

Technological innovation, tax incentives and economic efficiency in the Brazilian scenario: analysis of the case of the State of Piauí

Gésio de Lima Veras

Instituto Federal do Piauí

Mário Jorge Campos dos Santos

Universidade Federal de Sergipe

Rafael Sales Almendra

Instituto Federal do Piauí

Daniel Pereira da Silva

Universidade Federal de Sergipe

Abstract

The current market imposes on economic agents the use of different strategies to achieve a sure competitive differential or even enough for the regular maintenance of their organizations. From this perspective, innovations emerge as an alternative capable of boosting the revenues of companies and technological development, a fact that, as a consequence, leads to an improvement in the well-being of the population, income distribution, and socioeconomic progress. In this context, it is up to the public authorities to adopt different incentive instruments to create an environment conducive to innovation in the country and in each state, such as tax incentives, which stimulate such activities by eliminating or reducing tax collection. So, considering the peculiarities of the State of Piauí, which presents incipient figures on technological innovation, this paper aims to analyze the effects of public policies of tax incentives for technological innovation in this part of the federation alternatives for improvement given the reality found. It is a bibliographic, documental, descriptive, exploratory research, with an inductive method and qualitative approach, carrying out a case study in which the actual context of Piauí State using the Law and Economics instrumental as an analysis tool. With this methodology, we were able to confirm our hypothesis that there are flaws in the public policies that currently exist and, therefore, the improvement of actions and public projects to support innovation with a focus on the State's specificities, a measure that is needed.

Keywords: Technological innovation; Tax incentives; State of Piauí; Law and economics.

1. Introduction

The recognition and high relevance to technological innovation are present both within scientific papers and in the companies to improve society. Moreover, it is seen as a strategy for competitive advantage or even a matter of survival of organizations in the increasingly competitive and globalized business market (BESSANT and TIDD, 2009).

In this scenario, as established by article 218 of the Brazilian Constitution of 1988, the State is responsible for creating a favorable environment for the technological development process to take place inside and outside the organizations, a fact that leads to a potential improvement in the population's well-being, productivity, income distribution, and socioeconomic progress. To this end, the public authorities elaborate several instruments to foster technological innovation. Among them is the exoneration of the tax burden through tax incentives, provided in Law no. 11,196, of November 21, 2005, and no. 13,969, of December 26, 2019.

However, it is not easy to create efficient tax incentive policies for such a large and varied territory as Brazil. There is the need to deal with the different socioeconomic profiles of the states and the companies' sizes located there (TEIXEIRA, VIEIRA, and RAPINI, 2016). The financial resources were available by these federal entities and the organizations themselves, in short, with the institutional and regional particularities.

Previous studies have contributed to the debate on the subject by investigating the impacts of tax incentives on innovation in large companies (SANTOS et al., 2020), such as (1) analyzing the companies innovation process in order to receive tax benefits (BORNIA et al., 2020); (2) relations between investments in research and development and the innovation results (PORTO and MEMÓRIA, 2019); (3) reasons for not using the incentives provided in the Good Law¹ by Brazilian companies listed on BOVESPA (OLIVEIRA, ZABA, and FORTE, 2017); and (4) general reasons for the (in)adequacy of the Good Law (SANCHEZ, 2013), which reveals the analysis of this type of tax incentives in many different contexts.

However, we found few studies in the scientific literature aimed at analyzing the effects of tax incentives for technological innovation in the context of specific federation entities, that is, investigating the effectiveness of such incentives from their socioeconomic profiles. Particularly for the State of Piauí, no research of this nature was found, and its incipient numbers in technological innovation require individualized analysis. The State was not even selected in the last three national innovation surveys conducted by the Brazilian Institute of Geography and Statistics – IBGE (2020).

Thus, because of these specificities and the idea of contributing to local development through taxation and other incentive instruments, this paper aims to analyze the effects of tax incentive public policies in the State of Piauí, suggesting alternatives for improvement in the face of the reality found. Given the socioeconomic context of the State of Piauí, we raise the hypothesis that the currently existing tax incentive policies are inefficient for this federative entity.

As an application tool, the economic analysis of Law, also known as Law and Economics². Was used in this research, a theory developed with the contributions of authors such as Posner (1975), Becker (1968),

¹ This is Law 11,196/2005, which became known in Brazil as the "Good Law."

² In the doctrine of Law and Economics, different epistemological approaches can be found. However, because of the objectives set out in this research, they will not be discussed in this paper. On this subject, among others, see: "ZANATTA, Rafael Augusto Ferreira. Desmistificando

and Williamson (1993). It is a theory that makes use of legal techniques to eliminate negative externalities and create positive incentives aimed to stimulate economic facts and to assist in the creation of more efficient (in an economic sense) and fairer (from the Law's perspective) rules or public policies (POSNER, 1975).

Given the objectives outlined, the research was characterized by bibliographic, documental, descriptive, exploratory, with an inductive method and qualitative approach, carrying out a case study in which the real context of the State of Piauí is investigated. Therefore, in addition to the content of legislation and scientific papers on the theme, reports from IBGE and the Secretariat for Technological Development and Innovation (SETEC), an agency of the Ministry of Science, Technology, Innovations, and Communications (MCTIC), were analyzed.

