Harmonization and Globalization of Intellectual Property Culture[†]

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Abstract

This paper explores the relationship between the two sides of intellectual property culture in an international context, namely the harmonization of its protection and the globalization of its creation. To this end, we explore the role of intellectual property rights (IPR) protection in the recent surge in the internationalization of patents that originate from the newly emerging economies. The aim is to capture the outreach of the Northern intellectual property culture to the South and the South-North globalization of the resulting intellectual property that emerges in the South. Global bilateral patent data is used to investigate the location-specificity of IPR enforcement for the emergence of this phenomenon. We find that the harmonization of IPR protection encourages foreign patenting activities of Southern innovators. Our findings suggest that a global convergence of IPR protection can stimulate the production and the internationalization of intellectual property in the South. As the North and the South grow closer in terms of levels of development, a harmonized institutional structure becomes more adequate as they increasingly share similar markets.

Keywords: Intellectual property culture, Globalization, Harmonization, Foreign patenting, Southern innovation.

JEL Classification: F2, O1, O3

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1. Introduction

Growing demand for new and affordable technologies in an increasingly competitive global market is changing the geography of innovation. The impact of geographic distance on international research and development (R&D) investments has diminished over the last decade owing it partly to the ability of multinational enterprises (MNEs) to absorb and transfer knowledge on an international scale (Castellani, et al., 2013). Today, MNEs do not only seek to exploit their knowledge in other countries, but also strive to source technology internationally and tap into new hubs of knowledge around the world (OECD, 2008a). We now observe a greater scope of international innovative activities and a wider range of actors involved.

While most R&D investments still take place in OECD countries (also referred to as North), newly industrialized countries (NICs, also referred to as the South) have attracted an increasing amount of R&D investments in recent years (OECD, 2008b). As knowledge starts to flow more freely across the globe, the heated debate on the suitability of a globally uniform set of intellectual property rights (IPR) standards becomes more complex. A survey by the Economist Intelligence Unit (EIU) in 2004 revealed that 84% of all executives perceive the lack of IPR protection in emerging markets as a challenge when outsourcing their R&D. Branstetter, et al. (2006) provided solid evidence that IPR enforcement encourages Northern firms to increase their R&D activities abroad (in terms of foreign patent applications as well as R&D expenditure and royalty payments). Does the same motivation apply for firms from the South? The issue is no longer a duel between developed and developing countries. With NICs taking a lead in developing technologies of global standards, the Southern view towards intellectual property culture has taken a new meaning.

The observed global dynamics of innovation hint at one clear phenomena, the globalization of intellectual property culture. This paper sheds light on the incentives and the capacity of the new class of firms (inventors) in NICs to engage in international patenting activities. It investigates the relevance of the harmonization of intellectual property culture, in terms of IPR protection, on the internationalization of Southern intellectual property. Our main results reveal that foreign patenting is highest between countries where the North-South IPR distance is small. We interpret this as an indication that convergence of IPR standards tends to contribute to the expansion of South-North patenting activities.

Previous literature underlines the need for a reliable IPR protection system for innovative firms in advanced countries, where intellectual property culture is already well-developed. But is the blessing of a strong IPR regime also valid for Southern firms? And if so are the effects of IPR protection uniform across locations, or are IPRs location-specific? In the spirit of Braga and Fink (1999) and Falvey, et al. (2009) who estimated a gravity equation to study the impact of IPRs on international trade, we use an empirical gravity-like model designed to capture the extent of NICs' involvement in the internationalization of their intellectual property in OECD countries. We use the number of patents filed by nationals from 14 NICs in 30 OECD patent offices as the variable of interest to estimate the impact of country and country-pair specific variables such as IPR protection in both countries. We show that the location of IPR enforcement is crucial for South-North expansion of intellectual property. To capture a more precise measure of our variable of interest, we also make use of newly available data from the World Intellectual Property Organization (WIPO) that allow us to (i) classify patents by technology field to account for the fact that industries differ with respect to their vulnerability to imitation (see Ivus, 2011; and Ivus, et al., 2016a), and (ii) identify original patents from the South that were first filed in the North.

The effect of IPR protection on the internationalization of intellectual property for economies in the catch-up phase is heterogeneous and location-specific. The positive impact of a strong domestic IPR regime in countries that have overcome the developing stage works in same manner as in advanced economies. IPRs create incentives to innovate, promote growth and allow Southern firms to enter the world market for knowledge. IPR protection at the destination country closer to the technological frontier does not have the same effect in attracting Southern innovation. Instead, the harmonization of IPR protection has positive implications for the internationalization of Southern innovation. In other words, the harmonization of intellectual property culture substantially contributes to the globalization of the latter by enabling the South to enter the intellectual property market in the North. However, the empirical findings reveal that a more complex mechanism of harmonization is required for this to be effective in catch-up economies, placed in a limbo state between the developing and the developed world. In particular, the results suggest that a convergence of IPR enforcement in the two regions, that is weakening (strengthening) the level in the North (South), can be beneficial for the internationalization of Southern innovation. This is slightly, but meaningfully, different from the TRIPS obligations that requires the South to upgrade its IPR regime to the standards in force in the North. It instead hints at the idea, in line with Grossman and Lai (2004) and Chu, et al. (2014), that similar institutional structures are more adapt for economies that have comparable levels of development and therefore share similar markets.

Our work can also be thought of as applying the idea in Disdier, et al. (2015) that the harmonization of technical barriers between developed and developing expands South-North trade, into the framework of Yang and Kuo (2008) that studies the influence of trade and IPRs in the destination country on outward patenting activities. The question we tackle is whether the harmonization of IPRs works in a similar way for South-North internationalization of innovation. We learn that Intellectual property culture has many dimensions that are strongly interrelated. The results show that the globalization of intellectual property culture defined both as the emergence of innovators in the South and the expansion of their activities on a global scale heavily depends on the global harmonization of the intellectual property culture on the institutional side.

The reminder of the paper is organized in the following way: the next section gives a number of stylized facts on recent innovation activities in major emerging economies, followed by a short literature review on which our conceptual framework is based on. In section 3 we report methodology, data, and results for the cross-country estimation. Section 4 concludes.

2. Intellectual Property Right Standards and Southern Innovation

2.1. Patenting trends in emerging economies

In OECD countries, the 'propensity to patent' has increased by 20 percent in less than 20 years (OECD, 2004).[2] This change is generally attributed to technological change, economic transformation, and a shift of patent policy in the region since the 1990s. A same trend can be observed in emerging economies after reforming their IPR legal framework according to the standards set by the WTO. In 1985, the total number of patents granted in China was only 138. This figure grew by 700 times in 1999, though Chinese domestic enterprises were still not considered innovative compared to their foreign counterparts (Sun, 2003). In 2011, China's patent office received 526,412 patent applications becoming the largest patent office in the world. Today, the growth in patent filings in China is mostly due to substantial growth in resident filings (WIPO, 2012).[3] In some new technological sectors such as digital communication, telecommunication and high-speed trains, some 20% of total world Patent Cooperation Treaty (PCT) applications in years 2008-2010 came from China (Tian, 2011). The first Patent Law came into force in China in 1985 and the two major rounds of modifications occurred in 1992 and 2000.

