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Characterization on the patents deposits from Brazil's Public Research Institutes from 2004 to 2013

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Abstract

Public Research Institutes (PRI) in Brazil have played a considerable role in the development of the country given the design and creation of specific usable knowledge in their areas. To this process is important the knowledge's systematization created through patents, since it allows that the 'best' knowledge is practically implemented and what benefits are obtained for such institutions and for the country. Through the survey of patent applications, this paper demonstrates the technological development promoted by PRI. Based on deposits of patents in Thomson Innovation data, is performed a quantitative approach, from the collection of secondary data, based on frequency analysis, regression and chi-square test. We conducted a survey of patent deposits by PRI from 2004 to 2013, proving the joint and individual technological development, the most frequent types of partners promoters of deposits. Thus, we propose a presentation and signaling technological development of PRI by production of patent deposits and this becomes the basis for further analysis.

Keywords: Patents; Public Research Institutes; Innovation; Technological development

Introduction

The evolution of a country is measured by the development of technological innovation and according to Tigre (2006) they provide the increase of organizational productivity and competitiveness which represent this evolution. This competitiveness can occur through technological research (predominantly to solve problems in the productive system) and through development of the technological autonomy of a country as stated by the articles 218 and 219 of the Constitution of the Federative Republic of Brazil from 1988 (BRASIL, 1988). Thus it is possible to evaluate the national development.

The government needs to establish public policies and actions of strategic planning which lead to technological research and promote productive, scientific and technological development. Therefore, the Public Research Institutes (PRI) must be supported by the government because they provide for Brazil to reach some differentials that are relevant in the technological development process and solutions to the productive system.

The PRI have expertise in research in some areas as in agriculture, health, among some others (Póvoa, 2008). It provides the development of each practice area which allows the intensive use of information and knowledge from a specific area to solve the problems in addition to help finding new solutions to eventual future needs.

This can generate opportunity to return, as an example, there is the practice of patent production that brings the results of the work through commercial technologies (Henderson, Jaffe, & Trajtenberg, 1998); the systematization of knowledge by science tend to generate technologies that are able to be applied in practice (Rosenberg, 1982), this means that when PRI develop

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new knowledge and are able to systematize it through patents, enable practical uses and achieve returns.

It is important to highlight that the practice of innovations is linked with the relation between the interacting agents from the National Innovation System (NIS) (Albuquerque, 1996; OECD, 1997; Plonski, 2005; Póvoa, 2008; Stal, 2006). When the PRI keep a relationship with some agents from NIS (industries, governmental agencies, universities) they raise the possibility of innovation because, according to Póvoa (2008), it is difficult to get it isolated.

This happens because of the interaction between the acting parts of that system, which increases the potential of commercial application by complementarity (Gusberti, Dorneles, Dewes, & Cunha, 2014). The technological development occurs through the process of cooperative action between universities, research institutes and industries because throughout this process knowledge is risen, according Etzkowitz and Leydesdorff (1996), Plonski (1999), Porto (2000, 2007), Sábato and Botana (1968), Segatto (1996), Segatto-Mendes and Rocha (2005), and Segatto-Mendes (2001).

This kind of action enable the creation of innovation, for example, stimulating innovation comes from the offer of right infrastructure, laboratories for researches, financial support (Pinto & Feldmann, 2016). Competences and abilities to generate quality in technological aspects of a country are built by cooperation process (Garcez & Sbragia, 2013).

It is important to notice that the technological capacity influence of a country is on its policies applied by the government to the development of science and technology (S&T); the governmental policies that support the cooperation between research institutions and industries have a considerable impact in the developing countries (Zeng, Xie, & Tam, 2010). Especially because these policies create the effort to stimulate Research and Development (R&D) which allows, in practice, the existence of scientific publication and patents register (Dalmarco, Dewes, Zawislak, & Padula, 2011; Stal, 2006).

It is pointed out that the patent analysis proposed come from the perspective that theses analysis carry the characterization of innovation development of a country (Dalmarco et al., 2011; Póvoa, 2008; Stal, 2006), apart from the economic indicator considered applicable to the measurement of the technological process (Danguy, Rassenfosse, Potterie, & de la, 2013). These analysis produce a quantitative indicator of production measurement, among others, of partnership research (Segatto, 1996; Segatto-Mendes & Rocha, 2005). Ferreira, Guimarães, and Contador (2009) emphasize that the patents are sources of technological information and competitive instrument.

With patents, there is the possibility of practical uses and the acquisition of temporary gains in a specific sector (Tigre, 2006), once the patent is a temporary title of property of a determined technology created given to its inventor by the state and which guarantees the exclusivity and economic use as it is established by the USP Innovation Agency (2014).

