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Investments in the Brazilian Space Agency and the patenting process: a correlation analysis

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Abstract

Purpose – This study aims to analyze the correlation between the investments in the Brazilian Space Agency (BSA) and the patenting process.

Design/methodology/approach – The methodology used was a statistical analysis through correlation and linear regression between the secondary data of investments made by the federal government, retrieved from the Transparency Portal, in the BSA and the patenting process, taking into consideration the number of invention, utility model and certificate of addition of invention.

Findings – After a brief presentation of the emergence of innovation and patent applications with the investments of governments in space agencies, this study presents the analysis of information in different times of investment that showed positive correlation between the two variables adopted.

Originality/value – One can point to the value of this study as strategic investments in space agencies to boost the filing of patents in a nation in the most diverse areas.

Keywords Innovation, Patent, Correlation, Space agency

Paper type Research paper

Introduction

The issue of patents has been seen as a national development strategy for countries seeking to protect the results of investments in research and innovation. Knowing what to protect, as well as when and how to protect it makes it possible for a country to protect itself from a peripheral economy, since it results in increased business productivity and improved competitiveness. The common understanding is that patenting protection is a means of encouraging innovation and technological development, boosting technology transfer and promoting scientific, economic, social and technological progress (Almeida, 2014; Lima, 2013).

In this sense, there is an emerging concern worldwide about patenting protection, which has been growing year after year due to the advancement of the innovative capacity of each country (Burhan & Jain, 2015). A study by WIPO in 2014 reported that China, despite

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increasing the registration of trademarks by 18.2 per cent, reduced the number of patents of industrial projects (14.4 per cent).

In Brazil, the public investment in R&D and innovation has been growing at a significant rate. The institutional environment has undergone a full review since 2006, after the publication of the Innovation Law, and such change has not been interrupted since then (Barbosa, 2012). In 2014, the country ranked as the second country with the largest number of patenting applications with more than 7,400 applications, only behind the USA that presented more than 9,600 processes (Barcelos, 2014). In 2015, the National Institute of Industrial Property, INPI, reported that Brazil has grown a lot since 2000, reaching 6.1 per cent between 2002 and 2011; and the application for patenting in the country increased by 1.6 per cent over 4.5 per cent of the world rate.

According to Burhan and Jain (2015), patents have been increasingly used as a currency in markets driven by innovation and technology. Therefore, it is important to highlight the actions of the US government in funding companies and institutions for the development of technologies. One of the highlighted institutions is the North American Space Agency – NASA (Brazil, 2013), which contributed to the emergence of various technologies and patents (NASA, 2015).

From such context, there has been an interest to investigate whether the Brazilian government's investments contributed to the development and increase of the patenting processes in recent years. Thus, this study aimed to analyze the correlation between the investments in the Brazilian Space Agency (BSA) and patenting process.

Academically, the contribution of the article to the debate on innovation is how the emergence of are directly associated with the investments of the federal government in agencies directly linked to the development of technologies, especially the BSA, which develops activities linked to the emergence and development of technologies.

More specifically, first we carried out a survey in order to obtain information on investments accomplished by the Ministry of Science, Technology and Innovation (MCTI, in Portuguese) in the BSA, and on the number of patents based on data retrieved from the World Intellectual Property Organization (WIPO). Later on, we carried out a statistical analysis, which comprehends the correlation between government investment in the BSA and the number of patenting applications in the three kinds of patenting: patent of invention, utility model and certificate of addition of invention.

Registration of patents in the world and in Brazil

The copyright system was developed over the past centuries. In 1734, engravings became the first art form to be protected by the Copyright Law. In 1814, fabricated sculptures were added into the copyright system by copyright law in the year 1833. This means of protection has been extended to cover the public performance of musical and dramatic compositions. In this context, the United Kingdom was the first country to recognize the copyright. The essence of copyright can be deduced from the name. The owner of copyright in a work has the right to copy and therefore the right to prevent others from copying it (Mingaleva & Mirskikh, 2015).

