

Analysis of scientific initiation in Brazil with emphasis on regional disparities and distribution between public and private institution

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Abstract

The advance in the production and dissemination of scientific knowledge around the world has been causing an increase in public actions to contribute to decision makers at specific levels of competence. Within this context, this study aims to analyze the impact of investments in public policies at the beginning of the academic research chain in Brazil, that is, scientific initiation and regional disparities about it. This research has a qualitative nature and is based on information obtained from the National Council for Scientific and Technological Development. As a result of this analysis, it was found that, despite the existence of a legal basis that protects the North, Northeast and Midwest regions, regional disparities are still critical. Additionally, the participation of private Higher Education Institutions in the Scientific Initiation scholarship system is still low, which is mainly due to the low quality of the projects presented by these institutions. Thus, more effective actions to reduce disparities and increase the quality of research in private Higher Education Institutions, such as, for example, the use of clear criteria and scripts in the notices for the evaluation of research projects, must be adopted by the governmental sphere of public policies to foster research in Brazil.

Keywords: Scientific initiation, Promotion of research, public policy, Academic research.

1. Introduction

The increase in the distribution of knowledge in the world can be expected to return in the proportion of one to three, that is, each 1% invested in research, which results in the production of knowledge and changes the size of the market through an assessment of competitiveness, can correspond to 3% of cutting edge technology that is exported (Braunerhjelm and Thulin, 2008; Ryzhkova and Prosvirkin, 2015; Dzshukha et al., 2017). This growth has provoked an increase in the movement of public actions to contribute to decision makers at specific levels of competence, being verified not only within the municipalities where the universities are located. The involvement in this set of interests of institutions and interactive, private and public organizations, is necessary to facilitate, for those responsible for the knowledge produced, the dissemination and exploration of possible solutions (Rauniar et al., 2019).

The importance of universities as responsible for the production and dissemination of knowledge is paramount for the regional level when collaborating for the composition of innovation systems, acting as the main knowledge provider for the industrial sector (Comunian and England, 2019). Regional medium and high technology companies benefit almost equally from university knowledge (Silva et al., 2016). Thus, there is the possibility of harnessing the potential of scientific production as a direct effect between concentrations of industries and university research in high technology (Huang, 2018).

However, there is an important regional disparity regarding the distribution of universities, especially regarding centers of excellence and scientific production. The great schools of knowledge of life sciences and engineering are those that present more significant concentration of courses in certain regions of the country. As expected, the regions with the greatest contribution to new knowledge are those with the largest number of inhabitants and with the best indicators of socioeconomic characteristics, which is southeastern Brazil as 53% of undergraduate enrollments, which motivated the deconcentrating action in the country (Barros, 2015; Fundação Capes, 2010).

The development agencies, responsible for operationalizing the policies, when disclosing their calls, should provoke in the perception of scientists the demand of society through actions that motivate scientific production. Public funds should not be associated with political pressure, but with a long-term program, where the researcher must have minimum conditions for the continuity of his projects. Thus, academic research boundaries seek frequent discovery of the alignment of researchers from scientific initiation to doctoral students, in order to facilitate the direct transformation of the generated product into industrial use (Remington-Doucette et al., 2013).

1.1 Objective

This study aims to analyze the impact of investments in public policies at the beginning of the academic research chain in Brazil, that is, scientific initiation and regional disparities about this process.

2. Literature Review

In Latin America, the development of scientific policies since the 1950s has significantly influenced the distribution of resources and the establishment of priorities (Bekerman, 2018). In Brazil, on this same occasion, the scholarship program for Scientific Initiation (CI) was implemented with the main objective of awakening, for science, young talents through public calls launched periodically.

The period between 1970 and the beginning of this century was characterized by the great expansion of the Brazilian university system, and the main action, in this period, was the expansion of the number of places through the creation of new public and private non-profit universities. The Brazilian government invests in postgraduate scholarships to contribute to the creation of new programs or even the growth of existing ones. The main objective of this action was to improve the supply of human capital to meet the market demand for specialized labor (Freitas et al., 2013).