This paper focuses the patent deposit of PRI from Brazil that rendered information to the Report of Brazilian Intellectual Property Policy of scientific institution and technological – Formict Report (2012), by MCTI (2013), according to the article 17 of the Brazilian Innovation Law (BRASIL, 2004), and the ones that have a patent registered in the basis of Thomson Innovation.[1] It is necessary to highlight that a way of characterizing the technological development of a country through the patent deposits (Dalmarco et al., 2011; Póvoa, 2008; Stal, 2006), thus, answering the issue about this development is the purpose of this study.

Based on that, through the analysis of the production of patent deposits by the PRI from Brazil, based on Thomson Innovation, this aim is to overview how the technological development from these institutions is working. Therefore, it is understood that this study contributes to the literature once it brings up a technological survey throughout patents which can raise other discussions and start better managing practices to the studied institutions.

Therefore, it is performed a signaling of the technological development of the PRI by the patent deposits in the period of 2004–2013, considering the individual technological development, the existence of partnerships in the deposits, the identification of the kind of partners that promote the deposits more often.

Theoretical background

Joint technological development

The technological development of a country comes from its domestic capacity in R&D, from its competence to create and use technology in different areas, so it is possible to provide social improvement to people and economic benefits to industries (Tigre, 2006). Technological innovation comes from R&D actions.

Products have their value renewed in the Market because of innovation; resources are saved by technology, new sources of material are developed (Rosenberg, 1982). The process of joint technological development, through cooperation, is an effective way to decrease prices, to allow bigger access to resources, complementarity between the acting parts among others.

Cooperative processes in technological development, as the ones occurred in the relation among Universities, Public Institutions and Industries, allow the rise of knowledge, because they increase the productive and technological capacity of products, the processes improvement, the dissemination evolution and efficient use of knowledge (Etzkowitz & Leydesdorff, 1996; Plonski, 1999; Porto, 2000, 2007; Sábato & Botana, 1968; Segatto, 1996; Segatto-Mendes, 2001; Segatto-Mendes & Rocha, 2005).

In this kind of relationship, the information sharing and/or know how is the resource to the activities evolution (Garcez & Sbragia, 2013; Lind, Sthyre, & Aaboen, 2013); it is possible that resources are used efficiently, especially through the competences created by the complementarity (Penrose, 1959). Some benefits are gotten in this relationship: saving in transaction

[1] The Thomson Innovation is the basis of patent data which gather information from 47 patent offices from many countries, where INPI belongs to Brazil (WIPO, 2014a).

expense, uncertainty reduction (Vaidya, 2011), risk reduction, achieving of returns to scale, knowledge sharing (Tidd, Bessant, & Pavitt, 2008).

There are aspects to develop innovation that help the process, it can be done through infrastructure, research laboratories and development centers, financial support, this happens because when it is joint innovative and industries, the created infrastructure and the correct management to stimulate innovation become the differentials to bring innovation (Pinto & Feldmann, 2016).

It is not unusual that the technology developed have a higher potential in commercial application due to the cooperation between U-I (Gusberti et al., 2014), whereas there is complementarity between the interacting parts of the process, plus these partnerships allow building competences and abilities to make it better the technological aspects of a country (Garcez & Sbragia, 2013).

This interaction arises a bound between the agents from the National Innovation System (NIS) – industries, government, universities, research institutes, the parts related to create, develop and disseminate technological innovation (Albuquerque, 1996; Póvoa, 2008) – in the chain of interaction between public and private institutions to make the technological performance better (OECD, 1997; Plonski, 2005; Stal, 2006). The effectiveness of NIS is in the knowledge's creation based on the interactions between the participants (OECD, 1997).

This enables the country to become capable of evolution and also the development of scientific research. In developed country it leads to technological development as well as the interconnection between the productive system, Science and Technology, promote scientific and financial gains (Rosenberg, 1982); when there is the development of knowledge, the industry gets opportunities of growth (Penrose, 1959); the interconnection between the acting parts in NIS is responsible for making this process available.

The inducement to cooperation, enabled by the Brazilian Innovation Law (BRASIL, 2004) allows the interaction process to happen. This is because there are three points to highlight: i) there is a proper ambient to strategic partnerships between universities, technological institutes and companies; ii) inducement to the Scientific and Technological Institution (STI) to participate in the innovation process, within technology transference contracts, patent licensing; iii) benefits provided by the government to support innovation in companies, STI and Funding Agencies, once they are in accordance with the industrial policy and national technology.

Consequently, the joint technological development ensure the company technological competitiveness and its upgrading (Costa, Porto, & Feldhaus, 2010), by inducement like that law, it becomes possible the knowledge 'transfer', where sectors that produce knowledge (for example PRI) are able to interact with the productive sectors (industries) considering the innovative industrial development (MCTI, 2012).

