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Competition policy and Industrial Property: relation through panel data approach 2007 – 2015

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Abstract

In the last century, the relation between competition and innovation has been a subject of particular interest, considering the important role that technological progress plays on economic growth and social welfare. Moreover, for several decades, the interest and discussion in regards to this matter has been the focus of heated debates among economists, jurists; and, most notably, among Competition and Industrial Property Authorities, since competition and innovation are the main axes in any modern approach to industrial policy. This paper examines the relation between competition and innovation, based on the estimation of panel data models for 75 countries between 2007 and 2015. The results show an inverted-U relation between innovation and competition. In other words, increases in competition generates innovation to a certain level (turning point) where the effect of competition on innovation is negative. This is consistent with Aghion *et al.* (2005) approach. The results are robust to different variables used as a proxy for innovation.

Key words: Industrial Property, Competition, Panel Data, GMM, inverted-U.

JEL Classification: C32, L11, L22, M13.

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I. Introduction

Competition Policy is pivotal for economic growth. Indeed, studies have shown that increases in market competition levels generate increases in Gross Domestic Product (GDP) (Aghion, Braun and Fedderke (2008), Ma Cheng (2011)). Likewise, innovation increases the firms' productivity and their production, thereby resulting in economic growth in the medium and long term (Nickell (1996), Blundell, Griffith and Van Reenen (1999), Aghion *et al.* (2005), Campo and Herrera (2016). Therefore, given the impact that innovation and competition policy have on economic growth, this paper examines the relation between economic competition and innovation. Moreover, derived from the Fourth Industrial Revolution, the foregoing relation is a key issue in the design and implementation of economic policy, as a means of boosting output. In fact, an increase in the number of patents granted has a broad impact on the prices of innovative products. Consumers and other users of such patents, will be required to pay more for either licences or transaction costs arising from bilateral and multilateral licensing agreements.

For several decades, the interest and discussion in regards to this matter has been the focus of heated debates among economists, jurists; and, most notably, among Competition and Industrial Property Authorities, since competition and innovation are the main axes in any modern approach to industrial policy. In this sense, the subject of innovation versus the intensity of competition in markets is far from reaching a consensus from either a theoretical or empirical point of view.

While theories of Industrial Organisation predict that higher levels of competition in the market mean less innovation, empirical works have shown that innovation increases with higher competition levels. Schumpeter (1943) and Scherer (1967) survey the beginning of these debates between the theoretical and the empirical results. Hart (1983) proposes an interesting analysis to understand the Salop's limitations (1977), including in his model, the agency problems. In addition, this discussion has focused on identifying the type of relation between competition and innovation. In this sense, the empirical literature has evidenced a lack of consensus in the type of relation between them, although the most accepted, nowadays, is the existence of an inverted-U.

Hence, Competition Authorities and Protection of Industrial Property Entities must work together in order to obtain benefits from the technical cooperation, exchanging information and knowledge and acknowledging the tension between the protection of the rights inherent in Industrial Property and competition. In the Colombian case, the Superintendence of Industry and Commerce (SIC) is one of the few institutions worldwide that is both the administrator of the national system of Industrial Property and the national antitrust authority.

The document is structured in seven sections, including this introduction. The second section presents classic approaches to the Competition and Innovation relation. The third section reviews the literature dealing with the link between competition and innovation. The fourth section presents some graphic and statistical elements that depict a preliminary relation between competition and innovation. Furthermore, this section also describes our panel data approach. The fifth section presents the estimates and results of the proposed models. Conclusions are presented in the final section.

II. Classic perspective of the Relation between Competition Policy and Innovation

The issue of competition has multiple layers, and universally valid methods for its quantification are yet to be established. Theoretically, competition is considered as a game among profit-maximizing firms in a given market. However, it should be mentioned that such interaction is complex since several determinants are involved: firms' behaviour including their strategic interaction with other competitors, consumer demand, barriers to entry and current regulation.

In addition to measurement challenges, there is no single accepted definition of competition. It is generally assumed that a market (or industry) is more competitive if the number of firms in the market can be increased. For example, lower costs create lower entry barriers and, consequently, greater incentives for new firms to enter or intensify competition between existing ones. Competition is also considered to be intensified if firms' behaviour is more aggressive, for example, when firms compete for prices (van der Wiel, 2010, 16-17)

It is difficult to capture all competition elements in a single variable, so the literature suggests using indirect indicators, for instance, Concentration measures such as the Herfindahl Index or market power indices such as the Lerner Index. These measures have been, for a long time, the main competition measures used in empirical studies.

