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Analyzing the evidence of an IPR take-off in China and India

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ABSTRACT

Both China and India have been experiencing a historical take-off in the use of intellectual property rights (IPR). In terms of trademark applications filed with domestic IP offices in 2009, the evidence demonstrates that China now ranks 1st worldwide and India 5th, while for patent filings China ranks 3rd worldwide and India ranks 9th. This performance is remarkable as both China and India experienced negligible demand for IPR protection as recently as two decades ago. The IPR take up trends in these two countries are analyzed in detail, highlighting the structure of patent and trademark demand since 1990. Specifically, the available series are broken down and analyzed according to: (i) national versus foreign origin of patents and trademarks; (ii) technological (IPC) and trademark (NICE) classes; and (iii) the major individual patent users in each country. The data used refers to applications in the Chinese and Indian IP offices although the demand from residents of these two countries in both the international and other national systems is also assessed. Beyond the existing momentum in IPR registrations by China and India and their capacity to maintain it into the near future, the paper addresses practical questions about the strategies, motives and benefits behind the current trends. In particular, we seek to evaluate the capacity of both China's and India's National Innovation Systems to internalize the potential returns of this increasing demand for IPR. The insight reached finds that should both China and India sustain their current IPR growth rates, they will be able to catch up with the most advanced economies within the time span of a few decades.

1. Introduction

Both the People's Republic of China (hereafter China) and the Republic of India (hereafter India) have been experiencing a historical take-off in their usage of intellectual property rights (IPR). In this paper we focus on two of the most important IP rights, trademarks and invention patents. The evidence is that China is now (2009 data) number one worldwide in trademark applications, while India is just behind the US, Japan and the Republic of Korea. In terms of patent filings, China ranks 3rd worldwide and India ranks 9th.

The IPR take up trends in both China and India are analyzed in detail, highlighting the structure of patent and trademark demand in the two decades since 1990. Specifically, the available series are broken down and analyzed in accordance to: (i) national versus foreign origin of the patents and trademarks requested; (ii) technological (IPC) and trademark (Nice) classes; and (iii) the major individual users of patents and trademarks in both countries. The data used refers to applications in the Chinese and Indian IP offices, but the demand for patents and trademarks of residents from both countries in the international and other national systems is also assessed.

Beyond the existing momentum in IPR take up in both countries and the capacity to maintain it into the near future, the paper addresses practical questions about the strategies, motives and benefits behind the current trends. Specifically, we seek to evaluate the capacity of both China's and India's national innovation systems to internalize the potential returns on this increasing demand for IPRs. One aspect that is implicit to the discussion in this paper is whether the current trends in IPR take up by China and India are part of an innovative effort enabling certain segments of these economies to catch up with leading edge technology in a relatively short period of time.

The paper below is divided into seven sections. Section 2 deals with the economic progress of China and India and discusses several aspects that might affect future sustainability. Section 3 addresses the historical dynamics of IPR take-up and raises the question of whether patenting and trademark registration trends can be correlated with innovation. Section 4 introduces several methodological

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Table 1
R&D, 1995–2007.

	FTE researchers per 1000 workforce											
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Japan	8.3	9.2	9.3	9.8	10	9.9	10.4	10.1	10.6	10.6	11	11.1
S. Korea	4.9	4.8	4.8	4.7	4.9	5.1	6.3	6.4	6.8	6.9	7.9	8.7
USA	8.1	–	8.8	–	9.3	9.3	9.5	9.7	10.2	9.8	9.6	–
EU27	4.8	4.9	4.9	5	5.1	5.2	5.3	5.5	5.6	5.8	6	6.1
China	0.8	0.8	0.8	0.7	0.7	1.0	1	1.1	1.2	1.2	1.5	1.6
India	–	–	–	–	–	0.3	0.4	0.5	–	–	–	–

	GERD/GDP ratio (%)												
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Japan	2.71	2.81	2.87	3	3.02	3.04	3.12	3.17	3.2	3.17	3.32	3.39	–
S. Korea	2.37	2.42	2.48	2.34	2.25	2.39	2.59	2.53	2.63	2.85	2.98	3.22	–
USA	2.51	2.55	2.58	2.61	2.66	2.75	2.76	2.66	2.66	2.59	2.62	2.66	2.68
EU27	1.67	1.66	1.67	1.67	1.72	1.74	1.76	1.77	1.76	1.73	1.74	1.77	–
China	0.57	0.57	0.64	0.65	0.76	0.90	0.95	1.07	1.13	1.23	1.33	1.42	1.49
India	0.63	0.65	0.72	0.73	0.76	0.78	0.76	0.75	0.74	0.71	–	–	–

Source: OECD (2010).

considerations concerning the data used and the analyses carried out. Sections 5, 6 and 7 are dedicated to empirical exploration, presenting respectively data on patent and trademark demand by India and China in different systems, issues related to the technological and trademark specialization of both countries and the presence of Chinese and Indian firms in the international ranking of most intensive patent users. Finally, Section 8 provides our conclusions.

2. How far will China and India get in their catching up?

In terms of their population China and India are the two largest countries in the world, with 1.3 and 1.1 billion inhabitants respectively. As it is known the economic performance of these two countries has been remarkable. Over the last three decades, China has advanced at an average Gross Domestic Product (GDP) growth rate of 10% per year. By 2009, China was already ranked number two worldwide in terms of its purchasing power parity (ppp), GDP while India was number four. At $6700, Chinese ppp income per capita was over double the $3100 Indian figure, qualifying China as an intermediate income economy with India still a low income economy (Dahlman, 2008). Nevertheless, Chinese GDP per capita ranked only 127th worldwide in 2009, indicating a still very significant way before catching up in terms of income per capita with high income economies.

The high Chinese GDP growth rates observed have happened simultaneous to a rapid integration into the world trade system. By 2007, China was world exporter number two with a world market share of 9%, 8 times higher than the Indian. India has, however, been performing quite well in terms of the export of services. As a matter of fact, the volume of Indian service exports is similar to the Chinese and the Indian share in world services trade is close to 3%, three times higher than its share in goods exports. In contrast, China has excelled in the exports of goods, with 30% of them being medium-tech and high-tech products in 2006. As pointed out by Baldwin (2006), China has benefited from the delocalization of production worldwide while India has benefited from ICT (Information and Communication Technologies) dissemination, which has enabled the delocalization of specific tasks to within its jurisdiction.

Investment in R&D has progressed along economic growth in China and India. Once again, the Chinese performance is striking with its GERD/GDP ratio rising to 1.5% by 2007. Despite these advances, China is still way behind Japan and South Korea, which both have GERD/GDP ratios above 3%. Furthermore, the Chinese performance is poorer in terms of the proportion of its workforce devoted to research activities (Table 1).

