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Giuseppe Di Vita

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The TRIPs Agreement and Technological Innovation

Giuseppe Di Vita

Abstract

In this Paper we attempt to evaluate the possible spill-over of the international agreement on Trade-Related aspects of Intellectual Property Rights (TRIPs for short), underwritten in 1994, regarding economic growth for both wealthy and developing countries. The topic is very important for the European integration context, since Union is a party of the 1994 Marrakesh Agreements.
We find that the TRIPs convention has prompted, at the same time, innovation in developing countries and a rise in the per capita income for all the economies involved in international trade. As a by-product of our research we find that, despite the strong growth of resident patents application after 1995 (the year in which TRIPs came into force), most of the increase in the gross domestic product *per capita* in developing Countries is attributable to the international transfer of technologies, via foreign direct investments.

Il presente contributo si propone di valutare le potenziali ricadute dell'accordo internazionale che disciplina gli aspetti della tutela della proprietà intellettuale connessi al commercio internazionale (*Trade-Related aspects of Intellectual Property Rights* TRIPs), sottoscritto nel 1994, sulla crescita economia dei paesi ricchi e di quelli in via di sviluppo. Nel lavoro si affronta un problema di cruciale importanza per l'integrazione europea, essendo l'Unione parte dell'accordo di Marrakesh del 1994.
I principali risultati del lavoro riguardano gli effetti che l'accordo TRIPs ha avuto sia nel promuovere l'innovazione tecnologica nei paesi in via di sviluppo, che nel consentire un aumento del reddito pro-capite in tutti i paesi coinvolti nel commercio internazionale.
È stato, inoltre, osservato che nonostante la crescita imponente del numero di domande di registrazione di brevetti da parte dei cittadini dei paesi in via di sviluppo, dopo il 1995 (anno in cui l'accordo TRIPs è entrato in vigore), buona parte dell'incremento del prodotto interno lordo pro-capite nelle economie povere è da attribuire al trasferimento internazionale di tecnologie, tramite il canale degli investimenti diretti esteri.

Keywords

Foreign Direct Investments - Intellectual Property Rights (IPR) - Patents Protection - Technological Transfer - TRIPs agreement.

THE TRIPS AGREEMENT AND TECHNOLOGICAL INNOVATION *

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Summary: 1. Introduction.- 2. Preliminary analysis of data and their sources.- *2.1. Data description*.- 3. Econometric analysis.- 4. Final remarks.- 5. Bibliography.- Tables

1. Introduction

One of the most interesting issues in the theory of economic development is the spread of technologies internationally. Until two decades ago there was no consensus on a uniform regulation of intellectual property right (IPR) protection. The developing economies fear that an increase in the protection of innovation may constitute an unsustainable burden for their possibilities of growth. They also greatly feel the necessity to satisfy the needs of the current generation, that cannot pay the monopolistic prices imposed by full protection of innovation, for drugs and agricultural inputs that are essential to ensure the survival of poor people (Gopakumar, 2010, Gupta and Manchikanti, 2010).

In 1994 the same countries that are members of the World Trade Organization (WTO) subscribed an agreement to ensure a uniform protection of IPR among all the economies, with the implicit aim to remove the obstacles to international commerce.

The Trade-Related Aspects of Intellectual Property (TRIPs) agreement, that was underwritten in 1994 in Marrakech, Morocco, as a part of the Uruguay Round of multilateral trade negotiations, constitutes the first attempt to establish minimum standards of IPR protection for all members of the WTO. It first came into force on 1st January 1995 (Nain, 2006). Less developed countries have five years to acknowledge the TRIPs agreement in their domestic legal systems (Nain, 2006).[1]

The TRIPs agreement is of such importance that even the World Bank and United Nations Organization have undertaken some research, regarding, for example, the ethical aspects of IPR protection in developing countries (Lall, 2003, Sonderholm, 2010).

In economic literature there are many theoretical studies regarding the effects of a stronger protection of IPR on international trade and the distribution of welfare among the countries involved in commerce (Branstetter, 2004; Chen and Puttitanum, 2005; Ivus, 2010). Despite this considerable theoretical effort there is not any consensus about the consequences of an increase of innovation defence for growing economies.

The upholder of IPR extensive protection suggests that this fosters the innovation and, indirectly, the growth of developing countries (Dinopoulos and Segerstrom, 2010; Glass and Saggi, 2002; Grossman and Lai, 2004; Helpman, 1993; Lai, 1998).

The detractors of IPR defence argue that this kind of policy leads neither to development for less wealthy nations, nor to growth for the world as a whole, but merely transfers rent to the multinational enterprises (Glass and Wu, 2007; Lanjouw, 1997; Maskus, 2000; McCalman, 2001; Sener, 2006).

