INTELLECTUAL PROPERTY AND COMPETITION AS COMPLEMENTARY POLICIES: A TEST USING AN ORDERED PROBIT MODEL[1]

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Abstract

Utilizing economic theory, this paper tests the proposition that intellectual property rights and competition policy are complementary policies. An ordered probit model is applied to a sample of over 4,000 firms in 36 countries in order to estimate the marginal effects of the use and quality of enforcement of intellectual property rights on a measure of the degree of seriousness of competition problems. The results obtained reinforce the notion that competition and IP are not contradictory policies.

Keywords: Competition policy, intellectual property, ordered probit models.

Resumo

Este artigo testa a proposição da teoria econômica de que propriedade intelectual e defesa da concorrência são políticas complementares. Um modelo probit ordenado é utilizado para estimar os efeitos marginais do uso e qualidade do *enforcement* dos direitos de propriedade intelectual em uma medida da gravidade dos problemas relacionados à concorrência. Os resultados obtidos reforçam a noção de que as políticas de concorrência e propriedade intelectual não são contraditórias.

Palavras-chave: Defesa da concorrência, propriedade intelectual, modelos probit ordenado.

JEL Classification: L49, O34, C25.

Área ANPEC: 8 – Economia Industrial e da Tecnologia

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[1] This paper is based on a section of a report prepared for the World Intellectual Property Organization (WIPO) project on Intellectual Property and Competition Law. Earlier versions were discussed at the Center for the Brazilian Studies at Columbia University, the Regulation, Competition and Trade Group at Fundação Getúlio Vargas in São Paulo, Brazil and at the Instituto Tendências in São Paulo, Brazil. We thank the numerous suggestions and comments, and especially Cinthia Konichi, Gustavo Onto, Isabell Dold, Vinícius Yosimoto and Virgínia Resende for their competent research assistance in collecting data on intellectual property and antirust in various countries. Revision of the text by Jessica Gillota is gratefully acknowledged. The usual caveats apply.

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Introduction

Economic theory suggests that intellectual property rights and competition policy are complementary policies. The objective of this paper is to test this proposition by applying an ordered-probit model to a sample of over 4,000 firms in 36 countries.

The paper is divided in two sections. Section 1 contains a brief theoretical discussion of the relationship between intellectual property rights (IPRs) and competition policy as interdependent and complementary tools. Section 2 contains a test of such theoretical expectation using an ordered probit model.

The contributions of this paper are threefold. First, it contains a measure of the degree of seriousness of competition problems as well as a measure of the degree of implementation of IPR. Second, it offers a test of the relationship of these two variables while controlling for a number of relevant characteristics. Third, the results obtained reinforce the notion that competition and IP authorities should cooperate.

1. Intellectual Property and Competition as Complementary Policies: the Theoretical Argument

Intellectual property rights and competition policy share a common objective, namely to protect competitive markets so that they generate economic efficiency and welfare. There is no clear trade off between competition and innovation, and therefore the two policies must not be seen as contradictory.

1.1 The scopes of competition policy and intellectual property rights

Competition policy is a set of tools used by the state in order to protect and promote the process of competition, with the aim of achieving allocative efficiency. When competition is absent, market power is exercised and the equilibrium price obtained is at a level above marginal cost. This creates allocative inefficiency.

Competition is also regarded as an important source of productive efficiency (x-efficiency), which occurs when firms produce the maximum output possible from a given amount of inputs, and dynamic efficiency, which occurs when society takes full benefit of innovations that are economically viable.

Intellectual property (henceforth IP) allocates exclusive rights (intellectual property rights, or IPRs) for creators, innovators and artists. As the cost of reproducing ideas and innovations tends to be low and sometimes close to zero, IPRs encourage further innovation by enabling its owners to be rewarded for its use. This reward can occur in two ways: by the economic profits the innovator can obtain by being the sole user of the invention and/or by licensing the IPR and receiving royalties for its use.

As the objective of IP is to induce innovations that will ultimately provide better conditions for price, quality and diversity of products available to consumers, it possesses the same final goal as competition policy, which is to promote welfare.[2]

[2] The concept of economic welfare varies among jurisdictions. In some countries total welfare including both consumer´s and producer´s welfare is considered. In others, only consumer´s welfare is taken into consideration.

1.2 Is there a conflict between competition policy and intellectual property?

At first glance, one would think that there would exist an inherent conflict between intellectual property rights and competition policy. However, for this to be accurate, two conditions must hold:

i. There must exist a trade off between competition (or short run allocative efficiency) and innovation (or long run dynamic efficiency).

ii. Since IP induces innovation by granting market power to innovators and competition policy aims at restricting the use of market power, the policy objectives may be contradictory at some point in time.

1.2.1 Does market power induce innovation?

The idea that market power is necessary for R&D investment and innovation dates back to the work of Joseph A. Schumpeter in the 1940s.[3] There are two reasons why market power should induce innovation. First, monopoly profits may be an important form of financing R&D projects. Second, market power generates the profits necessary for the appropriation of R&D investments.