The paper is divided into five sections, starting with this introduction. In the second and third sections, respectively, we discuss the national and state policies on tax incentives for innovation, followed, in the fourth section, by the presentation of the methodological outlines of the research. In the fifth section, we analyze the efficiency of these policies for the State of Piauí, detailing the socioeconomic particularities of the federation, investigating the effects of the stimuli in the local scenario, and suggesting alternatives for improvement in the face of the reality found. Finally, we present our considerations and outline approaches for a future research agenda on the subject.

2. Considerations about the Brazilian national policy of tax incentives for innovation

The Brazilian Constitution of 1988, in its chapter dedicated to Science, Technology, and Innovation, determines that the State will promote and encourage scientific development, research, scientific and technological training, and innovation. To this end, the State makes use of the benefits of the so-called *extrafiscalidade*, in such a way that it is not only concerned with collecting taxes and applying the respective resources, but also with intervening in society in order to materialize its constitutionally foreseen guidelines (BUFFON and JACOB, 2017).

At the *infra-constitutional* level, the main state incentives for technological innovation can be found in Laws no. 10,973/2004 (Innovation Framework), no. 11,196/2005 (The Good Law), no. 8,248/1991 (Informatics Law), and no. 13,969/2019 (Industrial Policy for the information and communication technology sector and the semiconductor sector), as well as in the decrees that complement them. These last normative acts, however, have a merely regulatory role.

Among the various incentives for technological innovation found in the rules, as mentioned earlier, tax incentives stand out for minimizing the burden on business activities by suppressing or reducing tax collection (ELALI, 2007). Moreover, given their attractiveness, especially in a country where the tax burden is high³, these incentives are used as mechanisms of economic induction to stimulate desirable and specific behaviors, such as technological development.

a Law & Economics: a receptividade da disciplina Direito e Economia no Brasil. Revista dos Estudantes de Direito da UnB, n. 10, p. 25-53, 2012".

³ For a more detailed study on this topic, see: "VARSANO, Ricardo et al. Uma análise da carga tributária do Brasil. Rio de Janeiro: IPEA, 1998".

Due to the need to delimit the object of this research, our analysis will focus, among the stimuli to technological innovation, on the existing tax incentives. Thus, the Innovation Framework Law is concerned. However, it refers to such incentives as a mechanism to encourage companies (Article 19, §2-A, item VI and §6, item I, and Article 28). Unfortunately, the legislative text does not offer more details on how, when, and how these incentives would be given. As it could not be otherwise, Decree No. 9283/2018, the rule that regulates it, does not do so either.

This does not mean that its text left something to be desired. On the contrary, the Innovation Framework authorized the Union, the States, the Federal District, and the Municipalities to grant, within their respective competencies and without this resulting in an unlawful act of tax waiver, the necessary tax incentives for technological innovation, according to their managerial, territorial, and budgetary particularities. Moreover, these incentives can be granted together with other incentives described in the Law.

With the Law of Good, the situation is already different. Through it, for Research, Development, and Innovation (RD&I) activities, the Union granted incentives that can be seen in the Corporate Income Tax (IRPJ), in the Social Contribution on Net Profit (CSLL), and the Tax on Industrialized Products (IPI), besides the possibility of federal economic subsidies.

According to Sanchez (2013), the Law of Good sought to a) decrease spending on the purchase of capital goods for RD&I via a 50% reduction in IPI and accelerated depreciation and amortization; b) facilitate the hiring of personnel, researcher, or Microenterprises (ME) and Small Business Enterprises (EPP) through tax cost reduction or subsidy; c) increase the costs of funding via the creation of additional presumed expense, with savings in the IRPJ and CSLL; d) stimulate the protection of Intellectual Property (IP) generated, either by relieving the cost of IP abroad via an exemption from the IRPJ or by granting additional presumed expense in case the protection is granted.

Zucoloto (2010) points out that the Law of Good was essential to debureaucratize the procedure previously foreseen in the now revoked Laws 8.661/1993 and 10.637/2002. The extent was dispensed with the prior approval of projects by the Ministry of Science and Technology or by federal and state agencies and technological development entities or research accredited by the ministry to exercise this attribution. With the new legislation, even though there are minimal formalities, such as filling out an electronic form, the adhesion of companies to the benefits of the Law of Good became automatic.

Despite this simplification, the number of firms that used the benefits of the Good Law some time ago should be closer to the number of companies that develop R&D&I activities (ARAÚJO, 2010), a fact that persists until today. Hence, Lopes and Beuren (2016) suggest that further research be conducted to find possible explanations for this phenomenon, given the government's attempt to maximize the productive capacity of companies and maintain the social commitment to technological development.

Its initial objective was to encourage automation and information technology products concerning the Informatics Law. As a result of this production with tax incentives, companies should invest in RD&I activities (SALLES FILHO et al., 2012). In this case, the reduction of the tax burden is made through IPI exemptions and financial credits.

This legal provision was partially revoked more recently by Law 13,969/2019, which provided for the Industrial Policy for the information technology and communication sectors and semiconductor sectors. Nevertheless, in this last normative act, the Federal Government maintained the tax incentive policy by

granting financial credits both in the CSLL and in the IRPJ, without prejudice to the fact that they may be offset against tax debts managed by the Special Federal Revenue Service of Brazil or that they may be reimbursed in kind, following an act of the Executive Branch (BRASIL, 2019).

