

# **PROJECTS DEVELOPED WITH RESOURCES OF THE CT-PETRO SECTOR FUND IN THE NORTH, NORTHEAST AND CENTRAL- WEST REGIONS**

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## **Abstract**

*The present work aims to analyze the development of projects with resources from CT-Petro; since its creation. This Sectorial Fund envisioned the technological development of the Oil and Natural Gas production chain in the North, Northeast and Midwest regions. This study sought to survey the actions of the projects developed and whether patents were somehow created with the financial resources released through FINEP for the realization of CT-Petro. The unfolding of the activities was carried out with the application of questionnaires to public institutions registered in the Electronic System of the Citizen Information Service – e-Sic-CGU. From the tabulation of the information collected from the sample, the direction given was to compare with the information from the patent application filing database, of the National Institute of Industrial Property - INPI, in order to identify the percentage values of filing applications of these three regions and how the Sectoral Fund has impacted the development of patents and their respective application for protection. The survey carried out showed that even after the implementation of CT-Petro there was little change in the national scenario of IP productivity, aimed at the Oil and Natural Gas production chain, in Brazilian territory. This research is qualitative and quantitative, with the application of a semi-open questionnaire and data collection on INPI database websites, technological innovation agency websites, technological innovation centers, scientific journals, dissertations, theses and access platform information from the Brazilian Federal Government.*

**Keywords:** Projects, Regional Development, CT-Petro, Sectorial Found

## **1. Introduction**

After the break of Petrobras' monopoly, the State reduced its direct contribution to technological development. This lower participation was reversed in the expansion of public policies to encourage S&T. Note that this type of policy comes from the creation of the National Development Plan – PND, in 1970. However, the incipient results generated by these policies raise questions about their effectiveness (NEGRI, 2015).

As of 1999, there has been a change in the State's public policies:

... restrict the State's performance to those functions that are proper to it, reserving, in principle, non-exclusive services for non-state public property, and the production of goods and services for the market for the private sector (BATISTA, 1999, p. 7-ARTICLE IPEA)

Brazilian public policies, from the 1990s onwards, have been acting more actively with the demands of Brazilian society in relation to technological development (stimulus in R&D). The weakness is in the budgetary limitations and in the profile of the governors in each electoral process, generally for a period of four years. Even though there is a normative framework that has strengthened some areas, these aforementioned limitations, associated with the insecurities and culture of national entrepreneurs, have a direct impact on Brazilian technological development (MUELLER, 2015).

With this scenario, the Government's role is to be the link between the University (producer of studies and research – the providers) and the Company (the demanders of society). According to Fuentes (2015), the relationship between science and politics is of fundamental importance and quite complex, so it is understood that the modeling of public policies that promote science would facilitate the visualization of the desired results. In particular, CT-Petro presents itself as a public policy of paramount importance for the P&G production chain, as well as the role of the Government only as a normative agent and interposed between the University and the Company.

In the present work, the profile of what was developed in the North, Northeast and Midwest regions is presented. The decision for these regions was based on the main objective of CT-Petro, which is to develop them and make them competitive, since the axis of greatest technological indicators is in the Southeast and South regions. The research is qualitative and quantitative in order to demonstrate, through the numbers of patent application filings, the possible efficiency of this public policy. In the next topics, a brief contextualization on public policy to promote S&T will be presented, the participation of institutions by Brazilian regions in the CT-Petro public notices, from 2000 to 2015, and patents were generated by integrating the development of the winning projects of the public notices.

## **2. Theoretical Foundation**

### **2.1 Contextualization**

It is observed that the technological capacity of a country, in general, can be measured by the structure of society through its legal framework, public institutions and the customs of individuals, and this set or performance of these agents is the mold of the system that strengthens the technological structure (CASTELLI, 2017).

When looking at Brazil's technological capacity, one can see the country's potential in terms of S&T production. On the other hand, there is a lack of standard in all territorial regions (NEGRI *et al.*, 2018). It is observed that part of S&T production is concentrated in the Southeast and South regions (NEGRI, 2015; SOARES & PRETE, 2018).

In the Brazilian case, in addition to territorial issues, there are also cultural and financial aspects that imply barriers for S&T. One of the barriers for Brazilian companies to innovate is in the form of financing, that

is, the current mechanism is not the most suitable. Financing in the country generally takes place in companies considered stable, which can provide some guarantee in the financing relationship when it occurs through banking institutions (FARIA, 2015).

With the difficulty of financing for this purpose and making the connection to economic issues, Soares & Prete (2018) state that the economy was more influenced by scientific and technological development, resulting from new forms of business, helping to make strategic policies to boost new sources of income in countries. For a greater relationship between science (University) and business (Company), the State (Government) acts as a mediator.