Nevertheless, the measures above mentioned have certain limitations. First, many firms within the same industrial classification do not necessarily compete on the same stage in the production chain. Typically, heterogeneous firms specialize in different goods and services, different quality segments and different geographical areas. Second, in many cases competition for imports is not considered. Notwithstanding the fact that these criticisms are not applicable to the Lerner Index, its use in a dynamic context is not advisable. Boone et al. (2012) explain that an increase in the Lerner Index over time due to a decrease in costs, does not necessarily correspond to greater market power, but instead it may reflect greater technical efficiency. If competition intensifies due to more aggressive behaviour by competitors, this will increase the efficient firms' Lerner Index at the expense of inefficient firms. This reallocation will also increase market concentration measures.

Unlike the Lerner Index and market concentration measures, the Boone Index (2008a) discriminates between market power and efficiency. In other words, when the above reassignment involves a significant increase in the Lerner Index, the Boone Index will correctly indicate an increase in competition and not in market power (Raymond & Plotnikova, 2014). In this line of thought, as an alternative and considering the increasing availability of macro data, the Boone Index relates benefits and efficiency, it may be estimated for a market (or industry) and it is defined as the percentage drop in profits due to a percentage increase in a variable cost that captures a firm's efficiency. In all markets, an increase in costs per unit of product reduces the firm's profits. Nonetheless, in a more competitive market, the same percentage increase in these costs will cause a larger drop in profits. The underlying intuition is: in competitive markets firms are more heavily penalized (in terms of profits) for being inefficient (van der Wiel, 2010).

In contrast to the notion of competition, literature agrees on exactly what innovation is. In order to measure innovation in the context of its interaction with competition, two well-known indicators have been used in theory and practice: R&D expenditure and patents (van der Wiel, 2010).

The measures used in the literature include the behaviour of patents, R&D and questions included in questionnaires such as, for example, the estimated percentage of sales attributed to innovative projects or binary variables that indicate whether a particular type of innovation was carried out or not. Investment in R&D is used, especially for its availability in the R&D Satellite Account. Therefore, it focuses on innovation efforts rather than the outcome of the innovation process. Thus, the effect of competition on R&D investment is investigated, but not the effect on the success of that investment. It is more natural to view competition primarily as an incentive to employ innovative activities rather than as a determinant of innovative success.

Stemming from technological progress, the relation between competition and innovation has been a subject of particular interest in the last century, even more considering the important role that plays on economic growth and social welfare. The first approach was proposed by Adam Smith (1776), who noted that competition is positively related to technological progress. In fact, such a market structure generates the need to adopt efficient production methods which largely involve the development of innovative processes.

However, in 1942, Schumpeter raised an inverse relation between competition and innovation. The latter idea is based on his notion of creative destruction, whereby the existence of a small firm in a competitive market leads to a static resource allocation (Escape Effect), whereas a large firm in an uncompetitive market leads to progress and product expansion in the long run (Schumpeterian Effect). The author concludes that monopolists have greater incentives to innovate than a competitive firm, since an increase in levels of economic competition reduces profits to be earned and, there will therefore be fewer incentives to innovate. In consequence, when competition is low, the Escape Effect of Competition dominate the Schumpeterian Effect, while when competition is high, the Schumpeterian Effect is predominant.

This vision was changed by Arrow (1962), who found that there is a great incentive to innovate in more competitive environments. In this sense, the theoretical models that result from these perspectives predict a range of outcomes that depend on the type of innovation (products vs. processes), the innovation strategy (patents vs. licenses) and the characteristics of firms (quality and motivation to escape competition).

Scherer (1967) and Kamien and Schwartz (1976) predicted the existence of an inverted-U relation between competition and innovation, an approach that was popularized by Aghion et al. (2005) who demonstrated that Arrow's approach applies when competition is low and that Schumpeter's approach applies when competition is high. In other words, if the initial degree of competition is low, the inverted-U predicts a positive impact of increased competition on the innovation effort. On the contrary, at high levels of initial rivalry, increases in competition reduce incentives for innovation.