The issue of stronger protection of IPR is usually addressed, from the theoretical point of view, by using international trade models (Dinopoulos and Segerstrom, 2010; Grossman and Lai, 2004; Parello, 2008).

The issue of international transfer of technologies has become of crucial importance not only for growth, but also to direct all the countries towards development according to a more environmental sustainable pattern (Dechezleprêtre *et al.*, 2010).

* This report was presented at the Fifth Conference of Empirical Legal Studies, New Haven, University of Yale, November 5-6, 2010.

[1] The extremely poor countries have an extra term of six years to implement the TRIPs Agreement (Richman, 2000).

As always happens when the theoretical models does not achieve the same results, the debate on the effects of stronger IPR protection is shifted to the empirical research arena.
Among the very few empirical papers regarding the effects of stronger IPR on innovation, there are at least three different streams of literature. Some experts find no positive connections between the stronger IPR and domestic innovations (Bessen and Maskin, 2000; Lerner, 2002a,b; Sakakibara and Branstetter, 2001; Scherer and Weisburst, 1995). Others do not find any relation between the increase of patents protection and the advancement of technology (Chen and Puttitanum, 2005; Kanwar and Evenson, 2001). Finally, some scholars demonstrate the existence of a positive correlation between stronger IPR protection and patents applications (Branstetter *et al.*, 2006; Parello, 2008).

Despite this deep interest among the academia in the consequences of reinforcing IPR legal and economic monopoly, there is just a little research on the TRIPs agreement (Lall, 2003; Nain, 2006; Reichman, 2000), and there is not, to the best of our knowledge, any empirical research regarding the impact of the TRIPs convention. This paper tries to fill the gap in economic theory.

We assume that the TRIPs agreement is of such importance in strengthening the protection of IPR that, if effectively applied, it should create a radical change in the international transfer of technologies, thus influencing the growth of countries involved in cross-border trade.

In this paper we use a database covering twenty-one years from 1986 to 2006, for thirty-eight countries. We account for twenty-one wealthy economies and seventeen developing nations. The latter possess a per capita income, defined in terms of US $ at 2000 current prices, lower than or equal to 10.725 $. In this category we include the developing and middle countries, according to the definition of the World Bank[2], while wealthy nations are those which have a per capita income greater than 10.725 US $ at 2000 current prices.

Our research makes a step forward in empirical analysis of the effects of stronger protection of IPR on welfare and growth, even with respect to one of the most interesting analyses in this topic. The reference is to Branstetter *et al.* (2006), who study the effects of international trade transfer by using a panel data of firms and collected survey data for eighteen countries, using royalty payments as a proxy of technology transfers. Here we conduct a study on the effects of the TRIPs agreement on innovation using official data, came from the World Development Indicator (WDI) of the World Bank (World Bank, 2010).

The structure of the paper is as follows. After this introduction, we conduct a preliminary analysis of the data. Section three regards the econometric analysis. Final remarks conclude the paper.

2. Preliminary analysis of data and their sources

The choice of the countries undertaken in this research is heavily constrained (severely limited) by the availability of data regarding patents applications for both residents and non-residents, especially regarding the less developed economies. After checking the availability of data we decided to consider the countries reported in Table 1 below.

[**Table 1, about here**]

The thirty-eight nations considered in the analysis are split into two sub-samples following the per capita income criteria.

For the purposes of this research we may take a look at the data regarding patents applications of residents and gross domestic product per capita, in both kinds of economies considered, before and after the date when the TRIPs agreement came into force.

[**Figure 2, about here**]

[2] The world Bank classifies countries, on the basis of their *per capita* income, in three groups: i) developing, with a *per capita* income between, $0 - $3,465; ii) middle, with a *per capita* income in the range between $3,466 - $10,725; iii) industrialized countries with a *per capita* income of $10,726 or more. For the limited purposes of this paper, and due to the scant availability of data regarding patent application of residents and non-residents in the period accounted for, we decided to incorporate the first two groups of economies in one category that we call developing countries with a *per capita* income ranging from zero to 10,725 US$ at 2000 prices.

From table 2 we may observe that both patents applications of residents and gross domestic product per capita have grown between 1986 and 2006. The percentages of increase are greater in developing countries for both patents applications by residents and the per capita income.

After the TRIPs agreement came into force we may observe, in developing countries, a greater increase of patents application of residents: in just twelve years this variable increased by almost five times. The per-capita income, however, did not grow at the same rate: the average increase of the per capita income in the less wealthy countries is in fact, for the same period, a little greater than in developed economies.