This way, the possibility of a modern society is tied to actions of scientific and technological investigation (Sábato & Botana, 1968) and, when PRI interact with NIS institutions, the technological development is provided, by means of patents which knowledge can be applied in practice, and not rare, it can happen in a fruitful way with benefits to all elements involved.

Public Research Institute

A Public Research Institute (PRI) is a branch of public administration that acts in specific areas such as agriculture, health, etc., whose basic prerogative is to develop specialized researches in their specific field (Póvoa, 2008), which means, being a specialized research center and act in a particular sector.

These institutes are linked to the concept of Scientific and Technological Institution (STI) according to the Brazilian Innovative Law (BRASIL, 2004), second article, item V, which means that this branch or public administration authority has as institutional mission, among others, perform activities in basic or applied research in scientific or technological nature. The STI and the PRI can contribute to the national technological development by researches.

It is important to notice that the emergence of PRI arises from the institution of research centers in Brazil from late 1960 to 1980, when incentive to scientific and technological development, as in programs to encourage research and development, was enforced (Segatto, 1996), and starting in 2000 bigger stimulus to the development of scientific researches, according to Dalmarco et al. (2011).

With incentive and government actions for the development of PRI in Brazil, through laws, in the intensity of academic research, the role of an PRI is to offer technological services and researches; these institutes allow the cooperation with universities in basic research and take advantage of academic knowledge to develop new solutions to the productive system (Oliveira & Telles, 2011).

The PRI have, as their essential competence, the research they develop because the apprenticeship is built by the passing of time, searching for continuous qualification (Salles-Fillho, 2000). This allows the endeavor of more actions able to fix problems, of generating sources to development in many different ways.

The PRI can also deal with process of articulating partnerships to reach innovation due to the act that they can promote more resources to innovation, bring more security to potential partners, as in government agencies, industries and other research (Oliveira & Telles, 2011).

Which means that the PRI actions to the national technological development are fundamentally important because "they can be appropriated to encourage the production of innovation by offering services as technology scheduling and concepts proofs besides the product tests and other services" (Oliveira & Telles, 2011, p. 214).

The PRI hold the possibility of developing the country technologically once they are able to perform a specific research to find a solution to a specific problem, to develop new technologies and besides they can play an active role in the cooperation process among the acting agents of NIS.

Patent

A patent is a title granted by the government to the author by which allows the protection and defense against the use of the created knowledge without previous approval (Abrantes, 2011). The patent is a document that guarantees, to the inventor, the power of decision to explore their invention and in return they have the dissemination of the knowledge created (WIPO, 2014b), which is in the 'technological border' of technology (Merola, Ayres, & Antunes, 2008).

The patent belongs to the Industrial Property field, whose Brazilian Industrial Property Law – IPL (BRASIL, 1996) establishes rights and duties about the protection of human creation and produces possibilities of returns to the creator/responsible of the invention (Severi, 2013). The second paragraph of this law determines "the protection to the rights related to industrial property considering its social interest and the technological development of the country", which becomes true because of the patent concessions of inventions and of utility patterns, among others, that represents the technological development due to the patent concession the knowledge is transformed into something useful that produces life changes.

In the second article, item one of the Brazilian IPL, the patent of invention means to create something new and the utility model means to improve in a product or process already existing where the patent of invention is valid for 20 years and the utility model for 15 years (BRASIL, 1996, article 40º).

The federal agency responsible for the Industrial Property System in Brazil is the National Institute of Industrial Property (Instituto Nacional da Propriedade Industrial – INPI), whose role is to improve, disseminate, and manage this system (INPI, 2012). The application of a patent must be required in this agency (Ferreira et al., 2009) and also getting it.

Obtaining a patent requests new requirements, industrial application, inventive activity and patentability conditions (INPI, 2012; Severi, 2013); it is needed a technical examination in relation to merit if the patent object respond to the requirements and conditions highlighted in order to get the 'state of technique' – what has become of public access (BRASIL, 1996, article 11th).

After getting the patent document, there is a possibility of exploring the characteristics such as competitor monitoring, the technological sectors emphasized, what are their claims (Fernandes & Antunes, 2008), factors that encourage the technological innovation once they enable returns to the inventor, profit through legal monopoly among others.

Methodological procedures

This study has a quantitative approach, because organizes, characterizes and interpret numerical data (Martins & Theóphilo, 2009). This is done by verifying the secondary data got in a patent data base registered in Thomson Innovation database.

The data achievement consider 44 PRIs presented in the Formicit Report (2012) of the Ministry of Science, Technology and Innovation (MCTI, 2013), which means that all the deposits held by these institutes in the data base mentioned above were raised and to perform the search the representations pointed in the names of the institutions were considered.

To each one of the PRI, the research proceeded the following steps (for example, the search for Embrapa data): it was employed the name and abbreviation specified in the report as in the "Brazilian Agricultural Research Company" and Embrapa; the deposits were searched following this specification. Considering the most frequent kinds of partnerships identified information was raised by simple searching on a website for the name of the institution registered as well as the in the owner of the patent deposit.