In India, the Patents Act 1970 was amended in 1999, 2002 and 2005. The stagnant level of patent applications in the country experienced a remarkable change with a peak in 1997.[4] PCT applications by Indian inventors and industries registered a sustained growth up to 43% in 2001.[5] Today, the country stands above Japan, Korea and China in terms of patent filings abroad relative to resident patent applications (WIPO, 2011). Trends in ICT-related patent applications to the European Patent Office (EPO) show that India ranked second after China between 1995 and 2003. Over the period 2004-2007, the country presented the highest average growth rate in terms of patent applications (26.3%) reaching almost 37 thousand applications in 2008 (WIPO, 2010).

If we consider the extent of cross-border patenting by looking at the share of Indian and Chinese inventors in PCT applications by foreign-owned firms, in 2006 they ranked 1st and 2nd in the world respectively with 66.9% of Indian and 59.5% of Chinese inventors contributing to foreign-owned patent applications. Today, India still presents the greatest share of inventors contributing to innovative activities of foreign companies (66.2%), while the percentage of Chinese inventors in foreign-owned patent applications has declined to 26% ranking 12th in the world (WIPO, 2012). Finally, Indian IT sector is estimated to aggregate revenues of US$88.1 billion in 2011, with the software and service sector (excluding hardware)

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[2] That is, the number of patents created per dollar or euro of R&D, assuming the productivity of R&D is constant.

[3] Chinese providers of telecommunications equipment and network solutions, namely, ZTE Corporation, Huawei Technologies and Huawei Device are among top world PCT applicants ranking respectively, 1st, 3rd and 40th.

[4] This can mostly be attributed to Indian accession to the WTO-TRIPS and the implementation of the transitional mailbox procedure before extending patent protection on pharmaceutical products.

[5] WIPO Magazine 10, 2002.

accounting for 86.4%.[6] Conversely, China accounts for 14.6% of global electronics hardware production (Bhattacharya and Vickery, 2010). Indeed, the large share of Chinese patent applications in ICT-related areas is associated with considerable focus on ICT hardware production (van Welsum and Xu, 2007).

[Figure 1 about here]

As we are concerned with global knowledge flow in terms of engagement in international scientific activities, an index of interest would be patent applications by citizens of the newly emerging economies away from their home patent office. To pin down the idea, here we focus on the largest NICs, namely the BRICS countries. As WIPO patent data does not represent whether the applicant is a resident in his home country or the country of application, the raw patent count abroad together with the proportion of applications that have been made abroad could be a more adequate measure. We first look at patent applications abroad in the top panel of Figure 1 and find China and to a lesser degree Russia to be successfully active in international innovation activities. An interesting observation is India, whose patent applications abroad has been increasing in a remarkable rate and has surpassed Russia. This suggests that Indians may be more active in patenting activities away from their country of origin. The bottom panel of Figure 1 confirms this, where the share of Indian patent applications abroad have increased to above 40 percent, only second to South Africa. Brazil also demonstrates to be active internationally, but to a slightly lesser degree in absolute terms with a modest growth in the share of their innovation activities abroad in recent years. Interestingly Russia and China fall very short in their share of patent applications abroad, as a large amount of their patent activities take place in their home countries.

[Figure 2 about here]

To get a better understanding of the globalized nature of knowledge and its worldwide circulation, we use another measure from the newly made available WIPO data on patent statistics to see more details of the international patenting activities conducted by the BRICS countries. This measure looks at home versus foreign PCT international applications, which should contain patents of higher qualities. When filed, PCT international applications are valid in all the PCT member countries, which currently consist of 144 countries. This can clearly lead to a large amount of cost saving for the innovator. Although a large share of PCT applications take place by the US and other OECD countries, the share of emerging economies, particularly China and India, has been growing over the last two decades. Figure 2 shows that PCT applications, which can be related to patents of higher importance than those applied for as a normal patent at the home patent office, have been growing in China, and to a lesser degree in India, Russia, and Brazil respectively. South Africa has not been very successful in this area. It is interesting to observe foreign PCT international applications by each of the countries under study to get a picture of the degree to which they engage in international innovation activities. Here India surpasses China to show the extent of the

[6] NASSCOM cited by India Brand Equity Foundation, 2011.

internationalization of patenting by Indians, whereas South Africa and China have also shown a modest growth. The data on South Africa here shows a remarkable contrast to home PCT international applications made there. Russia and Brazil here lie low, suggesting lower levels of international patenting in terms of PCT international applications.

2.2. Theoretical background

Our analysis is based on theories that explore the consequences of differences in IPR standards in the North and the South. Our starting point is Lai and Qiu (2003), who question the suitability of North's IPR standards for the South. The conceptual framework also relates to Chu, et al. (2014), who build a model to show that the optimal degree of IPR protection for each country depends on its stage of development. Lorenczik and Newiak (2012) specifically consider the role of IPRs in generating a shift from an imitating to an innovating South. Empirically, Chen and Puttitanun (2005) illustrate the trade-off created by IPR protection for developing countries between imitation and innovation and find that a country's optimal level of IPRs is U-shaped in their level of development. A similar non-monotonic relationship was also found in Maskus (2000) and Braga, et al. (2000). In what follows, we divide the problem at hand to first isolate the effect of IPR protection in the North and in the South. Our aim is to build a framework through which we could draw conclusions with respect to the worldwide harmonization of IPR standards and differentiate between the dynamics through which it can be achieved.

As we are particularly concerned with the internationalization of Southern intellectual property, we start by reviewing related literature on the role of IPR protection in encouraging or deterring Southern innovation. The basic economic consequences of IPR enforcement in the origin country on domestic innovation are by now well-established in literature. Patent protection provides firms with temporary monopoly power over their inventions increasing their incentives to innovate. The negative effects of IPR protection instead arise from the increased market power that is granted to inventors and their subsequent monopolistic behavior.[7] In the context of newly emerging economies, a strong IPR regime at home may also facilitate the dissemination of knowledge by helping firms acquire governance capabilities and better manage their intellectual property abroad (Martínez-Noya and García-Canal, 2011).

The impact of IPR protection abroad on the internationalization of intellectual is less obvious. According to Allred and Park (2007), IPR protection stimulates patenting in developed countries by increasing the appropriability of, and expanding the market for, inventions. Protection in the host country could reduce imitation risks faced by multinationals and induce them to engage in foreign patenting activities by outsourcing innovation (Lai, et al., 2009). However, from a South-North perspective, market power effect could obstruct entry by new firms and make it difficult for firms from NICS with less advance technologies to obtain patents in countries with a tougher IPR regime (Boldrin and Levine, 2008).

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[7] See Deardorff (1992) and Maskus (2000) for a clear in-depth overview of the basics.

The conclusion drawn from previous literature is that the effect of IPR protection on the globalization of innovation is at best mixed. The results are even more complex and ambiguous when the question deals with the new phenomenon of South-North knowledge transfer.[8] The idea is to capture the adoption of the intellectual property culture in the South and the dissemination of Southern intellectual property back in the North. We proceed in the next section to study how this globalization process of intellectual property culture reacts to the harmonization of the protection of intellectual assets. We first investigate the location-specificity of IPR protection and show how IPR protection home and away determines the extent of international patenting activities by Southern firms. We then explore whether the harmonization of IPR standards gives rise to or obstructs South-North innovation activities.

