

Factors that Influence the Number of Patent Deposited in some Countries of the American Continent

Fatores que Influenciam no Número de Patentes Depositadas em alguns Países do Continente Americano

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Abstract

The information technology available in the world is disclosed only in the form of patent documents deposited, which also reflect the scientific and technological level of a country. This paper has the objective of identifying what are the main factors that influence the generation of these patents in some American countries. A modeling study via multiple linear regression to analyze the effects of the number of published articles, gross domestic product (GDP), population and variations in number of patents over the last year and the last two years, about number of patents in those countries. The patent data were obtained from the World Intellectual Property Organization, data on GDP and population come from the World Bank and the amount of scientific articles from the SCImago Journal & Country Rank. Based on the selection criteria, the countries chosen for modeling were United States, Canada, Brazil, Mexico, Colombia, Chile and Argentina. The results indicated that in the United States the number of patents increases as GDP. In all other countries, the variation in the number of patents in relation to two recent years contributes to an increase in the number of patents. In Brazil, Argentina and Chile, in addition to this variation, an increase of the population favors the patent number. In Canada and Colombia, the number of patents also increases according to the number of articles published. In Mexico, the variation in two years and the GDP contributed to the increase in the number of patent.

Key-words: America; intellectual property; multiple linear regression; technological development.

1. Introdução

Latin American countries are constantly seeking innovation, which has been an important factor in all countries that have experienced rapid economic development. Finland, Korea and the USA are examples of how innovation can increase economic wealth and quality of life for its citizens (OLAVARRIETA; VILLENA, 2014). According to Pacagnella Júnior et al. (2009), an indicator of technological innovation that allows to verify the technological performance of companies, regions, industrial sectors and even countries is the analysis of patents, because they are directly associated to the development of technologies.

There has been a significant increase in the number of patents in several countries of the American continent in recent years, but it is not clear what factors are responsible for this increase. According to Montenegro et al. (2014), there is an enormous disparity in the volume of economic resources among the countries of America, even though they are from the same geographical area and have similar population and cultural characteristics. The main economies are the United States, Canada, Brazil and Mexico. Having a patent makes possible the remuneration of scientific research and technological development, while at the same time generating incentives for economic growth, enabling prosperity for an entire nation (FERREIRA; GUIMARÃES; CONTADOR, 2009).

According to the World Intellectual Property Organization (WIPO, 2013), intellectual property – IP refers to the creations of the mind: inventions, literary and artistic works, symbols, names, images and drawings used in commerce. IP is divided into two categories: industrial property, which includes inventions (patents), trademarks, industrial designs and geographical indications of origin and copyright, which includes literary and artistic works such as novels, poems and plays, films, musical works, artistic works such as drawings, paintings, photographs and sculptures and architectural projects. Wipo (2013) defines a patent as "An exclusive right granted to an invention, which is a product or process that provides, in general, a new way of doing something, or a new technical solution to a problem".

According to the National Institute of Industrial Property (INPI, 2015), patent is a temporary title to an invention or utility model, granted by the State to inventors or authors or other natural or legal persons who hold rights over creation. In return, the inventor undertakes to disclose in detail all the technical content of the subject matter protected by the patent. During the term of the patent, the holder has the right to exclude third parties, without prior authorization, from acts related to the protected subject matter, such as manufacturing, marketing, import, use and sale.

The registration of a patent requires description of a novelty, whose operability is proven. It is the codification of an innovation. It is worth noting that not all information is patentable, such as new surgical techniques. Amadei and Torkomian (2009) refer to patents as an industrial property

title over invention or utility model. According to the authors, it is a prize granted by the State as a reward to the inventor, which guarantees him certain security in the negotiations between him and the party interested in buying a certain technology so that it can be applied industrially.

The technical subject matter protected by the patent is disclosed to the public, not being a mere monopoly of the inventor, but also a source of technological information offered to society. It is a new technical knowledge that facilitates the generation of new inventions. In fact, monopoly rights are restricted to the production of goods and, thus, patent-protected technical knowledge can be freely used for the research and development of new inventions or improvements (MACEDO; BARBOSA, 2000). According to Bergerone et al. (2012) thousands of patents are owned by individuals who create new avenues to solve a problem or create new products or services to achieve specific goals.