It is observed that, even today, the main contribution to scientific production comes from Brazilian public universities, which today are responsible for 99% of the research carried out in the country (Clarivate Analytics, 2017). Most of them have federal or state resources, although a small number of private universities also encourage research. The quality of the combination of teaching and research presents a differentiated product in the richest states when compared to the poorest, which can be seen in the ranking of publications in Latin America, where the leadership is from the city of São Paulo and the eighth world position with three universities among those that publish the most (Mena-Chalco et al., 2014; Haddad et al., 2017; Infográficos, 2019).

In Brazil, 2018 was marked by a reduction in resources earmarked for education as a whole; in basic education there was a reduction of 42%, and in higher education, the cut was 32% (Druck et al., 2018). In this way, the restrictions imposed on the application of resources from the National Fund for Scientific and Technological Development (FNDCT), which has as its main objective the financing of key themes for science, technology and innovation, will reduce the country's possibility of following the technological frontier. This situation puts our country against countries like the USA, China, Korea and Israel, which used investments in research as a central basis for resuming growth after the 2008 crisis (Cintra, 2017).

The construction of a learning environment with a focus on research is fundamental for the student who starts the course and is in a process of transition to higher education (Brew, 2010). Teachers, despite this context of scarce

resources, must continue to clearly encourage, at graduation, the importance of developing research activity. As a result, the importance of benefits in integrating research is highlighted as promoting student learning outcomes (Prosser and Trigwell, 2014). Thus, the construction of values and beliefs about the importance of research becomes a facilitator for a country that is known for presenting low performances in the formation of human capital, integrating the demands of the university market with the productive sectors.

Scientific initiation is perceived as the gateway to the development of the student's critical sense while still undergraduate, enabling students to get closer to community practices, favoring through dialogue the learning and understanding of different opinions (Too and Bajracharya, 2015). Scientific initiation and, mainly, technological initiation have the ability to provide insights into elements to improve the valuable knowledge of the operational practices of micro processes, available outside the company's limits.

The selection of undergraduate students to be scholarships for scientific initiation is carried out by the professors, as a rule by qualitative analysis, based on the assumption that the university must define prerequisite criteria for the selection of the scholarship holder (RN-17/2006) (Conselho Nacional de Desenvolvimento Científico e Tecnológico, 2006) and most of the IES use the cumulative yield in the course greater than or equal to 60% for a scholarship lasting one year.

The current context presents innovation in Brazilian universities as an action that is still timid, which limits the process of knowledge transfer, mainly in the use of technology patents, which can contribute to the enrichment of the industrial technological heritage of Brazilian society, improving the precarious Brazilian industrial process (Faria et al., 2018).

Although the promotion of research can be assessed using indicators such as number of publications and citations, the leadership that Brazil occupies with 76% of publications with the open access scientific information movement (Archambault et al., 2014), is positive, since support for payment of charges is limited to a few Brazilian agencies (Pavan and Barbosa, 2017). With this, the country can provide a policy that facilitates OA for its researchers (Pavan and Barbosa, 2018).

Thus, the planning of a research policy organized by the government, as a rule, tends to choose a linear model, featuring as a characteristic the use of a direct correlation between the resources employed locally and the effects of growth in that same location (Rostrup-Nielsen, 2016). This attitude represents a mistake due to the breadth of the parallel developed between science and technology in the global context (Valero and Van Reenen, 2019).

The use of this linear model led to an industry expectation for innovation, which generated an increasing influence in directing research to some areas that were determined according to its relevance. The dysfunction of this action is the absence of market return, which makes it difficult to assess the applicability of research (Rostrup-Nielsen, 2015). In this reality, universities are institutions responsible for maintaining knowledge and reflection, not limited to teaching, but also developing and transferring knowledge (Howlett et al., 2016).

The development of a research policy is a difficult activity that constantly manages the oscillation between order and chaos, favoring that each scientist finds a favorable environment for the performance of the initiative without forcing the university to classify the research as applicable or not applicable. In this way, scientific initiation to basic long-term research is developed, bringing students closer to high-tech companies to establish joint action with the academy, in order to guarantee future options for the company (Rostrup-Nielsen, 2016).

