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Determinants of the trademark in Colombia: a panel data application

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Abstract

The purpose of this paper is to establish the variables that explain the behavior of trademark applications in Colombia between 2012 and 2016. For the analysis, a fixed effects model with robust panel errors was used, for which a determination coefficient of 99% was obtained. From these, it was possible to establish that the number of patent applications, the number of industrial design applications, the number of establishments, professional technical and technological salaries of permanent production or indefinite term contracts, departmental GDP, national investment in administration and other support activities, sales of companies in the country and advertising expenditures are significant to explain the number of trademark applications.

Keywords: Trademarks, distinctive signs, industrial property, innovation activities, panel data, Colombia.

1. Introduction

Here introduces the paper, and put a nomenclature if necessary, in a box with the same font size as the rest of the

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paper. The paragraphs continue from here and are only separated by headings, subheadings, images and formulae. The section headings are arranged by numbers, bold and 10 pt. Here follow further instructions for authors Studies related to innovation can be found in the works of [1], who defined innovation as (i) the development of a new process or product by a company, which allows its subsequent introduction into the market with a new production method, (ii) access to new sources of supply and (iii) the implementation of a new structure in the market. More recently, the importance of innovation activities in economic growth has been recognized [2], and this has allowed several studies to be carried out from the intellectual property literature in order to analyze those factors that contribute to the development and success of innovation processes in companies ([3], [4], [5]).

One of the variables considered for innovation studies corresponds to applications for distinctive signs, specifically trademarks. According to the [6], a trademark "is a sign which makes it possible to distinguish the goods or services of one undertaking from those of another. Trademarks are protected intellectual property (IP) rights".

This research aims to establish the variables that explain the behavior of trademark applications in Colombia between 2012 and 2016. The selected period is explained by two reasons: (i) the increase in the total number of trademark applications explained by the increase in applications via National and via Madrid Protocol; (ii) the availability of departmental investment data.

The methodology implemented was a fixed effects model with robust errors for panel, whose dependent variable is the number of trademark applications and the explanatory variables are the patent applications, industrial design applications, the number of establishments in the departments, the salary of professionals and technicians, the departmental GDP, the national investment in administration and support at the departmental level, the expenditure of the departmental establishments in advertising and the sales of the establishments in the country.

2 Literature Review

In an overview of the intellectual property studies analyzed by country, the study [3] carries out an analysis of 71 Singaporean companies evaluating the significance of variables such as communication channels, decentralized structure, presence of organizational resources, belief that innovation is important, willingness to take risks and willingness to change ideas, as possible determinants of innovation. Within the findings of the study, a positive relationship was found in all the variables, except for the communication channels.

[7] analyzed 189 firms from France, Germany, Italy, Spain and the United Kingdom over 4 years, which implies 712 observations. From these, they constructed a data panel. They showed that the inclusion of external brands in the portfolio favors the international performance of the companies.

The study [4] analyses 149 industrial biotechnology companies in Japan, showing that the rate of R&D expenditure on sales, the rate of R&D employees, the characteristics of presidents, state support and international networks are positively correlated with the firm's capacity for innovation. And, on the other hand, [5], which are based on the premise that innovation is the key factor for the development and growth of companies, analyzed 205 small and medium-sized manufacturing companies (SMEs) in Canada, demonstrating that the intensity of research and development processes has a direct influence on product innovation.

In terms of the firm's efforts and commitment to innovation, [8] used the firm's level of information to study the determinants of cooperation in research and development. It focuses on the impact of the diffusion of R&D cooperation and explores the role of factors such as: size of the firm, cost and risk sharing and other complementary elements. Additionally, [9] they emphasize that innovation depends on the circumstances of the firm, which is why they take small firms with scarce resources as a sample. They consider that factors such as the age of the company, the type of innovation and the cultural context affect its innovative behavior. For their part, [10] study the effects that a brand has on the value of companies, concluding that the value of a brand is the result of the marketing activities that a company carries out, such as investment in advertising and maintaining a high level of service and product quality.

In the specific case of Colombia, [11] analyzed the spatial distribution of the request and the granting of new creations between 2000 and 2016. A spatial cluster model was used to identify groups of departments with respect to their innovation behavior, considering as a proxy, the applications, and awards of new creations by residents in

Colombia between 2000 and 2016. And [12] included the different strategies for using intellectual property in a specific sector such as tourism.