In 2014, for example, China overtook the USA and Japan and already has more patenting applications than the two latter countries combined. Despite the growth, China posted a substantial growth in the registration of trademarks (18.2 per cent) but a decrease in the number of industrial patenting projects (14.4 per cent) (WIPO, 2014).

Brazil had a latent growth over the past 15 years. According to information from INPI (2015), the growth rate between the years 2002-2011 was 6.1 per cent. This

represents an increase of patenting applications by 1.6 percentage points above the global rate (4.5 per cent).

In 2014, the country ranked second with the largest number of patenting records with more than 7,400 applications, only behind the USA with over 9,600 applications (Economic Research Working Paper, 2014). The following chart shows the evolution of the patenting filing in Brazil by type, between 2000 and 2016 (Figure 1).

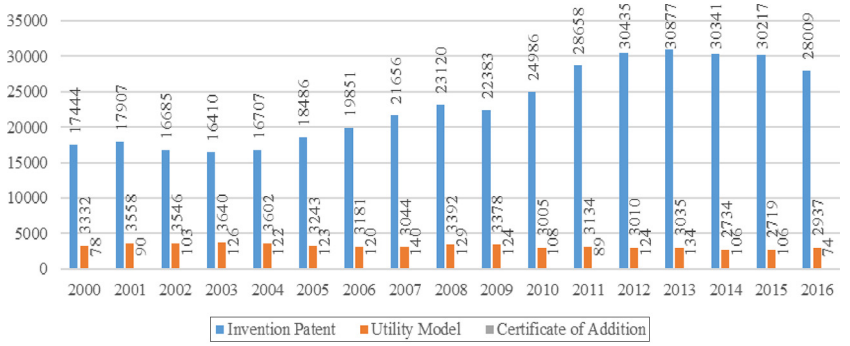
Patents are related to the creation of something resulting from the intellectual capacity of its author and are a new solution to an existing problem, resulting in an unexpected technical effect in a particular technology area, having an inventive step. The inventions may be related to industrial products (compounds, compositions, objects, appliances, devices, etc.) and industrial activities (processes, methods, etc.) (National Institute of Industrial Property [NIIP], 2018).

Law 9,279/96 states that patents should be assigned to technical creations, which are designed to solve problems in a specific technological area. On the other hand, utility model patents are intended to improve the use of an object, with the intention of promoting greater efficiency and convenience in the handling of the product (Brazil, 1996).

Finally, the certificate of addition of invention is given to the achievement of improvements in a previously made patenting application. In this case, this mode differs from others by the fact that it only represents a change in the patenting application process (NIIP, 2018).

It is possible to notice a discontinuity in the patenting processes. The patenting applications in the utility model, for example, showed a continuous evolution between 2004 and 2012. However, from 2013 onwards, there was a decrease. On the other hand, the patents of invention showed a decrease between 2004 and 2010, and evolved from 2011 onwards. Finally, the certificate of addition of invention were reduced from 2004 to 2011; increased in 2012, but showed a decrease until 2016.

According to Burhan and Jain (2015), patenting applications are increasingly being used as a currency in markets driven by innovation and technology. In this context, China and the USA are sovereign in terms of innovative capacity and patenting applications largely due to investments in science and technology, with emphasis on innovation policy and military demands.



Source: INPI (2018)

Figure 1. Evolution of the patenting filing in Brazil by type, between 2000 and 2016

The government demands and space programs

In this context, it is important to highlight the emergence of technologies such as microwaves, radars, communication systems, among others. However, for that to happen, the US Government invested in the emergence of innovative companies and projects that had the support of universities and companies that were directly financially supported. One example was the creation of the National Aeronautics and Space Administration (NASA) and the increase of the budget of the National Science Foundation (NSF), essential to enable the first manned mission to land on the Moon in 1969 (Brazil, 2013).

Space demands emerged due to the space race promoted by the dispute with the socialist bloc headed by the Soviet Union and the capitalist, with the USA ahead. The Soviets were the pioneers sending to orbit the satellite Sputnik 1. In response, the US created NASA culminating in the arrival of the landing of men on the Moon in 1969 and several other innovations (Vasconcellos & Amato Neto, 2012). European countries and China began their space programs with the purpose of developing nuclear technologies and sending satellites into the orbit of the Earth. In this context, China is among the most advanced countries in the world in terms of space technologies and activities. To reach such purpose, China developed links with countries outside Asia, such as South Africa and Brazil (Cepik, 2011; Wu, 2015); the latter has started space exploration activities since the post-World War II period (BSA, 2016).