3. Methods

The methodological procedure started with exploratory research in 2018 in the ScieLO, CAPES periodicals and Scopus databases, to identify studies that are pertinent to the theme proposed in this research. The articles in each bibliographic database were selected using the terms "Research promotion AND Public policies AND Academic research" the search was limited only to articles published in the last four years in any language, with open access, and duplicate publications were excluded. The preliminary result found was 89 articles. In a second step, the summary and conclusion of all selected articles that deal with the theme of this study were read and analyzed. Thus, for the beginning of the literature review, the 26 most relevant articles were selected and organized by the number of citations, which brought contributions to the understanding of the process that involves the propagation of the development of critical sense in the training of the research student, which it is fundamental for the decision-making

process in organizations and for the development of human resources, thus forming the basis for the literature review.

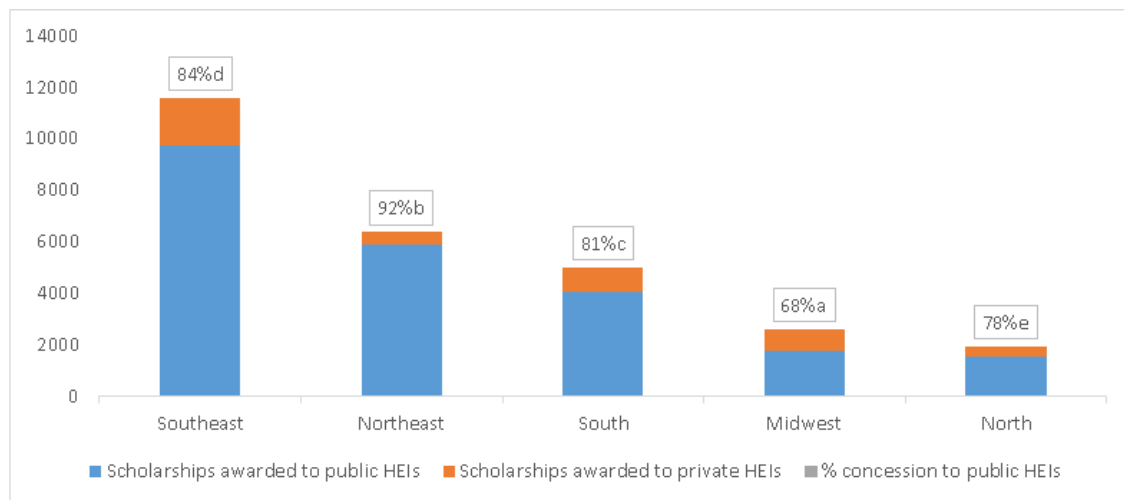
In a third moment, once the literature review has been built, the theoretical contributions for the analysis of the data were defined. Obtained through surveys carried out in documentary research in technical reports to analyze the behavior of research in Brazil in documents of the last five years of the main research promotion body in the National Council for Scientific and Technological Development (Brazil), which is also part of the methodology used.

For these characteristics, the research is mixed and can be classified as qualitative, in line with the objective of this study, which is to analyze, based on data and information from the referred funding body, public policies in the scope of scientific research, and was possible to consider the reality of the opinions and perspectives that encompass the contextual conditions, and contribute to the revelations, observing the concepts of the different sources that help the understanding of social and human behavior (Yin, 2016). In the quantitative part of the analysis, the criteria of inclusion for a more detailed description of the analysis occurred with the use of a statistical tool and included the variables: (i) research on the distribution of scientific initiation grants throughout Brazil and (ii) the relationship between Higher Education Institutions (HEI) public and private studied, with adequate geographical distribution.

The verification at the level of significance occurred through a quantitative tool that supported the qualitative analyzes. In this way, the Chi-square statistical model was used with the use of the SPSS statistical analysis software, considering that it allows to identify agreement and correlations between variables (Li et al., 2019). In this case, the two variables were analyzed: total scholarships between regions and total distribution of scholarships between public and private institutions by region. The test legitimized this correlation, adopting a significance level of 5%.

4. Results and Discussion

The bibliographic review was compared with the National Council for Scientific and Technological Development (Brazil) database, which provided a set of data and information on the distribution of scientific initiation scholarships by the main funding agency in the country in 2018, as shown in Figure 1. Only 17% of the total scholarships granted by the funding agency, went to private HEIs, which can be justified academically by the low quality of the projects submitted by such HEIs. This is due, in part, to the fact that these institutions have, often, low-qualified teaching staff, hired by an hourly regime, and with low scientific production, small tradition in research and laboratories, often poorly equipped.