Surprisingly, after the TRIPs agreement became current, the data (in our sample) for the period from 1995 to 2006 show that the gross domestic product per capita and patents application of residents ratio (gdppc/par), for developing countries, became lower than that of wealthy nations. This means that the TRIPs have promoted technological discovery in the less developed economies, but such a finding is insufficient to explain the rise in the per capita income. On the basis of this first evidence we bring some arguments in favour of the theory according to which technological transfer from North to South in the world is channelled by foreign direct investment.

The results reported in Table 2 confirm the findings of Branstetter *et al.* (2006) for which a stronger protection of IPR entails an increase in domestic patents applications and a rise in gross domestic product *per capita*.

2.1 Data description

Two different indicators of the technological development of the countries considered were used as dependent variables. The first was the number of patents applications of residents (par), which is a measure of domestic innovations for each country. The second was the number of scientific and technological journal articles, that constitutes a proxy of general research, conducted by universities, public institutions and governments, that cannot usually be applied immediately to produce market-oriented goods, because it requires some sequential or applied innovation.

The indicator of general research constitutes simultaneously a complement and a prerequisite of the applied research measured by patents applications. The number of scientific and technological articles published in journals, an indicator of scientific improvement never previously taken into account in economic literature, constitutes a measure of the capacity of a country to innovate and to support applied research. The data of both variables were obtained from the database of the World Development Indicator provided by the World Bank (2010).
Unfortunately, data for patents are not always available, especially with regard to the patents applications of non residents (Dechezleprêtre *et al.*, 2010).

To account for the effects of the TRIPs agreement we enclose among the covariates a dummy variable (tripsbreck) that assumes a value of zero for the years from 1986 to 1994, before the international convention came into force, and a value of one for the remainder of the period up to 2006.

The theoretical models accounting for the effects of international transfers of technology have detected two possible channels by means of which a stronger protection of IPC may influence international trade: a) foreign direct investment; b) imitation of innovation in the South of technological improvement developed in the North. In consideration of this fact, we enclose among the covariates international trade (trade) and the flow of foreign direct investment (fdi).

While the data for cross-border commerce and fdi are immediately available and testable, we are not able to account for the second possible channel of international transfer of technology: the imitation of innovation. Moreover it is beyond the aims of this research and is left to further and deeper analyses.

Another explanatory variable that we consider is gross fixed capital formation (gfcf), that usually constitutes an alternative input with respect to innovation. This covariate is useful to

explain the loss in the capability of firms to use capital as a collateral to gain credit from banks, when more technology is implemented under the form of patents.

The gross domestic product per capita considers the effects of technology improvement, produced endogenously or by means of transfer via foreign direct investment, on the welfare of the countries reviewed.

The full description of the variables used in our analysis and their sources are reported in Table 3, below

[**Table 3, about here**]

Before performing the econometric analysis we report the descriptive statistics in Table 4, and analyse the relation among the variables that could be of interest for our research by means of the correlation matrix of Table 5.

[**Tables 4 and 5, about here**]

From Table 5 it is possible to observe that the pair of coefficients between the TRIPs breck and the patent applications of residents (par), and the number of scientific and technological journal articles (stja) is almost the same and approximately equal to 5%. On the basis of this first empirical evidence we may conclude that the TRIPs agreement has had a positive impact on the world economy, but not of significant magnitude. If we split our sample into two sub-sample based on the per capita income, however, we may observe that the pair of correlation coefficients between the tripsbreck and the number of patents applications of residents and scientific and technological articles is, for developing countries, of 21.72 % and 15.54% respectively, while for wealthy nations they are slightly lower compared to the panel data as a whole.[3] This means that the international agreement underwritten in Marrakech in 1994 has had a widespread effect on developing countries, promoting domestic technological progress.

We may incidentally note that the patents application of residents (par), that are an indicator of applied research, and the scientific and technological journal articles (stja), that constitute a good proxy of basic research, are positively correlated or, in other words, are complementary inputs in the aggregate function of production.

The preliminary analysis of data seems to confirm the theory according to which the international transfer of technology is driven by the foreign direct investment (fdi). For all the countries in our sample we find a negative relationship between the fdi and the two indicators of technological improvements, respectively, the patents application of residents and the scientific and technological journal articles. The negative sign for par and stja variables means that if innovations are driven by the fdi, domestic firms and institutions have not perceived any incentive to carry out R&D activity, basic or applied, because they benefit from the research efforts of wealthy nations. The negative sign of those regressors means that there is an inverse relation between the FDI and the indicators of technological improvements (par and stja, to be clear).