Scherer and Ross (1990) point out that the theoretical literature on the first condition does not lead to a single conclusion. Henceforth, the importance of monopoly profits in R&D financing is mainly an empirical question. Unfortunately, as Scherer and Ross (1990) also note, this is a difficult hypothesis to test, since it is hard to establish what the time lag between profits and R&D investments is and to exclude both the feedback from innovation to profits and other variables that affect both innovation and profits, such as demand changes.

It must also be noted that, for the first assertion to be true, other forms of R&D financing such as credit markets and government grant programs must not be available. There is no *a priori* reason to suppose that this is true. In conclusion, <u>the theory that monopoly profits are necessary for R&D financing is not sound or robust enough to serve as a basis for public policy decisions.</u>

On the other hand, there is extensive literature exploring the relationship between market structure and innovation.[4] Most of this literature focuses on the effect of market structure on innovation (not considering the effect that innovations can have in forging market structures variables such as concentration and entry barriers). However, this literature presents ambiguous results.[5]

However, one of the most robust conclusions of this literature can be presented in a simple model that demonstrates the interaction between the two main effects of competition on innovation[6]:

- Firms under stronger competitive pressure innovate rapidly in order to be the first with the new product; and
- The existence of more rivals split the potential benefits into more parts.

The model considers innovation as the speed of new products (or productive processes) development. It is assumed that, the faster a new product is developed, the higher R&D costs. Although this is somewhat intuitive, Scherer and Ross (1990) present reasons justifying this assumption. Hence, there exists a cost-time tradeoff in the development of new products that is presented as the CC' curve in Chart 1.

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[3] Schumpeter (1942) is the main reference.
[4] Reinganum (1989) presents an early extensive survey of the theoretical literature on market structure and innovation.
[5] Scherer and Ross (1990) point out that "through an astute choice of assumptions, virtually any market structure can be shown to have superior innovative qualities".
[6] Viscusi et alli (1995).

Also, the longer the time that it takes for a new product to be introduced into the market, the smaller is the present value of the firm's profits with this product. This profit-time tradeoff is presented for the case of a monopolist (which is, in this model, a firm that only considers the development of this product) as the V_1 curve in Chart 1.

Chart 1: Incentives to Innovate in a Monopoly

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Source: Adapted from Viscusi et alli (1995)

Let T1 be the optimal time that the monopolist represented in Chart 1 will take to develop the new product. T1 is the time where the distance between V1 and CC' is the greatest, that is, where the expected profit is maximized[7].

Now, suppose that there is another firm considering the development of this new product. This competitor faces the same cost-time tradeoff (that is, the same curve CC'). However, the profit-time tradeoff is affected by the presence of competition, being now represented as V2 in Chart 2. This new curve must be lower and steeper than V1, since, respectively, the total market potential profit must now be split between two firms and the payoff of innovating early is higher (the earlier the first firm innovates to develop its product, the longer it will be able to reap monopoly profits). Furthermore, as the number of rivals increase, the profit-time tradeoff curve becomes lower and steeper. Hence, Chart 2 demonstrates the curve representing the tradeoff when there are ten rivals (V10).

Chart 2: Incentives to Innovate in Different Market Structures

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Source: Adapted from Viscusi et alli (1995)

Two conclusions can be drawn from Chart 2. First, innovation occurs faster in a duopoly than in a monopoly (or $T_2 < T_1$). This is due to the fact that competition creates the incentive to be the first to innovate. Second, there are cases where the number of rivals is so large that any R&D investment is unprofitable, and no innovation occurs; or in terms of Chart 2, the curve V_{10} is beneath CC', implying that the expected profits are smaller than any expected cost of innovating.

As the number of rivals presented are merely representative and can be understood broadly as a proxy for the intensity of competition in the model, one can conclude that *some* degree of competition is necessary to spur faster innovation, but, there can be cases where *too much* competition makes innovation unprofitable.

The model above considers competition in R&D itself, as multiple firms consider the development of a new product. However, if only a single firm is able to engage in some innovation, then being in a more competitive market only has a positive effect on innovation.

[7] Geometrically, this is the point where the two curves have the same slope.

Suppose a monopolist produces at cost c_a and obtains a profit equal to A. The company has the choice of sum F in R&D and then to produce at a lower cost c_b, which allows it to earn a higher profit B. This monopolist will only engage in innovation if the difference between B and A is higher than F (that is, the investment is profitable).

Now consider a firm with the same cost structure under perfect competition. If this firm spends F in R&D and starts to produce at cost c_b, it will be able to supply to the whole market and earn a profit of B earning thus a profit of zero. This firm would innovate if B[8] is higher than F. As B is obviously higher than the difference of B and A, the firm under competitive pressure has a higher incentive to innovate and, in the cases where F lies between A and B, only the firm under competition would choose to invest. This is the so-called *Arrow's replacement effect*, due to the fact that, while a firm under competition replaces its competitors when it innovates, a monopolist replaces itself.