For his part, [13] analyzed the relationship between well-known brands and innovation, considering the perspective of transaction costs and the benefits of innovation. [14] studied the effects of branding strategies when companies decide to introduce their product portfolios in a new foreign market. [15] seek to measure the technical expertise of U.S. patent examiners, finding that there is no random assignment for patent and trademark examinations. [16] evaluated the impact of intellectual property rights protection mechanisms on the competitiveness of high-tech or knowledge-intensive companies in Portugal, and found that the impact of informal protection mechanisms on the competitiveness of firms is greater as the size of the firm decreases.

More recently, the work of [17] uses artificial intelligence, specifically neural networks, to identify matches in images, pronunciation or phonetics when comparing marks. Its application is associated with the possibility of resolving conflicts. Similarly, [18] found evidence that piracy affects the company's profit margins, but there is not enough evidence that it has an impact on innovation or increased brand sales.

3 Methodological framework

3.1 Sample and data

The variable of interest corresponds to the applications for registration of trademarks in 22 departments, which represent the greatest participation in national production and had a number of applications greater than nine (9) in the period. The period selected is explained by two reasons: (i) the increase in the total number of trademark applications explained by the increase in applications via National and via Madrid Protocol; (ii) the availability of departmental investment data (Table 1).

3.2 Model

An econometric exercise was conducted to analyze the determinants of the trademark application at the departmental level. To avoid heterogeneity bias, panel data were used since it reduces problems related to model identification ([19], [20]). The model-dependent variable is the number of trademark applications and the explanatory variables are patent applications, industrial design applications, number of establishments in the departments, salaries of professionals and technicians, departmental GDP, national investment in administration and support at the departmental level, expenditure by departmental establishments on advertising and sales of establishments in the country. With all of this, the regression model with panel data, which produced the best results, corresponds to

$$mar_{it} = \beta_0 + \beta_1 pate_{it} + \beta_2 disein_{it} + \beta_3 numestabl_{it} + \beta_4 salarprofesi_{it} + \beta_5 pib_{it} + \beta_6 iadmi_{it} + \beta_7 gastopub_{it} + \beta_8 ventaspais_{it} + \varepsilon_{it} \quad (1)$$

Where i is the departments, t is the year, mar represents the number of trademark application, pate is the number of patent application, disein is the number of industrial design application, numestabl is the number of established, salarprofesi is the salary of the technical professionals and technologists, gdp represents the departmental GDP, iadmi is the national investment in administration and other support activities, gastopub is the expenditure on advertising, ventapais is the sales of the departmental establishments in the country and ε_{it} is a random disturbance that is supposed to $\varepsilon_{it} \sim N(0,\sigma^2)$.

Table 1. Model variables

Dimension of study	Variables	Unit	Source	Hypothesis	Expected relation
Business Innovation	Number of trademark applications	Net	Superintendence of Industry and Commerce (hereinafter SIC)	--	--
Business innovation activities	Number of patent applications. Number of industrial design applications Number of utility model applications	Net	Superintendence of Industry and Commerce (hereinafter SIC))	Patenting, designing and branding are complementary creative activities that describe the dynamism of a company	Positive
Competition	Number of stores	Thousands of pesos	DANE Annual Manufacturing Survey	The more competitors, the more technology transfer and the more companies are encouraged to innovate	Positive
Human Capital	Wages and salaries of permanent and temporary staff Salaries Professional technicians and technologists with permanent production or indefinite term contracts	Thousands of pesos	DANE Annual Manufacturing Survey	The training profile of the workforce can contribute to the capacity for business innovation.	Positive
Economic environment	GDP Population per capita GDP Gross production National investment in administration and other support activities National Investment in innovation National investment in research and development Sales of the companies in the country Sales of companies abroad	Billions of constant pesos 2015 Net Billions of constant pesos 2015 Billions of constant pesos 2015 Thousands of pesos	DANE DANE Annual Manufacturing Survey Statistical Bulletin 2017 Colciencias DANE Annual Manufacturing Survey	Strategy and market orientation have a positive effect on innovation capacity	Positive
Promotion	Expenditure on advertising of	Thousands of pesos	DANE Annual Manufacturing Survey	A brand's reach is the result of marketing related activities, such as investment in advertising	Positive

4 Results

To establish the quantitative model of this investigation, some tests were carried out, the results of which are indicated below.

In order to detect whether to use the random effects model or the pooled data model, the Lagrange Multiplier for Random Effects test was performed. By rejecting the null hypothesis, that is, the estimated variance of errors is not equal to zero, it allows the selection of the random effects estimate instead of the pooled one.

