644), while in 2018 it was the fiftieth position (with ECI of 0.16). This attests how the country is lagging behind other economies and societies in the technological race and therefore on the path to improving our socioeconomic performance.

After the assumptions of the evolutionary approach and the information compared here revealing the scenario of innovation in Brazil, it is observed that there is still much to be done. The medium and long term planning and management of the Brazilian innovation system can – and should – be an essential component of a national strategy of sustained socioeconomic development. Whatever macroeconomic policies to be designed for the country, it is necessary to take into account the importance of technology for its growth and development, given the increasing complexity and interdependence among international economies. It is in the light of this reality that in the next section are analyzed challenges and opportunities of Brazil and its innovation system.

4 INNOVATION SYSTEM OF BRAZIL: CHALLENGES AND OPORTUNITIES

As expressed in the previous section, the actions of the innovation system are of the type top-down without the recognition of their most promising and advantageous niches. Government comes in and out; the initiatives normally fails to materialize in concrete advances. This consummated in a structure of the type stop-and-go. Perhaps, more promising was a smaller amount of investments, provided with the guarantees of financing of the proposed projects and policies.

There are many reasons for the loss of space in Brazil in issues concerning the NIS, as seen in this research. They range from the late beginning of the country in implementing its innovation system, through the precarious way in which this process took place, to the problems arising from the low capacity of knowledge absorption, new technologies, *etc.*.

It must be acknowledged that over time there have been success cases (EMBRAPA, EMBRAER and PETROBRAS, for example), but also that it is not enough to Brazil's numerous potentialities, *vide*, for example, the Ipea study that presents the main results of the mapping project of the Brazilian scientific and technological research infrastructure (DE NEGRI and SQUEFF, 2016). The conclusion is that: there are a few Brazilian institutions capable of harnessing economies of scale and scope that could increase efficiency of scientific research in the country. The most of its research infrastructure is made up of small laboratories (spaces) that do not seem to be able to provide, by themselves, the same conditions of research as in other countries.

Brazil should review its S&T resource allocation policy that has long prioritized greater fragmentation and may have helped in the creation of such a dissolved system, which caused little competitiveness. In this sense, it is the case of the self-explanatory expression of limited by design from Crow & Bozeman (1998), whose defends the thesis that says the NIS is a result of policy contexts in which they are embedded over time.

Another aspect that deserves special attention on the national innovation system is what concerns social technology (application of technology for social purposes). It should have active participation of the State – in addition to conventional technologies – when it comes to the role of innovation for socioeconomic development. This niche is little explored and has great potential for improving the life conditions of the Brazilian citizenship, especially its most vulnerable portion.

It is on the guidelines of the so-called Innovation Law (BRASIL, 2004) that is in its article 27 says: “VI – to promote the development and dissemination of social technologies

and to strengthen the technological extension for productive and social inclusion”. In order to comply with this orientation, there must be an articulation of the various agents involved in the Brazilian S&T process, which includes: incubators, scientific institutions, technology and innovation (ICTs), parks and technological centers for innovation, *etc.*

An objective of the Innovation Law is to stimulate the social technologies focused on the problems of the general population. To this end, financial resources are made available annually to public educational institutions, but there is a lack of clarity in defining what they fit as social technologies hinders (or prevents) the budget execution of these resources. It can be seen that the agents of the national innovation system have hardly watched for this opportunity, typical of the 21st century scenario, which in the NIS of the countries with technological avant-garde have been repeatedly stimulated.

Based on the above, it is clear that Brazil presents enormous challenges to consolidate its innovation system. The largest of these is directly related to a structural transformation aimed at catching up with which only conventional economic policies will be insufficient to do so. If this process occurs, it will necessarily be in a more uncertain environment – with the increasingly complex and globalized economy and society – where information, competence to add value and economic integration will be the flagships of economic growth and social development. To this end, Brazil needs to accelerate the step in the quantitative and qualitative promotion of knowledge, in order to carry out its projects.

However, given the current Brazilian and international conjuncture, it is hard to predict that this will be the path followed. It is certain that, whatever it is, it must be clear that the Brazilian innovation system lacks adjustments to contribute more efficiently and effectively to its socioeconomic development.