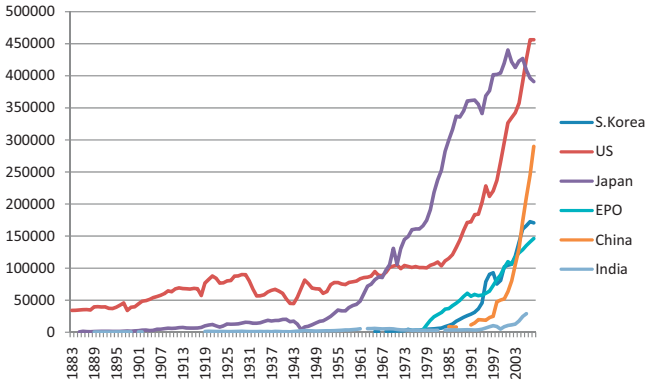

Fig. 1. Patent filings in the largest PTOs, 1883–2008.

One striking aspect in the recent development of China and India is their performance in terms of intellectual property rights (IPR). Patent and trademark applications have risen very fast in these two countries. If the focus is on the demand recorded at the national Patent and Trademark Offices (PTOs), China has risen to number one worldwide in trademarks and number three in patents, immediately after the US and Japan, while India is now, respectively, number five and number nine. The dynamic trends are illustrated by Figs. 1 and 2, which provide information from 1883 through to 2008 for patents and from 1964 up to 2008 for trademarks. What is clear from the charts below and from the data to be analyzed in

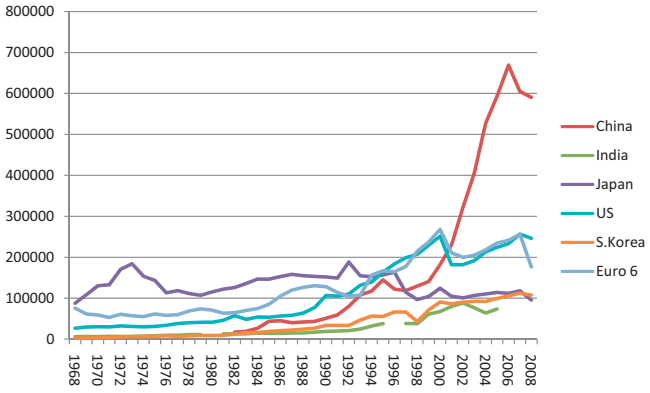

Fig. 2. Trademark applications in the largest PTOs, 1968–2008.

the subsequent sections is that an important change in the global geography of innovation is taking place.

The information displayed in Figs. 1 and 2 requires some qualifications. Firstly, the data refers to gross demand for patents and trademarks, which include both applications by residents and by non-residents (i.e. foreign entities which apply for IPRs outside their home-countries). Secondly there are different systems of patenting and trademark registration, which need to be analyzed in parallel. Given these differences, most of the remaining of the paper will be dedicated to analysis of the IPR demand by residents and non-residents in the designated "national systems" in China and India and by an analysis of the Chinese and Indian IPR demand in the designated "international systems" and in other national systems.

There are two major "international systems", which are the "international patent" (or PCT) system (regulated by the Patent Cooperation Treaty) and the "international trademark" system (regulated by the Madrid Agreement on Trademarks). The most important national systems are the American (managed by the USPTO) and the Japanese one (managed by the JPO). The European Patent System (managed by EPO) and the European Community Trademark system (managed by OHMI) share some characteristics of the international and national systems. The PCT system does not concede patents, but supplies a common entrance for latter national grants.

Regardless of the analysis differentiating between domestic and foreign users of patents and trademarks, the evidence is that IPR take up has grown extremely fast in China and India in recent years. These trends suggest both countries might be on an economic catching up trajectory not only in terms of GDP per capita but eventually also in innovative capacities. This particular dimension of the catch up process might have important implications.

In the early 2000s, Goldman Sachs projected that in less than 30 years the combined GDP of the BRIC economies would collectively exceed that of the G6 in US dollar terms (Goldman Sachs, 2003). There are some indications that due to their size and growth dynamics, at least China and India may advance faster than the other BRIC economies (Altenburg et al., 2006). Growth rates and high savings also enable these countries to invest heavily in infrastructure and R&D, concentrate highly skilled workers in certain regions, purchase licenses and promote mass education (Altenburg et al., 2006). Further to this endogenous effort, the codified nature of most business knowledge related to information systems, logistics, or supply chain management make its transference easier. The two countries are also benefiting from inflows of R&D, with China today the leading recipient of outsourced R&D (UNCTAD, 2006). Moreover, Chinese and Indian researchers are increasingly linked up to transnational scientific networks (Saxenian, 2006).

In the case of China, a combination of factors has proven successful in bringing about this catching up process. China ensured its industries were oriented towards technological learning and prepared for innovation and able to become the natural partners for foreign companies, even before trade liberalization was implemented (Chandra et al., 2009). This was achieved through policies supporting investment in R&D in combination with financial subsidies to selectively nurture certain industries, especially in high-technology areas, in parallel with an export growth strategy and strongly attractive terms for foreign investment (Chandra et al., 2009). Once trade liberalization was implemented, China did not hesitate in taking advantage of competitive prices to attain additional gains in efficiency.

In relation to India, it is clear that the different strategies adopted do not reveal the same coherence over the course of time as in the Chinese case (Dahlman, 2008). The anti-export bias of strategies based on import substitution and the lack of consistent innovation-enhancing policies proved unhelpful in promoting the international competitiveness of domestic production (Chandra et al., 2009). However, the focus on education quality in certain areas plus an incremental opening up of the Indian economy have helped the country to develop some world-class industries (Chandra et al., 2009), namely in the ICT and software fields.

The boom in Indian and particularly Chinese patenting, together with very intense usage of trademarks in both countries, may signal a turning point in the development of both countries. The observed trends may represent a strong indicator of the sustainability of economic growth in China and India, enabling them eventually to effectively catch up in economic terms. As Fagerberg and Godinho (2005) noted, other successful catching up processes occurring since Britain took over economic leadership with the Industrial Revolution in the early 19th century have been marked by the newly catching up countries adopting important institutional innovations together with the absorption and diffusion of foreign technological know-how. The surge in IPR usage in both China and India may be indicative of such a type of institutional change.

3. IPR dynamics and innovation in the context of emerging economies

The origins of Intellectual Property Rights (IPR) go back several centuries but the institution matured and took its modern configuration in the first half of the 19th century, in the sequence of the industrial revolution. This assertion is particularly true for patents and trademarks, the two IP rights we are dealing with in this paper.

Patents were envisaged as a device to provide inventors with monopoly power so that they appropriate the returns on the invention. Such monopoly power is granted over a given period of time, during which the inventor has the exclusive rights to exploit the new technology. Given this role, patents have been portrayed as an intermediary stage between invention and innovation, without which the inventors would not have enough incentives to market their inventions.

The use of patents statistics in innovation assessment was first proposed by Jacob Schmookler (Schmookler, 1966). Since then patent statistics have been widely used over the last few decades, with the number of new patents being taken as an indicator of innovation. Marzal and Tortajada-Esparza (2007) point out to the many advantages of using patent statistics: a patent is associated with the development of a new technology; patent databases give easy access to information and enable comparison between countries; and patent analysis also allows for the understanding of knowledge flows, through citations analysis. Some studies have shown a strong relation between innovations and patenting. The European Patent Office estimated that 50 per cent of innovations are patented (EPO, 1994, p. 25). Also, some empirical studies which have been carried out with both patents and actual innovations have not detected significant differences among these two output indicators (Jaffe, 1989; Acs and Audretsch, 1993; Acs et al., 2002).