It is worth noting that the dummy variable brecktrips showed a positive coefficient of regression with both the indicators of scientific improvement. Moreover we may observe that the dummy variable that accounts for the TRIPs agreement showed a positive correlation coefficient with the Gross Domestic Product per capita (gdppc), but if we perform the same analysis on developing and wealthy countries separately, we should observe that the coefficient still remains positive, but that its value is almost double for developed economies. The stronger protection of IPR, sanctioned by an international agreement, will benefit all the countries involved in international trade, but proportionally will increase the income in industrialized nations more than developing countries.

Reading Table 5, we may observe that between the dummy variable that accounts for the TRIPs agreement and foreign direct investment there is a positive correlation coefficient. In particular, considering the two sub-samples, wealthy and developing economies, this coefficient is slightly greater for industrialized countries.

[3] Due to space constraint the two correlation matrices regarding developing and wealthy nations, respectively, are not reported here, but are available, upon request, from the author.

The correlation coefficient between foreign direct investment and the gross domestic product per capita for developing countries is nearly triple that of the wealthy economies. This is another argument to confirm that international transfers of technology take place through the channel of foreign direct investment. It is possible to observe that the correlation coefficient regarding the two indicators of technological development and the gross domestic product per capita amounts to half in developing countries with regard to residential patent application and is negative, although quantitatively irrelevant, in the case of the number of scientific and technological journal articles.

3. Econometric analysis.

Ex ante we expect the stronger international protection of IPR to increase patents applications from residents and non-residents. Due to data availability constraint, because the figures regarding patents applications of non-residents are often unavailable, only the patents applications of residents were used as a dependent variable (for the same assumption see: Branstetter *et al.*, 2006, 327). Moreover some regressions were performed in which the scientific and technological journal articles were used as a variable that we want to explain. Moreover, a reinforcement of the legal protection of innovation, for example by means of the instruments provided in the TRIPs agreement, should improve, at the same time, international trade (Dinopoulos and Segerstrom, 2010) the transfer of technologies from North to South, by means of foreign direct investment, reducing investment in fixed capital formation, and increasing per capita income. For a direct consideration of the effects of the TRIPs agreement the dummy variable tripsbreck was enclosed among the covariates
The specification that satisfies the above assumptions is

[1] $par_{j,t} = \alpha_1 const + \alpha_2 brecktrips_{j,t} + \alpha_3 gfcf_{j,t} + \alpha_4 trade_{j,t} + \alpha_5 fdi_{j,t} + \alpha_6 pci_{j,t} + u_t.$

where:
const = is the intercept term,
u_t = is a stochastic term;
α_i = are coefficient regressors (i = 1, …, 6);
j = 1, … , 38, denotes the thirty-eight countries considered, and t = 1, … , 21, is the period of observation (from 1986 to 2006).
The results of the regression are reported in Tables 6 and 7.
[Tables 6 e 7, around here]

Column I illustrate the outcomes gained by using OLS, just for purpose of comparison, while all the other columns indicate the results of regressions using the fix effects (FE) model. On the basis of the F-test it is evident that the specificity of each country plays a not negligible part in explaining the impact of the TRIPs agreement on technology advancement.

We may note that R-squared is low. The dummy variable that accounts for the effects of the TRIPs agreement always possesses a positive algebraic sign and is statistically significant at a value close to 1%. Moreover, when this covariate is removed from the regressions, the value of R-squared drops by two percentage points, which implies reducing by ten per cent the explicative power of our model. In other words, the regression confirms the indication of the autocorrelation matrix in Table 5, the dummy that accounts for the TRIPs agreement is positively correlated with both the proxy of general research (stja) and the patent applications of residents (par). Moreover, we may affirm that the endogenous increase of applied research in developing countries is insufficient to explain the increase of per capita income, but the international standardization of legal protection of IPR is an essential condition to promote the transfer of technologies from the North to the South of the globe by foreign direct investment. The latter variable always possesses a negative algebraic sign, and is strongly statistically significant when the patents application of residents (par) is used as a dependent variable. Our results seem to confirm the theoretical results and previous empirical findings according to which foreign direct investment is the main channel through which wealthy nations transfer technologies to the rest of the world.

The quality of our outcomes was checked by using different specifications of the econometric model in [1]. The results of empirical analysis, reported in columns IV and V of Tables 6 and 7, confirm that including further covariates does not change our result to a notable degree. The coefficient of regressors, their sign and the coefficient of the explicative power of regressions are not significantly changed, thus we may confirm the robustness of our results.

4. Final remarks

Our findings confirm those of Branstetter *et al.* (2006) according to whom a stronger protection of property rights increases technological transfer from North to the South of the world, benefiting the reforming economies. In this study we demonstrate that the IPR reform, here under form of the TRIPs agreement, has increased the number of patents applications of residents, although this is insufficient to explain the observed improvement in the gross domestic product per capita in developing countries.