These strategic policies were also perceived in Brazilian territory, CT-Petro represents one of them. Created at the end of the 1990s and with the publication of promotion notices in 2002, this Sectorial Fund aims to expand the development of R&D to the Brazilian regions, especially the North, Northeast and Midwest. In order to provide innovative arrangements and systems, creation of products and services that can be used in the oil and natural gas production chain (NEGRI, 2015; SAMPAIO, 2011).

It is noteworthy that, in addition to barriers to S&T, in Brazil there is also funding to pay scientists and trained professionals, thus the Government's role in being able to mediate this relationship (University/Company) is essential. Such action consists of strengthening the ties between the University and the Company, that is, the government would be the link between the development of applied research that can be transferred or licensed to companies (SAMPAIO, 2011; NEGRI *et al.*, 2018).

When it comes to technological development in the country, public institutions make up the highest percentage of activities (BATISTA, 2012). In Brazil, teaching and research institutions are primarily responsible for the development of pure and applied research, providing mechanisms for companies to seek new technologies and innovations, contributing to the formation of interactive models in which companies can demand solutions from universities, so that they can develop such solutions and transfer technology (SOUZA & BARBOSA, 2018).

From the 2000s onwards, changes in the legal framework to strengthen Brazilian S&T are evident. Costa *et al.* (2015) argue that government incentives, from the Federal Innovation Law (Law No. 10,973/2004), have incisively contributed to intensifying the transfer and licensing of technology, stimulating the development of applied research, being the responsibility of research institutions and the Center Innovation and Technology – NIT, to intensify the relations between Universities and Companies. In other words, the policies and the legal framework need to shape the whole set: structure of institutions, training of those involved, cultural aspects of the region, business profile of each region and emphasis on the main production chains (SAMPAIO, 2011).

It is unanimous for Araújo *et al.* (2012), Negri (2018), Rosa and Frega (2017) that the enactment of the Lei do Bem has strengthened and stimulated technological development in the country. In addition, the NIT's willingness to manage the development policy in this area has increased the possibilities. However, within the institutions themselves there are weaknesses in the performance of the centers; looking at the Brazilian territory, there are considerable differences between the regions. Some NITs are well structured, transferring technologies, others do not have a minimum team working, making it difficult to monitor what is produced by the professionals of the institutions (ROSA & FREGA, 2017).

According to Negri (2015), countries with good S&T indicators, such as the USA, have adopted the

diversification of public development policies and instruments for evaluating institutional models. With the Lei do Bem and the Lei de Inovação (Innovation Law), legal structures strengthened S&T stimuli, minimizing barriers for researchers to work with companies.

Second, the design and implementation of science and technology (S&T) policies need to be improved in order to expand their contribution to solving the concrete problems faced by Brazilian society. Better planned, consistent and result-oriented public investments in S&T could leverage this contribution – which is no longer small –, leading to gains in productivity and improvement in the living conditions of the population (NEGRI et al. 2018, p. 534).

For Castelli (2017), innovation policies act together with a country's industrial policy, and such policies may be implicit and explicit. It highlights that within the explicit policies there are groups, among them the science, technology and innovation policy – PCTI. The performance of the PCTI takes place in technical assistance, in the promotion and financing of technologies, making up, also, the establishment of contracts, public purchases, regulation of economic activities, guarantees regarding Intellectual Property - IP and tax policy.

In several studies carried out in scientific articles on technological development in Brazil, it is evident that there is a lack of company-university interaction (ARAÚJO et al., 2012; NEGRI et al., 2013; ROSA & FREGA, 2017).

Another point that needs to be taken into account is the formation and consolidation of a national database on S&T, which is necessary for the elaboration and implementation of efficient public policies, considering these extremely valuable resources. Thus, to develop public policies that generate positive results for society, a structured database is needed, a minimum of asymmetry of information between the institutions involved in projects aimed at R&D, the survey of social demand and the formation of partnerships that can exchange experiences between agents (FURTADO et al. 2015; NEGRI, 2015).

It is understood that, in order to reach this level, the Brazilian State, in addition to expanding financial support for the development of R&D, needs to encourage organizational structures that already have good results and consolidate support networks that can generate exchanges of experiences and strengthen this culture in the country (SAMPAIO, 2011).

Thus, it is possible to affirm that it is the State's duty to induce the transformation of the economy through innovation..., implementing actions that minimize its own difficulties... (FARIA, 2015, P. 31).

Paraphrasing Negri (2012), a significant change in the Brazilian innovative capacity is necessary, with aggressive and focused public policies, without permeating in meeting the demands and pressures of some groups that often follow the interests of certain classes. Another factor raised, mainly by neoclassical economists, is the action of market failures that directly impact technological development. These failures are due to information asymmetry, the existence of public goods and some type of externality that can be negative or positive. These three factors described need strong action by the State until economic balance is reached, in order to avoid strong economic crises in the country (CASTELLI, 2017).