However, several authors, some of them pertaining to the very community that championed the use of patent statistics, have also highlighted problems in using patents as an innovation indicator (Pavitt, 1988; Griliches, 1990; Trajtenberg, 1990; Archibugi, 1992; Smith, 2005). Since the pioneering study of Levin et al. (1987) it is well known that the intensity of patent demand varies widely across sectors. Levin et al. (1987) and Cohen et al. (2000) have further shown a strong variance in the use of patents vis-à-vis other appropriability mechanisms. It is also known that traditional SMEs display a much lower patenting propensity than larger firms (Marzal and Tortajada-Esparza, 2007). Moreover, Cohen et al. (2002) point out how patent usage depends on national laws.

Despite these criticisms, the interest on patent statistics in connection with the analysis of innovation has grown significantly as the advanced economies moved in an era of "intellectual capitalism" (Grandstrand, 1999), which arose in the sequence of the so-called "patent boom" or patent explosion (Hall, 2005).

Several studies associate that patent boom that happened in the advanced economies in the 1980s with the emergence of R&D-intensive sectors such as microelectronics, ICT and the biotech sector (Kim and Marschke, 2004). Growth in R&D expenditure has led to a rise in innovation which, together with managerial improvements, has resulted in a rise in patenting (Kortum and Lerner, 2003).

However, many other studies link the patent boom with a more intensive strategic use of patents by business firms. Referring to the US case, Hall (2005) points out that patenting might be important for new firms as a means of signalling their innovative capacity while mature firms tend to use patents in a more defensive manner and build up large IPR portfolios. Similar results have been highlighted for other advanced economies. Harabi (1995) in a study of Swiss companies had already stressed that business firms use patents as a negotiation lever. Blind et al. (2006), referring to German data, demonstrated that beyond using patents to avoid imitation, business firms also use them to protect domestic markets by keeping competitors out of their relevant markets and to improve their technological image. Duguet and Kabla (1998) concur with these views, pointing out that despite generally mentioning using patents to avoid imitation, 60% of French companies indicated using patents to avoid litigation and as a lever for cross licensing and other technological negotiations.

Most studies carried out in relation to IPR usage in emerging economies focus on patents but little attention has been paid to the use of trademarks. In this paper, both patents and trademarks are adopted to generate insights into the innovation potential of these economies.

The joint use of patent and trademark data has the additional advantage of providing a more reliable perspective on the innovation potential. We observed above on the diversity of purposes patents serve in contemporary advanced economies in addition to their traditional role as a means for protecting innovation. In this context, many studies have identified the need for complementary indicators that, together with patents, may provide a more realistic and encompassing account of innovation capacity.

The so-called Oslo Manual (OECD, 2005) was written under the main assumption that patents do not reflect the different sources and shapes through which innovation occurs, especially in the services sector where organizational change and the co-creation of new solutions with clients often takes place beyond the scope of R&D labs.

This dissatisfaction with a view of innovation as necessarily technological and R&D-borne led to the suggestion of alternative approaches. Several empirical studies put forward alternatives such as the share of new products in total sales (Liu and White, 1997), measures of organizational changes within firms (Pakes and Griliches, 1984), innovation counts (Acs and Audretsch, 1993), number of new products (Fritsch, 2000) and the use and citation of patent information (Trajtenberg, 1990). Obviously, these alternative measures also share some of the problems pointed out in relation to patents as innovation indicators and hence the reason others maintain patents should still be accepted as a good innovation proxy (Li, 2009). Within this context, there has been increasing interest in the use of trademarks as an innovation indicator.

Landes and Posner (1987) have pointed out that trademarks are used to signal product quality to the market. One easily understands that as the brands associated with existing trademarks gain wider recognition, firms need to invest further to keep and improve the quality of their trademark-protected products, thus leading to incremental improvements.

In what concerns new trademarks, the storyline is slightly different. Applications for new trademarks are related to broader marketing strategies where firms apply for a trademark to strengthen product differentiation. In most cases, this differentiation might involve incremental changes in relation to other goods or services within existing product lines even though in some cases the use of new trademarks might also be related to more radical product changes. Typically, new trademarks involve a diversity of steps such as changes in branding, packing and labeling, communication with the potential market through public relations activities and publicity and promotion (Elliott and Percy, 2006), which, altogether, may involve important changes in firm behavior. What might be argued is that trademarks are more downstream, related to the launching of new products and helping them get established in the market, rather than to the inventive step itself as happens with patents.

Several studies have shown how trademarks are more intensely used in consumer goods sectors (Greenhalgh et al., 2001; Mainwaring et al., 2004), and it has also been shown that trademarks related with new services have grown steadily in recent years (Schmoch, 2003; Jensen and Webster, 2004; Loundes and Rogers, 2003; Greenhalgh et al., 2001). Statistical studies on trademarks have also been carried out so as to obtain information on issues such as international differences in trade participation (Baroncelli et al., 2004a), trade specialization (Fink et al., 2003) or the use of trademarks as a protectionist device (Baroncelli et al., 2004b).

Furthermore, through the use of empirical data, other studies have highlighted that there is a correlation between trademark use and innovative activities. These studies found a significantly positive relationship across different sectors between trademarks applications and several other innovation indicators, such as patents, R&D or new products launched (Millot, 2009). This correlation would also seem to be more intense in service sectors (Schmoch, 2003; Mendonça et al., 2004) and in high-tech sectors (Mendonça et al., 2004), especially in sectors such as the pharmaceutical industry (Malmberg, 2005; Millot, 2009).

Given the patterns of specialization in both India and China, and their growing involvement in international trading activities, it therefore becomes more important to adopt the double focus of analyzing innovation capacity through both patents and trademarks.

Some studies have been produced on the rising IPR usage in both China and India. In relation to China, and referring to a sample of medium and large-sized firms, Hu and Jefferson (2009) have shown that the increase in patenting is linked not only to rising R&D expenditure but also to foreign direct investment inflows and to a changing legal framework that favors patent owners.

In India, the Patents Act of 1970 eliminated product patents for pharmaceutical and food products, while process patents were shortened for a period of 5–7 years. This step made the domestic market unattractive for large foreign multinationals, allowing for reverse engineering and the development of important competencies in these sectors (Dahlman, 2008). As India started to adapt to TRIPS disciplines, it already had an established pharmaceutical industry, producing generic drugs at very low cost. Despite imitation not directly leading to innovation, it is often a necessary step for learning and capability acquisition (Katz and Shapiro, 1987). These advancements have allowed Indian firms to develop innovative capabilities and more recently increasing their IPR uptake.

One issue raised in relation to the patents issued by both China and India is their quality. Using patent citation ratios is an important measure to accessing patent quality (Bloom and Van Reenen, 2002). The citation ratio is defined as the average number of a country's

patents cited in subsequent patents. The underlying assumption in using patent citations to measure patent quality is that frequently cited patents probably involve significant technological advances (Tseng, 2009). Tseng (2009) points out that patent quality is extremely heterogeneous in China and India, with most patents being of a lower quality, as indicated by an average citation ratio of 3.6 which is the same for both countries. Zhou and Stembridge (2008) also echo this preoccupation with possible patent quality problems in China.