The empirical outcomes of this research are in contrast with the theoretical conclusion of an important contribution of Grossman and Lai (2004, p. 1650), according to which the harmonization of IPR protection around the world is a matter of distributional welfare issues rather than of efficiency. In this short paper we show how the TRIPs agreement represents a typical win-win situation for both wealthy economies and developing countries.

This paper contributes to a current debate on the effects of stronger protection of IPR, in this case through the TRIPs agreement, on domestic innovation. On the basis of our findings it is possible to affirm that an improvement in the guarantees for innovators leads to a growth in patents applications of residents. In fact our dummy variable that represents the TRIPs agreement is always positively related to innovation and is highly statistically significant.

With respect to the relation between the two indicators of scientific development and foreign direct investment, the results of the regressions confirm what may be observed from the correlation matrix. These variables are negatively related (almost always statistically significant), because domestic innovations seems to be alternative to technological progress driven by foreign direct investment. To conclude on this point it is highlighted that the foreign direct investment possesses a very high coefficient in the regression with respect to international trade and gross capital fixed formation. International trade always shows a negative algebraic sign, and is never statistically significant when the fixed effects model is used. In other words, an increase in domestic technological progress seems to reduce international trade, but this is just one side of the coin. It is worth observing, from Table 5, that the quantitative effects of foreign direct investment are greater than those of patents applications of residents and scientific and technological journal articles, as confirmed by the results of the regressions reported in Tables 6 and 7. In other words, the restrictive effects on cross-border commerce of domestic technological improvement are more than counterbalanced by the expansive effects of foreign direct investment.

The effect of the TRIPs agreement on the process of imitation of ideas (Glass and Wu, 2007) may indeed constitute a valid topic for successive studies. It is just possible to observe that this channel of innovation, spreading around the world and especially from North to South, coexists with the other source of innovation diffusion represented by foreign direct investment moving from the North to the South of the globe.

5. BIBLIOGRAPHY

BESSEN, J., MASKIN, E., *Sequential Innovation, Patents, and Imitation*, Massachusetts Institute of Technology*, Department of Economics Working Paper* No. 00-01, 2000.

BRANSTETTER, L., FISMAN, R., FOLEY K., F., *Does stronger intellectual property rights increase international technology transfer? Empirical evidence from U.S. firm-level panel data*, in 2006 *QJE* **121**(1), pp. 321–349.

BRANSTETTER, L., G., *Do Stronger Patents Induce More Local Innovation?,* in 2004 *JIEL* **7**(2), pp. 359-370.

CHEN, Y., THITIMA P., , *Intellectual Property Rights and Innovation in Developing Countries,* in 2005 *JDE* **LXXVIII,** pp. 474-493.

DECHEZLEPRÊTRE, A., GLACHANT M., MÉNIÈRE, Y., *What Drives the International Transfer of Climate Change Mitigation Technologies? Empirical Evidence from Patent Data*, 2010 *FEEM Working Papers* **10**(12).

DINOPOULOS, E., SEGERSTROM, P., *Intellectual property rights, multinational firms and economic growth*, in 2010 *JDE* **92**(1), pp. 13-27.

EVENSON, R., KUMAR, S., *Does Intellectual Property Protection Spur Technological Change?,* 2001 Yale Economic Growth Center Discussion Paper No. 831.

GLASS, A., KAMAL, S., *Intellectual property rights and foreign direct investment*, in 2002 *JIE* **56**, pp. 387-410.

GLASS, A., WU, X., *Intellectual property rights and quality improvement*, in 2007 *JDE* **82**, pp. 393-415.

GOPAKUMAR M. K., Product *Patents and Access to Medicines in India: A Critical Review of the Implementation of TRIPS Patent Regime*, in 2010 *LDR* **3**(2), Article 11.

GROSSMAN, G., LAI, E., *International protection of intellectual property,* in 2004*AER* **94**, pp. 1635-1653.

GUPTA, R., PADMAVATI, MANCHIKANTI, P., *Analysis of patenting trends of antifungal drugs in the product patent regime in India*, in 2010 *WPI* **32**(2): pp. 135-140.

HELPMAN, E., *Innovation, Imitation, and Intellectual Property Rights*, 1993 *Econometrica* **LXI**, pp. 1247-1280.

IVUS, O., *Do stronger patent rights raise high-tech exports to the developing world?* in 2010 *JIE* in press.

KANWAR, S., EVENSON., R. E., *Does Intellectual Property Protection Spur Technological Change?*, in 2001 *Yale Economic Growth Center Discussion Paper* No. 831.