*Statistical analysis has shown that all regions are statically different from each other

Figure 1. Distribution of scientific initiation grants by type of HEI and geographic region.
Source: Prepared by the authors based on data from the National Council for Scientific and Technological Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico, 2019)

It appears that, despite the reserve of scholarships and grants for the Northeast, North and Midwest regions, according to Law no. 11,540 / 2007, which provides that at least 30% (thirty percent) of the funds will be invested in institutions based in the North, Northeast and Midwest regions, and which have been in force for 12 years, will be able to respect the particularities to contemplate inferior quality projects when compared to those submitted in other regions. Despite this, the Southeast and South Region together still represent 61% of the scientific initiation scholarships distributed in the country, which is justified by the combination of the highest concentration of HEIs in Brazil with the most industrialized region in the country, while the rest of the scholarships are distributed by other regions in this proportion: northeast 23%, central west 10% and north 7% (National Council for Scientific and Technological Development, 2019). The North region, for example, despite having 24 public HEIs (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2017), still has the lowest number of CI scholarships distributed in the country. In this way, the National Fund for Scientific and Technological Development was created to support the financing of scientific development whose consequence will be the promotion of economic and social growth in the country (Negri et al., 2018).

This process still needs to be reviewed. Currently, it has attracted few companies failing to contribute to the effective social inclusion of these students in a corporate market, which, consequently, makes it difficult to attract new companies, generating a bad cycle for the region (Costa, Bispo et al., 2018). In this way, there is a concentration in the distribution of scholarships, necessarily demonstrating the association with private companies or a certain industry, its teaching reputation and the publications of its faculty, subject to the best response functions of the researcher and the dynamics of citations (Von Hippel et al., 2016).

Regarding the distribution by public or private HEIs, it is observed that the Northeast Region stands out for the smaller participation of private HEIs in the scholarship program, when compared to other regions of the country. Although it demonstrates a high dependence on the participation of the public sector in the training of researchers, this region today has 66 public universities (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2017); however, this did not show the expected evolution for the region, especially when the patent product is compared with the other regions of the country (Costa, Florêncio et al., 2018). To exemplify, the state of Maranhão has only 2% of the scholarships granted to private HEIs, that is, in absolute numbers, only seven students. This finding reflects the lack of tradition and structure for research in private HEIs in the region. In contrast, the Midwest region includes the inclusion of students from private HEIs that are less unequal in the country, representing a better effectiveness of public policies, demonstrating a lower level of dependence on the government to train a researcher. Table 1 shows the total number of projects whose academic merit was recognized with the granting of scholarships within the scientific initiation program, supporting the distribution of scholarships.

Table 1. Distribution of scientific initiation scholarships 2018

Region	Scholarships awarded to public HEIs	Scholarships awarded to private HEIs
Midwest	1.779 (68%)	847 (32%)
North	1.514 (78%)	427 (22%)
South	4.048 (81%)	958 (19%)
Southeast	9.721 (84%)	1.882 (16%)
Northeast	5.878 (92%)	514 (8%)
Total	22.940 (83%)	4.628 (17%)

Source: Prepared by the authors based on data from the National Council for Scientific and Technological Development (Brazil) and information obtained from Higher Education Institutions via telephone contact

Thus, the average number of students per institution places the Midwest region as the most effective in the national scenario. Thus, private HEIs are influenced by the actions of agribusiness, which is the main economic activity in the region, and which direct or indirect, destines investments for the development of the research area of these institutions, driven by international demands for commodities (Henders et al., 2018; Sauer; 2018).

The highlight of this analysis is the federal district, which, in addition to students taking undergraduate courses with public funding incentives, is also influenced by products that are exported in an economy that uses technology in

agribusiness, reaching levels that Southeast HEIs cannot reach, despite the country's private teaching tradition (Gonzaga et al., 2019).

Another important point concerns the North region, which has 22% of the grants directed to private HEIs. This is partly due to the proximity of some industries that are interested in the biodiversity of the Brazilian Amazon, mainly those linked to the aesthetic and pharmaceutical segment that have their own laboratories and some partnerships with local HEIs (Santos et al., 2019).