Parallel to all these incentives granted by the Union, the States and Municipalities can also grant tax incentives aimed at innovation and technological development locally. Considering the objectives outlined in this work, we will now investigate the existing incentive policy in the State of Piauí to finally analyze the effects of the set of rules, national and state, on this federation entity.

3. Tax incentives for innovation in the State of Piauí

The search for state rules focused on innovation was conducted in the Legislative Process Support System (SAPL), available on the website of the Legislative Assembly of the State of Piauí. In this opportunity, we identified the State Law No. 7.511 of June 4, 2021, which provides incentive measures for innovation and scientific and technological research in the production environment, with a view to training and the achievement of technological autonomy and industrial development the State of Piauí.

In effect, the referred state legislation brings norms that stimulate (a) the construction of specialized and cooperative innovation environments, (b) the participation of scientific and technological institutions in the innovation process, (c) innovation in companies and private non-profit entities, and (d) the performance of independent inventors, besides creating its fund for the state policy of science, technology and innovation. Specifically, concerning tax incentives, the local legislation mentions what is already foreseen in Law 10973/2004, establishing that all those incentives for innovation in companies will be equally applied in the state scenario, without prejudice to other incentives that may be granted. However, although similar facts happen at the national level, the legislative text under analysis did not offer more details on how, when, and how these incentives would be given, being up to the Public Authorities to grant them according to their managerial, territorial, and budgetary particularities.

In truth, it is not possible to analyze, for now, the effects and economic efficiency of State Law No. 7.511/2021, given its recent implementation and still in the course of the pandemic resulting from COVID-19. However, even if late, it is necessary to recognize the normative advance of the State of Piauí since the topic of technological innovation enters the state radar as another alternative to local economic and technological development.

On this point, Favareto and Lotta (2017) point out that the experience in Piauí brought the innovation potential, even if in embryonic form, in at least two aspects. (a) In the face of the articulation between the State, society, and the market, it foresees strong participation of the private sector and an opening for other segments of civil society besides agriculture. (b) By attempting to escape the limits of short-term demands by prioritizing funding and support to strategic projects.

Regarding the first aspect, the state has been supporting industrial, agro-industrial, and wind and solar energy generators by granting deferrals and presumed credit for the Tax on Transactions related to the Circulation of Merchandise and Services of Interstate and Intercity Transportation and Communication (ICMS), in an attempt to expand the existing industrial park in the region. These are measures provided for

State Law No. 6146/2011 and subsequent amendments, creating the Piauí State Industrial Development Fund (FUNDIPI).

Given the lack of a more significant fiscal stimulus to innovation, the incentives for such state activity have concentrated on the realization of fairs, seminars, workshops, support of projects, and the concession of financing. It is worth mentioning the Calls for Proposals launched by the Research Support Foundation of the State of Piauí (FAPEPI) and other development agencies and the institutional actions of the Brazilian Micro and Small Business Support Service (SEBRAE).

Once characterized by the public policies of tax incentives aimed at innovation both nationally and in the State of Piauí, we must now proceed to its analysis based on the tools available by the Law and Economics theory. Before, however, it is necessary to describe the methodological procedures adopted.

4. Methodology

The main stages of the research were: a) definition of research questions and strategies; b) elaboration of criteria for data search and selection; c) data analysis; and d) interpretation of results.

Our research is characterized as a bibliographic, descriptive, documental, exploratory, inductive, and qualitative approach, carrying out a case study in which the actual context of the State of Piauí is investigated. In the case, we first investigated the national and state policies of tax incentives for technological innovation through content analysis (BARDIN, 2011) of the legislation that regulates the matter and the search for previous works that have faced the subject, such as Favareto and Lotta (2017) and Oliveira, Zaba, and Forte (2017).

Specifically, regarding the state level, we searched for local legislation through the Legislative Process Support System (SAPL), available on the website of the Legislative Assembly of the State of Piauí. As a search criterion, the term "innovation" was typed in the "Search expressions in the rule's menu" tab, leaving the other search fields open.

The reports of the latest innovation survey made by IBGE (2017) were also analyzed, as well as the annual report on tax incentives, prepared by the Secretariat for Technological Development and Innovation (SETEC), an agency within the Ministry of Science, Technology, Innovation and Communications (MCTIC). Whose most updated version available refers to the base year 2015.

Both the legislation and the reports, as mentioned earlier, were analyzed from the perspective of the socio-economic profile of the State of Piauí, extracted from data released by the Superintendence of Economic and Social Studies (CEPRO). This agency is part of the State Secretariat of Planning of Piauí (SEPLAN). Once the data was collected and analyzed, we started interpreting the results based on the assumptions extracted from Law and Economics, emphasizing economic efficiency, scarcity of resources, agent rationality, incentive system, and externalities. Its entire development can be checked in the lines that follow.

5. Analysis of existing tax incentive policies based on Law and Economics

This topic analyzes the efficiency of the tax, as mentioned earlier, incentive policies in the State of Piauí. To this end, it details the socioeconomic particularities of this federation state and then investigates the effects of the incentives in the local scenario.