One relevant research question is ascertaining whether the increased involvement of emerging economies such as China and India in IPR usage derives from the same underlying reasons as in advanced economies or whether other distinct factors are driving the trends recently observed. This paper addresses this question through the observation of the patent and trademark specialization of China and India, specifically to find out whether the increase in IPR usage in these countries occurs across the different IPC and Nice classification classes at the same intensity as in advanced economies.

4. Methodology and data

Several studies have pointed out that when conducting international comparisons on patent data approaches should avoid using patents filed or granted by national patent offices, as the data might be biased towards domestic users. Patel and Vega (1999) mentioned this problem with regard to US domestic users of USPTO (United States Patent and Trademark Office) patents. This situation stems from the fact that domestic firms typically tend to protect with a higher intensity in their home markets. Many studies have however used USPTO patents under the assumption that regardless of its geographical origin when an invention has significant market potential it will seek protection in the US, as the US is considered the most dynamic technological market in the world. The recommendation in that case is that one should control for possible "domestic bias", not directly comparing patents filed or granted to US residents with those of foreign origin. An important alternative to using US data alone is to look at the so-called triadic patents, which are families of patents with the same priority date and filed at the USPTO, the JPO (Japanese Patent Office) and the EPO (European Patent Office). The main disadvantage of the triadic patents statistics is that they are only available with a certain time lag. This is the reason many studies opt to carry out international analyses using the so-called "international (or PCT) patents" and European (or EPO) patents. The PCT system has matured since 1978 when it entered into force, as its geographic span has widened from 18 countries initially to 144 contracting states in June 2011. The fact that a single filing under the PCT agreement provides coverage in many different countries has made this a truly global system, with an annual growth rate of above 16% over the last two decades. Many studies have also used the European patents granted by the EPO. As stated above, EPO patents share characteristics of the national and international systems and at least when the study to be carried out seeks to compare European countries, there is no reason to be concerned about any "home bias" (Criscuolo, 2006). As an alternative to using PCT or EPO patents, there is the option to simultaneously draw on data from several national PTOs.

The same comments put forward for the national and international patent systems also apply to the analysis of trademarks, as the "home-bias" might similarly occur. However, no statistics have been produced on "triadic trademarks". In this case, the best option would be using the PCT patent equivalent, which are "international trademarks" registered under the WIPO-administered Madrid Agreement. Additionally, there is the possibility of analyzing the Community Trademarks, which are managed by OHIM, a European Union organization. The disadvantage of both the International and the European trademarks in relation to the PCT and the EPO patents is that the former two systems are much younger, therefore providing much shorter series. The "WIPO-Madrid system for the international registration of trademarks provides one single procedure for the registration of a mark in several territories. It is governed by two treaties, the Madrid Agreement and the Madrid Protocol, and is administered by the International Bureau of WIPO in Geneva, Switzerland" (WIPO, 2010a). The Madrid Union system (that comprises both the Agreement, that has been in force for 110 years and the Protocol, that has been in force since 2004) has 85 members, while the Community trademark system was established in 1997 having the 27 EU countries as its members. As both China and India are not yet signatories of the Madrid Agreement, this paper does not consider "international trademarks".

Specifically, this paper handles data for both India and China stemming from the respective national PTOs, from the international PCT system, from the European EPO and OHIM systems and from the JPO and USPTO. The intention is to compare, as far as possible, the trends over the two most recent decades (1990–1999 and 2000–2009). However, due to variations in data availability, ease of access or diverse incidences in the existence of alternative systems, the different series lengths are not the same. The data for residents in India and China is compared with equivalent information for US, Japanese and European residents and whenever possible residents in the "world" category. As the European Union membership has increased over time, the EU data refers to a EU6 or EU5 group, accounting for the EU members with higher volumes of patent and trademark demand. EU5 refers to Germany, France, UK, Netherlands and Sweden, while EU6 also includes Italy.

With regard to the specialization analyses, these are conducted only with data from the two international systems (PCT and Madrid-WIPO) and from the European systems (EPO and OHIM). These specialization analyses are based on the two internationally recognized classification systems, respectively the International Patent Classification (IPC) and the Nice trademarks classification.

The SI specialization index used in this paper compares the relative importance of the patents (or trademarks) in a given class s in country i with the equivalent relative importance of that class s for all countries worldwide.

$$IP = \frac{P_{is}/P_i}{P_s/P}$$

P_{is} accounts for the number of patents (or trademarks) in class s in country i, P_i accounts for the total number of patents (or trademarks) in that same country i, P_s accounts for the total number of patents (or trademarks) in class s in the world, and finally P accounts for the total number of patents (or trademarks) in the world.

To assess whether a country is "specialized" or "not specialized" the Chi-square of sectoral specialization used by Anderson and Ejermo (2006), Laursen (2000) and Archibugi and Pianta (1992, 1994) is estimated. This measure provides a ratio which displays in the numerator the square of the difference between the relative importance of class s in country i and the relative importance of that class in the world, while in the denominator displays the sum of the weighting of all classes in country i, with this ratio summed up across all s classes. The Chi-square of sectoral specialization grows with the specialization intensity of a country and is calculated as follows:

$$\chi_i^2 = \sum_s \left(\frac{\left[\left(X_{si}/\sum_s X_{si} \right) - \left(\sum_i X_{si}/\sum_s \sum_i X_{si} \right) \right]^2}{\left(\sum_i X_{si}/\sum_s \sum_i X_{si} \right)} \right)$$

Three further methodological clarifications are required before moving onto the exploration of the data in the subsequent sections. The first is that the data analyzed refer to applications and not to

granted IP rights. This should not, however, significantly impact on the conclusions as the existing literature on the topic has shown that a strong correlation typically holds between applications and grants. The advantage of using application data is that it allows for a more up-to-date assessment of contemporary trends as normally there is a time lag between applications and grants, which extends to as long 3 years for patents. Further for the so-called PCT system there are only application data as this is not a granting system.

The second clarification stems from the fact that when one is comparing data from different national and international patent systems, the quality of the patents issued and the requirements of the formal examinations carried out beforehand vary significantly, thus potentially affecting the propensity for patent demand in different systems. However, as the option was precisely for analyzing data concerning those different systems, the derived cross section perspective should enable control over this source of variation in patent demand.

The final clarification regards the analysis of IPR catching up, which in the context of this paper is understood as the ability of China and India reaching a quantitative demand for patents and trade-marks similar to those of the triadic economies (US, EU, Japan). Based on the actual trends as given by the compound annual growth rate of each series over the relevant period (in general, the last two decades), it is estimated how long it will take so that the patenting and trade-marking absolute levels coincide for the different economies.

5. Patent and trademark demand

This section is broken down into two successive points dedicated to the analysis of patent and trademark data, respectively.