In the Brazilian reality, public policy depends on the ability of HEIs to effectively transmit knowledge, becoming the central point of a more organized structure (Jacob et al., 2003; Pugh, 2017). Thus, funding agencies need to use the current structure of the HEIs to implement a good part of public research policies in the country.

A structure specific to funding agencies, with servers and researchers dedicated to the process of checking academic merit, would provide the definition of a policy that seeks to reduce the distance between educational institutions and industries and society itself. Therefore, it is important to measure the intensity of the relationship between the government and companies through the analysis of micro-level constructs (Felin et al., 2015).

The existing distance can be justified in the precarious actions of research policies influencing results in entrepreneurs of some regions, and the real contribution of the HEIs located there can be verified (Sant'anna and Nelson, 2017). However, it is important to develop, for example, mechanisms that observe the characteristics of each area of knowledge, the potential impacts on society, and that can contribute to the identification of possible flaws in the process of teaching and research institutions. Thus, it is important with the use of this tool to assess the impact of this approximation policy to plan and guide actions that compensate for the eventual regional shortages of university capacity and not to adopt a punitive stance (Qiu et al., 2017).

Thus, the opportunity, which should be seized following the models of some European countries, is in the dissemination of a critical mass resulting from academic research, which through research networks brings companies or industries closer to universities, including in their staff PhD researchers from these universities in the corporate R&D area (Leten et al., 2014). In turn, the successive financial crises, which affect the various countries of South America, directly influence scientific and technological policy and the unresolved strength correlations between State, society and market (Naidorf et al., 2015; Ocampo-López et al., 2019). Thus, the opportune proposal is a public policy to encourage scientific initiation, but investments in research infrastructure are vulnerable to the interests of some sectors, such as: biotechnology, nanotechnologies and information and communication technologies, directly influencing the distribution of resources.

Thus, the publicity of the act of distribution of internal resources allows HEIs to develop a new relationship with the business environment, with the aim of facilitating interaction, that is, universities can also be important mediating instances between university scientific communities and companies (Lemos and Cario, 2017). In this way, HEIs could also contribute through conflict management programs with difficult interaction, despite the effort.

In view of this scenario, the use of new organizational structures favors the accommodation of new proposals demanded from those involved with scientific technical thinking aimed at investment at the beginning of the researcher's career, which expands the discussions with the aim of improving the proposed alternatives, as occurred with small producers in Europe (Sutherland et al., 2017). However, it cannot be forgotten that the increase in private HEIs in Brazil, often motivated by the government itself, also influences this scenario, favoring competition and beneficially increasing the dispute for distributed funding, which today is concentrated in public HEIs in the country (Salto, 2018). Thus, granting authorization for new private HEIs should not be seen as a solution to the problem as in general, these HEIs do not focus on research.

In this way, what designates education as a public good is the quality of service that can be offered by HEIs, however for this to happen the State must be responsible for transforming these organizations into providers of teaching, research and extension services (Pereira et al., 2018). In addition, they can be quantified, when standardizing values for the construction of indicators, which reflect aspects such as socioeconomic characteristics of a region and concentrations of interests in a given activity of decentralization in the distribution of scholarships will be favored as the frontiers of companies are opening up and there is clearly a level of dependence on a high level of social capital, which will require further studies (Steinmo and Rasmussen, 2018).

5. Conclusion

When analyzing the information on investments in public policies for scientific initiation in Brazil, in the existing model, we find that, despite the legal basis that protects the North, Northeast and Midwest regions, regional disparities are still critical. In addition, the participation of private HEIs in the scientific initiation scholarship system is still low, which is mainly due to the low quality of the projects presented by these institutions, especially due to the low focus of these HEIs in the research field. Thus, more effective actions to reduce disparities and increase the quality of research in HEIs must be adopted by the governmental sphere of public policies to promote research in Brazil. In this sense, the objective of the research was met by making a critical analysis of the impact of investments in public policies at the beginning of the academic research chain in Brazil, that is, scientific initiation and regional disparities about this process. The research found difficulties in compiling the total of scientific initiation proposals submitted by all HEIs in the country, due to their scope and diversity. Thus, the analysis points to the need for a more in-depth study of the mechanisms that guide the distribution of resources for scientific initiation in Brazil.

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