The national policy aimed at Brazilian technological development makes use of instruments used in most

developed countries (NEGRI et al., 2015). Nevertheless, the existing evaluation mechanisms, the economic and political instability and the various market failures, operating in the vast national territory, reflect on the technological development indicators by regions (ARAUJO et al., 2012; CASTELLI, 2017; NEGRI et al., 2015)

The creation of CT-Petro emerged as a form of grant for research projects within universities and ICT, grant for companies, grant for state support foundations, as well as subsidized credit (NEGRI, 2015).

The importance of the CT-Petro Sectorial Fund for the oil and natural gas production chain and, above all, for technological development is evident. In the next topic, the performance of CT-Petro in the North, Northeast and Midwest regions will be dealt with in order to briefly demonstrate the S&T scenario after the implementation of this fund.

## ***2.2 CT-Petro and the North, Northeast and Midwest Regions***

With the discoveries of new points of oil and natural gas reserves in Brazilian territory, concurrently with the break of the oil exploration monopoly by PETROBRAS, an environment was created for public policies to stimulate the development of S&T (FURLAN JUNIOR, 2015; MIRANDA & ZUCOLOTO, 2015). In this case, it can be said that CT-Petro was planned and developed to stimulate R&D, mainly in the North, Northeast and Midwest regions; as an attempt to present a homogeneous scenario of technological production by Brazilian territorial regions (MELO, 2009; NEGRI et al., 2018).

The adoption of public policies to encourage the interiorization of educational institutions in the country, as well as exchange programs for professionals and students, also served as yet another mechanism for the development of S&T (TURCHI & ARCURI, 2019).

Negri et al. (2018) describe the growth of new federal and state higher education institutions, between 2000 and 2013, as a driving valve for scientific and technological development. However, there was no proportional budget growth impacting the quality of the intellectual production of these new institutions.

Allied to this variable presented, in the first years of CT-Petro's operations, large public resources were noted for the development of projects approved through FINEP's public notices (QUEIROZ, 2006; SENADO, 2016). Sectoral Funds came to "...generate positive externalities for society as a whole" (ARAUJO et al., 2012, p.88). However, as of 2006 there has been a reduction in public resources directed to the sector fund, as a result of the untying of revenues for the development of S&T through CT-Petro (FINEP, 2019; QUEIROZ, 2006; SENADO, 2016).

CT-Petro was created to strengthen R&D and, therefore, strengthen technological development and encourage the production of intellectual property (patents, brands, software, among others). However, for the satisfaction of this development policy, it is essential to adopt management tools that can accompany this entire process and identify, among the Brazilian territorial regions, those that effectively participated in the public notices and reflected in technological development (BATISTA, 2012).

When it comes to evaluating and identifying technological development:

It appears that the development and insertion of a new technology need to be well managed and evaluated, in order to identify the feasibility of implementation, costs and if there are no other technologies capable of doing the same job at lower costs (MENDES & MELO, 2017, p. 571).

Thus, the complexity of assessing the situation of CT-Petro in the entire Brazilian territory is observed. It is evident that the marked differences between Brazilian territorial regions have an impact on the volume of development and request for protection of intellectual property generated, in particular, for the participants in development notices (GENTILLE et al., 2015).

It appears that the involvement of variables such as regional and cultural issues, political factors, professional training and dissemination of intellectual property reflect the complexity of a system that directly impacts economic and social issues (MELO, 2009; GENTILLE et al., 2015). Thus, it is also inferred that:

The economy should be interpreted as a complex system, a system where agents with different capabilities, different resource endowments and different preferences interact to generate a result that is not known a priori and that is a direct consequence of the way the interaction process unfolds (GOMES, 2015, p. 188).

However, it is observed that the performance of FINEP's notices, even having created a favorable environment for the development of S&T, with regard to its impact of released resources, did not reach the general objective of the stimulus policy. In view of this, it is understood that the country's territorial extension, with the most diverse regional characteristics, needs to have public policies that adapt to these divergences and the complexities of the economy. Therefore, one way to consolidate these policies is to intensify the support network and seek the exchange of experience between research institutions, that is, those that have a greater value for protecting intellectual property, which is one of the parameters to assess technological development that can establish partnerships (SAMPAIO, 2011).

When analyzing public policy for development, technological development and, consequently, economic development, some points are observed that need special attention (GENTILLE et al., 2015):

...public policy can be more effective if oriented to: i) improve the system's resilience and reduce its vulnerabilities; ii) avoid (or promote) dangerous (or positive) critical points; and iii) identify the main actors in a network that can promote (or prevent) changes in the system (FURTADO et al. 2015, p.33).

According to Mueller (2015), it is verified in the country and in other countries that a good portion of the identified failures of public policies are in an attempt to reduce complex phenomena, that is, using simple instruments and assumptions for situations and regions with a plethora of quirks. If the role of public policies is to help a country's technological development, it must be borne in mind that "...the design and implementation of science and technology (S&T) policies need to be improved in order to expand the contribution of the science and technology in solving the country's concrete development problems" (NEGRI, 2015, p. 7).