5.1. Patent analysis

In section 2, we observed how gross patent demand (among residents and non-residents) in different PTOs has grown almost continuously since late in the 19th century. If anything, this historical trend has only intensified in the most recent decades. Our analysis now concentrates closer on those trends and goes into greater detail by examining each of the relevant national systems (US, Japan, China and India), a regional system (EPO) and also the international PCT system over the two most recent decades (or over the most recent period for which data is available).

Data is analyzed for China, India, US, Japan, a group called Euro 6 (which includes the 6 largest European patentee countries) and South Korea, which is deemed as relevant for deriving lessons given its recent historical success in moving closer to the most advanced economies.

The PCT system differs from most of the remaining patenting systems in scope and also in the fact of being relatively younger. This may account for the fact that growth in patent filings from all countries in this system tends to be much higher than in the remaining systems. As shown in Table 2, over the two most recent decades the Indian and Chinese demand for patents through the PCT system has grown at annual rates in the range of 40–60%, while for the advanced economies the corresponding rates are in the range of 10–20% and for South Korea slightly above 30%.

Comparing the decades of 1990–1999 and 2000–2009 in terms of accumulated PCT applications, we find China, India and South Korea are still relatively far from the more developed economies. As a matter of fact, in the most recent of these two decades the US leads with around 487 thousand applications followed by the Euro 6 group and Japan with 387 thousand and 218 thousand each, while China, India and South Korea rank far lower respectively with around 32 thousand, 7 thousand and 48 thousand applications. However, what is most striking is how far these three economies improved from the first to the second decade, with China multiplying PCT patent applications 31 times over, India 175 times and Korea almost 20 times.

The same differentials in terms of absolute demand and growth tend to be verified across all the remaining systems but generally with lower annual growth rates. Nevertheless, patent demand from China and India, and to a certain extent also from South Korea, at the offices of the mature economies (EPO, USPTO, JPO) has been growing at annual rates in the range of 20–30% over the two most recent decades.

Patent demand in the national PTOs of China and India has been growing fast for all the observed countries, though Chinese filings in India and vice versa of Indian filings in China remain relatively low. Additionally, the volume of domestic demand in India from local residents has not been growing that fast, particularly when compared to what has happened with domestic demand from local residents in China.

Overall, one might infer that were Chinese and Indian growth in patent demand to maintain similar rates to those experienced over the two most recent decades particularly China, but also India, will catch up with the triadic economies in patent filing volumes in a time span of a few decades. Specifically, if one projects into the future the current patent demand of China, India and the US taking into account the respective growth rates estimated by regression (last column of Table 2), one infers that catch up in the PCT system will happen relatively soon (6 years for China, 13 years for India) and catch up in the EPO, the USPTO and the JPO will happen in about 2–3 decades (see Table 3). The US was chosen as the yardstick for this exercise as it is the leading economy in the PCT, the EPO and the USPTO. Table 3 also provides figures for Japan in the JPO case, as local demand by residents by far exceeds filings from any other country. However, as the growth rate of that demand has been close to 0 over the two most recent decades, the estimated catching up period for China and India does not differ significantly from that estimated in relation to US resident patent filings in the JPO.

The data provided for South Korea in Table 2 shows it has not only reached an outstanding position in the most important patent systems, but also that this country has had a growth performance in most of those systems over the most recent period which is not inferior to that of China and India.

Summing up the analysis above, one concludes that the catching-up process that China and India embarked on in the most recent decades has also been accompanied by high growth in the demand for patents, thus indicating that not only imitation has been part of that process but also that innovation capabilities have actively been fostered. These conclusions seem robust since the high growth of patent demand from China and India is persistent across different systems (domestic, PCT, USPTO, EPO, etc.), thus minimizing problems with possible patent quality differences in each respective system.

5.2. Trademark demand

The dynamics behind trademarks demand are somewhat different to patents. As was pointed out in Section 2, patents are more directly connected to the upstream stage of invention, while new trademarks are more intensely connected to the downstream effort of establishing the innovative products in the marketplace. For this reason, trademarks demonstrate greater sensitivity to the ups and downs of the business cycle. Furthermore, it should also be pointed out that this IPR modality is easier to access by potential users.

The available data shows that China now ranks number one worldwide, with more than 600 thousand annual trademark applications in the Chinese PTO. India also displays strong domestic trademark demand, with more than 70 thousand annual

Table 2
Patent demand in different systems.

	Initial and most recent year		Cumulative values over two periods		Annualized growth rates		
	Y_n 2009	Y_0 1990	P_1 2000–2009	P_0 1990–1999	Y_n/Y_0	P_1/P_0	Regres. (3)
PCT							
China	7905	1	32,770	1123	57%	40%	46%
India	885	1	6969	134	40%	48%	49%
Japan	29,806	1748	218,918	34,827	15%	20%	18%
US	45,589	7718	487,505	177,808	9%	11%	10%
Euro 6	39,681	7108	387,652	138,706	9%	11%	10%
S. Korea	8048	24	47,446	2652	34%	33%	31%
	Initial and most recent year		Cumulative values over two periods		Annualized growth rates		
	Y_n 2006	Y_0 1987	P_1 1997–2006	P_0 1987–1996	Y_n/Y_0	P_1/P_0	Regres. (3)
EPO							
China	983	22	6055	364	21%	32%	26%
India	288	11	3067	270	18%	28%	22%
Japan	14,376	9661	190,179	126,063	2%	4%	4%
US	34,020	13,748	304,642	192,268	5%	5%	5%
Euro 6	32,439	23,424	420,928	259,202	2%	5%	4%
S. Korea	6778	31	32,416	2817	31%	28%	25%
	Initial and most recent year		Cumulative values over two periods		Annualized growth rates		
	Y_n 2008	Y_0 1989	P_1 1989–1998	P_0 1999–2008	Y_n/Y_0	P_1/P_0	Regres. (3)
USPTO							
China	5487	220	26,723	3019	17%	24%	19%
India	2879	50	13,390	870	22%	31%	24%
Japan	82,396	31,791	655,874	380,376	5%	6%	5%
US	231,588	82,370	1,957,439	1,047,359	5%	6%	6%
Euro 6	57,366	25,418	458,662	265,015	4%	6%	5%
S. Korea	22,976	295	116,781	20,435	24%	19%	20%
	Initial and most recent year		Cumulative values over two periods		Annualized growth rates		
	Y_n 2008	Y_0 1995	P_1 2002–2008	P_0 1995–2001	Y_n/Y_0	P_1/P_0	Regres. (3)
JPO							
China	772	45	2778	407	24%	38%	25%
India	214	6	837	126	32%	37%	25%
US	25,112	9944	138,391	65,416	7%	13%	06%
Japan	330,110	333,770	2,470,432	2,503,952	0%	0%	9%
Euro 6	19,347	7240	104,105	45,997	8%	15%	10%
S. Korea	5599	2626	40,096	19,902	6%	12%	9%
	Initial and most recent year		Cumulative values over two periods		Annualized growth rates		
	Y_n 2008	Y_0 1995	P_1 2002–2008	P_0 1995–2001	Y_n/Y_0	P_1/P_0	Regres. (3)
China PO							
China	194,579	10,011	725,803	119,072	26%	35%	24%
India	184	2	953	126	42%	40%	33%
Japan	24,527	1645	120,015	41,884	23%	19%	20%
US	33,264	3772	190,837	52,427	18%	24%	18%
Euro 6	19,872	1694	104,454	38,498	21%	18%	19%
S. Korea (1)	10,596	1834	35,197	7640	19%		26%
	Initial and most recent year		Cumulative values over two periods		Annualized growth rates		
	Y_n 2008	Y_0 1995	P_1 2002–2008	P_0 1995–2001	Y_n/Y_0	P_1/P_0	Regres. (3)
India PTO							
China	388	40	1157	217	19%	32%	19%
India	6161	1545	32,168	14,135	11%	15%	11%
Japan	9013	2093	39,363	15,115	12%	17%	12%
US	2259	346	7928	3750	16%	13%	10%
Euro 6	8329	1476	31,622	12,781	14%	16%	12%
S. Korea (2)	697	88	2811	208	30%		32%