LAI, E., *International intellectual property rights protection and the rate of product innovation*, in 1998 *JDE* **55**, pp. 133-153.

LALL, S., *Indicators of the Relative Importance of IPRs in Developing Countries,* in 2003 *RP* **32**(9), pp. 1657-1680.

LANJOUW, J. O., *The Introduction of Pharmaceutical Product Patents in India: 'Heartless Exploitation of the Poor and Suffering'?* in 1997 *NBER Working Paper* No. 6366.

LERNER, J., *150 Years of Patent Protection,* in 2002a *AER Papers and Proceedings,* **XCII**, pp. 221-225.

LERNER, J., *Patent Protection and Innovation over 150 Years*, in 2002b *NBER Working Paper* No. 8977.

MASKUS, K., 2000, *Intellectual Property Rights in the Global Economy. Institute for International Economics*, Washington, D.C.

MCCALMAN, P., *Reaping What You Sow: An Empirical Analysis of International Patent Harmonization*, in 2001 *JIE* **LV**, pp. 161-186.

NAIN, B., *Impact of Trips Agreement on Developing Countries*, (October 20, 2006). Available at SSRN: http://ssrn.com/abstract=1021962.

PARELLO, C., *A North-South model of intellectual property rights protection and skill accumulation*, in 2008 *JDE* **85**, pp. 253-281.

REICHMAN, J. H., *Indicators of the Relative Importance of IPRs in Developing Countries*, in 2000 *Case W. Res. J. Int'l L.*

SAKAKIBARA, M.., BRANSTETTER L.G.,. *Do Stronger Patents Induce More Innovation? Evidence from the 1988 Japanese Patent Reforms*, in 2001 *RJE* **XXXII,** pp. 771-100.

SCHERER, F. M., WEISBURST S., *Economics Effects of Strengthening Pharmaceutical Patent Protection in Italy,* in 1995 *IRIPCL* **XXVI**, pp. 1009-1024.

SENER, F., *Intellectual property rights and rent protection in a North–South product cycle model*, 2006, Union College, *mimeo*.

SONDERHOLM, J., *Intellectual Property Rights and the TRIPS Agreement. An Overview of Ethical Problems and Some Proposed Solutions*, in 2010 *WBPR WP 5228*.

WORLD BANK, *World Development Indicator*, 2010 Washington: World Bank.

TABLE 1

COUNTRY CLASSIFICATION BY PER CAPITA INCOME LEVEL.

WEALTHY COUNTRIES (a)	**DEVELOPING COUNTRIES (b)**
AUSTRALIA, AUSTRIA, BELGIUM, CANADA, DENMARK, FINLAND, FRANCE, GERMANY, GREECE, HONG KONG, IRELAND, ISRAEL, ITALY, JAPAN, NETHERLANDS, NORWAY, SPAIN, SWEDEN, SWITZERLAND, UNITED KINGDOM, UNITED STATES.	ARGENTINA, BRAZIL, CHILE, CHINA, COLOMBIA, INDIA, INDONESIA, KOREA REPUBLIC, MALAYSIA, MEXICO, PAKISTAN, PERU, PHILIPPINES, PORTUGAL, TURKEY, URUGUAY, VENEZUELA.

Note: Column (**a**) lists the twenty-one developed countries with a per capita income greater than 10.725 US $ (measured at 2000, expressed in US $ current prices in that year), while column (**b**) lists the seventeen developing countries with a lower per capita income level.

TABLE 2

PATENTS DATA OVERVIEW (1986-2006)

	ALL COUNTRIES	DEVELOPED COUNTRIES	DEVELOPING COUNTRIES
PERIOD			
1986-2006	17.750 (14.607) [.8229]	27.713 (22.794) [.8225]	5.417 (4.495) [.8297]
1986-1994 (pre TRIPS)	18.282 (12.847) [.7021]	24.154 (19.904) [.8240]	1.564 (3.902) [2.4949]
1995-2006 (post TRIPS)	24.333 (15.928) [.6546]	30.271 (24.822) [.8199]	7.715 (4.990) [.6468]
Par1995-2006/par1986-1994	1.33	1.25	4.93
Gdppc1995-2006/gdppc1986-1994	1.24	1.25	1.28

Note: The data regarding the patents application of residents (par) are reported in the first column. The gross domestic product per capita (gdppc) is reported in round brackets. The gross domestic product per capita and patents application of residents ratios (gdppc/par) are in square brackets.