There is a large body of empirical literature on the effects of market structure and competition on innovation[9]. In general, this empirical literature concludes, through the analysis of industry-level data from developed countries, that the effect of concentration on R&D and innovation follows an "inverted U" shape, that is, too little competition or too much competition hinders innovation. Also, the analysis of firm-level data for the United States and United Kingdom points that larger firms are not more prone to engage in innovation, thus not supporting the Schumpeterian view of the monopoly-innovation relationship.

Taking this large theoretical and empirical literature into account, Scherer and Ross (1990) stated that:

> "*Schumpeter was right in asserting that perfect competition has no title to being established as the model of dynamic efficiency. But his less cautious followers were wrong when they implied that powerful monopolies and tightly knit cartels had any stronger claim to the title. What is needed for technical progress is a subtle blend of competition and monopoly, with more emphasis in general on the former than the latter.*" (Scherer and Ross, 1990, p. 670)

However, as noted by Motta (2004), it is almost impossible to use the results above in competition policy and/or intellectual property rights issues. The "optimal competition for innovation" in any market depends on an enormous array of parameters and variables that cannot be directly observed by policymakers.

In this sense, Motta (2004) advises against any policy trying to introduce the "right" level of competition in any market. This author also underlines the fact that that reducing the level of competition in a given industry in order to reach a theoretically optimal level of innovation is "*not justified by any robust theory*".

Thus, the theoretical and empirical literature does not support the existence of a clear tradeoff between competition and innovation. It is more likely that both competition and a certain amount of market power are necessary to spur the development of new products and processes.

1.2.2 Does intellectual property grant market power?

This subsection addresses the second condition, which states that IPRs convey market power to innovators, thus promoting the very phenomenon that antitrust aims at deterring.

The misleading part of this is not in its internal logic, but on the way it presents the objective of competition policy and the mechanisms through which IP policy induces innovation.

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[8] This requires the assumption that the cost reduction is large enough to make a monopoly price under cost c_b lower than c_a (the price that the innovator's competitor can supply the product). However, the main results hold without this assumption. See Motta (2004), which serves as a basis of the argument presented, for more details.

[9] See, for instance, Cohen and Levin (1989).

First, it must be noted that IPRs do not necessarily create or enhance market power. This view is almost consensual in both academia and public policy[10]. The product or production process which is protected by the IPR may have substitutes which remain unprotected. In the jargon of antitrust analysis, IPRs grant powers over specific products, and not whole relevant markets. In most cases, it is expected that the product under IPR protection is only a fraction of this relevant market.[11] Moreover, IPRs usually contain mechanisms which enable the possibility of a competitor as in the case of compulsory licensing.

Second, "restricting the use of market power" would not be an accurate description of competition policy. One of the basic tenets of antitrust is that market power is not, by itself, illegal. Some degree of market power is necessary for the occurrence of other efficiency enhancing phenomena such as economies of scale and scope, synergies, transaction costs economies and, also, innovation[12]. The problem is the abusive use of this market power.

Thus, it is clear that i) it is misleading to assume that IPRs necessarily create or enhance market power; and ii) challenging the possible market power granted by an IPR is not an objective of competition policy. Hence, it would be more adequate to think of both policies not as contradictory, but as complementary.

There are two recommendations on how IP authorities should address anticompetitive issues. First, including a rigorous assessment of competition issues on the analysis of IPR filings would probably generate more costs than benefits. Second, allowing for post-grant reviews and opposition by third parties and government bodies can diminish the cases which an IPR enables anticompetitive practices.

Evidence from seven selected countries suggest two facts[13]. First, there is no uniformity in stating specific provisions for IPR-related anticompetitive conduct or for exemption mechanisms for IPR owners. Second, the fact that most antitrust legislations include innovation as an important issue to be taken into account in merger review points out that: i) dynamic efficiency is a goal of competition policy, and ii) the possibility of applying the innovation markets approach is present in most countries.

2. Intellectual Property and Competition as Complementary Policies: the empirical evidence

The objective of this section is to empirically assess the relationship between competition and the use of the intellectual property system using national data.

2.1 Data on National Competition and use of IP systems

Obtaining data that provides a meaningful and comparable measure of competition at the national level is not trivial. The precise measure of market power predicted by economic theory (the difference between prices and marginal costs) is difficult to observe in practice.[14]

This work utilizes a sample of over 4,000 firms in 36 countries taken from the *World Business Environment Survey* (WBES) conducted by the World Bank in 1999-2000.[15] The survey asked qualitative

[10] This view was largely supported in an OECD Roundtable on IP and antitrust.
[11] A relevant market is the smallest group of products and geographical area in which it is plausible to assume the exercise of market power.
[12] See Gallini and Trebilcock (1998).
[13] This evidence is contained in a forthcoming study of the World Intellectual Property Organization (WIPO). The selected countries are USA, Brazil, India, South Africa, Mexico, United Kingdom and Canada.
[14] Economic literature usually applies methods that avoid measuring marginal cost, even when the researcher is studying a single market and possesses detailed data. An introduction to this subject can be found in Church and Ware (2002).

questions about the environment in which these firms operate. Of the several questions asked, two were of major interest for the present analysis:

- "*Please judge on a four point scale how problematic are the following factors for the operation and growth of your business:*

  […] anti-competitive practices by government or private enterprises".