5.1 Socioeconomic profile of the State of Piauí

The State of Piauí has an area of 251,616.82 km, occupying the third largest spatial dimension of the Northeast Region (NE). Its extension represents about 16% of the territory of this region and 2.95% of the national territory, and this entire area is composed of 224 municipalities, which are divided into four mesoregions: a) Northern Piauiense; b) Center-North Piauiense; c) Southeastern Piauiense; and d) Southwestern Piauiense (IBGE, 2018).

Regarding its socioeconomic profile, the industrial segments of the State of Piauí, in general, explore traditional economic activities with low technological content, which is why, in theory, no significant investments in innovation are found in this part of the federation (BANCO DO NORDESTE, 2015).

About this state profile, data divulged by the Superintendence of Economic and Social Studies (CEPRO), an agency integrating the Secretariat of Planning of the State of Piauí (SEPLAN), illustrate the percentage participation of the economic activities of the State of Piauí in the gross added value at current market price, as can be seen in Table 1 below (CEPRO, 2019):

Table 1 - Percentage share of economic activities in the gross value added, at market price of the total GDP of the State of Piauí - 2012-2017

Year	Agropecuary	Industry	Services
2012	7,84	15,25	76,90
2013	6,37	12,33	81,30
2014	7,43	15,90	76,67
2015	7,80	13,55	78,65
2016	5,10	12,70	82,20
2017	9,40	12,10	78,50
Medium	7,32	13,64	79,04

Source: CEPRO, 2019.

While in the State of Piauí, the industrial activity represented 12.10% in the gross value added, in 2017 (the last year analyzed by the research), this same activity in the Northeast Region (NE) had a percentage of 18.90%, rising to 21.10% nationally (BR), a fact that demonstrates the economic particularity of the analyzed federation. These data are corroborated by the percentages found in the Agriculture and

Husbandry (7.32% PI, 6.60% NE, and 5.03% BR) and Services (79.04 PI, 74.50% NE, and 73.10% BR) sectors, as revealed by CEPRO (2019).

Despite its participation in the local economy, when we analyze the industrial structure of the State of Piauí, we observe the presence of the construction, transformation, and public utility industries (BANCO DO NORDESTE, 2015). Furthermore, the Industry Portal (2021) data reveals that the construction sector represents 44.4% of the State's industrial structure, while this same sector represents 25.1% in the Northeast and 18.8% in Brazil. It is a local picture of low technological content, highlighting the need to elaborate strategies to develop innovation in the State of Piauí.

It is also important to highlight that micro and small companies are responsible for part of the economic productivity, income distribution, and local socio-economic development. According to data from the Internal Revenue Service (2020), as of May 31, 2019, there were 119,157 companies in Piauí opting for Simples Nacional, a number that represents approximately 85% of the total number of companies in the state.

In this scenario, the state challenge involves creating tax incentives directed to technological innovation, focusing on the particularities of Piauí. Unfortunately, we did not find any previous academic work contributing to this specific topic in the literature. However, a few scientific pieces of research analyze the effects of tax incentives for technological innovation in the context of federation entities, investigating the effectiveness of such incentives based on individualized socioeconomic profiles.

This lack of evidence does not mean that there is no research involving technological innovation and tax incentives. Previous studies have investigated the impact of these incentives on the innovation of large companies (SANTOS, 2020). Analysis of the company's innovation process to receive tax benefits (BORNIA, 2020). Analysis of the relationship between investments in research and development and innovation results (PORTO and MEMÓRIA, 2019). Investigate why Brazilian companies listed on BOVESPA do not use the incentives provided by the Good Law (OLIVEIRA, ZABA, and FORTE, 2017). Investigate the general reasons for the (in)adequacy of the Law (SANCHEZ, 2013).

As can be seen, different approaches are the subject of academic research, and the scientific gap pointed out above is linked to the analysis of the effects of tax incentives for technological innovation in the context of specific entities of the federation. Thus, scientific work should address this issue, including demonstrating inefficiencies and proposing improvements to the current reality. From this viewpoint, then, Law and Economics emerge as a theory whose stimulus system can provide attractive returns aiming at the efficiency of public policies or, in other words, the potential improvement of the population's welfare, economic productivity, income distribution, and local socio-economic development.

5.2 The effects of the current system of tax incentives in the State of Piauí

Federal Tax incentives were granted primarily through the Law for the Good and the Informatics Law at the federal level. The State encouraged companies to invest more in RD&I with the former, and the best incentives are found in the IRPJ and CSLL (SANCHEZ, 2013). However, only companies in good fiscal standing, profitable, and adhering to the actual profit taxation regime can take advantage of these benefits. However, these conditions restricted the scope of such tax incentives to the point where Sanchez (2013) stated that the Law of Good would be available to only 1% of Brazilian companies. Only 0.2% would make

use of the benefit. The situation of irregularity or tax loss may be temporary, and the legislative rigor contributes to such small numbers, hence why Oliveira, Zaba, and Forte (2017) suggest that such restrictions could be applied only to companies that have been in this situation for more than 3 (three) consecutive years.

Moreover, suppose we add the restrictions of access to the Good Law to the low technological content of the industrial structure of Piauí. In that case, we can hypothesize that it is more attractive to the local businessman to maintain the technological status quo or even choose to buy ready-made technology than to invest in RD&I. This is because, in general, the search for technological innovation is not the focus of most of these industries. The uncertainty of the result comes to weigh against the legislative conditions.