TABLE 4

SUMMARY STATISTICS

Variables	Obs.	Mean	S.D.	Min.	Max
Scientific and tech. journal articles (stja)	798	13802.24	31869.11	31	208513
Patent applications residents (par)	798	17558.63	58994.41	9	384201
Par/population (parpop)	798	.000241	.000483	0	.0030283
Stja/population (stjapop)	798	.000364	.000351	0	.001237
Gross fixed capital formation (gfcf)	798	21.7322	4.9826	0.944	43.59
Foreign direct investment (fdi)	798	2.5272	4.9106	-15.13	91.67
GDP per capita (gdppc)	798	14607.42	10668.62	271	41441
GDP per capita growth (gdppcg)	798	2.5021	3.4015	-14.31	16.24
Gross domestic savings (saving)	798	24.0167	7.2291	1.71	52.26
Exports of goods and services (exp)	798	35.0598	26.6022	5.25	205.46
Imports of goods and services (imp)	798	33.4892	24.4134	4.63	194.07
International trade (trade)	798	68.5599	50.7567	12.36	399.53
TRIPS dummy (brecktrips)	798	.5714	.4952	0	1

TABLE 3

VARIABLES AND DATA SOURCES

This table describes the variables considered for the thirty-eight countries included in our study, their definitions and sources

Variables Name	Description and source
(1) Scientific and tech. journal articles (stja)	Scientific and technological journal articles. Source: World Development Indicator (WDI)
(2) Patent applications residents (par)	Patent applications residents. Source: WDI.
(3) Par/population (parpop)	Patent applications residents/population ratio. Source: WDI and our elaboration .
(4) Stja/population (stjapop)	Scientific and technological journal articles/population. Source: WDI and our elaboration..
(5) Gross fixed capital formation (gfcf)	Gross fixed capital formation (% of GDP). Source: WDI.
(6) Foreign direct investment (fdi)	Foreign direct investment, net inflows (% of GDP). Source: WDI.
(7) GDP per capita (gdppc)	Gross Domestic Product per capita (constant 2000 US$). Source: WDI.
(8) GDP per capita growth (gdppcg)	Gross Domestic Product per capita growth (annual %). Source: WDI.
(9) Gross domestic savings (saving)	Gross domestic savings (% of GDP). Source: WDI.
(10) Exports of goods and services (exp)	Exports of goods and services (% of GDP). Source: WDI
(11) Imports of goods and services (imp)	Imports of goods and services (% of GDP). Source: WDI
(12) International trade (trade)	International trade (% of GDP). Source: WDI
(13) TRIPS dummy (brecktrips)	This is a dummy variable that assumes the value of 0 from 1986 to 1994, before the Trips agreement came into force. Since 1995 it takes the value of 1.

TABLE 5

CORRELATION MATRIX TABLE

Variable	(1) stja	(2) par	(3) parpop	(4) stjapop	(5) gfcf	(6) fdi	(7) gdppc	(8) gdppcg	(9) saving	(10) exp	(11) imp	(12) trade	(13) TRIPSbreck
(1) Scientific journal articles (stja)	1												
(2) Patent applications residents (par)	.5157	1											
(3) Par/population (parpop)	.2967	.8944	1										
(4) Stja/population (stjapop)	.2753	.0721	.2475	1									
(5) Gross fixed capital formation (gfcf)	-.0824	.1956	.2208	-.1842	1								
(6) Foreign direct investment (fdi)	-.0617	-.1026	-.0950	.0867	-.0032	1							
(7) GDP per capita (gdppc)	.4118	.3979	.4863	.7835	-.0766	.0877	1						
(8) GDP per capita growth (gdppcg)	-.0381	-.0121	-.0303	-.1445	.3303	.0895	-.1217	1					
(9) Gross domestic savings (saving)	-.1833	.0845	.1447	-.1217	.6365	.1055	.0453	.3183	1				
(10) Exports of goods and services (exp)	-.2208	-.2042	-.1496	.0306	.1339	.3044	.2039	.1163	.4374	1			
(11) Imports of goods and services (imp)	-.2077	-.2119	-.1673	.0247	.1735	.3018	.1851	.1195	.3317	.9800	1		
(12) Trade (trade) -.2157	-.2090	-.1587	.0282	.1537	.3050	.1959	.1183	.3887	.9953	.9945	1		
(13) TRIPS dummy (TRIPSbreck)	.0522	.0528	.0528	.6129	-.0566	.2064	.1430	-.0044	.0524	.1437	.1271	.1366	1