Patent is also a form of dissemination of scientific knowledge. According to Oliveira et al. (2005), a large part of the technological information made available annually in the world is disclosed only in the form of patent documents. Thus, research in patent databases is indispensable for the scientific and technological development of countries and companies and, an important source of competitive intelligence that provides great business benefits (SHIH; LIU; HSU, 2010). This becomes a differential mainly for companies that develop products, since it allows monitoring the speed of technological changes, making it possible to identify the impacts caused by the advancement of technology in various market segments.

The strategic importance of the scientific and technological information provided by patent documents is not new. In Araújo (1981), the results obtained through studies of about 70,000 US patents are highlighted, of which more than 80% described technologies that had not been published in the non-patented literature, as scientific journals. Thus, the only source of information for those patented technologies was patent documents alone.

According to Levy (2012), in the disclosure of patents to the public, inventors (patent holders) may publish in the scientific and technical literature the invention or technology embodied in the patent. In this respect, the inventor (s) will gain recognition and dignity without the protection of a moral right, which allows the use of this scientific knowledge by other researchers, provided that no intellectual property rights be infringed. This information arising from the disclosure of patents may facilitate the dissemination of knowledge about the patent and hence the transfer of technology, mainly by marketing or other form of technology granting by agreements between companies, such as the rights transfer relations discussed by Levy (2012).

Patents are rich detailed information about a technology or product (CORDEIRO et al., 2014) and may be used to some extent by other companies as an ideological reference for conceptions of their patents, provided there is no infringement of any intellectual property. The

success of technology transfer really depends on how much the company can learn from the patent information and use its knowledge to develop new products (YAM et al., 2011).

It is important to emphasize that policies related to intellectual property are essential in increasing the number of patents. Observing the number of patents in the United States, for example, in which the law is flexible, the most diverse products are more easily patented in up to three years, in contrast, in Brazil bureaucracy stalls patenting, in addition to a series of bottlenecks as to what can be patented, the process can last up to more than 10 years. Table I below shows some patentability criteria in different countries, showing the rigidity of the intellectual property law in some and the flexibility in others.

In Latin America and the Caribbean, the numbers are very low compared to other groups of countries, reaching only around 4,000 patents in 2010 following a downward trend from 2005-2008, when the region averaged more than 6,000 patents. As a comparison, Europe and Central Asia and the European Union presented around 150,000 and 100,000 patents, respectively, for the year 2011. Brazil leads the group of Latin American countries with 2700 patents in 2010, showing a decreasing trend from 2008, when it reached around 4000 patents. Brazil is followed by Mexico, which in contrast has reached its highest performance with more than 1000 patents in 2011 (OLAVARRIETA; Villena, 2014). According to Ferreira, Guimarães and Contador (2009), in the face of a globalized, competitive market filled with technological innovations, Brazilian companies have not yet realized the importance of the use of patents as a competitive tool, as they did not pay attention to the importance of exploration of patents as a source of technological information. The most relevant inhibiting factor to demonstrate that patents are not yet used as a source of technological information is the lack of culture in relation to patented technology research.

Pérez and Guadin (2014) presented a survey based on interviews using questionnaires with high-level government officials. In each of the Central American countries (Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama), it shows that governments have built organizations and public institutions to support science, technology and innovation, such as laws, national plans and a wide variety of policy instruments. However, the science and technology indicators show that the results are still low.

In 2012, science and technology indicators showed strong growth in China in previous years. Considering the report of the World Intellectual Property Organization (WIPO), China held the third place in patent registrations at the time, behind only the United States and Japan. Despite this discrepancy, Brazil is the most advanced country in Latin America in the practice of registering patents (CACCIAMALI; BOBIK; CELLI, 2012).

Several factors may be related to this disparity in the number of patents in these countries, some of which may be cited public policies for innovation, flexibility of regulatory policies for

patentability, scientific knowledge disclosed as articles or other patents (TEIXEIRA; SOUZA, 2013), technological level of the country, human resources, among others. Therefore, there is a need to establish methodologies that allow the knowledge of which of these factors influence more expressively the number of patent application deposits in these countries and how the knowledge of this influence can be used as a tool that can guide the establishment of policies aimed at increasing the number of patents in these countries.