The Brazilian space agency and government investments

The BSA was established in 1994 with the purpose of coordinating the Brazilian space policy. The BSA is a federal agency under the control of the MCTI to promote the autonomy of the Brazilian space industry. It is important to note that the Brazilian space program is placed among the top 10 world economic powers (Moltz, 2015).

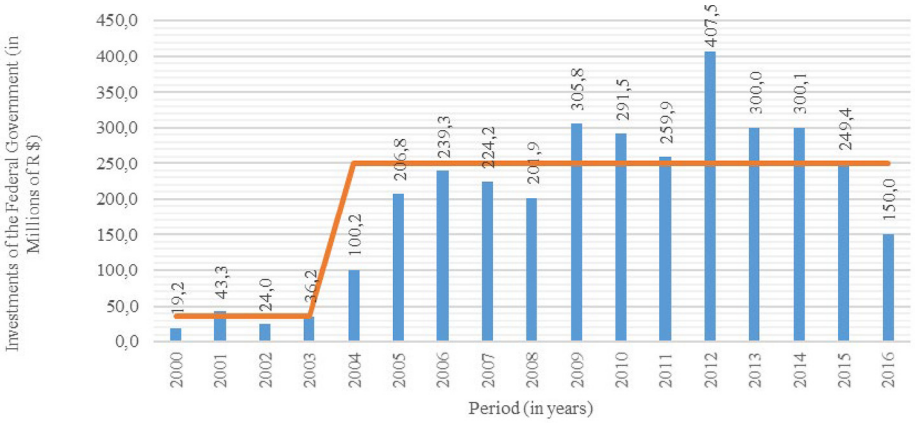
BSA is responsible for the National Policy for the Development of Space Activities (PNDAE, in Portuguese) established by Decree no. 1,332/1994, which settles objectives and guidelines for national programs and projects related to the space area and has the National Space Activities Program (PNAE, in Portuguese) as the main tool for planning and programming (BSA, 2016).

BSA depends on national partnerships with ministries, departments and other agencies that may fund part of the national projects to facilitate the development and expansion of the space program. International partnerships are also essential to share the high costs and development risks. In this case, Brazil has an intermediate capacity at international levels (Moltz, 2015). In this sense, the following Figure shows information on the investments that MCTI has been performing in BSA over recent years (Figure 2).

According to the information presented herein, it can be seen that there is a discontinuity in the investments of MCTI in the BSA. Between 2000 and 2010, there was an investment increase. From 2011 to 2016, there was an oscillation in investments, reaching its highest value in 2012. After presenting the period of patenting applications and MCTI investments in the BSA, it became possible to see a discontinuity in both cases. In this sense, the following question arose: Is there a relationship between investments in BSA and patenting applications? Below, we present the methodology used for this analysis.

Methodology

This study has a deductive and quantitative character (Gil, 2008; Saunders, Lewis, & Thornill, 2007), using secondary data as a source of information. In the study in question, we carried out a bibliographical research using government reports, scientific papers published in periodicals and books on the subject.



Source: Brazil (2018)

Figure 2.
Investments of MCTI in the BSA

We emphasize the use of available data on the INPI website, and the World Intellectual Property Organization (WIPO) on patenting applications, considering the period 2000-2016, in addition to information on the investments of the federal government in the MCTI and, consequently, in the BSA.

This study considered the period between 2000 and 2016. This range is due to the availability of information on the transparency website of the federal government, which started in 2000 and presents information from the first quarter of 2016. We used the MS Excel to process the information and to accomplish both correlation and polynomial regressions.