Thus, when studying the performance of CT-Petro in the North, Northeast and Center-West regions, which historically do not have large numbers of developed technologies, despite having an expressive number of oil reserves in activity and that can be explored, it is still incipient (MUELLER, 2015; NEGRI, 2015; NEGRI et al. 2018). This incipience results from the lack of structures of teaching and research institutions

that can participate in the fund's notices, of companies in the region that still maintain the culture that S&T is spent and not investment, human capital and the industrial park of each region (GENTILLE et. al., 2015; NEGRI et al. 2018; TURCHI & ARCURI, 2019). If the State does not act through public financing, there is a tendency to increase technological differences by territorial regions, so it has to be said that "... the main argument for public financing is that there would be a tendency for private expenditure in the the aforementioned activities would be lower than the socially and economically desirable levels if they were left to the invisible hand of the market..." (CASTELLI, 2017, p. 85). In other words, leaving investments in S&T under the responsibility of the market will maintain a concentration of production of technologies and IP in the Southeast and South regions, to the detriment of a possible inertia of technological productivity in the North, Northeast and Midwest regions (ARAUJO et al., 2012; SANTOS & MELO, 2017; CASTELLI, 2017).

Improving the governance and selection processes of the sectorial funds, ensuring competition and selection of the best projects and ensuring that part of the resources is effectively used to solve the country's major technological challenges... means reinforcing the original objectives of the sectorial funds. Over the years, a large part of the funds' budget was shifted to the so-called Transversal Actions, whose governance and project evaluation criteria are much less transparent. Overcoming these challenges has the power to mobilize the entire national S&T system in order to employ public investments in this area with a mission-oriented view. Researchers, public institutions and companies could work together carrying out equal or sequential parts of large projects (NEGRI et al. 2018, p. 551).

With the presentation of this scenario of the performance of the CT-Petro Sectorial Fund in the North, Northeast and Center-West regions, it is inferred that even with the advances in terms of technology development in Brazil, adjustments and adjustments need to be made, especially in the issue of governance of this public policy (MUELLER, 2015; TURCHI & ARCURI, 2019).

### ***2.3 CT-PETRO Versus Patent Profile in Brazil***

According to WIPO (2016), a patent is a title granted by the State in a certain territory, for a certain period of time, with the objective of giving the inventor exclusive rights for its economic exploitation, preventing third parties from benefiting from something that it did not develop or contribute to being developed. And when it comes to intellectual property, it refers to the idea of new technologies (SOUZA & ALMEIDA, 2019). In the Brazilian case, CT-Petro was created to stimulate the development of S&T for the Brazilian oil and natural gas production chain (FINEP, 2019). As can be seen throughout the text, S&T in the country are primarily developed by Universities and Research Centers (NEGRI, 2015).

Even so, differences were evidenced between the institutions that carry out research in the country. It should be noted that Universities, despite having similarities in their administrative structures, diverge from their organizational structures. This statement takes place in the context in which even with information asymmetries, some have well-structured and specific sectors to take care of intellectual property, others do not (SOUZA & ALMEIDA, 2019). With the knowledge of this information, the following question is inferred: if a possible change in organizational structures, associated with legislation aimed at IP and technical capacity, wouldn't they be the key to boosting the productivity of patents in Brazil? (SAMPAIO,

2011).

In addition to these changes, another point to be analyzed is innovation because:

... difficulties manifest themselves in several areas: i) in the time it takes to grant a patent; ii) the time and requirements necessary to approve a research or a new drug at Anvisa; iii) existing restrictions on opening and closing companies; iv) in the regulation of investments made by venture capital funds; v) the difficulty in importing research inputs and equipment; vi) operational difficulties in executing public resources in research institutions; and vii) in the difficult university-industry relationship etc (NEGRI, 2015, p.13).

It is noteworthy that the performance of patent filing requests in Brazil by non-residents should be considered. Garcez Júnior et al. (2015) highlight in their work that part of the patent applications filed by non-residents in the country, with the INPI, belong to multinational companies. Regarding the filing of patent applications from residents, the predominance is from Universities or Public Institutions.

In this way, the argument of the Government's participation in developing public development policies, updating the legal framework and strengthening the State as an intermediary agent in the University-Business relationship is strengthened (QUEIROZ, 2006; SOUZA & ALMEIDA, 2019).

Paraphrasing Souza & Almeida (2019), it is noted that, even with government stimuli, the supply of S&T there is still a minimal demand for what is generated from S&T with public resources, and it can be inferred that the lack of knowledge of what one is produced in academia by companies and the national business culture that investing in S&T is a cost and not an investment aggravate this scenario, reflecting in a barrier to "...effectiveness in leveraging the country's development" (NEGRI et al. 2018 , p. 540). And in encouraging the development of patents and/or other types of intellectual property.