3. IPRs and Internationalization of Southern Innovation

In this section, we examine the impact of IPRs on the internationalization of Southern intellectual property in a setting that consists of time-varying data on country pairs. Essentially, we are interested in examining the impact of IPRs on *South-North* innovation. Drawing from section 2, the impact of IPR protection on this phenomenon can be ambiguous. We aim to determine whether and how location specific (domestic versus destination) IPRs contribute to the internationalization of Southern innovative activities. This further allows us to deduce whether the worldwide harmonization of IPR standards is a blessing or a curse for inventors from the South. To this end, we look at the filing of patents in OECD patent offices by researchers resident in NICs, using IPR protection in both NICs and OECD countries as the main explanatory variable. Similar exercises are performed using first filings of patents and filing of ICT-related patents only. We start by a brief description of the main data before turning to the empirical methodology and the results.

3.1. Patent data and IPR measure

The main variable for patent applications (*PAT*) has been constructed using WIPO data on patent count by filing office and by applicant's origin (http://ipstats.wipo.int/ipstatv2/index.htm?tab=Patent). Patent applications may refer to (i) PCT applications by NICs nationals designating one or several OECD countries to seek protection or (ii) direct filing in an OECD country by NICs residents. We believe the foreign patenting activities of the South could at least partially capture the idea of the internationalization of innovation activity in the spirit of what we have highlighted earlier.

The complete WIPO dataset has information on 189 countries of origin of applicants and 139 countries (and groups of countries, such as the African Intellectual Property Organization or the European Patent Office) that host a patent office.[9] Information is available for years 1995-2008, so we construct

[8] See He and Maskus (2012) for a theory on local "reverse" knowledge spillovers from the South to Northern multinationals there.

[9] Since WIPO registers the residence of the *first* applicant of a patent, our measure could underestimate the real measure of patents whose applicants reside in a country different than the patent office. This is the case of multiple applicants with different residences, with the first applicant residing in the same country as the patent office where the patent is filed.

averages for three periods: 1995-1999, 2000-2004 and 2005-2008, hereafter referred to as 1995, 2000 and 2005 respectively. The number of observations is 1248, coming from 14 NICs, 30 OECD countries and 3 time periods.[10] The distribution of *PAT* has a strong positive skew: it takes values between 0 and 3563, the average number of patents is around 14 and standard deviation is 128.[11] Looking at the time dimension, the number of patents filed more than doubles every five years: in 1995 mean of *PAT* is 4.4, in 2000 it is 10.9 while in 2005 is 26.9, suggesting a remarkable increase in the international patenting activities.[12]

We also construct country-pair observations limiting patents to patents in the ICT sector and to first filings abroad in order to check the sensitivity of our results. Although these variables are in principle more appropriate to address the issue at stake, there are very few country pairs with non-zero observations. In the case of ICT sector patenting, only 269 out of 1248 country pairs record positive numbers, while in the case of first filings only 348 out of 1248 country pairs record a positive number of patents. Nevertheless, we believe these are important tests to guarantee that our results are robust. This is because looking at the ICT sector, singles out the impact of IPRs in a patent-reliant industry with a considerable risk of imitation. Looking at first filings, instead, limits the analysis to innovation from NICs that are truly linked to the North and not duplicate patenting of inventions originally filed in the home country.

The measure of IPR protection for both the origin and the destination country comes from Park (2008). The IPR index ranges between 0 and 5 and it is constructed adding five zero-to-one components relative to (i) the patentability of different industrial sectors, (ii) the membership in international treaties, (iii) the duration of protection, (iv) the type and number of available enforcement mechanisms and (iv) the type and number of restrictions on patent rights. The IPR index for the 14 NICs shows a mean equal to 3.17 and a standard deviation of 0.86. The pattern that it shows for the three periods is in line with the overall pattern that Park (2008) spots for the whole sample of countries for which he constructed the index: it is increasing over time and the standard deviation is decreasing, indicating a convergence of IPR protection among NICs. In particular, mean and standard deviations are 2.5 and 0.8, 3.3 and 0.8 and 3.7 and 0.5 in the 1995, 2000 and 2005 periods, respectively. Turning to OECD countries, the IPR index is overall larger than that of NICs: it shows a mean of 4.2 and a standard deviation of 0.5. This indicates not only higher protection of IPRs, but also more compressed values of the index among OECD countries. The time pattern is similar to that of NICs: the index is increasing, though more moderately, and its standard deviation is decreasing over time.[13]

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[10] Note that two countries are coded as both NICs and OECD (Mexico and Turkey) so we exclude these pairs.

[11] The number of patents can take fractional values because we take the average across years to quantify our dependent variable as patents per year.

[12] We take 5-year averages for two reasons. First, data for the IPR protection index are only available for 5-year intervals and second, even if we had data on a yearly basis, IPR protection varies slowly in general, with large jumps when agreements are set in place: taking the averages helps to smooth out these irregular movements.

[13] Mean and standard deviations are 4.0 and 0.6, 4.2 and 0.5 and 4.4 and 0.3 in the 1995, 2000 and 2005 periods, respectively.

3.2. Methodology and other variables

Given the nature of our analysis, i.e. looking at the determinants of international patenting by NICs in OECD countries, we make use of an *oriented* gravity-like model. Rather than considering bilateral flows, the standard practice in gravity estimation of trade flows (Frankel and Rose, 2002) or international invention activity (Picci, 2010), we specifically look at the number of patents filed in the patent office of an OECD country (the destination country) whose first applicant resides in an NIC (the origin country). Succinctly, our main dependent variable PAT_{ijt} is the average number of patents filed in the time period *t* by an applicant residing in country *i* in the patent office of country *j*, where index *i* runs over 14 NICs and *j* runs over the 30 OECD countries. Countries officially considered as NICs are: Brazil, China, India, Mexico, Malaysia, Philippines, Thailand, Turkey and South Africa (Mankiw, 2007). In our definition of NICs, we also include countries over which consensus has not yet been reached in the economic literature: Argentina, Chile, Egypt, Indonesia and Russia (Bożyk, 2006). Note the different pools from which *i* and *j* are taken and that, in general, $PAT_{ijt} \neq PAT_{jit}$.

The empirical model we estimate, written in general terms, is the following:

$$PAT_{ijt} = G_t + D_i + D_j + \boldsymbol{\beta 1}\, \boldsymbol{X}_{it} + \boldsymbol{\beta 2}\, \boldsymbol{Y}_{jt} + \boldsymbol{\beta 3}\, \boldsymbol{Z}_{ij} + \boldsymbol{\beta 4}\, \boldsymbol{W}_{ijt} + u_{ijt} \qquad (2)$$

The monadic terms $\boldsymbol{X}_{it}$ and $\boldsymbol{Y}_{jt}$ include time-varying variables common to origin and destination countries, respectively. In particular, they include our main explanatory variables IPR_{it} and IPR_{jt}. Among other monadic variables there are (log of) GDP per capita and population: instead of having only GDP as mass variable, we separate size (population) and development (GDP per capita) effects in the spirit of Head, et al. (2010), so to better interpret our results. We expect that both GDP per capita and population in the origin country should have a positive effect on innovation activity, including the filing of patents abroad. We also use the Barro and Lee (2010) data on the share of people aged 25 and above holding at least tertiary education to account for human capital in both the origin and the destination.