This hypothesis is based on the Law and Economics doctrine premises: the scarcity of resources and rationality. In this case, human players behave rationally because of the high costs involved. On the other hand, economic players will take the most timely decisions and imply lower costs considering the existing options and the alternatives presented. If the player is a company, for example, it will decide to satisfy its profits⁴.

In practice, without forgetting the role of large companies, including multinationals, in the development of RD & I in Brazil (SALERMO and KUBOTA, 2008), this means that the Good Law is inefficient for the business reality of the State of Piauí, either because most of the companies installed in this state do not meet the requirements of the Law, either because the industrial structure is not geared to technological innovation.

We must add that the current national policy of fiscal incentive to technological innovation does not stimulate small companies to invest in RD&I or to start acting in this field since the main existing incentives are directed to large companies. At this point, the existence of edicts from development agencies or even financing options does not seem equally attractive to the point of compensating for the lack of fiscal stimulus.

After all, the incipient local numbers have demonstrated this reality.

If it is true, even micro and small companies could join the tax regime of actual profit. Consequently, using the Good Law's tax incentives, it is also true that the incentives found in the Simples Nacional are attractive so that only a specialized technical consultancy could determine the best tax regime by the business particularity. However, it would demand additional costs for companies, and uncertainty of the result again comes to weigh in the choice of activity.

There is legislative permission given to large corporations to hire micro and small companies without paying taxes to carry out RD&I. However, doubts remain about the valid recipient of this benefit, whether the service taker (via the price lowering) or the smaller companies (SANCHEZ, 2013). Likewise, given the reality of the State of Piauí, this partial benefit is not enough to reverse the local situation.

To reinforce these arguments, in the last Annual Report on Tax Incentives released by MCTIC/SETEC, referring to the base year 2015, only 964 companies nationwide were recommended in whole or in part by MCTIC to enjoy the tax incentives provided for in the Good Law. The total number of companies that

⁴ In this regard, according to the innovation survey conducted by IBGE (2020), companies that implemented product or process innovations in the period from 2015 to 2017 responded that excessive economic risks and high innovation costs represented the most significant obstacles to innovating.

applied for the benefits, while 3.87% belonged to the Northeast Region, 61.71% and 28.82% belonged to the Southeast and South, respectively. The report also states that, during this period, only one company from the State of Piauí benefited from the tax incentives foreseen in the legislation (MCTIC, 2015).

When we cross-reference these data with the 2019 entrepreneurial universities ranking, for example, we observe that the 07 (seven) Teaching Institutions (HEIs) with the best innovation numbers belong precisely to the South and Southeast regions, followed by the Catholic University of Brasilia (8th place) and then returning to HEIs from those regions until the 11th place. The first from the Northeast Region is the University of Rio Grande do Norte State, which is in 12th place (BRASIL JÚNIOR, 2019).

Some factors that may contribute to these results are, first, the profile of the industrial structure of the regions of these educational institutions and, second, the incentives of the Law of Good, which, as mentioned above, directs its main tax incentives to companies that are tax regular, profitable, and adhere to the tax regime of real profit. With such incentives and faced with a technological industrial framework, these companies seek partnerships to carry out innovation activities.

Furthermore, the management and governance of these HEIs cannot be disregarded. If we analyze the best ranked, in this case, the University of São Paulo (USP), it has the USP Innovation Agency installed with 07 (seven) Poles distributed throughout the State, whose teaching, research, and extension activities vary according to the vocation and potential of each Campus or region. It is an example of the triple helix⁵ model in Brazil. Academia, government, and industry execute their mission cooperatively and successfully. Another federal legislation that uses tax incentives - in this case, primarily through financial credits - to stimulate innovation activities is Law No. 8,248/1991, which provides for the training and competitiveness of the computer and automation sectors. It is worth analyzing, then, its efficiency and results for the State of Piauí based on the latest Quantitative Report on Research, Development and Innovation Projects, released by MCTIC in 2019 and referring to the base year 2017.

In this case, we observe that only one legal entity installed in the State of Piauí appears in the list as mentioned earlier of companies benefiting from the tax benefits of the Informatics Law (MCTIC, 2019), which again puts in doubt the efficiency of the existing incentives for the business profile of this state. However, it is essential to reaffirm that this legislation was derogated by Law 13,969/2019, so there is still not enough time to analyze the efficiency and the results of the new benefits brought.

Thus, despite their results in other regions of the federation, the current fiscal incentive policies directed to technological innovation were not enough to stimulate such activities in the State of Piauí⁶, unlike what has been happening in the South and Southeast Regions (MATIAS-PEREIRA, 2013). Therefore, for technological innovation to work in a strengthened way, the government needs to successfully fulfill its

⁵ "We define the Triple Helix as a model of innovation in which university/academia, industry, and government, as primary institutional spheres, interact to promote development through innovation and entrepreneurship. New secondary institutions are formed on-demand in the interaction process, i.e., 'hybrid organizations.' The dynamics of the institutional spheres for development in a triple helix synthesize their internal and external power interactions. [...] A vibrant civil society is the basis of the ideal Triple Helix, with interactions between university, industry, and government as relatively independent institutional spheres" (ETZKOWITZ and ZHOU, 2017, p. 23).