After the survey (realized from March to May of 2014), the systematization of patent deposits of the PRI was carried in the 'Excel' software, where the data were tabulated, the patent information was joint and also obtained; with this software it was carried out tests of frequency, regression and the chi square test as presented in the next section.

It was considered the period from 2004 to 2013, once it is proposed to have the most updated period possible to the characterization of the technological development of these institutions, considering the most productive PRI, the existence of partnership in the deposits, the identification of the most frequent types of partners that promote the deposits.

Results

Patent deposits of Public Research Institutes

The survey data processed in Thompson Innovation basis allows the acquisition of information related to the Brazilian PRI patent deposits. Based on that the prerogative is the analysis of the deposits in the specified period. It was found 24 patent deposits in the research institutes among 44 PRI.

The patents were gathered by "Inpadoc Family ID", patents published in different places and/or different years are counted only once in order to avoid duplicity in counting as it can be seen in Fig. 1.

It is possible to notice that from 2004 to 2011 there is an evolution at the number of patent deposits but in the last two years there is a decline in those. It possibly happened because of some aspects as the 18 months confidentiality period to the patent filing, which would prevent the data dissemination, and the reduction of the total number of filings because of the increasing number of applications by Patent Cooperation Treaty (PCT).[2]

The PCT consists in a treaty in which the patent depositors can request protection to their patent filing in an international way what guarantee to the depositors requiring protection to their patent in other countries enrolled in the treaty through a single request (WIPO, 2014a). The PCT brings advantages to the depositors: it creates an extra period up to 18 months in the search for protection in foreigner countries, the request cannot be declined for any of the countries of the treaty; it

[2] Information available by electronic mail trough Reuters due to inquiry about the decrease in the patent deposits in the years of 2012 and 2013.

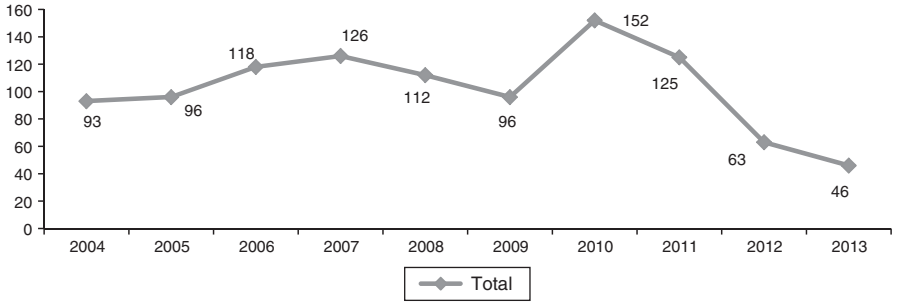

Fig. 1. Patent deposits of Public Research Institutions of Brazil from 2004 to 2013. *Source*: Developed by the authors based on Thomson Innovation database.

postpones expenses related to the search of international protection; it streamlines the procedures of patent formalization; it enables the access to knowledge developed by the whole world (WIPO, 2015).

Amadei and Torkomian (2009, p. 13) also claim that there are delays "between the deposits carried out in the INPI and the provision of its records in the base especially the patents deposited under the PCT", something that could explain the decrease.

Excepting the last two years, as posted above, Fig. 2 represents a linear regression trend line, by which, statistically, it is possible to predict a future behavior (FREUND, 2006).

When the tendency line of linear regression (Fig. 2) is observed, it is possible to notice that the regression statistics F presented a p-value equal to 0.1034. Which shows that the angular coefficient, the one applied to x (years of production), is not significantly different from zero. Even if the two last years (2012 and 2013) are disposed there is no evidence of patent production increase in the Public Research Institutes (PRI).

This fact can support what was presented by Quental, Gadelha, and Fialho (2001) that the PRI contribution would consist in providing specialized technical services to industries, which would be responsible for developing the country technologically although it would be much more than this service provision. Besides, the PRI could also be the articulators between NIS' actors (Oliveira & Telles, 2011).

The referring data of PRIs' patent deposits analyzed facing the occurrence or not occurrence of partnerships that can be seen in Fig. 3.

Some aspects can be noticed in the patent deposits of the PRIs, for example, the fact that 10 public institutes initially classified correspond to 94.55% of the deposit totals. However, it is observed the concentration of patenting by the three best positioned in their amount, i.e., respectively, FIOCRUZ, EMBRAPA, CNEN and it happens because they correspond to 68.26% of the total.

In Fig. 4 the patent deposits without partnerships are presented.

It was found patent deposits to nineteen PRI when considering the absence of partnership. FIOCRUZ is the biggest depositor, followed by EMBRAPA, CNEN, INPA, IBU, IPT, CBPFNITRIO.