### **3. Methodology**

With the presentation of the bibliographical reference, the importance of public policies to promote S&T in the country is evidenced, on account of the way in which Brazilian businessmen deal with the theme and the performance of Brazilian Universities and/or Research Centers. It is also worth emphasizing the disparities between Brazilian territorial regions that impact on Brazilian technological indicators. Notably, the Southeast and South regions have the highest index of patent application filings, inferring that these indicators are the result of higher industrial concentration.

As discussed throughout the work, the main objective is to verify whether the financial expenses generated through the CT-Petro notices contributed to the increase in the volume of patent application filings and whether these are directly linked to the P&G production chain.

The methodological structure of the results found was outlined as follows: FINEP was asked to provide the respective CNPJ for the projects approved in the CT-Petro notices, which are composed of contracting and executing institutions; in some cases, the same institution was convenient and enforceable; in other cases, there were only the covenants; and others, there were two different institutions for the same project.

The temporal analysis covers the years 2002 to 2015. With the defined period, the objective was to send a simple questionnaire to institutions registered in the Brazilian Federal Government database, created under



Law No. 12,527/2011 – Access Law to Information, through the e-sic system. The choice for this instrument was based on bibliographical references by specialists in public policies to promote Brazilian S&T, in which they discussed the massive participation of public institutions.

With the definition of the exploratory research method, the sample size was analyzed. With the data provided by FINEP, 652 projects were found approved by the notices for the period under study. Thus, the survey was about the institutions that were registered in the e-sic database. After this step, the verification was about the foundations supporting science, technology and research that were linked to the Universities. Next, the structuring of the work and definition of the methodological procedure, the orientation developed is to present the results for all Brazilian territorial regions. Subsequently, the analysis for the North, Northeast and Midwest regions.

#### **4. Analysis and discussion of results**

The direction of this work will be on the patents developed and filed by the participants of the CT-Petro notices. With breakdown by Brazilian regions, the time period of the sample will be from 2002 to 2015, in which participating institutions were found as covenants (signed agreements) and executing institutions. After treating the sample, year by year, 310 participating institutions were found during the study period. With a new treatment of the sample, it was possible to verify that part of these were support and research foundations linked to Universities.

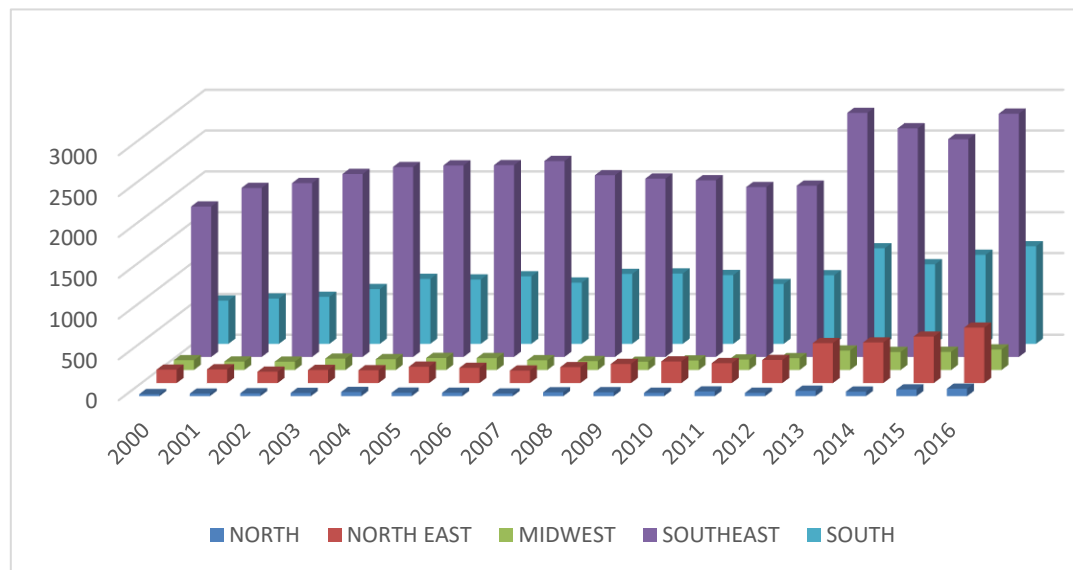
In order to verify whether the filings of patent applications prospected on the INPI website were directly linked to the resources released through the CT-Petro notices, a new treatment of the sample was carried out. Initially, it was verified on the respective websites of the institutions, of the sample in question, those that had technological showcases. In prospecting the technological showcases, no evidence was found that the patents presented were related to CT-Petro. Thus, the alternative found was to collect this information through the Access to Information Law, through the CGU e-sic channel. The decision for this method resulted from the finding in the sample of 125 participants as covenants and executors to be public institutions. Thus, the direction of the work was to prepare a questionnaire to be sent by e-sic, in order to find evidence on the filing of patent applications resulting from the resources spent by CT-Petro.