- "*Please judge on a four point scale how serious a problem are the following practices of your competitors for your firm:*

  […] they violate my copyrights, patents or trademarks."

The four points are "*1- No obstacle, 2 – Minor Obstacle, 3 – Moderate Obstacle, 4 – Major Obstacle".*

The answers to the first question are a meaningful and comparable measure of the (lack of) quality of the competitive environment of a given country. This variable (henceforth *anticompetitive practice index - API*) measures, on a discrete scale from 1 to 4, how troublesome anticompetitive practices are for a given firm. A comparable measure of market power, if available, would not be so relevant to this study, since, as discussed in Section 1, antitrust aims not at fighting market power *per se*, but practices that extend, obtain or maintain it.

The answer to the second question can measure a quality attribute of intellectual property systems: how (un)able they are to enforce the rights they are granted. Henceforth we will refer to this variable as the *IP violation index - IPVI*. By taking the average of the firms' answers within a country, one can calculate both the API and the IPVI at the national level.

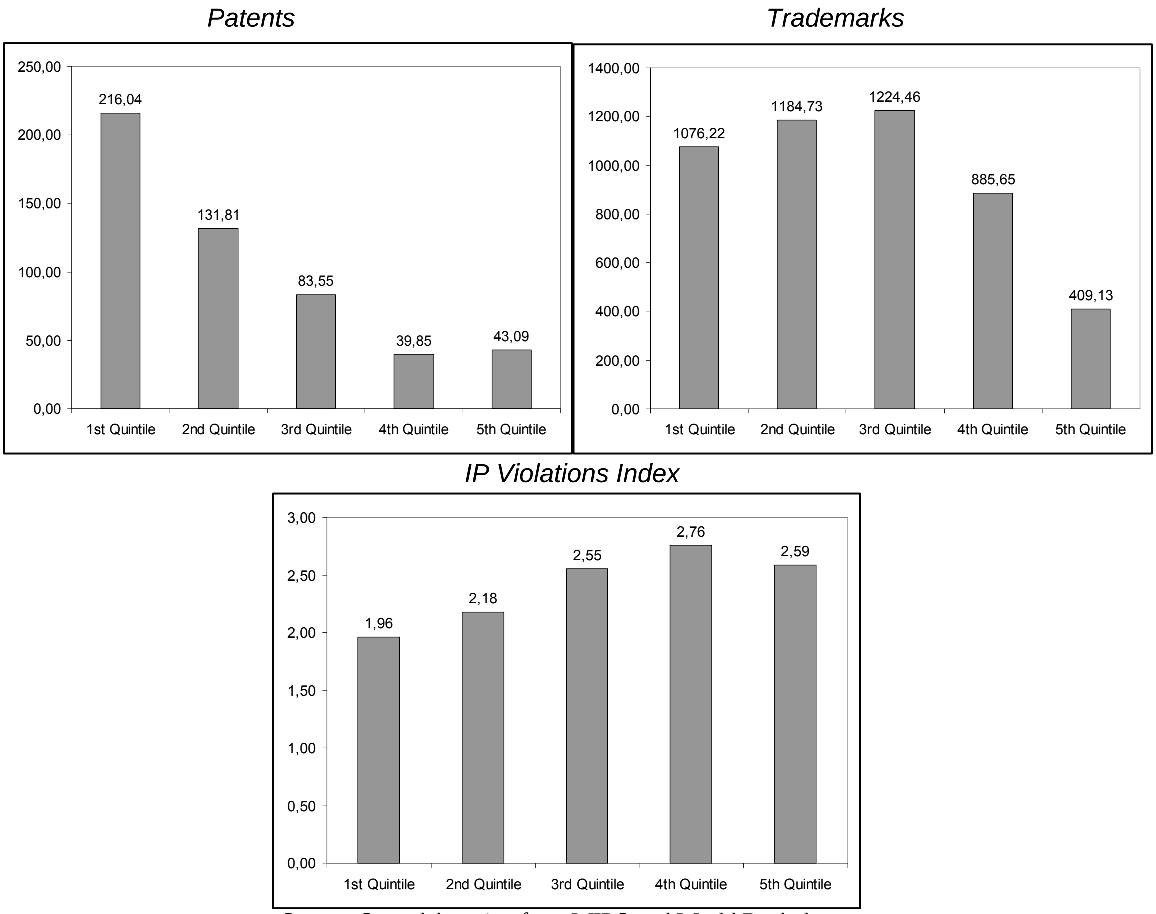
Two other measures of the use of intellectual property are also used. The number of patents and trademarks granted in 1999 in the firm's country (measured in patents/trademarks per thousand people).[16] The World Intellectual Property Organization (WIPO) is the source for this data.