The matrix $\boldsymbol{Z}_{ij}$ includes all the time-invariant dyadic variables, collected by CEPII and used by Head, et al. (2010). We use (log of) distance between *i* and *j*, commonality of borders and commonality of language. These variables have proved to have strong explanatory power in gravity equations for trade flows, foreign direct investments and services. With this respect, we want to compare the elasticities of the internationalization of innovation activities. The term $\boldsymbol{W}_{ijt}$ collects dyadic time-variant variables. Specifically, it will include our alternative explanatory variables, such as (i) the squared difference between IPR protection in country *i* and country *j* at time *t*, that should capture the impact of harmonization of the IPR regime within each country pair, (ii) the absolute value of the difference between IPR protection in country *i* and country *j* at time *t*, in the spirit of the previous variable but putting less weight on extreme differences, and (iii) dummies constructed with variables from (i) and (ii), flagging country-pairs with a difference above 1 and 3, respectively. In addition, $\boldsymbol{W}_{ijt}$ also includes the value of aggregate bilateral import flows from country *j* to country *i* at time *t* from the IMF's Direction of Trade Statistics (DoTS) to account for bilateral trade intensity.[14] The term G_t is a common year-specific factor and we use year dummies to capture for it. Similarly, D_i and D_j take into account country-specific fixed effects. [15]

3.3. Empirical Results

In terms of empirical model, the count nature of the dependent variable *PAT* suggests that the Poisson estimator is the most adequate choice (Picci, 2010). Throughout our analysis we specifically use Silva and Tenreyo (2006)'s Pseudo-Poisson Maximum Likelihood estimator to have flexibility when estimating the more saturated models.[16] The results of our first specification are present in column 1 of Table 1, where the explanatory variables are IPR protection in origin and destination countries, and distance, dummies for common language and common border, population, GDP per capita, and bilateral imports from OECD countries to NICs are used as controls. In addition, NICs and OECD country dummies together with two (out of three) time dummies are included in all specifications.[17] IPR protection in NICs is positive and strongly significant, while it is negative but insignificant in the OECD countries. The results we obtain contrast with Yang and Kuo (2008), who find a positive and significant relation between IPR regime of the destination country and foreign patenting activity that takes place there. The difference arises because while Yang and Kuo (2008) look at bilateral relation between 30 selected WIPO members for the 4 contiguous years of 1995-1998, we exploit the South-North dimension and the time dimension of the data to study intellectual property culture. This concept will be accounted for in the upcoming specifications that use the squared (or the absolute value of the) difference between IPR protection indices within each country pair.

Distance shows an elasticity of *-0.3* that is comparable with findings by Picci (2010), even though he uses a different measure for patents. Language proves to be an important determinant, while the common border dummy does not. Population of origin and destination country are characterized by a positive but not statistically different from zero coefficient, while income per capita has a positive effect in the origin country and negative, not significant, in the destination. Referring to GDP per capita, the former effect could be the result of higher human capital and/or higher R&D spending, measures that are usually associated with higher GDP per capita. The negative sign on the GDP per capita in the destination country could be driven by the fact that NICs tend to engage in patenting in countries that are more similar to them in terms

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[14] The specification is log (1+import) averaged for each five-year period under study.

[15] According to Baldwin and Taglioni (2006), in specifications that use measures of distance between IPR indices as explanatory variable, we should include a full set of country-by-year fixed effects to take into account country-specific time-varying behaviors, but the short time variability would make it impossible to have enough degrees of freedom.

[16] Results obtained with the standard Poisson estimator delivers identical results with respect to those with the Pseudo-Poisson Maximum Likelihood estimator proposed by Santos Silva and Tenreyo (2006), except for those in which the presence of many dummies impede the algorithm to find a global maximum of the likelihood function. The large number of zeroes and the over-dispersion of the variable *PAT*, especially in the case of first filings and ICT patents, suggest the use of an alternative estimation, however using a Negative Binomial model we get results in line with the ones reported. These results are available upon request.

[17] These dummies already control for a lot of variation: a regression that uses only those delivers an R^2 of 0.74.

of the level of development.[18] Also bilateral trade between the two countries does not tend to have a significant effect on foreign patenting activities by NICs.[19]

[Table 1 about here]

In column 2 we introduce the measures of human capital for both origin and destination country. This marginally reduces the coefficient on GDP, as one could expect, while rendering the GDP per capital coefficient of the origin country negative and significant. The coefficients on human capital, though positive, are not statistically different from zero. The pattern of the IPR coefficients for the origin and destination countries remains unchanged. Column 3 adds the interactions of the IPR protection index with the share of exported goods belonging to the ICT sector in 2000 for NICs, obtained from World Bank World Development Indicators. Doing so considers the fact that countries more oriented toward production and exports in the patent-reliant ICT sector should gain more from IPR protection at home. As expected, the interaction between the share of exports in the ICT sector and the IPR protection index in NICs is positive and strongly significant.[20] In column 4 we replicate the specification in column 1 using the squared distance between IPR protection indices within each country pair instead of the two IPR indices. This variable is negative and strongly significant, indicating that a convergence of the IPR regimes between origin and destination country is conducive to foreign patenting by NICs. Column 5 replicates this last specification using a negative Binomial estimator, which accounts for the over-dispersion of *PAT* (Hausman, et al., 1984). This specification confirms the results obtained on the squared distance between IPR protection. [21]

[Table 2 about here]

Table 2 collects a series of specification checks, to test for robustness of our results. First, in column 1 we take the specification in column 2 of Table 1 and exploit the year in which each NIC was obliged to comply by the TRIPS agreement.[22] Using this information, we create an index for each 5-year interval that that measures the share of each period in which the NICs has enforced TRIPS. This variable is not significant and results on IPR measures are confirmed. Column 2 uses logs of the IPR index and the patterns of sign and significance of the coefficient is unchanged. In column 3 we get back to the original specification but we add country-pair fixed effects. In this case, the PPML algorithm drops many observations, however results on IPR

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[18] A regression using the squared difference of GDP per capita of origin and destination country, rather than the two separate variables, gives a negative and significant coefficient.

[19] The results remain the same when using bilateral export flows from *i* to *j,* or the sum of exports and imports as a measure of trade intensity.

[20] The direct effect of the share of ICT cannot be estimated because it is collinear with NICs' country fixed effects.

[21] The results under all specifications in the table remain valid when adding country-pair fixed effects, however in this case we lose information on the elasticities of country-pair variables due to collinearity. We report a specification with country-pair fixed effects in Table 2.

[22] This data was kindly provided to us by W.G. Park This dummy is used in Ivus, et al. (2016b) and is based on the year of greatest percentage change in the patent rights index of Park (2008).

measures are again confirmed. The subsequent columns use difference measures of IPR distance between the NICs and OECD, building on column 4 of Table 1. Column 4 adds education and TRIPS controls and continues to find a negative coefficient for the (squared) difference between IPR measures. To avoid giving too much weight on country-pairs with a large IPR difference, in column 5 we take the absolute value of the difference in IPR values, again finding a negative and significant coefficient. Finally, columns 6 and 7 define dummies for to capture squared difference and absolute difference between IPR values above 3 and 1, respectively, to rule out parametric assumptions on the relation between patent production and the difference in IPR measures across country-pairs. While TRIPS enforcement appears to boost patenting in the latter case, the main message of harmonization of IPR levels being conducive to South-North patenting is reinforced.