5 FINAL CONSIDERATIONS

Based on the evolutionary approach, in this research we aimed to examine the growing importance of NIS for socioeconomic development, focusing on the Brazilian case. Brazil presents a huge contrast between its economy and its society: it is among the ten largest economies on the planet at the same time as in 2018 it was in 79th place in the ranking of human development of the United Nations (*UNDP*, 2019). Its most due to its socioeconomic formation and political/institutional conduction through time.

This panorama and what it expresses reflects the country’s contemporary political-institutional architecture, revealing that the challenges to implement a solid national

innovation system for socioeconomic development are huge, while the prospects for this to happen – at least in the short and medium term – are not promising. The intense budget cuts and restraints in the R&D and C&T areas of the last six years are clear demonstrations of this reality.

As it is proper to innovation and technology, this uncomfortable situation does not have to be perennial. If it exists, there is nothing that determines it must persist. The advances – although timid – in this area corroborate this assumption. Perhaps what most can contribute to a better use of Brazil's potential in this field concerns the better articulation between policies directly and indirectly related to it, with the recognition of its most auspicious and advantageous niches. These should be stimulated and implemented deliberately by all agents (including by the State, with elaboration, implementation, control and evaluation of public policies implemented), establishing itself especially oriented to it.

Therefore, it is necessary to reflect and act around the potentialities and limitations of the Brazilian innovation system, as well as for its improvement. In this sense, it is also urgent to reflect and act on the social role of innovation. It is certain that such a system lacks adjustments so that it can contribute more effectively to the national socioeconomic development, especially in the face of the economy and society of the 21st century, which are increasingly complex and globalized.

REFERENCES

ALBUQUERQUE, Eduardo da Motta. Sistema nacional de inovação no Brasil: uma análise introdutória a partir de dados disponíveis sobre a ciência e a tecnologia. **Revista de Economia Política**, vol. 16, no. 3 (63), pp. 56-72, julho-setembro 1996.

ATLAS OF ECONOMIC COMPLEXITY (AEC). Center for International Development at Harvard University. Boston: Harvard Business School, AEC, 2018. Available at: <<http://atlas.cid.harvard.edu/>>. Accessed in: 12th August 2021.

BRASIL. **Lei n. 10.973, de 2 de dezembro de 2004**. Dispõe sobre incentivos à inovação e à pesquisa científica e tecnológica no ambiente produtivo e dá outras providências. Brasília: BRASIL, 2004.

BRASIL. **Lei n. 11.892, de 29 de dezembro de 2008**. Institui a Rede Federal de Educação Profissional, Científica e Tecnológica, cria os Institutos Federais de Educação, Ciência e Tecnologia, e dá outras providências. Brasília: BRASIL, 2008.

BRASIL. Ministério da Ciência, Tecnologia e Inovação (MCTI). **Estratégia Nacional de Ciência, Tecnologia e Inovação 2016-2019**. Brasília: BRASIL/MCTI/Encti, 2016.

CORNELL UNIVERSITY, INSEAD & WIPO. **The Global Innovation Index 2020: Who Will finance Innovation?** DUTTA, S.; LANVIN, B.; WUNSCH-VINCENT, S. (Eds.). 13rd ed. Ithaca, Fontainebleau and Geneva, 2020.

CROW, Michael; BOZEMAN, Barry. **Limited by design: R&D Laboratories in the US National Innovation System**. New York: Columbia University Press, 1998.

DE NEGRI, Fernanda; SQUEFF, Flávia H. S. (Orgs.). **Sistemas setoriais de inovação e infraestrutura de pesquisa no Brasil**. Brasília: Ipea/Finep/CNPq, 2016.

EDQUIST, Charles. *Systems of Innovation: Perspectives and Challenges*. In: FAGERBERG, Jan; MOWERY, David; NELSON, Richard, R. (Orgs.). *The Oxford handbook of innovation*. New York: Oxford University Press, pp. 181-208, 2005.