The number of patent application deposits is a complex process, and can be influenced by several factors, such as public policies focused on innovation, patentability regulatory policies, scientific knowledge, country technological level and human resources. Thus, the question that arises is to find out which of these factors most significantly influence the number of patent application deposits and to measure this influence quantitatively.

An alternative technique for this type of study is the multiple linear regression analysis. Which makes it possible to evaluate the effect of independent variables, called factors or covariates, on a main dependent variable, describing this relation through a model, by which it is possible to make predictions of the response variable studied using values of the factors under study (MONTGOMERY et al., 2001).

For this purpose, multiple linear regression analysis is a feasible statistical technique, since it makes it possible to evaluate the effect of factors on a main variable, describing this relation through a model, which allows to make predictions of the variable of interest using values of the factors under study (MONTGOMERY; PECK; VINING, 2001).

According to Montgomery et al. (2001), a multiple regression model is represented:

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \dots + \beta_k x_{ik} + e_i \quad (4)$$

where, k is the number of independent or predictive variables (x_i), y is the observed value of the dependent variable under study Y , $x_i = (x_{i1}, x_{i2}, \dots, x_{ik})$ are the independent factors used to evaluate variable Y , β_0 is the intercept y , $\beta_1, \beta_2, \dots, \beta_k$ are the coefficients of the independent factors x_i and e_i is the random error, assumed to be independent, identically distributed and following a normal distribution with zero mean and constant variance σ^2 .

The expression (4) can be reduced to:

$$Y_i = \beta_0 + \sum_{i=1}^k \beta_i X_{ij} + e_j \quad (5)$$

Using the matrix notation, model (5) is

$$Y = \beta X + e \quad (6)$$

where

$$Y = \begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_n \end{bmatrix} \quad X = \begin{bmatrix} 1 & X_{11} & X_{21} & \cdots & X_1 \\ 1 & X_{12} & X_{22} & \cdots & X_1 \\ \vdots & \vdots & \vdots & \ddots & X_1 \\ 1 & X_{1n} & X_{2n} & \cdots & X_{kn} \end{bmatrix} \quad \beta = \begin{bmatrix} \beta_0 \\ \beta_1 \\ \vdots \\ \beta_k \end{bmatrix} \quad e = \begin{bmatrix} e_1 \\ e_2 \\ \vdots \\ e_k \end{bmatrix}$$

The most used method to obtain the forecasts of the parameters of the multiple linear regression model is the least squares method (LSM). The estimators provided by this method have good properties, such as robustness, high power and low mean square error (MOOD; GRAYBILL; BOES, 1982). It consists of minimizing L , the sum of the squares of the residuals, where \hat{y} is the predicted value of y , based on model (6), we have that $e = y - \hat{y}$, and the expression of L is then given by:

$$\begin{aligned} L &= \sum_{i=1}^n (e_i)^2 \\ L &= \sum_{i=1}^n (y - \hat{y})^2 \\ L &= \sum_{i=1}^n \left(y_i - \beta_0 - \sum_{j=1}^k \beta_j x_{ij} \right)^2 \end{aligned} \quad (7)$$

According to Montgomery et al. (2001), considering the expression of L , and the terms y , b and e , as the vectors of the predicted values of the response variable of the parameter forecasts and the deviations respectively, that is

$$\hat{y} = \begin{bmatrix} \hat{Y}_1 \\ \hat{Y}_2 \\ \vdots \\ \hat{Y}_n \end{bmatrix} \quad b = \begin{bmatrix} b_1 \\ b_2 \\ \vdots \\ b_k \end{bmatrix} \quad e = \begin{bmatrix} e_1 \\ e_2 \\ \vdots \\ e_k \end{bmatrix}$$

with the application of LSM, the expression for the estimator β given by b , it is then

$$b = (X^T X)^{-1} X^T y \quad (8)$$

Assuming that $(X^T X)^{-1}$ exists.

Thus, it seeks to adjust multiple linear regression models that make it possible to assess whether the following factors influence significantly the number of patents in some countries of the American continent: number of articles published, Gross Domestic Product, population, variation of the number of patents in relation to the previous year and variation of the number of patents in relation to the previous two years.