Hence, Polder & Veldhuizen (2010, 2013) conclude that competition can foster or hinder business innovation. First, it encourages firms to innovate in order to escape competition and, second, it makes it difficult for firms to derive additional benefits from innovation.

III. Literature review

In order to characterise and quantify the relation between competition and innovation, Poldahl & Tingvall (2006), using data for the manufacturing sector in Sweden, determine that an inverted-U relation between both variables, when they take as proxy variable of the competition the Index of Herfindahl. Nevertheless, when they use the Lerner Index they find a negative relation.

Tingvall & Karpaty (2008) perform a similar analysis for Swedish firms in the service sector, using the Herfindahl Index and the Boone Index as competition measures. They find evidence for an inverted-U relation, except for non-exporting firms. External R&D expenditures do not fit the inverted-U pattern, but internal R&D and employee training expenses fit the inverted-U pattern.

Askenazy et al. (2008) find evidence of an inverted-U relation for large firms in France, but not for the complete sample. When they control for innovation costs (patent costs), the results suggest that the relation between innovation and competition is flat as costs increase. When innovation costs are relatively high compared to value added, changes in competition are less important in innovation decisions.

In his study for Austria, Friesenbichler (2007) reports evidence for a bell pattern for the mobile phone industry. The study uses the Herfindahl Index as a measure of competence and R&D and an indicator of service innovation as innovation measures. Although the sign of the quadratic coefficient of the Herfindahl Index is negative, indicating an inverted-U relation, the study presents only a test of the combined significance of the quadratic and linear terms.

Bos et al. (2009) found an inverted-U relation for firms in the US banking sector using the Lerner Index and they concluded that, over the period of time considered, the level of competition exceeded the optimum level, considering the fact that deregulation has reduced innovation rates in this sector.

Instead, as suggested by Schmutzler (2010), competition reduces margins and increases the sensitivity of the level of equilibrium production to efficiency. Competition may also have positive or negative effects on the level of equilibrium production and on price sensitivity respect to marginal costs. This explains why the effects of competition on innovation are ambiguous. For this reason, using a general structure in two stages, Schumutzler (2010) shows sufficient conditions for increases in competition to have positive or negative effects on investment in R&D, respectively. Both possibilities arise in plausible situations, even if relatively narrow definitions of increased competition are used.

In a model for postal services in France, Felisberto (2012) shows that the demand price elasticity for the incumbent has a consistently negative impact on the effort in innovation. In the case of a duopoly, the model also shows an inverted-U relation between the incumbent's market share and incentives for innovation (Peneder, 2012).

Berubé et al. (2012), using the Lerner Index and the Boone Index, find a consistent positive effect of competition on R&D expenditure. For the Boone Index, adding a quadratic term leads to a significant negative coefficient, which would be consistent with the inverted-U relation, but the above-mentioned relation disappears when they use a Lerner Index (Peneder, 2012).

However, Peroni & Gomes Ferreira (2012) found no evidence of the inverted-U relation. The overall impact of competition on innovation is negative, with a positive quadratic term in nonlinear specification. The inverted-U relation seems counterintuitive, but they coincide with Schumutzler (2010) and Tishler & Milstein (2009) proposals.

Raymond & Plotnikova (2014), using four perceived competition measures and three indicators of technological innovation, estimate a model of simultaneous nonlinear dynamic equations with pseudo-effects and they find that competition in obsolete products Granger-causes innovation activities and the eventual success of innovation. The analyses of these authors differ from other studies on the subject given that they use a perceived competition concept (several measures in the innovation survey). They consider that the competitive environment in Luxembourg is better described by these subjective measures than traditional measures such as market concentration, the Lerner Index or the Boone Index.

Like Tang (2006), the reasons behind the use of the perception of specific competition by Raymond & Plotnikova (2014) are manifold. First, the above measures are the result of competition and they do not capture the underlying process that influences the firm's decision making. Second, considering a competitive environment, different firms may have different perceptions of competition, which can induce different innovative reactions. Third, perception measures capture the competitive environment of diversified firms operating in different markets. Perception measures also capture external markets, while market concentration measures do not. And finally, competition is multidimensional. Consequently, these features make competition unlikely to be accurately measured by a single variable (Wright, 2011).