For an introduction to the relationship between the three IP variables and the API, Chart 3 presents the average number of patents, trademarks, and the IPVI by quintile of the anticompetitive practice index.

Chart 3: Average IPR Enforcement Index, by Anticompetitive Practice Index Quintile

[15] The survey interviewed over 10,000 firms in 81 countries. However, due to the fact that information on IP is not available for some countries and that there are several cases of missing data (due to questions that the surveyed firms have not answered) on the WBES, only 4,315 observations could actually be used. Annex 1 presents the list of the 36 countries in our sample.

[16] Data on population is from the Penn World Tables – Version 6.1 (Heston, Summers and Aten, 2002).



Source: Own elaboration from WIPO and World Bank data.

Chart 3 suggests that anticompetitive practices are not a significant obstacle to firms in countries with more use of patent and trademark systems. Also, the significance of IP violations as a concern to firms' business is positively correlated with the significance of anticompetitive practices.

Note, however, that the relationship between the API and the IP variables does not seem to be monotonic. In the cases of patents and the violations index, there seems to be an "inverted-U shaped" effect, while the trademarks present a "U-shaped" relationship with the API.

2.2 The empirical strategy

Since the API is a discrete variable, the empirical strategy is to estimate an ordered probit model for the firm responses to the API question. Basically, it is assumed that there is a theoretical latent variable Y_i^* that is continuous, given by:

$$Y_i^* = X_i\beta + e_i \qquad (1)$$

Where X_i is a $1xK$ vector of variables for firm i, β is a $Kx1$ vector of unknown parameters and e_i is a random term with standard normal distribution. The Y_i^* variable defines the answer to the API question:

$API=1$, if $Y_i^* < \alpha_1$

$API=2$, if $\alpha_1 \leq Y_i^* < \alpha_2$

API=3, if $\alpha_2 \leq Y_i^* < \alpha_3$

API=4, if $\alpha_3 \leq Y_i^*$

Since the αs are also parameters to be estimated, jointly with the βs, by maximum likelihood, it is possible to infer the marginal effect of independent variables on the firms' answer without assuming that the API has a cardinal interpretation.[17]

The *K* variables included in the X_i vector are:

- *patents, trademarks* are the natural logarithms of the number of patents/trademarks granted per thousand people in the country where the firm operates. The squares of these variables are also included, searching for possible nonlinear relationships.
- *violations,* which is the *intellectual property violations index* described in Subsection 3.1. The average of answers within a country is used in order to avoid endogeneity problems. Again, the square of the variables is also included.

- *gdp:* the natural logarithm of the PPP-adjusted *per capita* gross domestic product in the country where the firm operates, from the Penn World Tables database;
- *qcgov, qparl* and *qcourt* are variables from the WBES that reflect, on a continuous scale of 1 to 4, the quality of the central government, parliament, and courts, respectively. As in the case of *violations,* the average of answers within a country is used.
- Six dummy variables from the WBES, assigning a value of one if the firm is in the manufacturing sector (*manuf*), has a large domestic firm or an international multinational as its main competitor (*bigcomp*), has a state owned company as its main competitor (*statecomp*), does not have any competitors (*monopolist*), is state owned (*stateown*), and exports its output (*exports*).

The inclusion of the control variables allows one to observe the effect of the IPR system use/quality holding the level of economic development (*per capita* GDP) and the quality of institutions (central government, courts and parliament) fixed. This is important since it is expected that more developed countries present both stronger IPR and competition policy, and the correlation between these two variables may be entirely due to the effect of economic and institutional development. Chart 4 presents descriptive statistics of the data.

Chart 4: Descriptive Statistics of the Sample

Variable	Unit	Mean	Std. Dev.	Min.	Max.
antcomp	1-4 scale	2.316	1.122	1	4
patents	patents per 1,000 people	0.102	0.109	0.002	0.562
trademarks	trademarks per 1,000 people	0.883	0.820	0.132	3.627
violations	1-4 scale	2.391	0.441	1.388	3.134
gdp	PPP-adjusted US$ thousands	10.635	7.353	1.801	33.726
qcgov	1-4 scale	3.696	0.601	2.721	4.835
qcourt	1-4 scale	3.748	0.348	2.549	4.407
qparl	1-4 scale	4.002	0.485	2.758	4.790

[17] See Wooldridge (2002) for the derivation of the maximum likelihood function, and also for the formulae for calculating the marginal effects. Stata (Version 9) software was used in all the estimations (and marginal effect computations) in this paper.

manuf	Dummy Variable	0.110	0.313	0	1
bigcomp	Dummy Variable	0.177	0.382	0	1
statecomp	Dummy Variable	0.026	0.160	0	1
monopolist	Dummy Variable	0.014	0.118	0	1
stateown	Dummy Variable	0.151	0.358	0	1
exports	Dummy Variable	0.315	0.465	0	1

Source: Own elaboration from WIPO and World Bank data.

