What is an incremental but non-patentable invention?

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Abstract:

We explore conceptually and empirically the potential of utility model data as an innovation indicator. We argue that UM data can complement patent related indicators, both at the aggregate and micro levels. Making use of unit-record data we provide descriptive and multivariate analysis of the use of UM. In particular, we find differences in the use of UM across countries and industries. We also find within country differences correlated with the level of economic development and R&D intensity. In addition, we find that technologies which are more local, less valuable, and developed by smaller and more isolated entities are more prone to use UM protection.

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1 Introduction

Economists agree that patent protection is not necessary a suitable protection systems for every outputs of creative and inventive activities. Specifically, it may be less applicable to the types of innovation that originate from creative efforts (Lhuillery, Raffo, & Hamdan-Livramento, 2016), or those with "minor" improvements but do not meet the inventive step of patentability criteria (Johnson et al., 2015; Mott, 1963; Naumann, 1958). To address the latter issue, several governments have introduced a patent-like IP instrument to capture incremental and non-patentable inventions.

This IP instrument – generally known as utility models (UM), although this term varies according to different jurisdictions – is arguably an IP right that protects less-than-patentable inventions. It is implemented both in at least 75 countries, comprising of both developed as well as less-developed economies (WIPO, 2011).

But what are these "less-than-patentable" inventions? In particular, what exactly is this IP instrument capturing? In this paper we attempt to examine how UM are being used, and compare them to patents. We argue that UM provides a different perspective on innovative activities that should be considered alongside country-level analysis of patenting for both developed and less-developed countries.

Firstly, aggregating UM and patent filings together gives a more accurate picture of the level of technological activity than in the case of only counting patent filings by residents. While patent counts capture the types of inventive activities that are new, technical and involve an inventive step, UM captures those that are new and technical only. In other words, inventive activities that may not fall under the patentability criteria may be captured by UM. Taken this way, UM and patent protection are complements of one another.

However, to a certain extent, UM and patent protection are substitutes of one another. Essentially patent and UM protections are similar in that they confer an exclusive right over the sale and working of the intellectual asset. They differ by their maximum length of protection. Inventions granted with patents are allowed a maximum of 20 years of protection while UM are given 10 years of protection. Arguably, an inventor may choose to file for protection under UM rather than patent because it is easier and quicker to obtain. Therefore the choice of filing for protection on an invention may be a market or business strategy rather than on the type of invention produced.

Nevertheless, the substitutability of UM and patent protections is not likely to play a significant role at the aggregate level. An inventor's choice to choose UM protection over patent protection may simply reflect the nature of product life cycle or business choices. Total technological activity level will remain the same; and the difference may lie in the distinction in the types of technological inventions: patented versus UM inventions. In addition, the value associated with patented versus UM inventions tend to be highly correlated with the types of protection sought. Highly valuable inventions are protected by patents while lower valued inventions are protected by UM.

However, we caution that this aggregated information should be used carefully. Legislations on the scope, duration and subject matter of protection vary across countries and therefore using a one-to-one comparison of UM counts with patent counts across countries could be misleading.

To carry out our investigation, we rely on UM data available through both WIPO's Statistical Database as well as the EPO's PATSTAT database. We exploit the differences and similarities between patent and UM protections to investigate the types of inventions captured by UM. In particular, we provide descriptive statistics on their use, the forward citations they receive, priority claims, and classification types to name a few.

Like patent document that contain many useful data that relate to innovative activities, UM documents reveal some interesting insights into a country's and their firms' innovative competitiveness. In particular, it should reveal insights into how firms that engage in incremental innovation build their core competencies and how sophisticated they may be in using the IP system. For example, some jurisdictions allow for patent families to contain patents and UMs alike. The ability to use UM filing for priority date may provide useful insights into how firms rely on the different form of IP protection to protect their innovative, and maybe even creative, outputs.

The policy implications of including UM to patents counts at the country level are two-folds. Firstly, including UM measure into innovative activities enables a more comprehensive measurement of innovative activities in a country, regardless of whether the activity is new-to-the-world technology or not. Secondly, examining the types of innovation as well as which technological classification are filed under UM protection would allow for further inferences on how the different IP instrument used affect the different economic activities across countries.

The outline of this paper is as follows. The following section reviews the different literature on using patents to measure a country's or firm's innovative capacity, and provides reasons for why UM should be included in this measurement. The third section focuses on the descriptive statistics of UM use across countries and technological fields. In the penultimate section we run several econometric models to investigate if our hypotheses can be verified. The final section concludes and provides avenue for future research.

2 Why include UM in measurements?

Most papers on innovation focus on patent protection as a measure of a firm's innovative performance, and by extension the country's innovative capacity. This comparison, while justified, misses a component of the innovation landscape by favoring firms and countries that produce new-to-the-world inventions as well as those inventions that are patentable.

Firstly, it is relatively well known that not all inventions are patented (Griliches, 1990). Patentability criteria mandates that an invention meets the novelty, inventive step (or non-obviousness) and industrial application in order to be protectable under this IP instrument. Not all inventions may meet these criteria. Incremental and/or adaptive inventions, which usually involve a minor – but maybe significant – improvement on the existing technologies, would be ignored along with their potential economic effects.