Sources: WIPO and national PTOs. Notes: (1) first year – 1998; (2) first year – 2000; (3) growth rates estimated through log linear regression.

Table 3
Average number of years to catch up with US (Japan).

	Main patent systems			
	PCT	EPO	USPTO	JPO (Japan)
China	6.19	19.44	29.90	27.14 (26.30)
India	12.99	31.80	26.38	32.92 (36.34)

Source: Own calculations.

applications for trademark registration. In comparison, however, demand from residents of these two countries in most of the remaining trademark systems remains relatively low.

As regards international trademarks belonging to the WIPO-administered "Madrid system", it should be pointed out first that the US, Japan and South Korea joined this system more recently than the European countries or China. This may account for the fact that the Euro 6 group ranks first followed by China.

Analysis of the demand for Community Trademarks (OHIM) reveals as expected a leadership of the Euro 6 group, which is followed by the US and, at a distance, by Japan. China overcame South Korea in 2005. In contrast with the triadic demand that has virtually stagnated in this system, demand from the two emerging economies and Korea is growing fast. If the current trends continue it is possible to estimate a possible catch up time of two to three decades.

The analysis of USPTO data confirms what was observed thus far for the remaining systems, despite as expected a strong "domestic bias" being noticeable in this system. The annualized growth rates of China (19%), India (22%) and S. Korea (12%) are well above the corresponding growth rates for the US, Japan and the Euro 6 group. Given the stronger domestic bias, this means a possible catch up time for the two emerging economies of between three and ten decades.

Summing up the analysis, one concludes that as regards the analysis above, the growth dynamics of trademark demand from both China and India indicate these countries are moving closer to an eventual catch up with the leading economies. However, how fast this process might occur varies significantly between different trademark systems (Table 4).

6. Technological (IPC classes) and trademark (Nice classes) specialization

As section 4 above, the present section is broken down into two successive points dedicated to the analysis of patent and trademark data. The focus now is on technological and trademark specialization, as given respectively by the IPC and NICE classifications. The analysis in this section intends just to reveal some broad patterns of IPR specialization, and it needs to be further expanded in forthcoming research along the lines of previous work in this area (e.g. Park and Lee, 2006).

6.1. Patent analysis

Technological specialization is analyzed by observing two different measures: the chi-square coefficients of specialization and the revealed comparative advantage indexes. For the first of these measures, it is evident that the two emerging economies display a much higher degree of specialization. However, as they have developed over the last two decades they have progressed to lower levels of specialization by becoming more competitive in a broader range of products and technologies. The economy's respective size also seems to play a role in the degree of specialization, as smaller economies tend to be more specialized than their larger counterparts.

The data available show the levels of technological specialization have been stable for the Euro 6 group and the US in the two most recent decades. In contrast the chi-square coefficients of specialization have declined in the remaining economies, a process which has been particularly sharp in the cases of China and India (see Table 5).

Table 6 contains the revealed comparative advantage indexes for the top five sectors of greatest specialization (out of 42 sectors) in each of the economies under observation. The table establishes a relationship between patent classes (as given by the IPC classification) and industrial sectors. This relationship is possible by applying the concordance method proposed by Schmoch et al. (2003). The data used in this calculation refers to PCT filings over the period 2000–2009. Again, it is clear that the emerging economies are relatively more specialized, with the top sectors of specialization in China and India displaying revealed comparative advantage indexes above 3. While for China telecommunications ranks second in terms of the specialization indexes, the top sector of technological specialization for India is Pharmaceuticals. As Mani (2009) has emphasized, despite the introduction of the Indian Patent Act in 2005 in compliance with TRIPS, the pharmaceuticals private sector R&D investment in India has been growing at a rate close to 35% per annum.

6.2. Trademark analysis

Specialization in trademarks is analyzed by observing data referring to OHIM trademarks applications, for the period from 1996 to 2007.

Trademark specialization is analyzed first by observing the chi-square coefficients of specialization (Table 7). As expected, given the fact that one is dealing with European Community Trademarks, the specialization of the Euro 6 is very low. As observed for patents, the specialization of both China and India (and South Korea, as well) has declined sharply over the period under observation.

Table 8 contains information on the five trademark classes with higher revealed comparative advantage indexes. Both China and India reveal a specialization in trademark classes associated mostly with low-tech sectors. This contrasts with the US and South Korea, which reveal both a specialization in trademark classes associated with high-tech sectors, and with Japan and the Euro 6 group, which display both a somewhat intermediate situation. This pattern, in combination with the one that came out of the technological specialization analysis, might be seen an indication that both China and India are innovating on a broader range of products, with strengths on a certain number of higher-tech sectors but also showing relevant activity in some lower-tech sectors. These results shall however be seen with some caution, as the analysis for trademarks is based on both just one regional system and a relatively short period of time.

7. Leading users of PCT patents

Table 9 reveals the number of firms who have filed at least six PCT patents in 2002 and in 2008. This table is congruent with other data analyzed above. China and India are still far from reaching the PCT patent use intensity levels of the most advanced countries. However, both countries display very fast growth, with the number of firms intensively using PCT patents multiplying more than six-fold between 2002 and 2008. In contrast, the advanced economies have had a much slower progress with no country recording duplication in the number of firms in that period. South Korea also experienced impressive growth with the number of intensive PCT patent users rising almost fourfold since 2002.

Table 4
Trademarks demand in different systems.