Breusch and Pagan Lagrangian multiplier test for random effects
marc[depar,t] = Xb + u[depar] + e[depar,t]
Estimated results:
| Var sd = sqrt(Var)
---------+-----------------------------
marc | 5377326 2318.906
e | 8282.939 91.01065
u | 5940.506 77.07468

Test: Var(u) = 0
chibar2(01) = 1.37
Prob > chibar2 = 0.1212

Subsequently, by rejecting the null hypothesis of the Hausman test, it is detected that the difference between the random and fixed effect coefficients is systematic. Therefore, the method used for the research modeling was the fixed-effect method.

Test: Ho: difference in coefficients not systematic
chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 1707.66
Prob>chi2 = 0.0000

Taking into consideration the selection of the fixed-effects model, the evidence of the assumptions is evaluated to analyze its feasibility.

When performing the Wooldridge test for autocorrelation, the null hypothesis is rejected at a significance level of 5%, i.e. first order autocorrelation in the model is presented.

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
F(1, 21) = 4.445
Prob > F = 0.0472

When Wald's test is performed to detect whether heteroscedasticity exists in the model, the null hypothesis of homoscedasticity at 5% significance level is rejected.

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model
H0: sigma(i)^2 = sigma^2 for all i
chi2 (22) = 2836.62
Prob>chi2 = 0.0000

Finally, when performing the Pesaran (2015) test of cross-sectional dependence for unbalanced panel data set, the null hypothesis is not rejected, therefore, the cross-sectional errors are weakly dependent

Pesaran (2015) test for weak cross-sectional dependence
H0: errors are weakly cross sectional dependent.
CD = 1.030
p-value = 0.303

The autocorrelation, heteroscedasticity and contemporary correlation problems detected in the model were solved together with robust panel standard error estimators with the inclusion of dichotomous time variables to

capture the fixed effects directly. However, since the dichotomous variables were generally not significant, they were excluded from the model. This results in the model presented in Fig. 1.

	marc
pate	17.234
	(5.64)**
disein	8.609
	(3.19)**
numestabl	0.973
	(3.22)**
salarprofesi	0.120
	(3.29)**
pib	0.019
	(3.91)**
iadmi	0.008
	(2.91)**
ventaspais	-0.000
	(5.90)**
gastopub	-0.000
	(2.09)*
_cons	-241.972
	(4.67)**
R2	0.99
N	110

* p<0.05; ** p<0.01

Fig. 1. Model results

The robust standard error model for panels has a determination coefficient of 99%, with all but 5% of advertising spending being significant. Therefore, it can be concluded that there is empirical evidence that supports the relationship between the innovation activities that companies perform such as patents and industrial designs, competition, human capital, economic environment, market power and promotion have a significant impact on the application of trademarks at the departmental level.

It is important to mention that the advertising expenditure variable does not have the expected sign, which contradicts the hypothesis of [10]. In the case of Colombia, this could be explained by the fact that the financial resources that a company allocates for spending and investment are scarce, leaving few resources for the business innovation area. With this, it is recommended that companies have a balance between their decisions to implement promotion and innovation in order to have more opportunities to position the company in the market.

5 Discussion and conclusions

This research sought to establish the variables that best explained the dynamics of trademark applications in Colombia between 2012 and 2016. Among the variables that turned out to be significant, are the number of patent applications, the number of industrial design applications, the number of establishments, professional technical and technological salaries for permanent production or indefinite term contracts, departmental GDP, national investment in administration and other support activities, sales of companies in the country and advertising expenditures. In spite of this, it should be highlighted that within the analysis, variables such as population, GDP per capita, number of applications for utility models, national investment in innovation and in research and development by department, salaries and wages of permanent and temporary personnel hired directly by the establishment, gross production of the establishments and sales of the companies abroad were taken into account, which did not turn out to be significant, therefore, they were excluded from the quantitative model.

This exercise made it possible to identify the importance of the efforts made by companies in terms of creating innovation and attracting qualified personnel to face an increasingly competitive market. Specifically, with regard to distinctive signs, trademarks become a differentiating element of the product or service. Likewise, the results allow

us to affirm that the construction of a stable economic environment is required and that it encourages internal and ecosystem innovation processes.

Future research would benefit from this same analysis with other IP variables such as new creations or copyright registrations. Likewise, with the data matrix constructed it would be possible to apply geographically weighted regression models to analyze the departmental effect from another perspective.