IV. Data and statistical analysis

This section presents the variables that make up the database and with which a descriptive statistical analysis is developed. Additionally, most of these data are used in the estimates presented in the following methodology section.

A. Data and variables definition

The database was constructed from the World Economic Forum surveys and World Bank data. Our database contains information between 2007 and 2015 for 75 countries, including 6 variables that measure innovation, 2 variables that measure competition and, 1 variable for economic activity.

Innovation variables

The most commonly used variables to measure innovation are R&D expenditure and patent activity (number of patents requested). For this reason, we include research and development expenditure as a percentage of GDP and patent applications per million of inhabitants.

Additionally, for the construction of the global competitiveness index, the World Economic Forum considers different variables to measure innovation. The first variable is innovative capacity (Pillar 12), which analyses research quality and quantity. In other words, this variable provides a measure for the capacity of a country to turn ideas into new goods and services. Other indicators such as Research and development collaboration between universities and industry, research and development expenditure by companies, are used as a proxy for each country innovative capacity.

Competition variables

We use two competition variables. Unlike Nickell (1996), who uses the Lerner Index and the marginal cost at the industry level, we use data that aggregate, at the country level, the indicator of competition market.

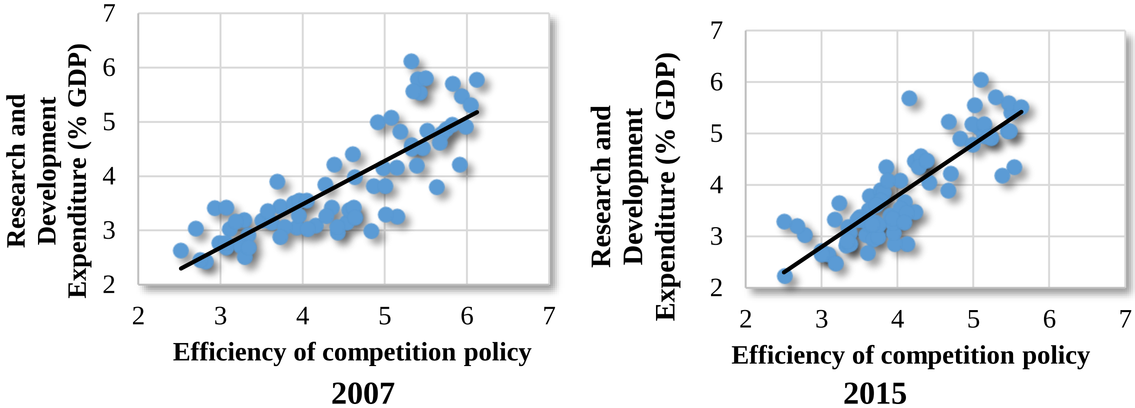
To measure the efficiency of the product market, the World Economic Forum uses two variables. The first measure is competition in the local market. The second measure depicts how effective anticompetitive policies are. Both variables are measured on a scale of 1 to 7. For the local market variable competition, 1 is the value assigned to uncompetitive market structures and 7 represents an intense competition. Similarly, in the case of the effectiveness of competition policy measure, 1 indicates that it is not effective and 7 that it is extremely effective.

B. Graphics and Statistics: a preliminary analysis

To observe the relation between the various indicators of competition and innovation, dispersion diagrams are carried out using as competition indicators the Efficiency of the Competition Policy and the Intensity of Competition and as innovation indicators the Expenditure is taken in Research and Development as a percentage of GDP and the intensity of competition for 2007 and 2015 for the total number of countries in the sample.