[Table 3 about here]

In Table 3 we report the results using the number of patents published specifically in the ICT sector as the dependent variable. Using the WIPO classification, we include technology fields of Telecommunications, Digital communication, Basic communication processes, Computer technology, IT methods for management and Semiconductors in the ICT sector. Numbers are even smaller than those for first filings: the number of patents go from 0 to 785, the average is 2 patents with a standard deviation of 24. The results mirror those in our baseline specifications in Table 1, with exception of the interacted column 3. The positive effect of IPR protection regime in NICs and the negative effect of the distance between IPR regimes are in place. In particular, the coefficient on the distance between North-South IPRs is larger in magnitude in specifications 3 and 4 with respect to their counterparts (columns 4 and 5 of Table 1, respectively). This is consistent with the positive effect of the interaction term between IPR protection and ICT export in column 3 of Table 1. Interestingly, the relationship between the flow of imports and patents into the OECD countries is negative and becomes significant for patents first filed abroad. This could be because domestic innovation gains importance for countries already well integrated in the global market, or alternatively due to their dependence on foreign technologies embedded in the imported goods.

Finally, in Table 4, we replicate all specifications in Table 1 using first filing of patents as the dependent variable. The procedure used to construct the variable is like the one used for *PAT* with much smaller numbers as anticipated. The distribution of first filings has a strong positive skew, as was the case for *PAT:* it takes values between 0 and 873, with mean 3 and standard deviation 29. In all specifications, the findings suggest that first patenting is more sensitive to distance, possibly because first filing is more closely associated with cross-border patenting than the original variable *PAT*. The coefficient of IPR protection in the OECD is negative and now strongly significant, suggesting that a weaker IPR environment makes it easier for researchers from NICs to file patents abroad. Since NICs are on average less technologically advanced than OECD countries, the former may find it easier to patent an original innovation in OECD countries with weaker IPR regimes whose technological frontiers are easier to reach. Results on the squared distance between IPR protection regimes are comparable with those obtained in Table 1. Bilateral trade does not affect the impact of IPRs on foreign patenting, but remains negative and significant implying the reliance of NICs on the technology content of trade when the latter is a more prevalent option.

[Table 4 about here]

4. Concluding Discussion

While the debate on the protection of IPRs has often been placed in a 'North-South' perspective, this paper addresses Southern innovation. We show the different roles IPRs can play for the globalization of Southern intellectual property depending on the location of enforcement. The aim is to study the relationship between the harmonization of intellectual property protection culture and the globalization of the culture of innovation. The road taken brings us to the question whether the harmonization of IPR protection can stimulate the internationalization of intellectual property that originates from the South. Observing the engagement of Southern innovators in patenting activities in the North brings the message that this culture has (i) already travelled to the South and (ii) is going through a phase of globalization.

Country-level data on the foreign patenting activities of NICs in OECD countries reveals that strengthening IPR protection in the South encourages domestic Southern firms to engage in global innovation activities. At the same time, the results reinforced the necessity of a strong IPR regime in the South to attract MNEs and for research activities to be operative there in the first place for the South to eventually engage in patenting activities abroad. In contrast, a stringent IPR regime in the North could hinder foreign patenting by NICs by making it more difficult for innovators from the latter to enter the Northern market. South-North patenting should hence be at their peak if we observe a convergence of protection levels in the two regions. By convergence of IPR protection levels we do not necessarily mean the need for relaxing IPRs in the North and upgrading them in the South, but a convergence of IPR systems. That is, reaching a rallying point in the implementation of an effective IPR policy to encourage the participation of each country in international innovation activities and the diffusion and use of state of the art technologies across countries. A starting point could be cooperating for the development of reciprocal legal and technical tools aimed at lowering barriers to foreign-patenting activities and improving the quality and transparency of the global patent system in general. In sum, the harmonization of intellectual property culture leads to its globalization.

References

Allred, B.B., Park, W.G., 2007. Patent Rights and Innovative Activity: Evidence from National and Firm-level Data, Journal of International Business Studies 38, 878-900.

Baldwin, R., Taglioni, D., 2006. Gravity for Dummies and Dummies for Gravity Equations. NBER Working Papers 12516.

Barro, R.J., Lee, J-W., 2010. A New Data Set of Educational Attainment in the World, 1950–2010. NBER Working Paper 15902.

Bhattacharya, M., Vickery, G., (Eds.) 2010. The Information and Communication Technology Sector in India: Performance, Growth and Key Challenges, OECD, Paris.

Boldrin, M., Levine, D., 2008. Against Intellectual Monopoly. New York, NY: Cambridge University Press.

Bożyk, P., 2006. Globalization and the Transformation of Foreign Economic Policy, NY: Ashgate Publishing.

Braga, C.A.P., Fink, C., 1999. How Stronger Protection of Intellectual Property Rights Affects International Trade Flows. World Bank Policy Research Working Paper 2051. World Bank, Washington, D.C.

Braga, C.A.P., Fink, C., Paz Sepulveda, C., 2000. Intellectual Property Rights and Economic Development. World Bank Discussion Paper 412. World Bank, Washington, D.C.

Branstetter, L., Fisman, R., Foley, F., 2006. Do Stronger Intellectual Property Rights Increase International Technology Transfer? Empirical Evidence from U.S. Firm-Level Data. Quarterly Journal of Economics 121, 321-349.

Castellani, D., Jimenez, A., Zanfei, A., 2013. How remote are R&D labs? Distance and innovative activities. Journal of International Business Studies 44, 649-675.

Chen, Y., Puttitanun, T., 2005. Intellectual Property Rights and Innovation in Developing Countries. Journal of Development Economics 78(2), 474-493.

Chu, A.C, Cozzi, G., Galli, S., 2014. Stage-dependent Intellectual Property Rights, Journal of Development Economics 106, 239-249.

Deardorff, A.V., 1992. Welfare Effects of Global Patent Protection. Economica 59, 35-51.

Disdier, A.C., Fontagné, L., Cadot, O., 2015. North-South Standards Harmonization and International Trade. World Bank Economic Review 29 (2), 327-352.

Economist Intelligent Unit, 2004. Scattering the seeds of invention. The globalisation of research and development. The Economist.

Falvey, R., Foster, N., Greenaway, D., 2009. Trade, Imitative Ability and Intellectual Property Rights. Review of World Economics 145 (3), 373-404.

Frankel, J.A., Rose, A.K., 2002. An Estimate of the Effect of Common Currencies on Trade and Income. KSG Faculty Research Working Paper Series RWP01-013.

Grossman, G., Lai, E.L.-C., 2004. International Protection of Intellectual Proprety. American Economic Review 94 (5), 1635-1653.

Hausman, J.A., Hall, B.H., Griliches, Z., 1984. Econometric Models for Count Data with Applications to the Patents R and D Relationship. Econometrica 52, 909-938.

He, Y., Maskus, K., 2012. Southern Innovation and Reverse Knowledge Spillovers: A Dynamic FDI Model. International Economic Review 53(1), 279-302.

Head, K., Mayer, T., Ries, J., 2010. The Erosion of Colonial Trade Linkages After Independence. Journal of International Economics 81, 1-14.

Ivus, O., 2011. Trade-Related Intellectual Property Rights: Industry Variation and Technology Diffusion. Canadian Journal of Economics, 44 (1), 201–26.

Ivus, O., Park, W., Saggi, K., 2016a. Intellectual Property Protection and the Industrial Composition of Multinational Activity. Economic Inquiry, 54 (2), 1068-1085.