	Most recent year	First year considered	Most recent period	Previous period	Annualized growth rates	
	Y_n 2009	Y_0 2003	P_1	P_0	Y_n/Y_0	P_1/P_0
Madrid system						
China	17,859	2048			43%	
India						
Japan	12,849	5402			16%	
US	15,745	238			101%	
Euro 6	34,200	25,155			5%	
S. Korea	9551	1694			33%	
	Most recent year	First year considered	Most recent period	Previous period	Annualized growth rates	
	Y_n 2007	Y_0 1996	P_1 2002–2007	P_0 1996–2001	Y_n/Y_0	P_1/P_0
OHIM						
China	357	51	1168	254	21%	36%
India	159	19	581	212	24%	22%
Japan	1354	1372	7811	7092	0%	2%
US	10,761	12,450	60,062	61,130	−1%	0%
Euro 6	33,165	17,556	163,662	110,016	7%	8%
S. Korea	125	43	851	533	11%	10%
	Most recent year	First year considered	Most recent period	Previous period	Annualized growth rates	
	Y_n 2009	Y_0 1990	P_1 2000–2009	P_0 1990–1999	Y_n/Y_0	P_1/P_0
USPTO						
China	2096	88	12,178	1586	17%	23%
India	461	13	3475	507	20%	21%
Japan	4832	2412	46,690	22,311	4%	8%
US	274,603	115,000	2,536,500	1,566,239	4%	5%
Euro 6	31,874	8860	261,880	108,279	7%	9%
S. Korea	1554	200	10,487	200	11%	49%
	Most recent year	First year considered	Most recent period	Previous period	Annualized growth rates	
	Y_n 2008	Y_0 1998	P_1 2003–2008	P_0 1998–2002	Y_n/Y_0	P_1/P_0
JPO						
China	10,031	2773	67,579	21,204	12%	26%
India	NA	NA	NA	NA		
Japan	118,130	96,845	656,788	530,758	2%	4%
US	2957	2971	18,385	15,349	0%	4%
Euro 6	1361	1660	9744	9316	−2%	1%
S. Korea						
	Most recent year	First year considered	Most recent period	Previous period	Annualized growth rates	
	Y_n 2008	Y_0 1998	P_1 2003–2008	P_0 1998–2002	Y_n/Y_0	P_1/P_0
China PTO						
China	604,952	129,394	3,391,346	1,002,540	15%	28%
India	NA	NA	NA	NA		
Japan	952	139	4368	901	19%	37%
US	2801	329	8572	1726	21%	38%
Euro 6	3527	564	18,478	3690	18%	38%
S. Korea						
	Most recent year	First year considered	Most recent period	Previous period	Annualized growth rates	
	Y_n 2008	Y_0 1998	P_1 2003–2008	P_0 1998–2002	Y_n/Y_0	P_1/P_0
India PTO						
China	392	35	1842	390	25%	36%
India	73,308	38,109	334,292	214,015	6%	9%
Japan	44	9	173	110	16%	9%
US	307	86	1546	812	12%	14%
Euro 6	85	48	411	157	5%	21%
S. Korea						

Sources: WIPO and national PTOs.

Table 5
Technological specialization (chi-squared ratio).

PCT patent filings	1990–1999	2000–2009
China	1.73	0.34
India	3.40	0.88
Euro 6	0.04	0.04
Japan	0.16	0.11
USA	0.04	0.04
S. Korea	0.78	0.21
EPO patent filings	1988–1997	1998–2007
China	0.65	0.46
India	1.43	1.18
Euro6	0.06	0.06
Japan	0.22	0.14
USA	0.08	0.10
S. Korea	0.24	0.11

Source: Own calculations.

Table 6
Top 5 sectors of technological specialization, PCT filings 2000–2009.

China	
Lightening equipment	3.1
Signal transmission, telecommunications	2.7
Tobacco products	1.9
Domestic appliances	1.7
Furniture, consumer goods	1.6
India	
Pharmaceuticals	3.4
Food, beverages	1.7
Pesticides, agro-chemical products	1.5
Petroleum, nuclear fuel	1.5
Basic chemical	1.3
US	
Medical equipment	1.4
Pesticides, agro-chemical products	1.3
Petroleum, nuclear fuel	1.3
Soaps, detergents	1.2
Pharmaceuticals	1.2
Japan	
Batteries	2.2
Electric components	1.9
Optical instruments	1.8
Non-specific machinery	1.7
Man-made fibers	1.7
Euro 6	
Motor vehicles	1.6
Energy machinery	1.5
Soaps, detergents	1.4
Electric distribution	1.4
Machine tools	1.3

Source: Own calculations.

Another relevant aspect to Table 9 is that Chinese firms have on average been granted many more patents than Indian firms also belonging to the group of PCT system intensive users, suggesting the presence of at least some heavy patent users among Chinese firms. This is entirely confirmed by the fact that the world leader in the 2008 PCT patents applicant ranking was for the first time ever a Chinese firm (Huawei Technologies). This same firm meanwhile has dropped to number 2 and number 4 in the 2009 and 2010 rankings, but this nevertheless remains a very remarkable performance (see Table 10). Meanwhile, in the 2010 ranking another Chinese firm, ZTE, has raised to the 2nd position, while in 2009 it ranked 22nd yet.

Table 7
Trademark specialization (chi-squared ratio).

	1996–1999	2000–2007
OHMI trademark applications		
China	2.11	0.99
India	2.61	0.77
Euro 6	0.02	0.01
Japan	0.67	0.86
USA	0.10	0.13
S. Korea	2.78	1.12

Source: Own calculations based on OHMI data.

Table 8
Top 5 sectors of trademark specialization, OHIM filings 2000–2007.

China	
Textiles and textile goods	3.2
Musical instruments	3.1
Leather and imitations of leather	2.4
Furniture, mirrors, picture frames; goods (not included in other classes) of wood	2.3
Lace and embroidery, ribbons and braid	2.3
India	
Tobacco; smokers' articles; matches	5.2
Vehicles; apparatus for locomotion by land, air or water	3.2
Precious metals and their alloys and goods in precious metals or coated therewith	3.0
Leather and imitations of leather	2.5
Beers; mineral and aerated waters	2.5
Korea	
Vehicles; apparatus for locomotion, etc.	3.6
Scientific, nautical, surveying, electric, photographic, cinematographic, optical, weighing, etc.	3.4
Apparatus for lighting, heating, etc.	3.3
Machines and machine tools; motors and engines (except for land vehicles)	2.8
Transport; packaging and storage of goods	2.2
Japan	
Musical instruments	4.9
Vehicles; apparatus for locomotion by land, air or water	3.6
Lace and embroidery, ribbons and braid	3.0
Scientific, nautical, surveying, photographic, cinematographic, optical, weighing, measuring, signalling	2.4
Yarns and threads, for textile use	2.2
US	
Surgical, medical, dental and veterinary apparatus and instruments	2.1
Scientific, nautical, surveying, photographic, cinematographic, optical, weighing, measuring, signalling	1.5
Pharmaceutical, veterinary and sanitary preparations	1.4
Chemicals used in industry, science and photography	1.4
Firearms; ammunition and projectiles; explosives; fireworks.	1.3
Euro 6	
Transport; packaging and storage of goods; travel arrangement	1.2
Building materials (non-metallic)	1.2
Agricultural, horticultural and forestry products	1.2
Yarns and threads, for textile use	1.2
Meat, fish, poultry and game; meat extracts; preserved, dried and cooked fruits and vegetables;	1.2

8. Final remarks

The first conclusion of this paper is that the geography of innovation seems to be changing fast worldwide. This conclusion is based on the assumption that both the series on patenting and trademark registration provide relevant information about the direction and intensity of innovation. Over most of the second half of the 20th century, the world rankings of patents and trademarks were dominated by the so-called triad (US, Japan and EU countries). Several other countries, however, seem to be catching up in patents and trademarks with the most advanced economies in recent decades. That was first the case with South Korea that has converged fast with the triadic countries beginning in the late 1970s.[2] And more recently, since the mid-1980s, China and lately India have been following an apparently similar trajectory of convergence.