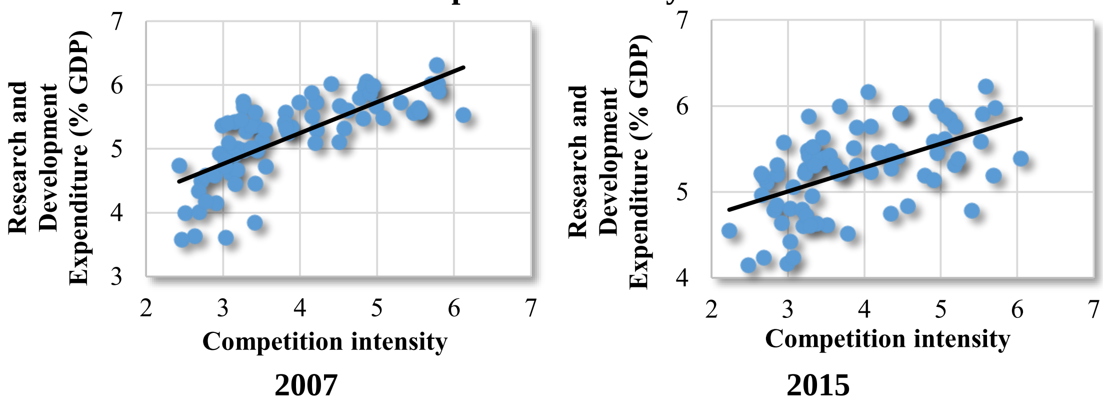
For the total of the comparisons analyzed, a positive relation is observed between the variables of interest, that is, high values in the competition indicators are related to high values in the innovation indicators, as well as low competition values are associated with low innovation values, both for 2007 and for 2015, this is observed in Graph 1, Graph 2, Graph 3 and Graph 4.

Graph 1. Relation between Research and Development Expenditure (% GDP) and the efficiency of competition policy.



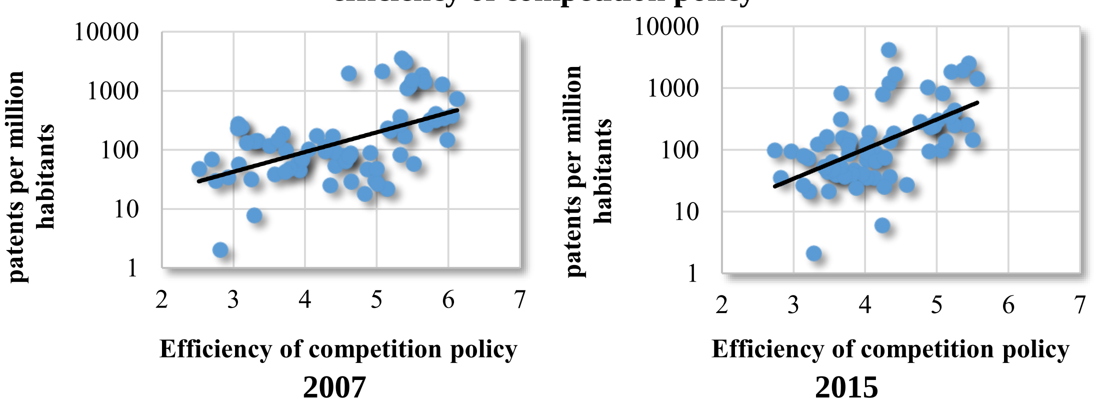
Source: WEF, World Bank – GEE-SIC.

Graph 2. Relation between Research and Development Expenditure (% GDP) and competition intensity



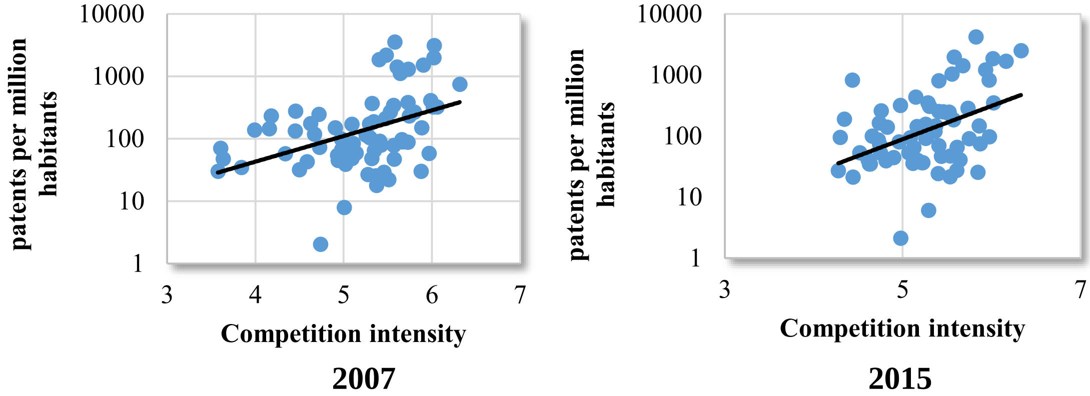
Source: WEF, World Bank – GEE-SIC.