⁶ The transition between the present and the future economy goes through understanding and analyzing the current reality. About this, Stiglitz and Rosengard (2015, p. 1) point out: "At the center of any country's political life are some basic economic questions: How does the government affect the economy? What is the appropriate role and size of government? Why are some economic activities are undertaken in the public sector and others in the private sector? Should the government do more than it is currently doing or less? Should the government change what it is doing and how it is doing it? To answer these questions, we must begin by understanding what the government does today".

role of stimulating such activities, which is why, in the following lines, we will discuss alternative fomentation mechanisms that could be beneficial to the State of Piauí.

5.3 Toward an innovation tax policy adequate for the State of Piauí

Immediately, it is necessary to recognize that no fiscal incentive policy alone can sufficiently stimulate innovation and technological development. The State needs to act in a systemic, coordinated, and integrated way with the other actors in this process. From fiscal incentives to mechanisms to stimulate the demand for innovation (PACHECO, BONACELLI, and FOSS, 2017) or innovations that tend to cause a positive net effect of generating new jobs (CASSIOLATO and LASTRES, 2005), the different and complementary strategies and instruments will lead to the success of this state mission.

This scenario is mainly because of the need to deal with the specificities of the different sizes of companies and the different financial resources available to each one during the innovation process (TEIXEIRA, VIEIRA, and RAPINI, 2016). Therefore, various instruments to promote innovation are necessary, and the tax incentive is a crucial alternative to contribute to this process.

Given the reality found in the State of Piauí, whose industrial structure reveals a low technological content, as pointed out in the previous section, an exciting alternative, but not exhaustive, is the tax incentive for new companies to operate in the area of innovation. In this case, all federation entities have the potential to contribute. The best incentives should be directed not only to large companies, as currently occurs within the scope of the Union but also to those adept at the presumed profit regime or the National Simples, broadening the base of companies benefited by state support.

It is because, if on the one hand, the Brazilian Constitution of 1988 itself determined that the federal entities should give different legal treatment to micro and small companies, on the other hand, these companies are responsible for a considerable portion of economic productivity, as is the case of the State of Piauí, where about 85% of all companies are part of the Simples Nacional (RECEITA FEDERAL, 2020) and, therefore, must necessarily fit into one of those categories.

Not coincidentally, the stimuli for innovation within ME and EPP are already on the national radar. First because in April 2019, Complementary Law No. 167 was published, creating the Inova Simples (IS). IS is a special simplified regime that granted business initiatives of an incremental or disruptive nature that self-declared themselves as startups or innovation companies differentiated treatment intending to stimulate their creation, formalization, and development.

In practice, the referred legislation reduced bureaucracy in the procedures but could have gone further by using tax incentives for these companies, which did not happen. The second reason that exemplifies the national attention to innovations given to EPPs and ME is the existence of the Complementary Law Project No. 366/2017. It was authored by Representative Lindomar Garçon, in progress in the House, which temporarily exempts such companies from collecting federal taxes to foster innovation and productive investments.

It is a measure that would reduce the transaction costs of this activity, inherent to the high risk, complexity, and uncertainty of the result. A similar project could be discussed by the states' legislatures (about the ICMS) and municipalities (entities that have the power to institute and regulate the Tax on Services of Any Nature - ISS).

For such measures to be successful, it is imperative that the state incentives, similar to what already occurs with the Good Law, should not be directed to companies that innovate and those that seek this result. Instead, this is a way to reward the activity itself and not only the final product, a line that the Union and States and Municipalities should follow.

In effect, tax incentives can also bring companies and HEIs closer together. Suppose it is true that many innovations occur in academia. In that case, it is also true that efficient stimuli for interaction should be aimed at both organizations so that there is reciprocal demand. Thus, besides the sharing of material and human resources, the effective suppression or reduction of taxes for companies would work as another tool for consolidating the triple helix in the State.

Even if these incentives were used provisionally or progressively, valuing results and partnerships were achieved. The interaction benefits would revert to the State, companies, and society. Considering the current scenario and the socioeconomic profile of Piauí, the promotion of entrepreneurship through tax incentive policies for small and medium enterprises will help develop and generate income and jobs in the local economy.

6 Final considerations

Technological innovation in the State of Piauí is still in its early stages. However, state measures contribute to this challenge, such as State Law No. 6146/2011, which grants ICMS benefits to some industry sectors, and the recent Law No. 7511/2021, which brought incentive measures for innovation in the state territory. Regardless, the fact is that the public power needs to go further in its actions, not letting the funding and support for strategic projects be the only mechanisms used to reverse the current situation.

The recent implementation of a State Public Policy focused on technological innovation can contribute to this development process. However, adopting different and complementary strategies and using various instruments to foster innovation would minimize the existing obstacles. In this perspective, tax incentives and the use of the expertise found in HEIs are inserted as important alternatives capable of contributing to this process.

In the same way, the existing tax incentives at the federal level are not adequate for the business reality of the State of Piauí. First, because most of the companies installed in this state do not meet the requirements set by Law to enjoy the best and current benefits, which can be seen by the latest report made available by the MCTIC in which only 01 company from Piauí has benefited from the incentives. Secondly, the local industrial structure is not geared towards technological innovation. It is necessary, therefore, new strategies of fiscal incentives to create, develop and consolidate an environment conducive to innovation in the state. Thus, as far as the Union is concerned, it is imperative to expand the universe of companies that operate in the area of technological innovation and, in this context, the reform of the legislation that grants tax incentives to these companies is a measure that will help achieve this goal. Micro and small companies are responsible for a considerable portion of the economic productivity, making them exchange one tax benefit for another (in this case, the Simples Nacional for the Lei do Bem, for example) have not shown efficient results.