2. Material and methods

2.1 Data

The data used for modelling refer to the period from 1997 to 2012 (16 observations). The number of patents deposited by the countries of the American continent in this period was obtained from the World Intellectual Property Organization (WIPO, 2014), the Gross Domestic Product (GDP) and the population from the World Bank (2014) and the number of publications from the SCImago Journal & Country Rank (2014). The total number of patents and articles is analysed in thousands, the population in millions of inhabitants and GDP in billions of dollars. Countries with a patent number greater than 300 in at least one of the last three years of the analysed period were identified as the inclusion criteria for analysis, then, seven countries were selected for modelling. Information on the number of patents from these countries is given below (TABLE 1).

Table 1 – Descriptive statistics on the number of country patents in the period analyzed

Countries	Minimum number of patents	Average number of patents	Maximum number of patents
USA	206400	349400	460000
Canada	10170	18550	16300
Brazil	3079	4715	6603
Mexico	612	1096	2142
Argentina	942	1151	1397
Chile	169	446	768
Colombia	55	171	403

Source: Author's own table (2018)

2.2 Modeling

A model with all the factors studied was adjusted for the pre-selection of the factors that would compose the final model. Those that had a significant effect at the 20% level by the t test were researched in more detail. Subsequently, a multicollinearity analysis was performed evaluating the Pearson correlation coefficient (ρ) between the factors, in order to identify the existence of possible correlations. The final model was selected according to the largest number of uncorrelated significant factors present in the model, which had the lowest Akaike Information Criterion - AIC (AKAIKE, 1969) and had the highest coefficient of multiple determination - R^2 , among all those who did not violate any of the basic assumptions of regression.

An analysis of assumptions was made for the validation of the models, in which the wastes were analysed for normality, independence and homoscedasticity of variance. The Shapiro-Wilk test was applied for verification of normality, the Box-Pearce and Durbin-Watson tests for independence and the Breusch-Pagan test for the homoscedasticity analysis.

The models were adjusted using the function `lm`, available in the stats package of the R Computer System (R CORE TEAM, 2017). All the analyses were carried out considering the 5% level of significance using the R Computer System (R CORE TEAM, 2017).

3. Results and Discussions

The Table 2 presents the general models containing all five factors studied for each of the seven countries, where "NART" is the number of articles, "GDP" the Gross Domestic Product, "POP" population, "NP_{t-1}" and "NP_{t-2}" the annual and bi-annual variations of the number of patents respectively.

Table 2 – Estimates of the parameters of each model and p-value of the general models

Countries	Estimates of parameters of adjusted general model factors						p-value
	Intercept	NART	GDP	POP	NP _{t-1}	NP _{t-2}	
USA	1764.810**	0.117	0.067***	-7.851**	0.253	-0.314	<0.001
Canada	29.212	0.187***	0.006***	-0.893	0.354*	0.072	<0.001
Brazil	-12.170***	0.0002**	0.022**	0.088***	0.164*	0.552***	<0.001
Mexico	0.3179	0.318***	-0.0005	0.002	-0.259***	1.275***	0.001
Argentina	0.591*	-0.0001	0.001	0.012	0.212	0.388*	0.779
Chile	-2.910*	0.051	-0.001	0.202**	0.283**	0.388***	<0.001
Colombia	0.419*	0.016	0.001***	-0.01	0.363***	0.442***	<0.001

* Significant at the level of 20%; ** Significant at the 10% level; *** Significant at the level of 5%

Source: Author's own table (2018)

In Table 3 below shows the *p*-values of the assumptions analysis tests of each model and its respective coefficient R².

Table 3 – Validation of fit models

Countries	p-value of Tests				Adjusted R-squared
	Shapiro	Box-Pearce	Breusch-Pagan	Durbin-Watson	
USA	0.238	0.239	0.155	0.051	0.980
Canada	0.048	0.625	0.960	0.681	0.974
Brazil	0.100	0.856	0.870	0.100	0.997
Mexico	0.305	0.651	0.652	0.216	0.988
Argentina	0.817	0.080	0.264	0.073	0.997
Chile	0.821	0.383	0.340	0.694	0.963
Colombia	0.210	0.132	0.637	0.228	0.951

Source: Author's own table (2018)

As observed in Table 3, in the model adjusted for Canada, the waste normality test (Shapiro-Wilk) had a p-value of 0.0482 but since this value is very close to the level of significance adopted for the Shapiro-Wilk test (5%) and the number of patents referred to is relatively small (low degree of freedom), it was decided to accept this value as approximately 0.05, thus the wastes were considered normal. Furthermore, from Table 3 it is observed that no assumption of the multiple regression was violated for the adjusted models, so that the conclusions obtained from them are valid.