2.3 Results

As the coefficients (βs) from the ordered probit model can only be interpreted as the marginal effect of a variable on the latent variable Y^*, and not on the variable of interest (the API), Chart 5 directly reports the marginal effects (measured at the average point of the sample) of the variables on the probability of a firm answering a specific level of API.[18]

These marginal effects are based on a model that excludes non-significant (at the 10% level) control variables. However, Annex 2 presents the results based on the unrestricted model, demonstrating that the main results are robust to the exclusion of non-significant variables.[19]

Chart 5: Marginal Effects from the Ordered Probit Model

Variable	Prob(API=1)		Prob(API=2)		Prob(API=3)		Prob(API=4)	
	Mg. Eff.	(P-Val.)	Mg. Eff.	(P-Val.)	Mg. Eff.	(P-Val.)	Mg. Eff.	(P-Val.)
patents	0.082	(0.004)	0.009	(0.006)	-0.028	(0.004)	-0.063	(0.004)
patents^2	0.010	(0.005)	0.001	(0.008)	-0.003	(0.006)	-0.008	(0.005)
trademarks	0.025	(0.025)	0.003	(0.030)	-0.008	(0.025)	-0.019	(0.025)
trademarks^2	-0.010	(0.166)	-0.001	(0.172)	0.003	(0.167)	0.008	(0.166)
violations	-0.639	(0.000)	-0.070	(0.000)	0.215	(0.000)	0.494	(0.000)
violations^2	0.115	(0.000)	0.013	(0.001)	-0.039	(0.000)	-0.089	(0.000)
gdp	0.025	(0.098)	0.003	(0.105)	-0.008	(0.098)	-0.019	(0.098)
qcgov	-0.051	(0.000)	-0.006	(0.001)	0.017	(0.000)	0.040	(0.000)
bigcomp	-0.057	(0.000)	-0.009	(0.004)	0.018	(0.000)	0.047	(0.000)
statecomp	-0.078	(0.017)	-0.015	(0.110)	0.023	(0.004)	0.070	(0.040)
monopolist	0.119	(0.043)	0.000	(0.972)	-0.044	(0.057)	-0.075	(0.012)
stateown	0.053	(0.003)	0.004	(0.000)	-0.018	(0.004)	-0.038	(0.001)

Source: Own elaboration from WIPO and World Bank data.

Each column of Chart 5 presents the magnitude of the effect of a marginal increase in the independent variables on the probability of the API assuming a given value. The P-Value of the marginal effect, taken from the comparison of a Z-statistic with standard normal distribution, is shown in parenthesis.

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[18] The estimated coefficients are available in Annex 2.

[19] The results are also robust to the exclusion of the square of *trademarks*, which is also nonsignificant.

In general, Chart 5 indicates that both the more frequent use and stronger enforcement of IP has a negative effect on API.

A larger use of the patent system is associated with a higher probability of answering that anticompetitive practices are "*no obstacle*" or "*minor obstacle*" to the firm's operation, while it lowers the probability of answering "*moderate obstacle*" or "*major obstacle*". The fact that the square of *patents* is associated with lower API indicates that the marginal effect of a granted patent granted is larger in countries where there already is ample use of the IP system.

The presence of trademarks is also associated with smaller API. The results point that a 1% increase in the number of trademarks granted raises the probability of a firm answering "*no obstacle*" in 2.5 p.p., while it decreases the probability of answering "*major obstacle*" in 1.9 p.p. Although the marginal effects are not large, the result is statistically significant. Also note that the coefficient on the square of *trademarks* is not significant (at the 10% level).

At first glance, it would seem that the IP violations index has an "inverted-U shaped" effect on the probability of a firm answering "no obstacle" o "minor obstacle", and a "U shaped" effect on the probability of a "moderate" or "major" answer. However, it must be noted that in all cases, the inflection point (the top or bottom of the "U") is at a number higher than four, which is the maximum value of the *IPVI.* Hence, an increase in *violations* raises the probability of a firm answering "*moderate*" or "*major*" and lowers the probability of a "*no obstacle*" or "*minor*" answer.

The marginal effects of firm-specific controls reveal the expected signs: firms that are state-owned and/or monopolists are less prone to have problems with anticompetitive practices, while the opposite occurs with firms that have large companies, multinationals or state enterprises as their main competitors. Economic development, measured by the per capita GDP, is also associated with smaller API. The only counter-intuitive result is the fact that the quality of central government has a positive effect on the API.