In truth, the tax as mentioned above incentives alone are incapable of reverting the State's current situation, as are the intellectual property generated in the HEIs and the very partnerships they enter into with companies for innovation. However, as pointed out, the public authorities must propose programs, actions, and projects to support innovation. The measures raised here based on the Law and Economics analysis tools can help.

In this case, the inefficiency of federal tax incentives and the lack of effectiveness of the state program (recently implemented) represent failures in public policies and represent obstacles to technological development in the state, and therefore need to be addressed. This scenario, within the economic analysis of Law, can be interpreted as the price paid for an opportunity cost (POSNER, 2007), i.e., if the government wants to achieve better rates of innovation, it will need to give up something, such as a portion of taxes.

Although it is difficult to talk about tax waivers when we face a scarcity of resources and local public accounts, the state stimulus aimed at technological innovation will improve national products or services and boost national socioeconomic development. Moreover, if a public policy is not designed efficiently, the result will be equally inefficient, as has been happening in the State of Piauí. Thus, we confirmed our initial hypothesis: this federative entity's current tax incentive policies are inefficient.

As a future research agenda, we suggest studies that present alternatives to enable a more significant interaction of the HEIs located in Piauí with companies, with or without the use of fiscal incentives, as well as investigations that help in the formation and consolidation of a new innovative culture in the state.

7. References

- Banco do Nordeste. Perfil socioeconômico do Piauí. Organisers: Francisco José Araújo Bezerra et al. Fortaleza: Banco do Nordeste do Brasil, 2015.
- L. Bardin. Content analysis. São Paulo: Edições, v. 70, 2011.
- G. S. Becker. Crime and punishment: an economic approach. *Journal of political economy*, nº 169, 1968.
- J. Bessant and J. Tidd. Inovação e empreendedorismo. Porto Alegre: Bookman Editora, 2009.
- A. C. Bornia et al. Indústrias inovadoras e a utilização dos incentivos fiscais à inovação tecnológica da lei do bem. *Contabilidade y Negocios*, vol. 15, n. 29, 2020, pp. 107-126.
- Brasil. Lei nº 13.969, de 26 de dezembro de 2019. Dispõe sobre a política industrial para o setor de tecnologias da informação e comunicação e para o setor de semicondutores e altera a Lei nº 11.484, de 31 de maio de 2007, a Lei nº 8.248, de 23 de outubro de 1991, a Lei nº 10.637, de 30 de dezembro de 2002, e a Lei nº 8.387, de 30 de dezembro de 1991. Available in: http://www.planalto.gov.br/ccivil_03/_ato2019-2022/2019/lei/L13969.htm. Accessed in: 14-jun-2020.
- C. B. E. J, Brasil Júnior. Ranking de universidades empreendedoras. São Paulo. 2019. Available in: <https://universidadesempreendedoras.org/wp-content/uploads/2019/10/ranking-2019.pdf>. Accessed in: 07-abr-2020.
- M. Buffon and L. R. Jacob. Os incentivos fiscais no ramo tecnológico como instrumento do desenvolvimento nacional. *Direito e Desenvolvimento*, João Pessoa, v. 6, n. 12, 2017, pp. 121-144.
- B. C. Cardoso. Incentivos fiscais à pesquisa e desenvolvimento e custos de inovação no Brasil. *Radar: tecnologia, produção e comércio Exterior*. IPEA, 2010, pp. 03-11.