Graph 3. Relation between patents per million habitants (logarithmic scale) and the efficiency of competition policy



Source: WEF, World Bank – GEE-SIC.

Graph 4. Relation between patents per million habitants (logarithmic scale) and competition intensity



Source: WEF, World Bank – GEE-SIC.

V. Methodology

Starting from the previous theoretical exposition, the general econometric model to estimate is presented below. A general model, because we estimate multiple econometric specifications with different controls.

In order to analyse the non-linear relation between R&D and competition, we estimated the flowing equation:

$$\log(Innovation_{it}) = \alpha_j + \lambda_t + \beta_1 Competition_{it} + \beta_2 Competition_{it}^2 + \varepsilon_{it}$$

Where i denotes the country, ID_{jt} the total expenditure in R&D in the i-th country; $Competition_{it}$ is the competition level in the i-th industry; α_j is the country dummy, λ_t year dummy and ε_{jt} is the error term.

If the relation is an inverted-U, the obtained result should be $\beta_2 < 0$. The optimal level for competition ($Competetition^{*}$) is $-\beta_1/2\beta_2$. This turning point represents the level where increases in competition level have a negative effect on innovation.

Provided that $Competition > 0$, it is necessary that $\beta_1 > 0$ in order to have $Competition^{*} > 0$. Moreover, to avoid spurious conclusions about the turning point, $Competition^{*} \in (Competition_L, Competition_H)$, where, $Competition_L$ indicates the minimum level of competition and $Competition_H$ corresponds to the maximum level thereof.

Furthermore, to determine the robustness of this relation, this link is estimated using numerous econometric techniques. We use two statistical techniques: Two-Stage Least

Squares (2SLS) with fixed effects and Generalized Method of Moments (GMM). As an initial step, several econometric models with different dependent variable are estimated.

In order to validate the model results, we applied the Hausman (1978) test for each 2SLS estimated regressions to determine whether fixed effects or random effects should be used. Besides, to compare the obtained results with 2SLS, the same estimates are made using GMM estimator. The foregoing methodology reduces the problem of reverse causality and endogeneity in the model, using lags of independent variables. Each estimate shows the Sargan (1958) J-test to assess the validity of the instruments used, under the null hypothesis instruments are valid.

VI. Results

This sections presents the estimates and the analysis results. In all cases, fixed effects for country and year were used. Besides, instruments were used to reduce endogeneity problems between competition and innovation variables. These instruments are independent variables delays, knows as internal instruments, which fulfilled the assumption of weak exogeneity. In some cases, the intensity of completion is used as instrument for antitrust policy efficiency.

The following tables present the results of econometric models estimates, with different dependent variable. It should be noted that the estimates with the "*antitrust policy efficiency*" variable do not validate the existence of an inverted-U relation between competition and innovation in some econometric specifications. While the results show a positive linear relation between competition intensity and innovation, either R+D expenditure as percent of GDP or patent request, they are not presented in this document.

Following, Aghion et al. (2005) specification, Table 1 presents the results for two models using innovation as the dependent variable (measured as the logarithm of R+D expenditure (% of GDP)) and "*intensity of competition in the local market*" as the independent variable. For the first regression (1), an 1% increase in the antitrust policy efficiency indicator generates an increase of 19,68% and a reduction of 7,19%*Log(*Com_loc*) in R+D expenditure (innovation). These results indicate that countries with an antitrust policy indicator greater than 3.92 are in the curve declining segment.

Table 1. Estimated models with logarithm of R+D expenditure (% of GDP) as dependent variable

	Dependent variable Log(R&D)	
	(1) Method: 2SLS *fixed effects*	(2) Method: GMM *fixed effects*
Intercept	-13,36172 (5,7367)**	-13,11938 (4,535974)***
Log(Eff_Pol)	19,68193 (8,6091)**	19,42531 (6,85361)***
Log(Eff_Pol)^2	-7,191306 (3,2595)**	-7,135934 (2,53571)***
R square	0,9644	0,9648
obs	506	506
Countries	73	73
Prob (F)	0,0000	0,0167
Prob (J)	0,3591	0,3361

(***) significance at 1% level.
(**) significance at 5% level.
(*) significance at 10% level.