Ivus, O., Park, W., Saggi, K., 2016b. Patent Protection and the Industrial Composition of Multinational Activity: Evidence from U.S. Multinational Firms. Working Paper.

Lai, E.L.-C., Qiu, L.D., 2003. The North's Intellectual Property Rights Standard for the South? Journal of International Economics, 59 (1), 183-209.

Lai, E.L.-C., Riezman, R., Wang, p., 2009. Outsourcing of Innovation. Economic Theory 38, 485-515.

Lorenczik, C., Newiak, M., 2012. Imitation and Innovation Driven Development Under Imperfect Intellectual Property Rights. European Economic Review 56(7), 1361-1375.

Mankiw, N.G., 2007. Principles of Economics, fourth edition.

Martínez-Noya, A., García-Canal, E., 2011. Technological Capabilities and the Decision to Outsource/Offshore R&D Services, International Business Review 20, 264-277

Maskus, K., 2000. Intellectual Property Rights in the Global Economy, Washington, DC: Institute for International Economics.

OECD, 2004. Patents and Innovation: Trends and Policy Challenge. OECD, Paris.

OECD, 2008a. The Internationalisation of Business R&D: Evidence, Impacts and Implications. OECD, Paris.

OECD, 2008b. Open Innovation in Global Networks. OECD, Paris.

Park, W.G., 2008. International Patent Protection: 1960-2005. Research Policy 37, 761-766.

Picci, L., 2010. The Internationalization of Inventive Activity: A Gravity Model using Patent Data. Research Policy 39, 1070-1081.

Santos Silva, J.M., Tenreyro S., 2006. The Log of Gravity. The Review of Economics and Statistics 88, 641-658.

Sun, Y., 2003. Determinants of Foreign Patents in China. World Patent Information 25, 27-37.

Tian, L., 2011. Meeting of International Authorities under the Patent Cooperation Treaty (PCT) Working Group: Chinese Patent Documents, WIPO PCT/MIA/18/12.

van Welsum, D., Xu, T., (Eds.) 2007. Is China the New Centre for Offshoring of IT and ICT-Enabled Services?, OECD Digital Economy Papers, No. 128, OECD Publishing, Paris.

WIPO, 2010, World Intellectual Property Indicators 2010. WIPO, Geneva.

WIPO, 2011, World Intellectual Property Report: The Changing Face of Innovation. WIPO, Geneva.

WIPO, 2012, World Intellectual Property Indicators. WIPO, Geneva.

Yang C.H., Kuo N.F., 2008. Trade-Related Influences, Foreign Intellectual Property Rights and Outbound International Patenting, Research Policy 37, 446-459.

Table 1: Determinants of South-North foreign patenting. Filing.

	(1)	(2)	(3)	(4)	(5)
Estimation method	PPML	PPML	PPML	PPML	Negative Binomial
Dep. Var.	*PAT_ijt*	*PAT_ijt*	*PAT_ijt*	*PAT_ijt*	*PAT_ijt*
DIST_ij	-0.301***	-0.286***	-0.260***	-0.304***	-0.648***
	(0.074)	(0.072)	(0.072)	(0.075)	(0.083)
COM_LAN_ij	0.531***	0.540***	0.531***	0.560***	1.094***
	(0.133)	(0.133)	(0.126)	(0.132)	(0.161)
COM_BOR_ij	0.267	0.215	0.132	0.263	0.025
	(0.239)	(0.235)	(0.221)	(0.244)	(0.242)
POP_it	3.306	1.919	3.390	3.791	7.356***
	(3.139)	(3.304)	(2.238)	(3.416)	(1.624)
POP_jt	2.057	7.848**	4.207	-1.034	8.350***
	(4.374)	(3.847)	(3.081)	(4.896)	(2.234)
GDP_pc_it	1.389***	1.197***	0.993***	1.364***	1.297***
	(0.276)	(0.360)	(0.296)	(0.274)	(0.171)
GDP_pc_jt	-0.643	-1.524***	-1.376**	-0.048	-1.130***
	(0.717)	(0.500)	(0.577)	(0.715)	(0.330)
IMP_ijt	-0.071	-0.054	0.057	-0.093	-0.034
	(0.054)	(0.056)	(0.038)	(0.063)	(0.024)
IPR_it	0.594***	0.583***	0.413***		
	(0.173)	(0.162)	(0.095)		
IPR_jt	-0.162	-0.130	-0.476		
	(0.345)	(0.338)	(0.372)		
EDU_it		0.157			
		(0.150)			
EDU_jt		0.031*			
		(0.017)			
ICT_IPR_it			3.672***		
			(0.391)		
dist_IPR_ijt				-0.116***	-0.062***
				(0.041)	(0.023)
Time dummies	YES	YES	YES	YES	YES
Country dummies	YES	YES	YES	YES	YES
Observations	1,248	1,248	1,158	1,248	1,248

Note: The dependent variable is the average yearly number of patents filed in OECD countries' patent offices filed by NICs-resident applicants. Pseudo-Poisson Maximum Likelihood (1-4) and Negative Binomial (5) estimations. Note that *i* refers to NICs while *j* refers to OECD countries. All specifications include monadic country dummies and time dummies. Detailed descriptions of the set of controls in the text. Robust standard errors clustered at the country-pair level in brackets. (***) p-value < 0.01, (**) p-value <0.05, (*) p-value <0.1.

Table 2: Determinants of South-North foreign patenting. Filing. Robustness.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Estimation method	PPML	PPML	PPML	PPML	PPML	PPML	PPML
Dep. Var.	*PAT_ijt*	*PAT_ijt*	*PAT_ijt*	*PAT_ijt*	*PAT_ijt*	*PAT_ijt*	*PAT_ijt*
IPR_it	0.609***		0.584***				
	(0.190)		(0.193)				
IPR_jt	-0.148		0.001				
	(0.350)		(0.320)				
Log(IPR_it)		1.468***					
		(0.510)					
Log(IPR_jt)		-0.234					
		(1.196)					
Dist_IPR				-0.112**			
				(0.047)			
Abs_IPR					-0.558***		
					(0.188)		
Dist_IPR>=3						-0.407**	
						(0.194)	
Abs_IPR>=1							-0.391**
							(0.165)
DIST_ij	-0.283***	-0.293***		-0.296***	-0.286***	-0.276***	-0.338***
	(0.071)	(0.071)		(0.071)	(0.071)	(0.080)	(0.077)
COM_LAN_ij	0.538***	0.541***		0.567***	0.536***	0.508***	0.624***
	(0.132)	(0.134)		(0.131)	(0.130)	(0.145)	(0.141)
COM_BOR_ij	0.207	0.233		0.227	0.197	0.253	0.363
	(0.236)	(0.240)		(0.240)	(0.234)	(0.249)	(0.226)
POP_it	1.569	1.278	2.498	2.565	1.944	6.036**	7.466**
	(3.549)	(3.938)	(3.527)	(3.800)	(3.550)	(2.990)	(3.276)
POP_jt	7.713**	8.098**	9.551***	6.395*	6.380	9.324**	9.553**
	(3.736)	(3.652)	(3.277)	(3.774)	(3.899)	(4.115)	(4.004)
GDP_pc_it	1.171***	1.123***	1.283***	1.180***	1.170***	1.427***	1.437***
	(0.333)	(0.372)	(0.321)	(0.351)	(0.322)	(0.303)	(0.305)
GDP_pc_jt	-1.550***	-1.475***	-1.179***	-1.092**	-1.366***	-1.426***	-1.656***
	(0.503)	(0.486)	(0.438)	(0.518)	(0.497)	(0.493)	(0.499)
IMP_ijt	-0.044	-0.075	-0.096*	-0.088*	-0.042	-0.098**	-0.069
	(0.047)	(0.046)	(0.055)	(0.046)	(0.050)	(0.039)	(0.044)
EDU_it	0.165	0.154	0.116	0.153	0.170	0.126	0.161
	(0.142)	(0.153)	(0.135)	(0.162)	(0.145)	(0.172)	(0.166)
EDU_jt	0.029*	0.034**	0.042***	0.040***	0.029*	0.054***	0.030*
	(0.015)	(0.015)	(0.012)	(0.015)	(0.015)	(0.016)	(0.018)
TRIPS	-0.081	-0.013	-0.002	0.079	-0.038	0.263	0.597**
	(0.313)	(0.280)	(0.311)	(0.308)	(0.323)	(0.260)	(0.251)
Time dummies	YES	YES	YES	YES	YES	YES	YES
Country dummies	YES	YES	YES	YES	YES	YES	YES
Country-pair dummies	NO	NO	YES	NO	NO	NO	NO
Observations	1,248	1,248	837	1,248	1,248	1,248	1,248