With this direction, there is a decrease in the sample size. This decrease is the result of some support foundations being directly linked to the Universities, as well as to the same agreement as the executor. In addition, it was taken into account within the bibliography presented that part of the research carried out in the country was carried out by public institutions (NEGRI et al., 2013). It is noteworthy that a questionnaire with ten questions was sent to institutions registered in the e-sic. Then, by consulting the e-sic database and crossing the data provided by FINEP through an Excel spreadsheet with the projects approved in the period, 120 institutions were found; stressing that this number is between contracting parties and executors, and between institutions linked to Universities. In this way, with a new analysis between the relationships of contracting parties and executors and the link with Universities, this number was reduced to 58 institutions. Among the 58 institutions, only 3 did not provide feedback on the survey of information, in percentage terms corresponding to 5.26%, being considered satisfactory, that is, a good part of the institutions that received the questionnaire via e-sic gave feedback. However, some reported the impossibility of answering

the questionnaire because some of these institutions do not have a mapping of the projects carried out by the institution, others requested information regarding the year and name of the approved project. Thus, it can be inferred that teaching and research institutions in the country do not centralize information on projects developed by their professors and researchers. The asymmetry of information and the lack of monitoring of what is developed is evident. The institutions that have a technological showcase did not answer the questions and the guidance given is that the survey should be carried out through this channel. The prospection carried out in the technological showcases could not find a connection between the patents and the CT-Petro Sectorial Fund.

After sending the questionnaire, information was consulted on the INPI website on the number of patent applications filed in all regions for all production chains. The intention was to verify the impact of patents developed by CT-Petro in contrast to the total volume of production chains. However, the INPI website did not present a historical series. The solution found was to request by LAI the period from 2000 to 2013, even though the sample of the work is the period from 2002 to 2015, the data calculated on the grand total informed by the INPI will be presented in the next figures. In Figure 1, the overview of patent application filings by region is presented.

Figure 1: Overview of Patent Application Filings with the INPI by Brazilian Region

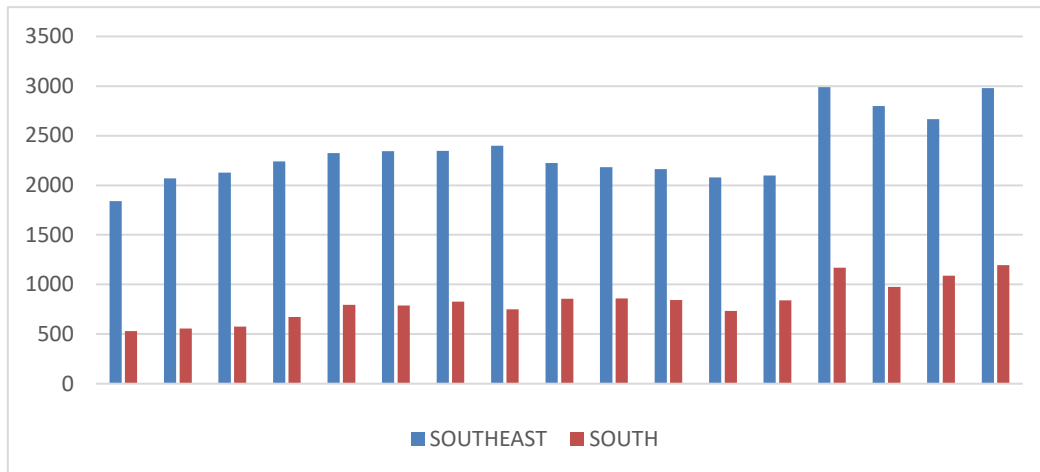


Source: Prepared by the authors with data from INPI, 2020.

During the historical series, there are few oscillations over the years in all regions. Highlighting the largest volumes are the Southeast and South regions, confirming what was presented in the literature presented throughout the work, of productive concentration in the SE and S regions. Regarding the North, Northeast and Midwest regions, the highlight goes to the Northeast region with the highest number.

With the data collected and presented, the option was to carry out a comparison between the macro-regions adopted by CT-Petro. The first to be presented is the most prominent on the national scene. In Figure 2, the differences and discrepancies can be identified. The distance between the Southeast and the South is quite considerable.