References

[1] Schumpeter, Joseph (1934) "The theory of economic development: an inquiry into profits, capital, credit, interest, and the business cycle." Harvard University Press, Cambridge, MA

[2] Gómez Vieites, Alvaro, & Calvo, José (2011) "Innovación: Factor clave del éxito empresarial." (eds) *Ecoe Ediciones*, Colombia

[3] Wan, David, Ong, Chin Huan., & Lee, Francis (2006) "Determinants of firm innovation in Singapore. "*Technovation,* **25:** 261—268

[4] Kang, Kyung-Nam, & Lee, Yoon-Sik (2008) "What affects the innovation performance of small and medium-sized enterprises (SMEs) in the biotechnology industry?" An empirical study on Korean biotech SMEs. BiotechnolLett, 30 :1699—1704

[5] Raymond, Louis., & St-Pierre, Josée (2010) "R&D as a determinant of innovation in manufacturing SMEs: An attempt at empirical clarification." *Technovation* **30**: 48—56)

[6] WIPO (2018) "Trademark". Ginebra: OMPI.

[7] Denicolai, Stefano., Hagen, Birgit, Zucchella, Antonella., & Dudinskaya, Emilia. (2019) "When less family is more: Trademark acquisition, family ownership, and internationalization." *International Business Review*, **28(2)**: 238—251

[8] López, Alberto (2008) "Determinants of R&D cooperation: Evidence from Spanish manufacturing firms." *International Journal of Industrial Organizatio,* **26**: 113—136

[9] Rosenbusch, Nina, Brinckmann, Jan, & Bausch, Andreas (2011) "Is innovation always beneficial? A meta-analysis of the relationship between innovation and performance in, SMEs." *Journal of Business Venturing*, **26**: 441—457

[10] Sadner, Philipp, & Block, Joern (2011)" The market value of R&D, patents, and trademarks." *Res. Policy*, **40(7)**: 969-985

[11] Lis-Gutiérrez, Jenny. Paola., Lis-Gutiérrez, Melissa., Gaitán-Angulo, Mercedes., Balaguera, Manuel, Viloria, Amelec., & Santander-Abril, Jairo (2018) "Use of the Industrial Property System for New Creations in Colombia: A Departmental Analysis (2000-2016) ." *Lecture Notes in Computer Science*, **10943**: 786-796

[12] Lis-Gutierrez, Jenny.-Paola., Gaitan-Angulo, Mercedes., Moros, Andreina., Lis-Gutierrez, Melissa., Viloria, Amelec (2017) "Use of Intellectual Property in the Tourism Sector." J*ournal of Engineering and Applied Sciences,* **12(11):** 2838—2841

[13] Bei, Xiaoshi (2019) "Trademarks, specialized complementary assets, and the external sourcing of innovation." *Research Policy*, **48(9)**

[14] Barroso, Alicia, Giarratana, Marcos & Pasquini, Martina (2019) "Product portfolio performance in new foreign markets: The EU trademark dual system." *Research Policy*, **48(1):** 11--21

[15] Righi, Cesare, & Simcoe, Timothy (2019) "Patent examiner specialization." *Research Policy*, **48(1)**: 137-148

[16] Teixeira, Aurora & Ferreira, Cátia (2019) "Intellectual property rights and the competitiveness of academic spin-offs." *Journal of Innovation & Knowledge*, **4(3)**: 154-161

[17] Trappey, Charles, Trappey, Amy, Lin, Sam (2020) "Intelligent trademark similarity analysis of image, spelling, and phonetic features using machine learning methodologies." *Advanced Engineering Informatics,* **45**: 101120.

[18] Butticè, Vincenzo, Caviggioli, Federico, Franzoni, Chiara, Scellato, Giuseppe, Stryszowski, Piotr & Thumm, Nikolaus. (2020) "Counterfeiting in digital technologies: An empirical analysis of the economic performance and innovative activities of affected companies." *Research Policy*, **49(5) :**103959

[19] Lis-Gutiérrez, Jenny, Henao, Carolina, Zerda, Álvaro, Correa & Juan, Viloria, Amelec (2018) "Determinants of the impact factor of publications: A panel model for journals indexed in Scopus 2017." *Lecture Notes in Computer Science*, **10943**: 491-499

[20] Henao-Rodríguez, Carolina, Lis-Gutiérrez, Jenny., Gaitán-Angulo, Mercedes, Malagón, Luz & Viloria, Amelec (2019)

"Econometric analysis of the industrial growth determinants in Colombia. "*Lecture Notes in Computer Science*, **10837**: 316--321