Table 2 presents the results for two models using innovation as the dependent variable (measured as logarithm of the number of patent requests per million population) and "*intensity of competition in the local market*" as the independent variable. For the first regression (1), an 1% increase in the antitrust policy efficiency indicator generates an increase of 11.43% and a reduction of 4.09%*Log(*Com_loc*) in patent requests (innovation). These results indicate that countries with an antitrust policy indicator greater than 4.04 are in the curve declining segment.

Table 2. Estimated models with logarithm of patent requests as dependent variable

	Dependent variable Log(Pat)	
	(1) **Method: 2SLS** ***fixed effects***	**(2)** **Method: GMM** ***fixed effects***
Intercept	-3.04890	-4.69300
	(3,7650)	(4,2619)
Log(Eff_Pol)	11.43980	13.90622
	(5,4938)***	(6,2145)**
Log(Eff_Pol)^2	-4.0922	-4.99674
	(1,9717)***	(2,2279)*
R square	0.9709	0.9688
obs	567	567
Countries	75	75
Prob (F)	0.0000	0.0000
Prob (J)	0.4672	0.2495

(***) significance at 1% level.
(**) significance at 5% level.
(*) significance at 10% level.

Table 3 shows the results of the estimation of two models in which innovation is explained (measured as the logarithm of innovation pillar (country innovation capacity)) based on the competence variable "*intensity of competition in the local market*" following the specification of Aghion et al. (2005), linear and squared. It is observed, for example, that for the second regression (2) an increase of 1% in the antitrust policy indicator causes an increase of 8.15% and in turn a reduction of 2.86%*Log (*Com_loc*) in the capacity indicator of innovation of the country (innovation), which indicates that countries that have an antitrust policy indicator greater than 4.14 are in the decreasing segment of the curve.

Table 3. Estimated models with logarithm of innovation pillar as dependent variable

	Dependent variable Log(INN)	
	(1) **Method: 2SLS** ***fixed effects***	**(2)** **Method: GMM** ***fixed effects***
Intercept	-2,6321	-18,8308
	(1,0902)***	(8,8493)***
Log(Com_loc)	9,1148	8,151825
	(2,3756)***	(2,0798)**
Log(Com_loc)^2	-3,2052	-2,866295
	(0,8572)***	(0,7524)*
R square	0,8956	0,9116
obs	590	590
Countries	75	75
Prob (F)	0,0000	0,0000
Prob (J)	0,4672	0,2495

(***) significance at 1% level.
(**) significance at 5% level.
(*) significance at 10% level.

Table 4 shows the results of the estimation of two models in which innovation is explained (measured as logarithm of firms R+D expenditure) based on the competence variable "*intensity of competition in the local market*", following the specification of Aghion et al. (2005), linear and squared. It is observed, for example, that for the first regression (1) an increase of 1% in the antitrust policy indicator causes an increase of 3.76% and in turn a reduction of 1.19% * Log (*Com_loc*) in the expense indicator in R&D by companies, which indicates that countries that have an antitrust policy indicator greater than 4.33 are in the decreasing segment of the curve.

Table 4. Estimated models with logarithm of firms R+D expenditure as dependent variable

	Dependent variable Log(R&D_Companies) (1) Method: 2SLS *fixed effects*	(2) Method: GMM *fixed effects*
Intercept	-1,6321 (1,2902)***	-18,8308 (8,8493)*
Log(Com_loc)	3,7643 (1,8966)***	25,7707 (11,5445)*
Log(Com_loc)^2	-1,1974 (0,6844)***	-8,2065 (3,7339)*
R square	0,9461	0,8665
obs	590	513
Countries	75	75
Prob (F)	0,0000	0,0000
Prob (J)	0,4672	0,2495

(***) significance at 1% level.
(**) significance at 5% level.
(*) significance at 10% level.

Table 5 shows the results of the estimation of two models in which innovation is explained (measured as logarithm of R+D collaboration between Universities and Industries (column 1) and logarithm of firms innovation capacity (column 2)) based on the competence variable "antitrust policy efficiency", following the specification of Aghion *et al.* (2005), linear and squared. It is observed, for example, that for the first regression (1) an increase of 1% in the antitrust policy indicator causes an increase of 4.63% and in turn a reduction of 1.60% * Log (*Com_loc*) in the collaboration indicator University-Industry on R&D issues, which indicates that countries that have an antitrust policy indicator greater than 4.22 are in the decreasing segment of the curve.