The final models selected for each country are shown in Table 4, which presents the estimation of each parameter associated with the factors, the standard deviation, the coefficient of multiple determination R² and the significance (p-value) of each parameter.

Table 4 – Parameter estimates, standard deviations and p-values for the adjusted models

Country	Fators	Parameter estimates	Standard deviation	Adjusted R-squared (%)	p-value
USA	Intercept	-65.198	16.074	98.01	0.001
	GDP	0.033	0.001		<0.001
Mexico	GDP	0.001	<0.001	98.79	<0.001
	NPt ₂	1.458	0.269		<0.001
Canada	Intercept	2.689	0.876	97.40	0.011
	NART	0.261	0.013		<0.001
	NPt ₂	0.322	0.130		0.030
Colombia	Intercept	0.054	0.012	95.12	0.001
	NART	0.042	0.005		<0.001
	NPt ₂	0.608	0.163		0.003
Brazil	Intercept	-15.664	0.319	99.75	<0.001
	POP	0.109	0.002		<0.001
	NPt ₂	0.587	0.053		<0.001
Chile	Intercept	-3.222	0.243	96.26	<0.001
	POP	0.224	0.015		<0.001
	NPt ₂	0.501	0.074		<0.001
Argentina	POP	0.031	0.001	99.70	<0.001
	NPt ₂	0.579	0.106		0.001

NART: Number of articles.; GDP: Gross Domestic Product.; POP: Population.; NPt-1: Variations in the number of patents in relation to the last year; NPt-2: Variations in the number of patents over the two last years.

Source: Author's own table (2018)

With the exception of the USA model, all the others presented the variation factor of the number of patents in relation to the last two years, and in all these cases this factor causes an increase in the number of patents. This may indicate that the discovery of new technologies / products, evidenced by the number of new patents (indicator of scientific development), can contribute to the generation of new technologies, also protected by patents, forming a development cycle. This result is consistent with the literature as in França (1997), Artz et al. (2010), Levy (2012), Ouellette (2012), and Cordeiro et al. (2014), in which the richness of the information detailed in patent documents on a technology or product is discussed, and may be used to some extent by other companies as an ideological reference for conceptions of their patents, as long as there is no violation of any intellectual property. The success of technology transfer really depends on how much the company can learn from patent information and use its knowledge to develop new products (YAM et al., 2011).

The fact that the variation in the number of patents in relation to the previous two years has a positive influence on the number of patents of the year is contrary to the theory discussed by some authors, such as Boldrin and Levine (2013), which show that there is no proof that patents serve to increase innovation and productivity. These authors use as an argument the fact that even with the high number of patents and the strength of their legal protection, the US economy has not seen a drastic acceleration in the rate of technological progress, which somehow advocates the non-patenting of inventions, claiming that patenting may increase the cost of technologies and thereby hinder their commercialization

For the US, the number of patents is heavily influenced by the country's GDP, according to the adjusted model each billion US dollars of GDP in the US will lead to an increase of 32800 patents per year. According to coefficient R² this model explains 98.01% of the variability of the data. The significant effect of GDP reflects the results of the Bayh-Dole Act. Since the approval of this law, the history of US science policy has changed radically. Essentially, the Law allows universities and researchers the right to property and patent for the inventions made in their laboratories, which have been developed with governmental resources. It is important to take into account that the USA invests 2.8% of its GDP in research and development, reaching an absolute investment of 450 billion dollars in 2013, ranking first in the absolute R & D investment ranking. As explained by Mowery et al. (2001), the university research portfolio has shifted somewhat in recent years regardless of Bayh-Dole, and these changes are important factors behind the rise in US patenting. In particular, the growth of government financial support for basic biomedical research at universities, which began in the late 1960s, coupled with increased biotechnology research that began in the early 1970s, contributed to growth in patents and university licenses.