Note: The dependent variable is the average yearly number of patents filed in OECD countries' patent offices filed by NICs-resident applicants. Pseudo-Poisson Maximum Likelihood estimations. Note that *i* refers to NICs while *j* refers to OECD countries. All specifications include monadic country dummies and time dummies, while specification in column 3 also include country-pair fixed effects. Detailed descriptions of the set of controls in the text. Robust standard errors clustered at the country-pair level in brackets. (***) p-value < 0.01, (**) p-value <0.05, (*) p-value <0.1.

Table 3: Determinants of South-North foreign patenting. ICT Filing.

	(1)	(2)	(3)	(4)
Estimation method	PPML	PPML	PPML	Negative Binomial
Dep. Var.	*ICT.PAT_ijt*	*ICT.PAT_ijt*	*ICT.PAT_ijt*	*ICT.PAT_ijt*
DIST_ij	-0.368***	-0.369***	-0.363***	-0.428***
	(0.094)	(0.093)	(0.099)	(0.088)
COM_LAN_ij	1.000***	1.013***	1.036***	1.011***
	(0.370)	(0.368)	(0.381)	(0.303)
COM_BOR_ij	-0.361	-0.554	-0.295	-0.462
	(0.383)	(0.337)	(0.439)	(0.319)
POP_it	2.815	1.015	2.830	7.557**
	(2.942)	(3.292)	(3.320)	(2.977)
POP_jt	22.999***	23.532***	15.323***	21.211***
	(4.256)	(5.815)	(5.485)	(4.636)
GDP_pc_it	1.211**	1.088*	1.200**	1.724***
	(0.541)	(0.614)	(0.548)	(0.477)
GDP_pc_jt	-0.499	-0.591	0.541	-0.817
	(0.881)	(0.862)	(1.089)	(0.797)
IMP_ijt	-0.197***	-0.181***	-0.246***	-0.127**
	(0.060)	(0.062)	(0.059)	(0.055)
IPR_it	0.867***	0.833***		
	(0.145)	(0.125)		
IPR_jt	0.464	0.345		
	(0.831)	(0.867)		
EDU_it		0.243*		
		(0.145)		
EDU_jt		0.000		
		(0.016)		
dist_IPR_ijt			-0.169***	-0.066**
			(0.040)	(0.033)
Time dummies	YES	YES	YES	YES
Country dummies	YES	YES	YES	YES
Observations	1,248	1,248	1,248	1,248

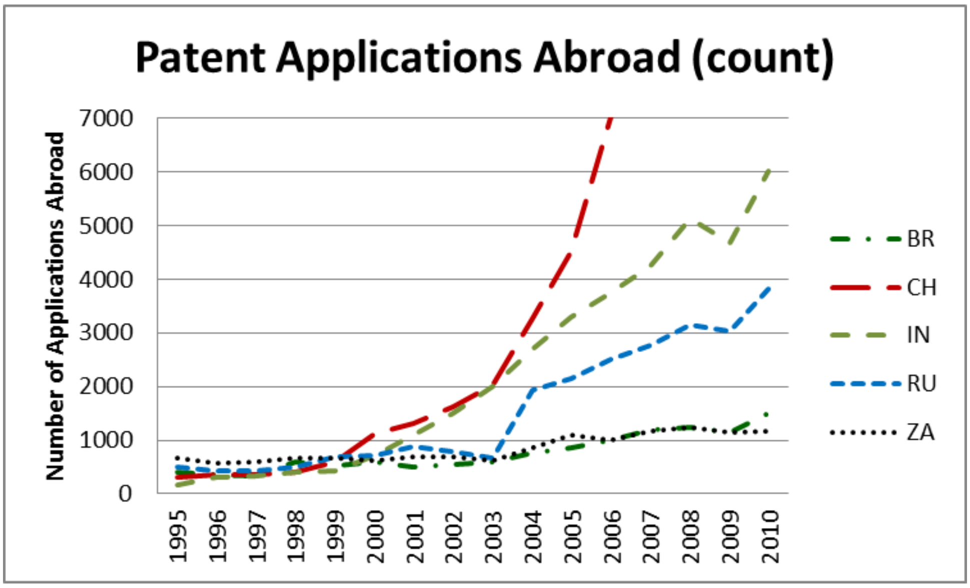
Note: The dependent variable is the average yearly number of patents in the ICT sector (Telecommunications, Digital communication, Basic communication processes, Computer technology, IT methods for management and Semiconductors, according to WIPO classification) published in OECD countries' patent offices filed by NICs-resident applicants. Pseudo-Poisson Maximum Likelihood (1-3) and Negative Binomial (4) estimations. Note that *i* refers to NICs while *j* refers to OECD countries. All specifications include monadic country dummies and time dummies. Detailed descriptions of the set of controls in the text. Robust standard errors clustered at the country-pair level in brackets. (***) p-value < 0.01, (**) p-value <0.05, (*) p-value <0.1.

Table 4: Determinants of South-North foreign patenting. First filing.