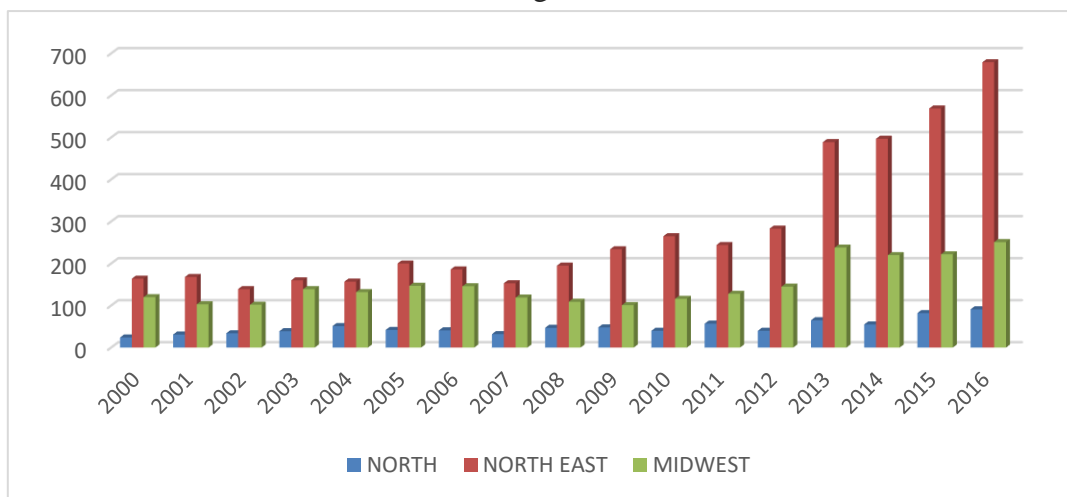
Figure 2: Overview of Patent Applications Filing with the INPI by the Southeast and South



Source: Prepared by the authors with data from INPI, 2020.

When making the comparison between the macroregion N, NE and CO, the highlight goes to the Northeast region. Between 2002 and 2007, the Midwest region approached the numbers of the Northeast region. It is worth emphasizing that the Northeast region, as of 2013, grew. From the analysis of Figures 2 and 3, it was observed that the regions within the macro-regions adopted by the CT-Petro Sectorial Fund that stood out were the Southeast and Northeast.

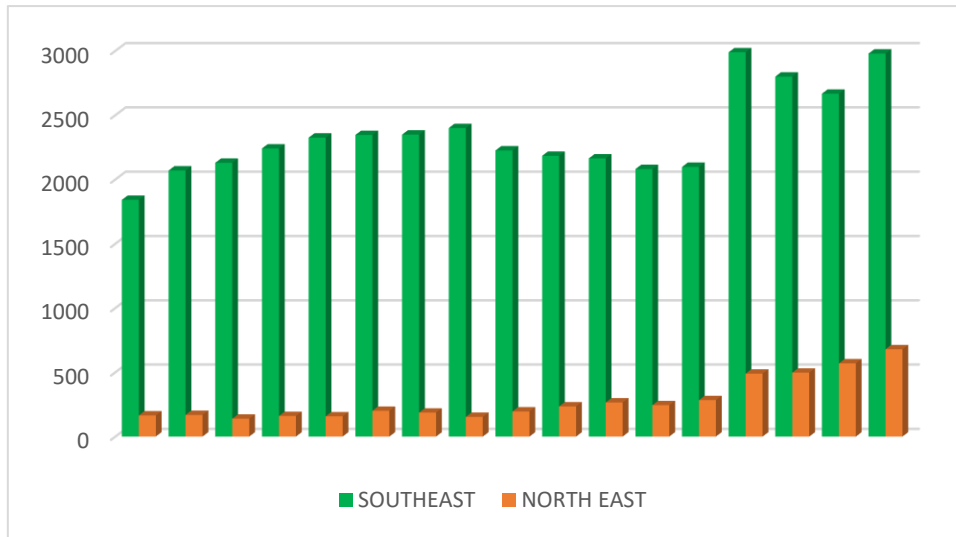
Figure 3: Overview of Patent Applications Filing with the INPI by the Northeast, North and Midwest Region



Source: Prepared by the authors with data from INPI, 2020.

Therefore, a comparison was made between the highlights of the macro-regions presented in Figure 4. Analyzing this figure, it becomes evident that even with all the incentives through public policies aimed at S&T, the Northeast region is still far away in terms of patent productivity.

Figure 4: Comparison of the Volume of Patent Applications Filing with the INPI between the Southeast and Northeast



Source: Prepared by the authors with data from INPI, 2020.

Patent application filings were provided by the INPI, all these numbers correspond to all production chains in the country. Table 1 shows the amount of patent applications filed, extracted from the material provided by the INPI. For the preparation of this table, the sum of the types of patent applications filed by cities and their respective states was carried out, finally, the sum of the per region was made. In order to verify the percentage by region, the analysis started with the application of a simple rule for the region by the entire country. Even though the research sample was delimited for the 2002-2015 range for the data provided by the projects approved by CT-Petro, it was necessary to present a larger range for the data provided by the INPI for a better understanding of the behavior of Brazilian society from the perspective of intellectual property protection through patents.

It is worth emphasizing that all regions showed few fluctuations, which can be inferred that even in a period of approximately 15 years there were few changes in behavior. Opposite behavior, when observing the productivity of Brazilian scientific articles. Another point that should be noted is the concentration of IP-related productivity in a single region, that is, the impact of public policies for this purpose was not enough to reverse this disparity.