Table 5. Estimated models with logarithm of R+D collaboration between Universities and Industries (left) and logarithm of firms innovation capacity (right)

	Dependent variable Log(Col_UI) (1) Method: 2SLS ***fixed effects***	**Dependent variable Log(Cap_Inn) (2) Method: MC2E** ***fixed effects***
Intercept	-1,9044 (1,2696)***	-14,4274 (3,9737)***
Log(Eff_Pol)	4,63561 (1,8663)***	22,4612 (5,8411)***
Log(Eff_Pol)^2	-1,6079 (0,6734)***	-7,8663 (2,1077)***
R square	0,9312	0,4065
obs	590	590
Countries	75	75
Prob (F)	0,0000	0,0000
Prob (J)	0,4672	0,2495

(***) significance at 1% level.
(**) significance at 5% level.
(*) significance at 10% level.

VII. Conclusion

This document constitutes an important contribution to the empirical literature relative to competition and innovation (industrial property) relations. Indeed, this study presents, firstly, estimates with information for 75 countries between 2007 and 2015. Secondly, the results are robust and they show an inverted-U relation, using different innovation indicators.

The results show that, regardless of the chosen variable as a proxy for innovation, the efficiency antitrust policy and the squarely efficiency antitrust policy variables are significant, as Aghion *et al.* (2005) analysis. In other words, there is statistical evidence to conclude that increases in competition level generates innovation. Nevertheless, these increases are not permanent. Besides, the results establish an optimal competition level (turning point) where the competition effect on innovation begins to be negative. For each model, the turning point was calculated and the value ranges between 3.9 and 4.3. The range can be discussed in further papers.

The increased and decreased curve segments can be explained with existing empirical literature and theoretical approaches. Firstly, competition in the market can increase the innovation incremental benefit (Escape effect). Secondly, competition can, also, reduce incentives for innovation (Schumpeterian effect). Therefore, the turning point is a starting point for determining which countries are in each segment (increasing or decreasing segments).

Future studies may include more countries and may have additional variables to measure competition intensity and competition policy efficiency. Additionally, some estimates can be made by continents and/or countries groups, also by income level, or income distribution.

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Annexes

A. List of countries

Code	Country	Code	Country
ARG	Argentina	LVA	Latvia
ARM	Armenia	LTU	Lithuania
AUS	Australia	LUX	Luxembourg
AUT	Austria	MKD	Macedonia, FYR
AZE	Azerbaijan	MYS	Malaysia
BGD	Bangladesh	MLT	Malta
BEL	Belgium	MEX	Mexico
BRA	Brazil	MDA	Moldova
BGR	Bulgaria	MNG	Mongolia
CAN	Canada	NLD	Netherlands
CHL	Chile	NZL	New Zealand
CHN	China	NOR	Norway
COL	Colombia	PAN	Panama
HRV	Croatia	PER	Peru
CYP	Cyprus	PHL	Philippines
CZE	Czech Republic	POL	Poland
DNK	Denmark	PRT	Portugal
EST	Estonia	ROU	Romania
FIN	Finland	RUS	Russian Federation
FRA	France	SRB	Serbia
GEO	Georgia	SGP	Singapore
DEU	Germany	SVK	Slovak Republic
GRC	Greece	SVN	Slovenia
GTM	Guatemala	ZAF	South Africa
HKG	Hong Kong SAR	ESP	Spain
HUN	Hungary	SWE	Sweden
ISL	Iceland	CHE	Switzerland
IND	India	TJK	Tajikistan
IDN	Indonesia	THA	Thailand
IRN	Iran, Islamic Rep.	TTO	Trinidad and Tobago
IRL	Ireland	TUN	Tunisia
ISR	Israel	TUR	Turkey
ITA	Italy	UKR	Ukraine
JAM	Jamaica	GBR	United Kingdom
JPN	Japan	USA	United States
JOR	Jordan	URY	Uruguay
KAZ	Kazakhstan		
KOR	Korea, Rep.		
KGZ	Kyrgyz Republic		