TABLE 6

RESULTS OF REGRESSIONS USING PATENTS APPLICATIONS OF RESIDENTS (PAR) AS A DEPENDENT VARIABLE

COVARIATES	(I) OLS	(II) FE	(III) FE	(IV) FE	(V) FE
Constant term	-70753.77 [8484.59] (-8.34)*	-5112.98 [4251.74] (-1.20)	-.8283.65 [4065.6] (-2.04)***	-5383.62 [4257.35] (-1.26)	183.96 [4407.94] (.04)
Dummy accounting for TRIPS Agreement (brecktrips) .	6823.73 [3588.77] (1.90)****	2612.17 [1060.86] (2.46)***		2598.92 [1060.69] (2.45)***	238.81 [1052.08] (2.24)***
Gross Fixed Capital Formation (gfcf)	34.08 [3.52272] (9.68)*	.9976 [1.3723] (.73)	.6534 [1.3697] (.48)	1.2686 [1.3921] (.91)	2.8087 [1.4303] (1.96)***
International trade (trade)	-3.9495 [.3681] (-10.73)*	-.4985 [.3387] (-1.47)	-.3386 [.3335] (-1.02)	-.4646 [.3399] (-1.37)	-.2441 [.3411] (-.72)
Foreign Direct Investment (fdi)	-6.2756 [3.7352] (-1.68)****	-1.9356 [.9545] (-2.03)***	-1.8284 [.9567] (-1.91)****	-1.8575 [.9568] (-1.94)***	-1.9072 [.9449] (-2.02)***
GDP per Capita (gdppc)	2.6703 [.1663] (16.05)*	1.5689 [.2287] (6.86)*	1.8624 [.1960] (9.50)*	1.5561 [.2291] (6.79)*	1.6989 [.2288] (7.42)*
GDP per capita growth (gdppcg)				-1.5033 [1.3081] (-1.15)	
Saving (saving)					-5.3038 [1.3107] (-4.05)*
R-squared♣ : overall .	3279	.2023	.1857	.2004	.1744
within		.1320	.1250	.1335	.1504
between		.2071	.1885	.2051	.1762
Observations	798	798	798	798	798
F test that all u_i=0		F(37, 755)=394.50	F(37, 756)=393.56	F(37, 754)=394.69	F(37, 754)=402.73

Standard errors in brackets and t-values in Parentheses. *, **, ***, **** indicate statistical significance at the 1 ‰, 1%, 5%, and 10% level respectively. ♣ In case of OLS only the values of R-squared are reported.

TABLE 7

RESULTS OF REGRESSIONS USING SCIENTIFIC AND TECHNOLOGICAL JOURNAL ARTICLES (STJA) AS A DEPENDENT VARIABLE

COVARIATES	(I) OLS	(II) FE	(III) FE	(IV) FE	(V) FE
Constant term	5345.68 [4803.10] (1.11)	6710.32 [1205.01] (5.57)*	3922.94 [1191.17] (3.29)*	6647.40 [1206.95] (5.51)*	7986.31 [1253.04] (6.37)*
Dummy accounting for TRIPs Agreement (brecktrips) .	1956.66 2031.59] (.96)	2296.41 [300.66] (7.64)*		2293.32 [300.70] (7.63)*	2235.37 [299.07] (7.47)*
Gross Fixed Capital Formation (gfcf)	.1617 [1.9942] (.08)	1585 [.3889] (.41)	-.1441 [.4013] (-.36)	.2215 [.3947] (.56)	5948 [.4066] (1.46)
International trade (trade)	-1.9307 [.2084] (-9.26)*	-.0755 [.0961] (-.79)	.0651 [.0977] (.67)	-.0677 [.0964] (-.70)	-.0143 [.0969] (-.15)
Foreign Direct Investment (fdi)	-.9938 [2.1145] (-.47)	-.5223 [.2705] (-1.93)****	-.4287 [.2803] (-1.53)	-.5048 [.2712] (-.186)****	-.5161 [.2686] (-1.92)****
GDP per Capita (gdppc)	1.4017 [.0942] (14.98)*	.4166 [.0649] (6.42)*	.6746 [.0574] (11.75)	.4136 [.0649] (6.37)*	.4479 [.0651] (6.89)*
GDP per Capita growth (gdppcg)				-.3495 [.3708] (-.94)	
Saving (saving)					1.2776 [.3726] (-3.43)*
R-squared ♣: overall within between	.2619	.1819 .2641 .1819	.1610 2071 .1620	.1791 .2649 .1923	.1932 .2754 .2050
Observations	798	798	798	798	798
F test that all u_i=0		F(37, 755)=1634.90	F(37, 756)=1519.99	F(37, 754)=1626.57	F(37, 754)=1624.74

Standard errors in brackets and t-values in Parentheses. *, **, ***, **** indicate statistical significance at the 1 ‰, 1%, 5%, and 10% level respectively. ♣ In case of OLS only the values of R-squared are reported.