- J. E. Cassiolato and H. M. M. Lastres. *Sistemas de inovação e desenvolvimento: as implicações de política. São Paulo em perspectiva*, v. 19, n. 1, p. 34-45, 2005.
- R. H. Coase. *The nature of the firm. Economica*. London, v. 4, p. 386-405, 1937.
- A. Elali. *Incentivos fiscais, neutralidade da tributação e desenvolvimento econômico: a questão da redução das desigualdades regionais e sociais. Incentivos fiscais: questões pontuais nas esferas federal, estadual e municipal*. São Paulo: MP, v. 1, n. 1, p. 37-66, 2007.
- H. Etzkowitz and C. Zhou. *Hélice Tríplice: inovação e empreendedorismo universidade-indústria-governo. Estudos avançados*, v. 31, n. 90, p. 23-48, 2017.
- A. Favareto and G. Lotta. *Inovações institucionais nas políticas para o desenvolvimento territorial em três estados brasileiros. Redes - Santa Cruz Sul (Online)*, v. 22, n. 3, p. 11-38, 2017.
- Instituto Brasileiro de Geografia e Estatística - IBGE. *Pesquisa de inovação (PINTEC): 2017*. Rio de Janeiro: IBGE, 2020. Available in: <https://biblioteca.ibge.gov.br/index.php/biblioteca-catalogo?view=detalhes&id=299007>. Accessed in: 07-abr-2020.
- _____. *Resolução nº PR-01, de 28 de junho de 2018. Aprova os valores de áreas territoriais do Brasil, Estados e Municípios, a partir do dia 29 de junho de 2018*. Available in: <https://www.ibge.gov.br/geociencias/organizacao-do-territorio/estrutura-territorial/15761-areas-dos-municipios.html?=&t=resolucoes-e-legislacao>. Accessed in: 20-abr-2020.
- I. F. Lopes and I. M. Beuren. *Evidenciação da inovação no relatório da administração: uma análise na perspectiva da lei do bem (lei nº 11.196/2005). Perspectivas em Gestão & Conhecimento*, João Pessoa, v. 6, n. 1, p. 109-127, jan./jun. 2016.
- J. Matias-Pereira. *Uma avaliação das políticas públicas de incentivo a inovação tecnológica no Brasil: a Lei do Bem. Parcerias Estratégicas*, v. 18, n. 36, p. 221-250, 2013.
- Ministério da Ciência, Tecnologia e Inovação (MCTI). *Relatório anual da utilização dos incentivos fiscais à inovação: ano base 2015*. Brasília, DF: MCTI, 2015. Available in: https://antigo.mctic.gov.br/mctic/opencms/tecnologia/Lei_do_bem/pages/Relatorio-Anual.html. Accessed in: 07-abr-2020.
- _____. *Relatório Quantitativo de Projetos de Pesquisa, Desenvolvimento e Inovação: ano base 2017*. Brasília, DF: MCTI, 2019. Available in: http://www.mctic.gov.br/mctic/opencms/tecnologia/incentivo_desenvolvimento/lei_informatica/_informacoes/resultados_lei_informatica.html. Accessed in: 08-abr-2020.
- O. V. Oliveira; E. F. Zaba and S. H. A. C. Forte. *Razão da não utilização de incentivos fiscais à inovação tecnológica da lei do bem por empresas brasileiras. Revista Contemporânea de Contabilidade*, v. 14, n. 31, p. 67-88, 2017.
- C. A. Pacheco; M. B. M. Bonacelli and M. C. Foss. *Políticas de estímulo à demanda por inovação e o Marco Legal de CT&I. Inovação no Brasil: avanços e desafios jurídicos e institucionais*, p. 213-239, 2017. Portal da Indústria. *Setores da indústria no Estado do Piauí*. In: *Perfil da indústria nos Estados*. Available in: <https://perfildaindustria.portaldaindustria.com.br/estado/pi>. Accessed in: 01-jul-2021.
- G. S. Porto and C. V. Memória. *Incentivos para inovação tecnológica: um estudo da política pública de renúncia fiscal no Brasil. Revista de Administração Pública*, vol. 53, n. 3, 2019, p. 520-541.
- R. A. Posner. *The Economic Approach to Law. Texas Law Review*, v. 53, n. 4, 1975.

_____. Economic analysis of law. 7. ed. Chicago: Aspen Publishers, 2007.

Receita Federal. Estatísticas do simples nacional. 2020. Available in: <http://www8.receita.fazenda.gov.br/SimplesNacional/Aplicacoes/ATBHE/estatisticasSinac.app/EstatisticasOptantesPorDataMunicipio.aspx?tipoConsulta=1>. Accessed in: 15-abr-2020.

M. S. Salermo and L. C. Kubota. Estado e Inovação. In: DE NEGRI, João Alberto; KUBOTA, Luis Claudio. Políticas de Incentivo à Inovação Tecnológica no Brasil. Brasília: Ipea, 2008.

S. Salles Filho et al. Avaliação de impactos da Lei de Informática: uma análise da política industrial e de incentivo à inovação no setor de TICs brasileiro. Revista Brasileira de Inovação, Campinas (SP), 11, n. esp., p. 191-218, julho 2012.

R. A. Sanchez. Incentivo fiscal à inovação: análise de (in)adequação da lei 11.196/2005. Rio de Janeiro. 2013. Dissertação (Mestrado Profissional em Propriedade Intelectual e Inovação – Academia de Propriedade Intelectual, Inovação e Desenvolvimento). Programa de Pós-Graduação do Instituto Nacional da Propriedade Industrial – INPI, Rio de Janeiro, 2013.

U. P. Santos et al. Impactos dos incentivos fiscais na inovação de grandes empresas: uma avaliação a partir da pesquisa Sondagem de Inovação da ABDI. Nova economia, v.30, n.3, 2020, p. 803-832.

J. Stiglitz and J. K. Rosengard. Economics of the Public Sector. 4^a ed. New York / London, W. W. Norton & Company, 2015.

Superintendência de Estudos Econômicos e Sociais - CEPRO. Piauí em números. 11^a ed. Teresina, 2019. 101p.

A. L. S. Teixeira; R. G. Vieira; and M. S. Rapini. Tipo de financiamento, grau de novidade da inovação e tamanho de empresa: uma análise a partir da PINTEC. In: I Encontro Nacional de Economia Industrial e Inovação (ENEI), 2016, Araraquara. Anais do evento. São Paulo: UNESP, 2016, p. 1426-1444.

R. Varsano et al. Uma análise da carga tributária do Brasil. Rio de Janeiro: IPEA, 1998.

O. Williamson Transaction cost economics and organization theory. Industrial and Corporate Change. Oxford University Press, 1993.

G. F. Zucoloto. Lei do Bem: impactos nas atividades de P&D no Brasil. Radar: tecnologia, produção e comércio Exterior. IPEA, 2010, pp. 14-20.