Results

After a brief explanation of the terms of patenting applications, we carried out a correlating test comparing information between MCTI investments in the BSA and the previously described patenting applications terms. In this regard, the following information was considered:

(1) 17 items (n) for annual *s* from 2000 to 2016;

(2) $\alpha = 0.05$, degree of confidence at 95%;

(3) correlation coefficient between the two variables (r) in the following cases:
- Utility Model: $r = -0.69$
- Patent of invention: $r = 0.78$
- Certificate of addition of invention: $r = 0.39$

(4) value of the calculated statistic (Zc):
- Utility Model: Zc = −3.69
- Patent of invention: Zc = 4.76
- Certificate of addition of invention: Zc = 1.63

(5) Value of the statistical statistics of Student *t* Distribution o Zt = ± 2,1098.

From the evaluation of each type of filing of the patenting process, it was noted that the patent of invention and the utility model present Zc > 2.1098; thus, the Null Hypothesis (Ho)

was rejected, so there is acceptance of the correlation between the patent of invention and utility model, with the investments of MCTI in the BSA. The regression table is shown below (Tables I, II and III).

First, the analysis in question was carried out considering the period from 2000 to 2016 of the Investors in the BSA and of the utility model patenting. After the analysis, a correlation coefficient of 47.59 per cent was found, which is considered acceptable and indicates a correlation between the variables. The logarithmic equation obtained was f (x) = −0x − 3.542.85, R^2 = 0.4759. In the following chart, we visualize the regression considering the investments in the BSA and the utility model patenting (Figure 3).

Hoffmann (2015) considers the regression analysis the most important method of econometrics, regarding it as important for knowing the effects that some variables have, or can have, over other variables.

After the analysis of the total period, the analysis between 2000 and 2016 regarding investments in the BSA and patents of invention was carried out. From the correlation, a coefficient of 60.15 per cent was obtained, which is considered a satisfactory percentage of correlation between the two variables. The regression tables are presented below (Tables IV, V and VI).

Such outcomes indicate that when there was an increase in the investments in the BSA consequently there was an increase in the number of patents of invention. The logarithmic equation obtained was f (x) = 0x + 15.881.32. a R^2 = 0.6015. In the following chart, the regression is shown considering the investments in the BSA and patents of invention (Figure 4).

Finally, the correlation analysis between the federal government's investments and the certificate of addition of invention generated a valid result; a little above 15 per cent. In this sense, such percentage was not taken into consideration in the research due to its statistical irrelevance.

Conclusion

This study aimed to analyze the correlation between the investments in the BSA and the filing of patenting. In order to conduct this research. We opted for the analysis of statistical

Regression statistics	
R multiple	0.706585695
R^2	0.499263344
R^2 set	0.46349644
Default error	217.4040571
Comments	16

Source: Elaborated by the authors (2018)

Table I.
Test regression analysis 1

	gl	SQ	MQ	*F*	*F* of significance
Regression	1	659756.4137	659756.4137	13.95880795	0.002213192
Residue	14	661703.3363	47264.52402		
Total	15	1321459.75			

Source: Elaborated by the authors (2018)

Table II.
Test ANOVA analysis 1

	Coefficients	Default error	Stat t	P–valor	95% bottom	95% higher	bottom 95,0%	Higher 95,0%
Intersection	3592.19282	118.832888	30.22894	3.76E–14	3337.32163	3847.06402	3337.321628	3847.064021
19177611	–1.891E–06	5.062E–07	–3.73615	0.002213	–2.977E–06	–8.056E–07	–2.977E–06	–8.0555E–07

Source: Elaborated by the authors (2018)