FAGERBERG, Jan; MRSHOLEC; Martin, Martin, 2010; VERSPAGEN, Bart. *Innovation and Economic Development*. In: *Handbook of the Economic of Innovation*. Vol. 2. HALL, Bronwyn H; ROSENBERG, Nathan (Orgs.). Amsterdam: North-Holland, pp. 833-872, 2010.

FREEMAN, Christopher. **Technology policy and economic performance: Lessons from Japan**, London, Pinter Publishers, 1987.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (IBGE). **Pesquisa de inovação 2017 (PINTEC)**. Rio de Janeiro: IBGE/PINTEC 2020.

INSTITUTO DE PESQUISA ECONÔMICA APLICADA (Ipea). **Políticas de apoio à inovação tecnológica no Brasil: avanços recentes, limitações e propostas de ações**. TURCHI, Lenita M.; MORAIS, José M. (Orgs.). Brasília: Ipea, 2017.

KLINE, J. Stephen; ROSENBERG, Nathan. *An Overview of Innovation*. In: Landau and Rosenberg (Orgs.). *The positive sum strategy: Harnessing technology for economic growth*. 1986.

LEIBETSEDER, Bettina. *A critical review on the concept of Social Technology*. *Social Technologies*, 1(1), pp. 7-24, 2011.

LIST, Friedrich. **The National System of Political Economy**, translated from the original German edition published in 1841 by Sampson Lloyd. London: Longmans, Green, and Company, 1885.

LUNDVALL, Bengt-Åke (Ed.). **National systems of innovation. Towards a theory of innovation and interactive learning**. London, Pinter, 1992.

NELSON, Richard, R.; WINTER, Sidney G. **An Evolutionary Theory of Economic Change**. Boston: Harvard University Press, 1982.

NELSON, Richard. A. (Ed.). **National Innovation Systems: A Comparative Analysis**. Oxford University Press, 1993.

OERLEMANS, Marius M. L. *National innovation systems*. **In:** *Innovation and institutions: a multidisciplinary review of the study of innovation systems*. CASPER, Steven; WAARDEN, Frans van (Orgs.). Cheltenham, UK; Northampton, USA: Edward Elgar, pp. 51-67, 2005.

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD). *The relevance of Innovation Systems to Developing Countries*. **In:** *Innovation and the development agenda*. KRAEMER-MBULA, Erika; WAMAE, Watu (Eds.). Ottawa: OECD, pp. 39-64, 2010.

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD). *OECD Science, Technology and Innovation Outlook 2016*. Paris: OECD Publishing, 2016.

PHILIPPE, Jean; LÉO, Pierre-Yves. *Innovation and internationalization: a dynamic coupling for business-to-business services*. **In:** GALLOUJ, Faiz, Faiz, DJELLAL, Faridah (Eds.). *The handbook of innovation and services: a multi-disciplinary perspective*. Northampton, Northampton, Northampton. Cheltenham, UK: Edward Elgar, pp. 501-526, 2010.

SOETE, Luc; VERSPAGEN, Bart; WEEL, Bas Ter. *Systems of Innovation*. **In:** *Handbook of the Economic of Innovation*. Vol. 2. HALL, Bronwyn H; ROSENBERG, Nathan (Orgs.). Amsterdam: North-Holland, pp. 1161-1180, 2010.

STIGLITZ, Joseph E. *Knowledge as a global public good*. **In:** *Global public goods: international cooperation in the 21st century*. KAUL, Inge, GRUNBERG, Isabelle; STERN, Mark. A (Eds.). Oxford University Press, New York, pp. 308-325, 1999.

WORLD BANK (WB). *Research and development expenditure (% of GDP): Brazil (2000-2017)*. Washington, D.C.: WB, 2020. Available: <<https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?locations=BR>>. Accessed in: 11th August 2021.

UNITED NATIONS DEVELOPMENT PROGRAMME (UNDP). *Human Development Report 2016. Beyond income, beyond averages, beyond today: Inequalities in human development in the 21st century*. New York: UNDP, 2019.

UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION (UNESCO). *UNESCO Science Report: towards 2030 - Executive Summary*. Paris: UNESCO, 2010.

WORLD ECONOMIC FORUM (WEF). *Insight Report -The Global Competitiveness Report 2019*. World Economic Forum, Switzerland, 2020.

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