As a robustness check, a linear probability model (LPM), which consists of an OLS regression of the API against the dependent variables, was also estimated. Although this model imposes a cardinal interpretation of the API, it does not require that the random term e_i in Equation (1) has a standard normal distribution. The sign and significance of the marginal effects inferred from the LPM were exactly the same as the ones observed in the ordered probit model.[20]

Conclusion

In conclusion, the results show that a more frequent use and stronger enforcement of the patent and trademark systems diminishes the probability of anticompetitive practices. These results confirm the theoretical proposition that IP and antitrust are complementary, not contradictory policies.

The common objective and the complementary nature of the two policy areas may strengthen the case for a closer cooperation between competition and IP agencies.

[20] Annex 2 reports the estimation of the LPM.

References

CHURCH, J. and WARE, R. *Industrial Organization: a strategic approach*. Irwin/McGraw-Hill, 1999.

GALLINI, N. T. and TREBILCOCK, M.J. Intellectual Property Rights and Competition Policy: A Framework for the Analysis of Economic and Legal Issues. In: ANDERSON, R.D. and GALLINI, N.T. *Competition Policy and Intellectual Property Rights in the Knowledge-Based Economy*, Calgary: University of Calgary Press, 1998.

HESTON, A., SUMMERS, R. and ATEN, B. *Penn World Tables Version 6.1*. Center of International Comparisons at the University of Pennsylvania: 2002.

LEVIN, R. and COHEN, W. Empirical Studies of Innovation and Market Structure. In: SCHMALENSEE, R. and WILLIG, R. *The Handbook of Industrial Organization.* Elsevier, 1989.

MOTTA, M. *Competition Policy: Theory and Practice.* Cambridge: Cambridge University Press, 2004.

OECD – ORGANIZATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT. Competition Policy and Intellectual Property Rights. *OECD Journal of Competition Law and Policy, vol. 3, n. 2, August 2001.*

REINEGAUM, J. F. The Timing of Innovation: Research, Development and Diffusion. In: SCHMALENSSE, R. and WILLIG, R. *The Handbook of Industrial Organization.* Elsevier, 1989.

SCHERER, F.M. and ROSS, D. *Industrial Market Structure and Economic Performance.* Boston: Houghton Mifflin Company, 1990.

SCHUMPETER, J. A. *Capitalism, socialism and democracy.* Harper & Brothers, 1942 [original edition].

VISCUSI, W. K., VERNON, J. M. and HARRINGTON, J. E. *The Economics of Regulation and Antitrust.* The MIT Press, 1995.

WHITE, H. A Heteroskedasticity-Consistent Covariance Matrix and a Direct Test for Heteroskedasticity. *Econometrica, vol. 48, n. 3, 1980.*

WOOLDRIDGE, J. M. *Econometric Analysis of Cross-Section and Panel Data.* The MIT Press: 2001.

Annex 1: List of Countries Analyzed in Section 3

Chart A1: Countries in the Sample Analyzed in Subsection 3.2

Country	Number of Firms in the Sample	Part. (%) in the Sample
Argentina	95	2.2
Armenia	110	2.55
Belarus	108	2.5
Bulgaria	106	2.46
Canada	99	2.29
Colombia	97	2.25
Croatia	119	2.76
Czech Republic	113	2.62
Ecuador	74	1.71
Estonia	120	2.78
France	96	2.22
Georgia	124	2.87
Germany	97	2.25
Guatemala	101	2.34
Honduras	90	2.09
Hungary	112	2.6
Italy	88	2.04
Kazakhstan	99	2.29
Kyrgyzstan	93	2.16
Lithuania	95	2.2
Mexico	99	2.29
Moldova	107	2.48
Nicaragua	97	2.25
Poland	214	4.96
Portugal	97	2.25
Romania	107	2.48
Russia	472	10.94
Slovak Republic	123	2.85
Slovenia	123	2.85
Spain	98	2.27
Sweden	98	2.27
Turkey	145	3.36
Ukraine	211	4.89
United Kingdom	100	2.32
United States	94	2.18
Uruguay	94	2.18
Total	**4,315**	**100**

Source: Own elaboration from WIPO and World Bank data.

Annex 2: Robustness Checks on the Statistical Analysis of the Impact of IP on Competition

This annex presents some robustness checks on the results presented in Subsection 2.3. First, Chart A2 reports the marginal effects obtained from an unrestricted ordered probit model, which includes three non-significant control variables (*manuf*, *exports*, and *qparl* and *qcourt*).