Next, it is displayed the patent deposits with partnership, in Fig. 5.

It was found 23 PRI patent depositors with partnerships. The main PRI depositor is EMBRAPA followed by FIOCRUZ, IPT, INT, FUNED, CNEN.

When the PRI deposits with and without partnerships in the period from 2004 to 2011 are compared, the results are observed in Fig. 6.

Based on the survey held, it is possible to notice that there is a sharper movement in the patents without partnership. However the statistics F of the regression presented a p-value bigger than 0.3870 which shows that the angular coefficient or the one applied to x (years with production), it is not significantly different from zero. When the two last years (2012 and 2013) are disposed there is no evidence that the patent production increase or decrease over the years in the deposits without partnership of the PRI.

On the other hand, in the ones held with partnership there is a tendency of evolution in the partnership accomplishment to the production of patent deposits. The statistics F of the regression presented a p-value lower than 0.010. This demonstrates that the angular coefficient, the one applied to x (years with production) is significantly different from zero. After eliminating the last two years (2012 and 2013) there are evidences that the patent production increase over the years in the deposits with partnership of the PRIs.

Some types of partners that were more frequent were observed, as shown in Table 1.

This table shows the number of times a more frequent partner is identified, which means that it is observed if a university, an institute or an industry figures among the PRI partners. In case of a partnership has three universities, two industries and a foment agency, were counted as three events from universities, two from industries and one event from a foment agency. This application was used for the next cases.

Following this perspective, as seen in Table 1, the universities are the biggest PRI partners with 205 events. In second place, there are the industries with 72 events and the Foment Agencies with 67 events. In this case, using the chi-square test, the null hypothesis is that there are no differences between the types of institutes' partner. The p-value found lower than 0.000 shows that there are evidences to reject such statement. Thus, there are

[3] The Public Research Institutes acronym and their respective meanings are in Appendix A.

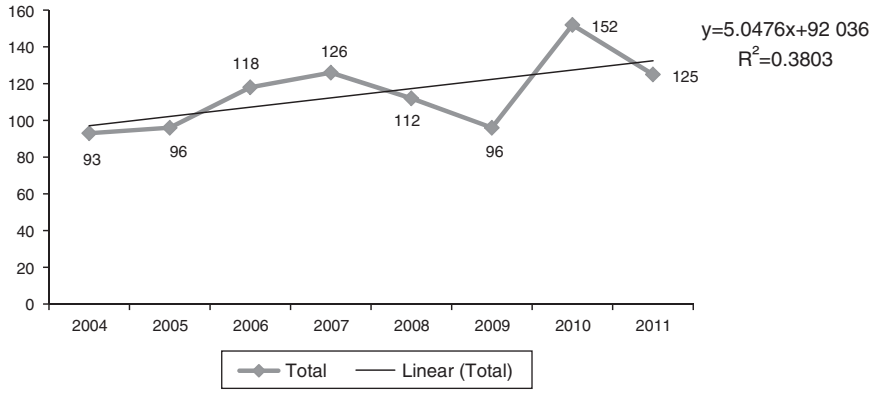

Fig. 2. Patent Deposits of Brazilian Public Research Institutes from 2004 to 2011. *Source*: Developed by the authors based on Thomson Innovation database.

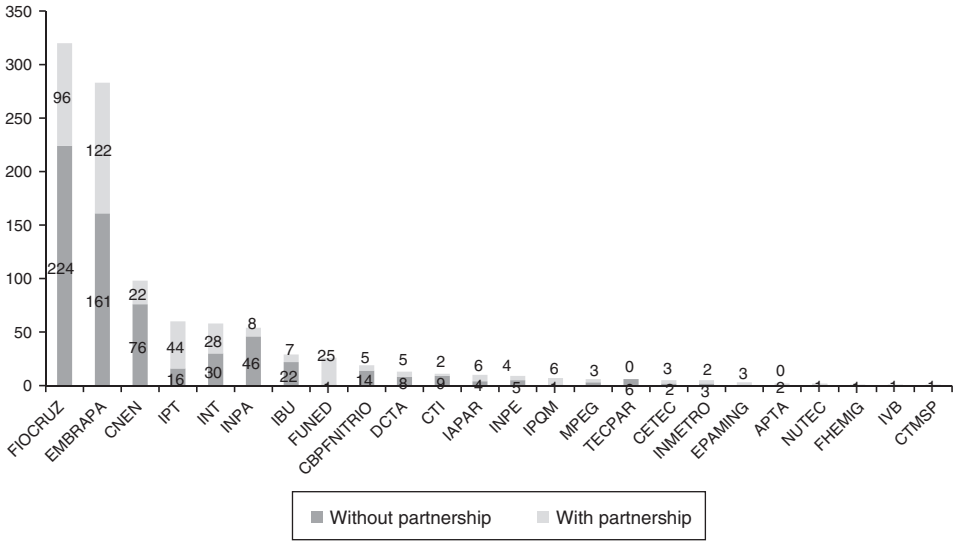

Fig. 3. Patent Deposits of Public Research Institutes[3] from 2004 to 2013. *Source*: Developed by the authors based on Thomson Innovation database. P.S.: Patent Deposits from more than one institute as holder were computed individually.