The factor number of articles published was only present in the adjusted models for Canada and Colombia. As there is an increase in the generation of scientific knowledge with basic research (articles publications) and its use in translational research, there is an inherent increase in the quantity of new products/services generated, which in turn can lead to innovation and consequent technological development.

In Canada, the number of patents is influenced by the number of articles published and by the number of patents in the previews two years. According to the adjusted model, for each one thousand published articles, there is an increase of 261.1 patents and each thousand variation in the number of patents in relation to the previous two years causes an increase of approximately 321.9 patents. According to coefficient R², this model explains 97.40% of the variability of the data. Although Canada is a developed country, there is a great influence of foreign companies in their patents, 50% of the nanotechnology patents invented by Canadian inventors are owned by foreign assignees (BEAUDRY; SCHIFFAUEROVA, 2011), although most be result of collaborations between Canada and the United States (TAHMOORESNEJAD; BEAUDR, 2017).

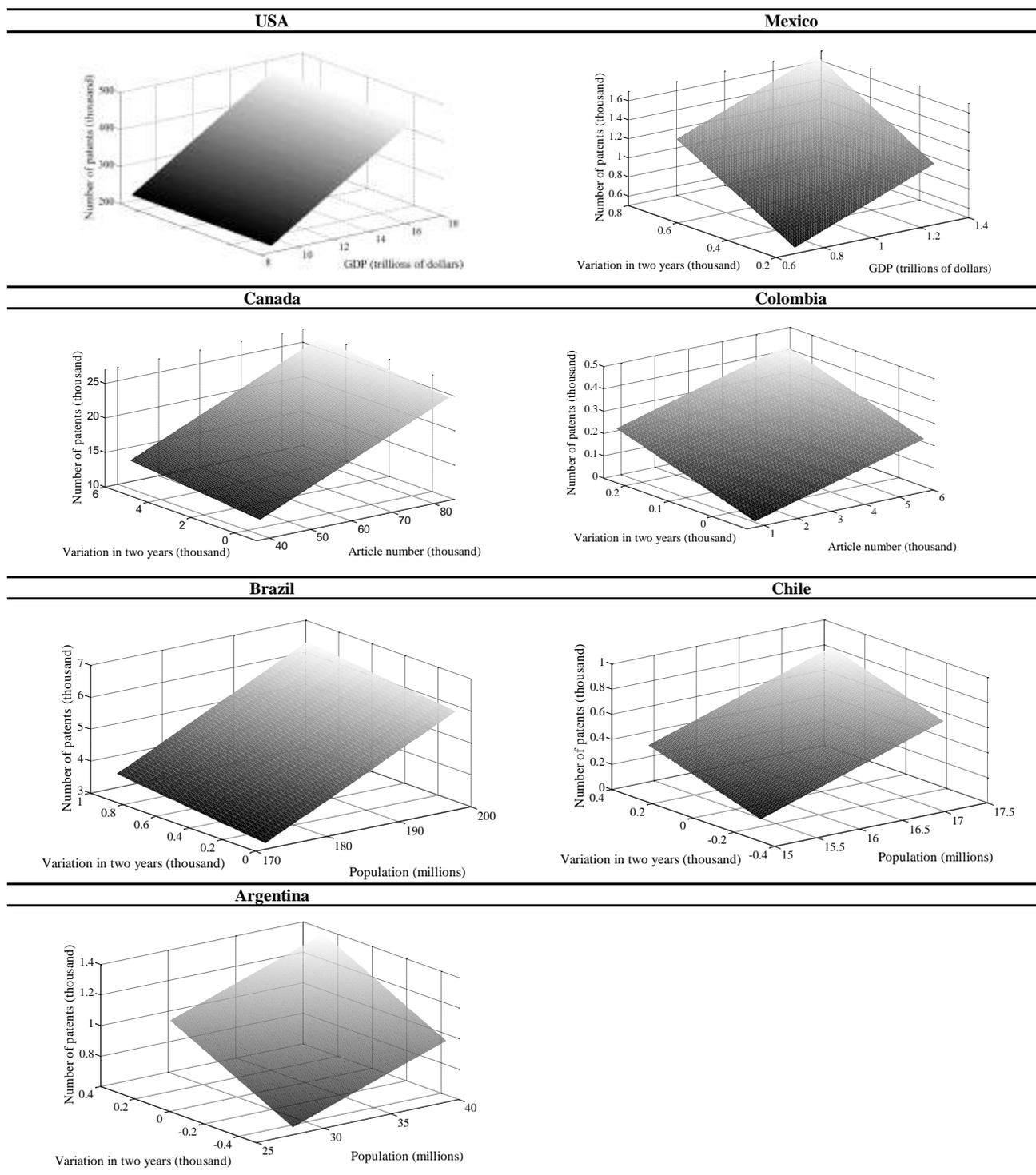
The behaviour of the number of patents in Colombia was similar to that of Canada, so that every one thousand published articles contributes to an increase of 42 patents and for each thousand variation in the number of patents in relation to the previous two years causes an increase of about 607.8 patents. This model explains 95.12% of the variability of the data. Although the Colombian model is analogous to that adjusted for Canada, when comparing the forecasts of the parameters of each model, it is noted that the number of articles published exerts a greater influence on the number of patents in Canada than in Colombia, considering the higher value of the forecast. On the