Chart A2: Marginal Effects from the Unrestricted Ordered Probit Model

Variable	Prob(API=1)		Prob(API=2)		Prob(API=3)		Prob(API=4)	
	Mg. Eff.	P-Val.	Mg. Eff.	P-Val.	Mg. Eff.	P-Val.	Mg. Eff.	P-Val.
patents	0.065	(0.034)	0.007	(0.040)	-0.022	(0.035)	-0.050	(0.034)
$patents^2$	0.009	(0.023)	0.001	(0.028)	-0.003	(0.023)	-0.007	(0.023)
trademarks	0.024	(0.034)	0.003	(0.040)	-0.008	(0.035)	-0.019	(0.034)
$trademarks^2$	-0.012	(0.121)	-0.001	(0.128)	0.004	(0.122)	0.009	(0.121)
violations	-0.586	(0.000)	-0.064	(0.000)	0.197	(0.000)	0.453	(0.000)
$violations^2$	0.104	(0.001)	0.011	(0.002)	-0.035	(0.001)	-0.080	(0.001)
gdp	0.031	(0.050)	0.003	(0.057)	-0.010	(0.051)	-0.024	(0.050)
qcgov	-0.053	(0.015)	-0.006	(0.020)	0.018	(0.016)	0.041	(0.015)
qcourt	-0.048	(0.089)	-0.005	(0.095)	0.016	(0.090)	0.037	(0.089)
qparl	0.020	(0.519)	0.002	(0.520)	-0.007	(0.519)	-0.016	(0.519)
manuf	-0.021	(0.275)	-0.003	(0.344)	0.007	(0.264)	0.017	(0.291)
bigcomp	-0.060	(0.000)	-0.009	(0.003)	0.019	(0.000)	0.050	(0.000)
statecomp	-0.079	(0.015)	-0.016	(0.104)	0.023	(0.003)	0.071	(0.036)
monopolist	0.116	(0.049)	0.000	(0.991)	-0.043	(0.063)	-0.073	(0.015)
stateown	0.051	(0.004)	0.004	(0.000)	-0.018	(0.006)	-0.037	(0.002)
exports	0.012	(0.385)	0.001	(0.367)	-0.004	(0.388)	-0.009	(0.382)

Source: Own elaboration from WIPO and World Bank data.

Second, a linear probability model (LPM) is estimated by regressing the API against the independent variables. Although this model assumes that the API has a cardinal interpretation, it does not imposes some of the distributional assumptions of the ordered probit model.[21] The White (1980) variance-covariance matrix is used to compute standard errors that are robust to the heteroskedasticity problems usually associated with models with discrete dependent variables.

Chart A3 presents the result from the LPM estimation.

[21] See Wooldridge (2001) for more on this subject.

Chart A3: Results from the Linear Probability Model

Variable	Coef.	P-Value
patents	-0.162	(0.044)
Patents^2	-0.022	(0.026)
trademarks	-0.077	(0.015)
trademarks^2	0.033	(0.120)
violations	1.483	(0.000)
violations^2	-0.256	(0.004)
gdp	-0.098	(0.029)
qcgov	0.141	(0.022)
qcourt	0.114	(0.152)
qparl	-0.064	(0.471)
manuf	0.065	(0.239)
bigcomp	0.176	(0.000)
statecomp	0.231	(0.024)
monopolist	-0.260	(0.058)
stateown	-0.142	(0.003)
exports	-0.036	(0.326)
constant	0.141	(0.840)
R2	0.079	
F-Stat	25.540	(0.000)

Source: Own elaboration from WIPO and World Bank data.

As the coefficient on a given variable can be interpreted as its marginal effect on the API, the sign and significance[22] of the marginal effects from the LPM are the same of the ones from the ordered probit model, pointing to the robustness of the result.

Finally, Chart A4 presents the estimated coefficients from the unrestricted (with all control variables included) and restricted (excluding nonsignificant control variables) ordered probit model.

[22] The P-Values reported on Chart A3 are taken from the comparison of a t-statistic with Student's t distribution.

Chart A4: Results from the Linear Probability Model

Variable	Unrestricted Model		Restricted Model	
	Coef.	(P-Value)	Coef.	(P-Value)
patents	-0,183	(0,034)	-0,232	(0,004)
Patents^2	-0,024	(0,023)	-0,029	(0,005)
trademarks	-0,069	(0,034)	-0,071	(0,025)
trademarks^2	0,034	(0,121)	0,028	(0,166)
violations	1,660	(0,000)	1,810	(0,000)
violations^2	-0,294	(0,001)	-0,326	(0,000)
gdp	-0,087	(0,050)	-0,071	(0,098)
qcgov	0,151	(0,015)	0,145	(0,000)
qcourt	0,137	(0,089)		
qparl	-0,057	(0,519)		
manuf	0,061	(0,281)		
bigcomp	0,174	(0,000)	0,166	(0,000)
statecomp	0,239	(0,023)	0,234	(0,026)
monopolist	-0,309	(0,040)	-0,317	(0,035)
stateown	-0,142	(0,003)	-0,145	(0,002)
exports	-0,033	(0,384)		
α^1	2,165		2,262	
α^2	2,850		2,947	
α^3	3,531		3,627	
Log-Likelihood	-5739,122		-5741,454	
LR Test	363,33	(0,000)	358,66	(0,000)

Source: Own elaboration from WIPO and World Bank data.