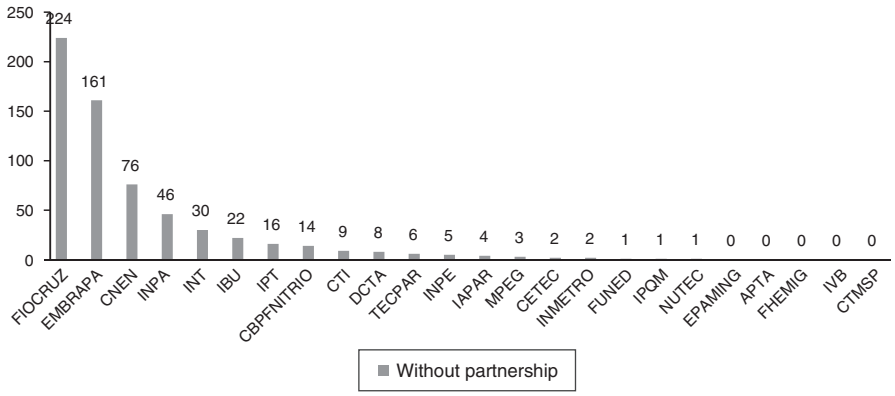

Fig. 4. Patent deposits without partnerships of the Public Research Institutes from 2004 to 2013. *Source*: Developed by the authors based on Thomson Innovation database. P.S.: Patent Deposits from more than one institute as holder will be computed individually.

Table 1
Types of partners more frequent in the patent deposits of the Public Research Institutes from 2004 to 2013.

	University	Institute	Industry	Foment agency	Total
PRI	205	72	196	67	540
	135	135	135	135	540

Source: Developed by the authors based on Thomson Innovation database.

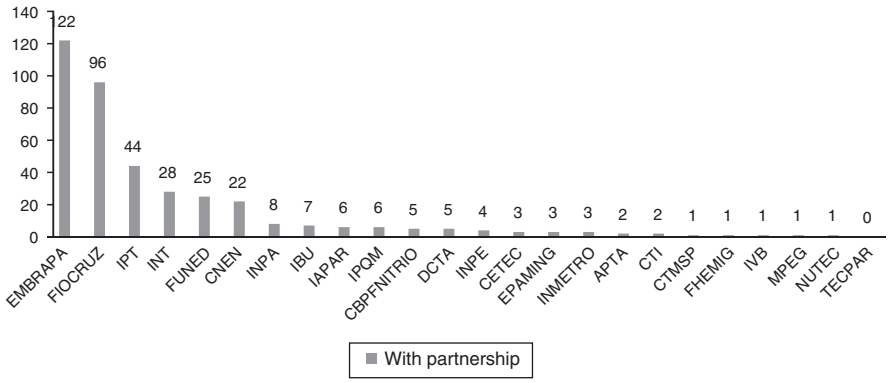

Fig. 5. Patent Deposits of the Public Research Institutes with partnerships. *Source*: Developed by the authors based on Thomson Innovation database. P.S.: Patent Deposits from more than one institute as holder will be computed individually.

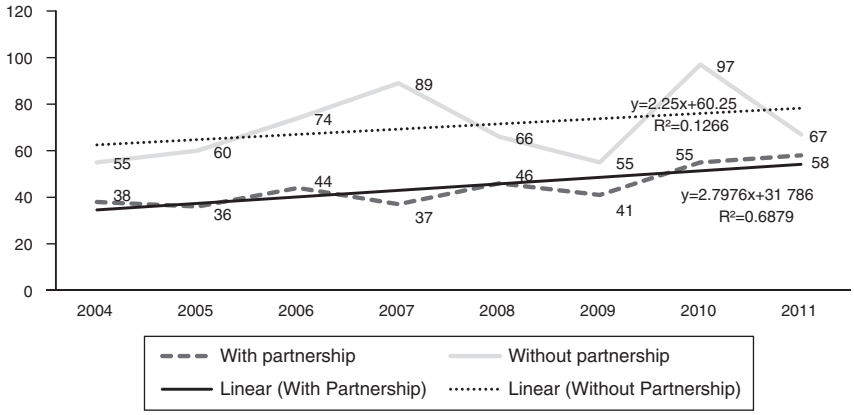

Fig. 6. Comparative of deposits with and without partnership of the Public Research Institutes from 2004 to 2011. *Source*: Developed by the authors based on Thomson Innovation database.

evidences that there are differences between the types of partners of the institutes.