	(1)	(2)	(3)	(4)	(5)
Estimation method	PPML	PPML	PPML	PPML	Negative Binomial
Dep. Var.	*F.PAT_ijt*	*F.PAT_ijt*	*F.PAT_ijt*	*F.PAT_ijt*	*F.PAT_ijt*
DIST_ij	-0.594***	-0.588***	-0.573***	-0.582***	-0.872***
	(0.135)	(0.134)	(0.127)	(0.137)	(0.139)
COM_LAN_ij	1.083***	1.082***	1.172***	1.132***	1.303***
	(0.229)	(0.227)	(0.214)	(0.226)	(0.239)
COM_BOR_ij	0.901*	0.902*	0.759*	0.953*	0.717*
	(0.510)	(0.500)	(0.445)	(0.540)	(0.428)
POP_it	-3.464	-3.370	-3.075	-4.193	-1.663
	(2.983)	(3.002)	(2.225)	(3.367)	(2.853)
POP_jt	23.848***	27.278***	25.168***	25.119***	22.066***
	(3.908)	(4.349)	(3.218)	(5.129)	(4.553)
GDP_pc_it	1.611***	1.605***	1.267***	1.566***	0.641**
	(0.338)	(0.320)	(0.357)	(0.350)	(0.316)
GDP_pc_jt	-0.685	-1.153	-0.861	-0.486	-2.292***
	(1.064)	(0.865)	(0.988)	(1.002)	(0.632)
IMP_ijt	-0.185***	-0.191***	-0.136***	-0.209***	-0.097***
	(0.060)	(0.063)	(0.051)	(0.060)	(0.026)
IPR_it	0.457***	0.453***	0.363***		
	(0.158)	(0.154)	(0.099)		
IPR_jt	-1.708**	-1.693**	-1.901**		
	(0.795)	(0.788)	(0.771)		
EDU_it		0.008			
		(0.106)			
EDU_jt		0.025			
		(0.020)			
ICT_IPR_it			2.301***		
			(0.434)		
dist_IPR_ijt				-0.110***	-0.133***
				(0.035)	(0.034)
Time dummies	YES	YES	YES	YES	YES
Country dummies	YES	YES	YES	YES	YES
Observations	1,248	1,248	1,158	1,248	1,248

Note: The dependent variable is the average yearly number of patents first filed in OECD countries' patent offices filed by NICs-resident applicants. Pseudo-Poisson Maximum Likelihood (1-4) and Negative Binomial (5) estimations. Note that *i* refers to NICs while *j* refers to OECD countries. All specifications include monadic country dummies and time dummies. Detailed descriptions of the set of controls in the text. Robust standard errors clustered at the country-pair level in brackets. (***) p-value < 0.01, (**) p-value <0.05, (*) p-value <0.1.

Figure 1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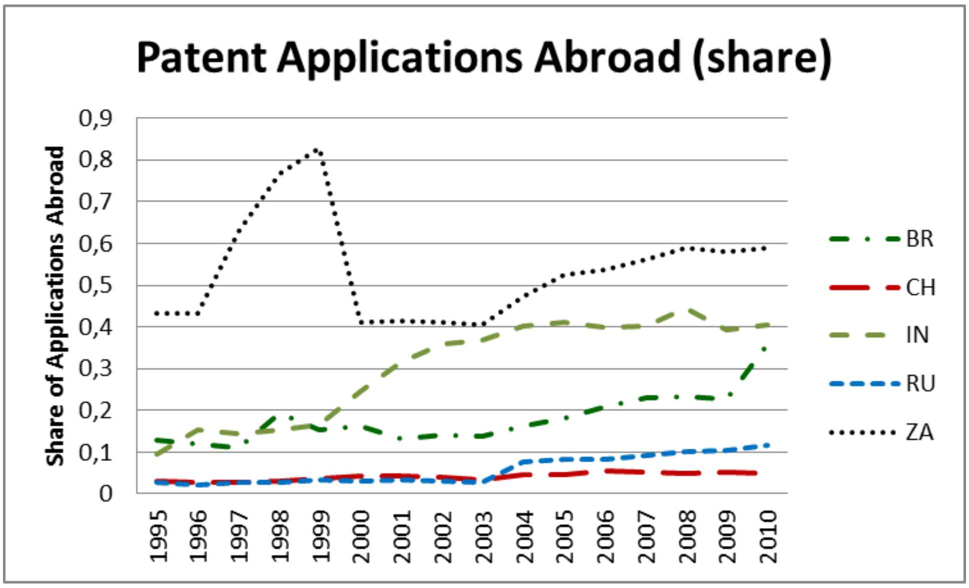
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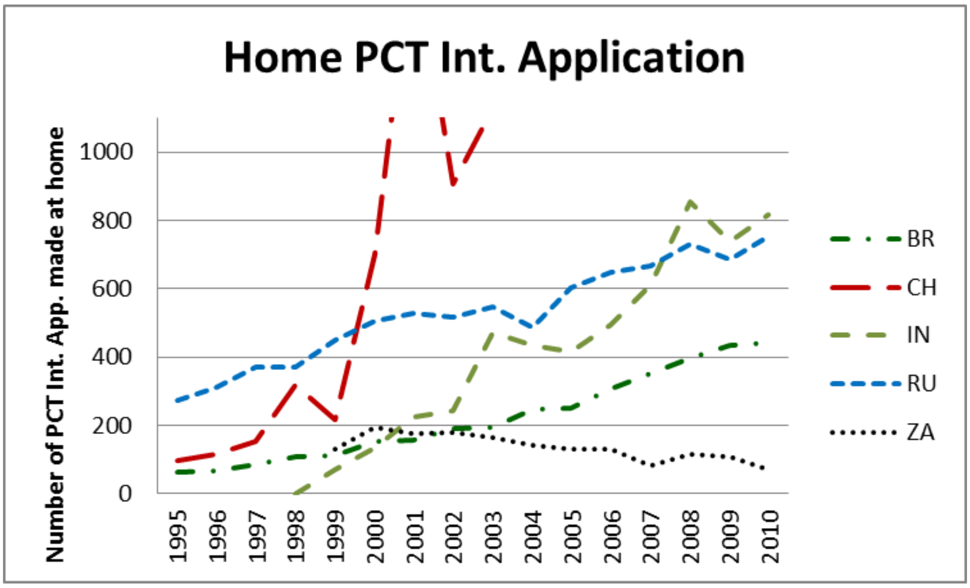
Figure 2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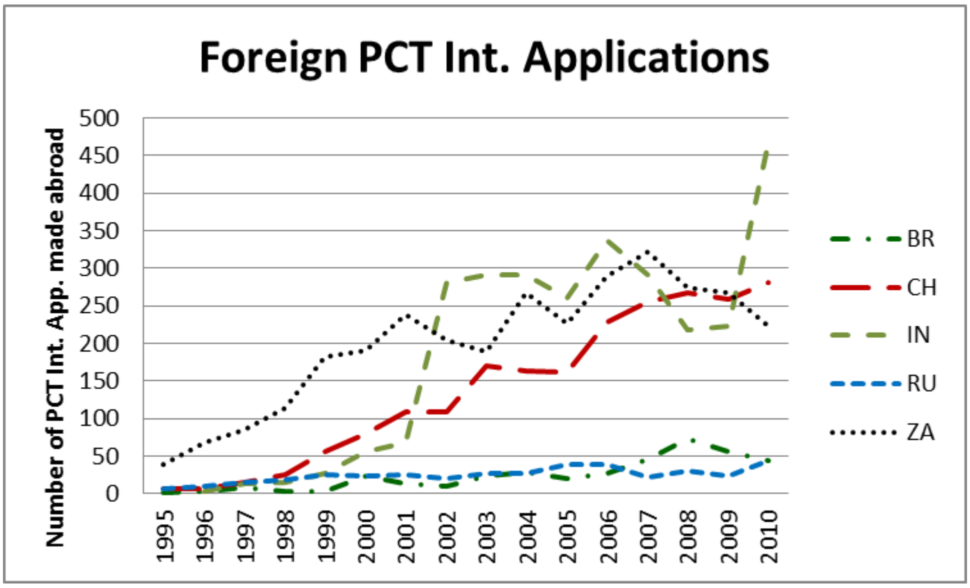
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