Table III.
Regression coefficient analysis 2

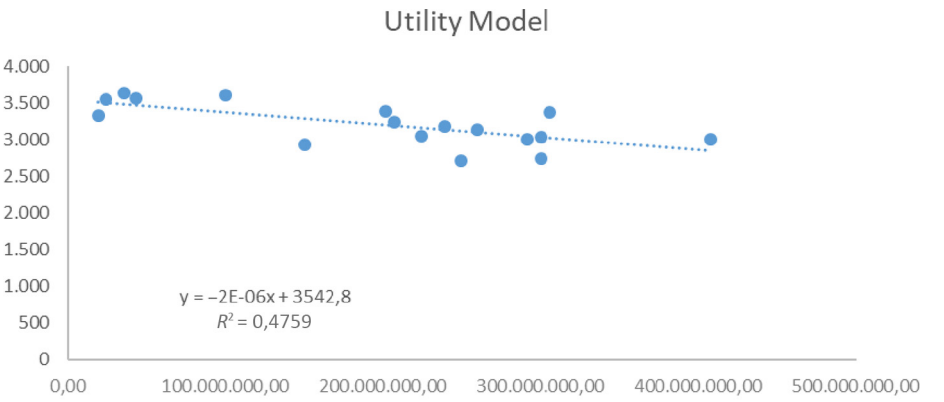


Figure 3.
Regression of the first period 2000-2016

Source: Elaborated by the authors (2018)

Regression statistics	
R multiple	0.706585695
R^2	0.499263344
R^2 set	0.46349644
Default error	217.4040571
Comments	16

Table IV.
Test regression Table II

Source: Elaborated by the authors (2018)

	gl	SQ	MQ	*F*	*F* of significance
Regression	1	264193967.4	264193967	18.800446	0.000684305
Residue	14	196735518.6	14052537		
Total	15	460929486			

Table V.
Test regression Table II

Source: Elaborated by the authors (2018)

correlation and linear regression considering information on investments accomplished in the BSA retrieved from the Transparency Portal of the federal government and the filing of patenting retrieved from the data available on the INPI.

After the correlation made between the variable investments of the federal government and utility model patenting, patents of invention and certificate of addition of invention, we found out that there is a strong correlation between investments in BSA and patent applications. This information indicates that the higher the MCTI investments in BSA, the higher the number of patent applications. From 2011 to 2016, there was an increase in the investment in the BSA and hence development in the patent applications, which indicates a higher correlation between these variables.

From the academic point of view, the results can generate relevant information on how the federal government's investments can generate the evolution in the registry of new innovations

Table VI. Regression coefficient analysis 2

	Coefficients	Default error	Stat *t*	P–valor	95% bottom	95% higher	bottom 95,0%	Higher 95,0%
Intersection	15644.785	2049.020848	7.6352	2.347E–06	11250.07248	20039.49776	11250.07248	20039.49776
19177611	3.785E–05	8.72841E–06	4.3359	0.0006843	1.91254E–05	5.65665E–05	1.91254E–05	5.65665E–05

Source: Elaborated by the authors (2018)

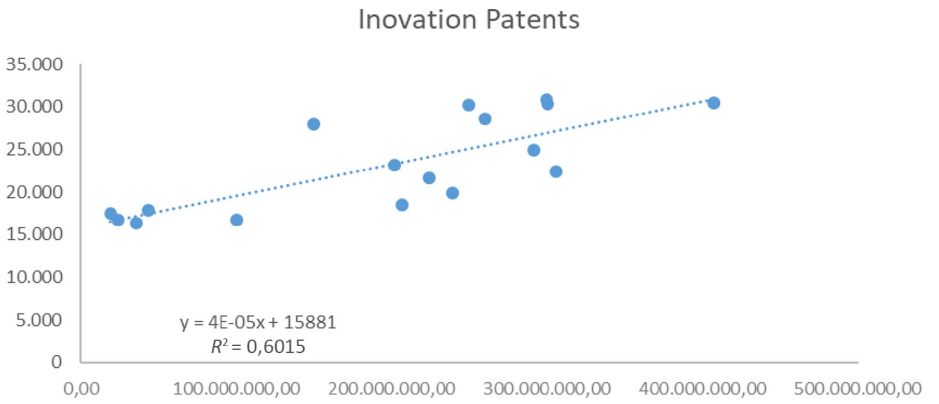


Figure 4.
Regression between 2000 and 2016

Source: Prepared by the authors (2018)

in other important follow-ups. This study proposed to report the investments of the federal government in the BSA according to the evolution of the number of patent registrations in Brazil. In this way, public policies aimed at the evolution of investments in this area can contribute to the evolution of innovation. Thus, in order to suggest future research, a survey between the federal government's investments and other areas of science and technology can be carried out in order to verify if there is any correlation with the evolution and/or decrease of patenting processes.

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