It is presented in the chart the percentage distribution of each type of partner of the PRI observed (Fig. 7).

Some items can be dismissed in the chart above considering that the most frequent partners correspond to 37.96% of the partnerships with universities, 36.30% with industries 13.33% with institutes and 12.41% with foment agencies. Therefore, it is observed that the institutes try to keep a bigger proximity with universities and industries.

Based on these aspects, it is noticed that the patent deposits of the Public Research Institutes analyzed indicated a concentration in a few of them, maybe for its relevance of the role they have in the country in their field, maybe for the necessity of guarantee of protection of the knowledge developed and a possible future use to get some benefits.

Discussion

Considering the technological development of a country through the patenting perspective, it is possible to notice that, although statistically there was not any evidence of evolution in the number of patent deposits, as shown in Fig. 1, the PRI have kept the development of this practice.

This may occur because of the patenting processes of the top three identified institutes, i.e., respectively, FIOCRUZ, EMBRAPA, CNEN (with 68.26% of the deposits total), they are the key to achieve and defend the right uses of produced knowledge. But not only that, the more knowledge and innovation are created the bigger and better opportunities to apply them.

Consequently, under the protection of knowledge through patents, FIOCRUZ, the most highlighted institution in the field of "health science and technology from Latin America" (FIOCRUZ, 2016) ensures that eventual returns of knowledge developed by the institute return and that new knowledge can be created aiming the promotion of even better improvements in its field.

Another example lays on EMBRAPA, which "is a technological innovation industry focused in generating knowledge and technology to the Brazilian agricultural" (EMBRAPA, 2016). Brazil is an agricultural country and stimulates more and more the production of knowledge and innovation in this field of study, it can start from what the 'best features' of the country and raise more benefits from this practice and thus help the national development.

Even if this happens through the patent deposits, as stated before by many authors, as a way of characterizing the technological development of a country (Dalmarco et al., 2011; Póvoa,

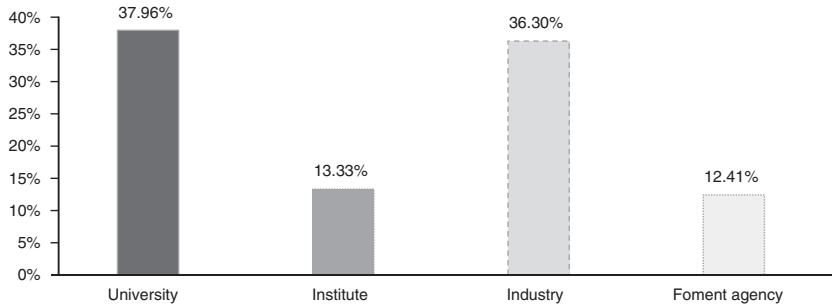

Fig. 7. More frequent types of partners' proportion in the patent deposits of the Public Research Institutes from 2004 to 2013. *Source*: Developed by the authors based on Thomson Innovation database.

2008; Stal, 2006), it is realized in patenting a good evidence and encouragement to develop technological innovation by the PRI of the country so that future gains arise. Nevertheless, the government could start to raise better acting condition in the field, moreover get better returns considering what is produced.

Combined with this, although still in an incipient process of partnerships realization, something that, according to Garcez and Sbragia (2013), tend to lead the country to build competences and abilities to develop technologies, it is noticed that the great concentration of deposits from these institutes is held without partnership. It is also possible to observe that, even incipient, practicing partnerships tend to increase.

It is a sign that, in 'third world' countries, as stated by Lopéz-Martinéz et al. (apud Segatto, 1996), establishing partnerships with universities and research institutes is still a highly efficient way of assuring that new innovative processes will be carried and something still necessary to develop new knowledge and innovation.

It is worth highlighting that there are studies of partnerships with universities, as well as with institutes, for example, the ones of Amadei and Torkomian (2009), Garnica and Torkomian (2009) and, more recently, the De-Carli, Segatto, Frega, and Alves (2015), however, the specific aim of this paper is only to the research institutes, and other studies focusing the universities, which make a comparative analysis involving these two types of institutions, are in progress and will be published.

Thus, it is understood that the patenting study of the Public Research Institutes, as well the universities, is very relevant because it demonstrates the importance that this kind of institution represents when considering the national technological development by the patenting proposed.

Final considerations

This research about characterizing and analysis of patent deposits of the PRI from Brazil reflects an overview of the technological development of these institutions during the period of 2004–2013 and it was possible to determine the ones that produces more and the existence of partnerships, in the deposits, the identification of the types of promoter partners of deposits to an effective signaling of this technological development.