As regards gross patent demand at national PTOs (by residents plus non-residents), China has already overtaken South Korea and

[2] This has been also the case of Taiwan, which is not dealt with in this paper due to severe shortcomings in the relevant available data.

Table 9
PCT applications by business firms, 2002 and 2008.

	Firms with at least 6 PCT applications		PCT applications by firms with at least 6 applications		Mean number of PCT applications by firms with at least 6 applications	
	2008	2002	2008	2002	2008	2002
US	1269	1030	35,420	24,090	27.91	23.38
China	75	11	3016	343	40.21	31.18
India	32	5	469	119	14.65	23.8
Japan	528	281	23,891	9479	45.24	33.73
Euro 6	807	590	26,498	19,059	32.83	32.30
S. Korea	103	27	3952	435	38.36	16.11

Source: WIPO (2010b).

Table 10
Top ten PCT system applicants.

Top PCT applicants in 2010				
2010 ranking	Position change 2010/2009	Applicant	Country of origin	PCT applications published in 2010
1	0	Panasonic Corporation	JP	2154
2	20	ZTE Corporation	CN	1863
3	2	Qualcomm Incorporated	US	1677
4	−2	Huawei Technologies Co., Ltd.	CN	1528
5	−1	Koninklijke Philips Electronics N.V.	NL	1435
6	−3	Robert Bosch Gmbh	GE	1301
7	0	LG Electronics Inc.	KR	1298
8	2	Sharp Kabushiki Kaisha	JP	1286
9	−3	Telefonaktiebolaget LM Ericsson (PUBL)	SE	1149
10	−2	NEC Corporation	JP	1106

Source: http://www.wipo.int/pressroom/en/articles/2011/article_0004.html#annex3.

will probably soon close the gap with the US and Japan. As for India, the gap is still significant but the country is moving fast and, by 2006, India was in a position similar to that of China in the early 1990s.

Observation of the international PCT filings reveals a convergence of the three triadic regions, each with around 100 thousand patents filings per year and China with about 10 thousand applications and India with a little over a thousand. However, observation of Chinese and Indian growth trends over the last two decades suggests the catch up with the triadic regions might happen in a period of less than one decade for China and slightly longer for India.

In addition to the domestic Chinese and India patent systems and the PCT data, the analysis was complemented with information from the European, US and Japanese patent systems. Despite the Chinese-originated demand in these other systems being below 10 thousand per year (it is actually closer to one thousand per year in both the EPO and the JPO), the simple extrapolation of the last two decades indicates a possible catch up in EPO filings taking place in about 20 years time and in both the USPTO and the JPO in about three decades. In the case of India, the trend is equally strong and its linear extrapolation indicates a possible catch up but occurring a few years later than China in most of the systems observed.

With respect to trademark use, the data available is not as abundant as those for patents. However, similar rapid growth trends were observed for trademarks, with the additional fact that the overall volume of demand is relatively much higher for trademarks than for patents in the domestic systems of the two emerging economies. China ranks now 1st worldwide and India 5th. In what regards the external systems, however, the gap tends to be yet high, in particular in the US system. It shall be noted that in relation to trademarks India is much closer to China than for patents, indicating a different IPR pattern of use in the two countries, eventually stemming from a relative advantage of India in services.[3]

Given the dynamics of the most recent period, and even allowing for some decreasing returns in the growth rates observed, it becomes perfectly feasible to propose that at least a few global brands will emerge out of the current patenting and trademarking trends of both China and India over the next few years.

One question raised in this paper approached the sustainability of economic growth in China and India and the likelihood of them catching up in terms of output and income with the most advanced economies in a relatively short period of time. The data analyzed allows us to infer that as innovation is moving to the forefront of concerns in these two countries, particularly in China, it looks as though these countries are putting together the necessary ingredients to compete over the forthcoming decades and propel their GDP and income levels further.

This, however, would still be a catch up in terms of volume and not in terms of per capita intensity. Nevertheless, as both these two countries contain extremely large populations, and as regional imbalances have been growing steadily over the most recent decades, it is possible to infer that some regions within them (Shanghai, Pearl River Delta area, Bangalore, Mumbai, etc.) will grow much faster than others, getting closer to the development levels of the most advanced economies. Of course these imbalances, which partly stem from typical innovation dynamics and partly from agglomeration economies and other specificities within those regions, may jeopardize the integrated development of China's and India's national innovation systems, as advanced knowledge might find difficulties in spreading from the leading enclaves to the broader economic and social environment.

Another question considered by the paper relates to the aspects behind the boom in patent (and trademark) demand in China and India and whether they were similar to those behind the patent explosion that has taken place in the advanced countries since the early 1980s. Analysis of the specialization patterns in patents and trademarks in both countries reveals much greater specialization (notwithstanding a decline as one moves into the most recent period) on the one hand, and specializations in technological and trademark classes that do not coincide fully with those dominant in the triadic economies, on the other hand. Furthermore, the

[3] In an another paper, it would be interesting to also analyze the position of both countries in terms of copyright use as the cultural industries seem to be much more advanced in India.

strategic motives subjacent to patent demand in the US and in other high income economies, despite probably being present in China and in India, do not play exactly the same role, especially in relation to raising the profile of stock market valuations. What seems important for both Chinese and Indian patentees and trademarks owners is to improve their competitive advantage and eventually acquire intellectual property in new, harsher market conditions as part of a more general rush for private property in these two economies.

As stated above our conclusions are based on the assumption that both patenting and trademark registration provide relevant information on innovation patterns. Such assumption stems both from the vast literature that since the 1960s has been linking patenting and technological innovation and from the more recent work that has been analyzing the possible connection of trademark registration with innovation. This latter work has pointed out that indicators based on new trademarks are suitable to capture incremental innovation and a broader range of innovations, namely from sectors such as services and lower-tech industries. In this sense, and despite the methodological problems that may subsist, patents and trademarks might be seen as complementary and mutually reinforcing as innovation indicators.

In addition to testing further this assumption, there are at least six aspects that, within the same scope of analysis, deserve further investigation sequential to this paper. One relates to specialization analysis, which needs far greater detail within the broad IPC and Nice classes. A second one regards the need to access and analyze further information on different national trademark systems, as the non-national systems provide insufficient information as regards innovation trends. A third one has to do with analyzing the relationship between R&D and new patents, contrasting the IPC and sectoral patent productivity of the emerging economies with the similar patterns observed in the advanced economies. A fourth aspect deserving attention is the role of foreign firms acting in China and India in relation to domestic patenting, comparing the quality of patents of foreign origin vis-à-vis domestic patents, namely in terms of their duration. Another aspect to be considered is the analysis of other IP rights in addition to patents and trademarks, being copyright and designs the two most important to be researched. Finally, a sixth aspect involves a better establishing of the causal links between IPR take up, innovative capabilities, competitiveness and economic catching up.

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