other hand, the variation of the number of patents in relation to the two previous years is more impacting in the number of patents of Colombia.

In Brazil, Chile and Argentina, countries with similar economic and social characteristics, the results indicated that the number of patents is influenced by the same factors: population and variation in the number of patents in relation to the previous two years. In the case of Brazil, for each variation of one thousand in the number of patents in relation to the previous two years there is an increase of 587.2 patents, in Chile this increase is 501.4 and in Argentina 579.3. When evaluating the effect of the population factor, in Brazil for each increase of one million inhabitants there is an increase of 109.1 patents. In Chile, this increase is 223.6 patents and in Argentina 31.2. The adjusted models explain 99.75%, 96.26% and 99.70% of the data variability respectively for Brazil, Chile and Argentina.

In Mexico, the number of patents is influenced by GDP and the variation of the number of patents in the previous two years. According to the adjusted model, for each increase of one billion dollars of GDP, there is an increase of nine patents and each variation of one thousand in the number of patents in relation to the previous two years translates into an increase of 1458 in the number patents. According to coefficient R^2 this model explains 98.79% of the variability of the data. It is important to note that, although present in the model, the GDP factor has little influence on the number of patents, given the small value of the associated parameter forecast. The response surfaces obtained from each model adjusted for the respective countries are presented in Figure 1.

Figure 1 – Response surface showing the behavior of the number of patents of each country



Source: Author's own figure (2018)

From Figure 1, it can be observed the evident increase in the number of patents in each of the countries according to the increase of their respective factors of influence. It is noteworthy that the US model, because it contains only one single factor, is reduced to a simple linear regression model, the illustration of the response surface of the US model shown in Figure 1 was constructed considering only the GDP factor.

4. Final considerations

The multiple linear regression models were adjusted and presented satisfactory results in modelling the number of patents in the American countries. Based on the forecasts obtained, it was noted that the number of patents is influenced differently according to the analysed country, and even those in which the number of patents is influenced by the same factors, this influence is quantitatively different.

In general, the main factor that has a positive impact on the number of patents in the analysed countries was the variation in the number of patents in relation to the previous two years, present in the adjusted final model in all the countries analysed, except in the USA.

The number of patents in Brazil, Argentina and Chile presented similar behaviours, being influenced by the same factors, the population and the aforementioned variation. In Canada and Colombia, the number of published articles also contributes to an increase in the number of patents. In Mexico, the influence was due to the mentioned variation in two years and the GDP (Gross Domestic Product) of the country. On the other hand, in the USA, given the massive investments in research and development, the number of patents was impacted only by GDP.

It can be noted that modelling the number of patents is a complex process, which may involve factors other than those studied here, such as patentability criteria, flexibility in intellectual property policies, culture of universities and / or companies regarding disclosure of their research results, the nationality of companies that have deposited patents in a particular country, among others. These issues could be studied in future work, as well as a more detailed study on the effect that population has on the increase in the number of patents in Brazil, Argentina and Chile.

Acknowledgements

The authors would like to thank Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), for the financial support to for the accomplishment of this work.

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Recebido em: 24/05/2018

Aprovado em: 24/03/2020