Table 1: Percentage analysis of patent application filings made in Brazil, by cities

YEAR	REGION				
	NORTH	NORTH EAST	MIDWEST	SOUTHEAST	SOUTH
2000	0,88	6,15	4,48	68,72	19,77
2001	1,06	5,74	3,52	70,71	18,97
2002	1,14	4,66	3,43	71,44	19,33
2003	1,20	4,93	4,28	68,94	20,65
2004	1,47	4,54	3,81	67,20	22,98
2005	1,19	5,68	4,17	66,58	22,38
2006	1,15	5,25	4,12	66,18	23,30
2007	0,93	4,43	3,45	69,47	21,72
2008	1,37	5,68	3,17	64,84	24,94
2009	1,40	6,83	2,95	63,70	25,12
2010	1,17	7,74	3,38	63,13	24,58
2011	1,76	7,52	3,95	64,16	22,61
2012	1,18	8,31	4,26	61,58	24,67
2013	1,31	9,89	4,80	60,36	23,64
2014	1,21	10,93	4,84	61,59	21,43
2015	1,77	12,29	4,80	57,59	23,55
2016	1,75	13,07	4,83	57,35	23,00

Source: Prepared by the authors with data from INPI, 2020.

Now, the analysis of the work will be pointed out based on the results obtained from the answers to the questionnaires sent to public institutions registered in the e-sic database. In previous paragraphs, it was described that the sample of 120 institutions was reduced to 58 institutions, of which 3 did not respond and others had limitations to respond because they did not have a mapping of the developed projects. Of the responses received through the questionnaire sent by e-sic, 5 were for the South and Midwest, 8 for the North, 12 for the Northeast and 28 for the Southeast. In percentage terms, the latter corresponds to 48.27% of the responses.

When part of these numbers is directed to the filing of patent applications related to institutions that participated in CT-Petro's public notices, such numbers have a low percentage. Before explaining these percentages, it is necessary to mention some questions to understand the study.

The questionnaire was prepared with 2 main questions, namely. In case the answer to the second question is the alternative YES, the others can be answered. Next, the first 2 questions will be presented and the complete questionnaire follows as a complementary document to this work.

**1- The institution participated in the CT-Petro Sectorial Fund notices:**

( ) No

( ) Yea. How many notices? \_\_\_\_\_ Wat years? \_\_\_\_\_

**2- Of the projects developed with resources from CT-Petro, patent applications were filed?**

( ) No

( ) Yea. How many? \_\_\_\_\_

With the presentation of part of the questionnaire, the results found will be presented. For the first question, 17 institutions answered the alternative YES, among all regions, the alternative NO 12 institutions and the others, 29 institutions, did not answer this question. Therefore, in response to the second question, the results were as follows: 8 institutions answered YES, 19 answered NO, 31 institutions did not answer this question. It is observed that even the institution having given a feedback on the request, many institutions did not answer the first questions, strengthening the evidence of information asymmetry within the institutions. It is worth noting that the COVID-19 pandemic scenario made it difficult to gather such information and also showed the existence of a lack of mapping of the developed projects, as well as of a control of these projects on a systems basis.

The next two questions are presented below:

**3- Of the patent application filings, is there any directly linked to the oil and natural gas production chain?**

( ) No

( ) Yea. How many? \_\_\_\_\_

**4- If a patent application has been filed, has any been granted?**

( ) No

( ) Yea. How many?

From the results found, 5 institutions that answered YES to the third question are presented, 16 institutions answered NO and 37 institutions did not answer this question. Regarding the fourth question, 6 institutions answered YES, 17 institutions answered NO and 35 institutions did not answer.

According to the data presented, it appears that the productivity developed by the projects approved by CT-Petro was not directed and/or stimulated to the development of patents that could reach the productive market.

Subsequently, the results of the tabulation of the questionnaire data are presented with 29 patents filed, 13 patents granted and 4 patents linked to the Oil and Natural Gas production chain for the whole country. Thus, it is impracticable to carry out a comparison with the number of patent applications filed for all production chains, within the material provided by the INPI and with percentages presented by geographic region in Table 1.

## **5. Conclusion**

With the results found and presented throughout the work, it is noted that all the incentives provided by the financial resources of CT-Petro contributed to improvements in the structures of laboratories and research institutions in the regions. From the perspective of the innovation cycle in which the actions developed by Universities, Government and Companies need to carry out a whole cycle of incentives, production and insertion in the market. From what was presented, this innovation cycle cannot be totaled in Brazilian territory.

Another important factor to be highlighted is that the institutions with the best structuring indicators of the Technology Innovation Centers - NIT and the Innovation and Technology Transfer Board do not have a mapping of developed projects in their databases, making it difficult to present technological results. As a suggestion for other works, it is necessary to use management tools that can better monitor the stages developed along the projects approved by FINEP, through CT-Petro.

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