It was possible to detect that from 2004 to 2013 there was an increase of patenting and in the last two years there was a decrease. FIOCRUZ, EMBRAPA, CNEN are responsible for 68.26% of these deposits. It was determined that the high concentration of patent deposits is in a few Public Research Institutes.

The deposits of the Public Research Institutes with partnership correspond to 35.44% of the ones produced. FIOCRUZ, the biggest depositor, presented 30% of the deposits held with partnership with other institutions and 70% without partnership. In second place it is EMBRAPA with 43.11% of partnership patents and 56.89% without it.

It was alleged that in cooperation processes, as the ones between the PRI and their most frequent partners (universities, research institutes, industries and foment agencies) it is possible to occur the parts' complementation, so both can get resources to technological development.

This indicates that cooperative processes can be a source to public institutes to develop themselves, maybe by providing higher access to resources, for example, the ones from foment agencies. Thus, public policies to stimulate research by these institutes could be developed, as well as better management practices by their sectors pursuing, more and more, to develop and/or keeping relationships that are capable to generate knowledge.

This way, it is believed that the characterization and analysis of the PRI patent deposits of Brazil can be exposed, contributing to literature after highlighting the importance of patenting to the national technological development. Therefore, considering the aspects studied in this paper, some mistakes and/or limitations could have happened due the restrictions of the researchers and/or of the methods.

The non-uniformity of registration of the data in the base researched is considered as limitations, what can have led to the non-identification of some deposits; the loss of some information after the data systematization of the software Excel by the researchers in each part analyzed.

Other limiting factors may be in the 18-month confidentiality period, which may bound the data found; as patent deposits have been considered, it may be that a patent will not be granted in the future, which makes this study, as highlighted, only a sign of the technological development of PRI.

It is suggested that some items are studied in the future, such as the accomplishment of a new survey based on Thomson Innovation database to check if the decrease identified in 2012 and 2013 is really caused by the decrease in quantity of patenting, by the option of the institutes in deposit through PCT or any other factor. It is also suggested the analysis of the PRIs technological

Table A1
National Institute for Space Research.

Acronyms	Meanings	
	Portuguese	English
FIOCRUZ	Fundação Oswaldo Cruz	Oswaldo Cruz Foundation
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária	Brazilian Agricultural Research Corporation
CNEN	Comissão Nacional de Energia Nuclear	National Nuclear Energy Commission
IPT	Instituto de Pesquisas Tecnológicas	Institute of Technological Research
INT	Instituto Nacional de Tecnologia	National Institute of Technology
INPA	Instituto Nacional de Pesquisas da Amazônia	National Institute of Amazon Research
IBU	Instituto Butantan	Butantan Institute
FUNED	Fundação Ezequiel Dias	Ezequiel Dias Foundation
CBPFNITRIO	Centro Brasileiro de Pesquisas Físicas/Nit-Rio	Brazilian Center for Physical Research/Nit-Rio
DCTA	Departamento de Ciência e Tecnologia Aeroespacial	Department of Aerospace Information Science and Technology
CTI	Centro de Tecnologia da Informação Renato Archer	Renato Archer Information Technology Center
IAPAR	Instituto Agronômico do Paraná	Agronomic Institute of Parana
INPE	Instituto Nacional de Pesquisas Espaciais	National Institute of Space Research
IPQM	Instituto de Pesquisas da Marinha	Navy Research Institute
TECPAR	Instituto de Tecnologia do Paraná	Parana Technology Institute
CETEC	Fundação Centro Tecnológico de Minas Gerais	Foundation Technological Center of Minas Gerais
INMETRO	Instituto Nacional de Metrologia, Qualidade e Tecnologia	National Institute of Metrology, Quality and Technology
MPEG	Museu Paraense Emílio Goeldi	Emilio Goeldi Paraense Museum
EPAMING	Empresa de Pesquisa Agropecuária de Minas Gerais	Agricultural Research Company of Minas Gerais
Nutec	Fundação Núcleo de Tecnologia Industrial do Ceará	Ceara Industrial Technology Nucleus Foundation
APTA	Agência Paulista de Tecnologia dos Agronegócios	Sao Paulo Agribusiness Technology Agency
FHEMIG	Fundação Hospitalar do Estado de Minas Gerais	Hospital Foundation of the State of Minas Gerais
IVB	Instituto Vital Brazil S.A.	Vital Brazil S.A. Institute
CTMSP	Centro Tecnológico da Marinha em São Paulo	Technology Center of the Navy in Sao Paulo

development that deposited the highest number of patents, to check if there are any constant and/or continuous practices of development, what activities are performed with this aim.

Finally, this research arose aiming to contribute with knowledge through surveying and analyzing the data mentioned. It is expected that, after this characterization, contributions to the increase of knowledge and proposals to the development of new studies were created.

Conflicts of interest

The authors declare no conflicts of interest.

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Appendix A.

Table A1

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