Secondly, there are differences across technological and industrial sectors with regards to their patenting activities. Some sectors see higher patenting rates than others, but this usually reflects the market competition as well as the scientific and technological dependence of the sector (Keith Pavitt, 1984; Scherer, 1965). A study on European firms in 1993 showed the different propensities to patent across 19 different industries with

8.1% of product innovation are patented in the textiles sector in comparison to the 79.2% of pharmaceutical product innovations (Arundel & Kabla, 1998).

In addition, focusing on patentable inventions tend to focus on countries that produce new-to-the-world type of inventions, and excludes many less-developed economies (Archibugi & Coco, 2005; Kumar, 2003; Lall, 1992, 2003; World Bank, 2002, 2008). This measurement omission ignores countries that do produce incremental or adaptive inventions. Evenson (1984), when comparing the technology market across countries noted that looking at UM counts were useful to indicate the country's relative innovativeness. Moreover, it also ignores countries that are building their innovative capacities. Kumar (2003) provided a few examples of countries such as Japan, South Korea and Taiwan that have effectively used UM protection – among other policies – as a stepping stone to building their technological capacities.

It also ignores the effect these types of innovation may have on the countries' economic performance. Maskus and McDaniel (1999) showed that UM applications were useful in contributing to Japan's total factor productivity over the period 1960-1993. Papers by Lee and Kim (2010) and Kim *et. al* (2012) have shown that these two different IP instruments played a crucial role in countries' economic growth. They found that UM protection has been beneficial for less developed economies while patent protection are more relevant when the countries have attained a specific level of technological capacity.

And thirdly, firms may have limited resources and thus are unable to file for patent protection on their relevant inventions. Studies examining the role of innovative activities in firms tend to underestimate those activities carried out by small sized firms, even if these firms were innovating (Griliches, 1990; K. Pavitt, 1988).

2.1 What is a utility model protection?

Germany was the first country to introduce UM protection, known as "Gebrauchasmuster," for minor inventions in 1891. The objective of this IP instrument was to provide protection for minor inventions that did not met the criteria for protection under the copyright, designs or the patent laws existing in the country (Johnson, et al., 2015; Mott, 1963; Naumann, 1958). These inventions were argued to be in industries that covered "practical life" industries. They were not necessarily on the technological cutting edge but were nevertheless useful for the society. Some of the industries that fell under this category included clothing, hardware as well as machines and factory-related tools and devices (Naumann, 1958). UM protection was also considered the "patent of the small business man (Hsueh & Luo, 2013; Johnson, et al., 2015; Mott, 1963; Naumann, 1958)" to indicate its relevance for small and medium sized firms.

For many less developed economies, another reason to provide for UM protection in their countries was to accommodate inventions that were not at the technological frontier. In particular, most of the inventions in these countries may be classified as non-patentable as seen in the significantly lower share of patents filed by residents in comparison to non-residents (WIPO, 2015). And UM protection may be a better suited IP instrument for these inventors. Therefore providing for UM protection would help inventors who produce adaptive or incremental inventions (Evenson, 1990; Kumar, 2003; Suthersanen, 2006; World Bank, 2002, 2008) to build their innovative and technological capacities (L. Kim, 1997; Y. K. Kim, et al., 2012; Lee & Kim, 2010; Maskus & McDaniel, 1999; Prud'homme, 2014; Yu, 1998), and eventually produce new-to-the-world inventions.

In addition, a few of the country case studies have argued that using UM protection helps the inventors familiarize themselves with the IP system, and that these inventors may later become sophisticated users of the system themselves (L. Kim, 1997; Kumar, 2003). However, a recent research in Australia on small and medium sized enterprises show that most the average users of UM tend to only file once in their lifetime and do not file for any patents (Johnson, et al., 2015). The extent to which the findings of the Australian findings can be extrapolated to other countries is not clear.

2.2 How is UM different from patents?

Inventors who apply for UM protection would want to benefit from the same protection as those that file for patent protection: to appropriate the returns to investment in innovation. These reasons include the need to protect their inventions from their competitors by claiming their "right to operate," when commercializing their inventions, to "defending (Gilbert & Newbery, 1982)" their position in specific technological fields, and/or for strategic purposes such as building their patent portfolio (Hall & Ziedonis, 2001; Walsh, Lee, & Jung, 2016). Thus, filing for either UM or patent protection would raise the cost for competitors to enter the market and give the firm or inventor time to recoup their investments into inventing.[2]

But the decision to file for UM protection, like patents, should differ according to the applicant type (Sichelman & Graham, 2010), the industries (Eisenberg, 1996; Hall & Ziedonis, 2001; Sichelman & Graham, 2010), market competition level (Greenhalgh & Rogers, 2006; Harhoff, Hall, von Graevenitz, Hoisl, & Wagner, 2007; Ziedonis, 2004) and availability of other appropriability mechanisms (Cohen, Nelson, & Walsh, 2000; Gallini & Scotchmer, 2002), to name a few.

In practice, applying for UM protection tends to be cheaper, easier and faster to obtain than for patents (see Table 1 for a summary). Firstly, many countries do not conduct substantive examination on UM applications (WIPO, 2011). This translates into less time to assess the application by examiners in the IP offices, which in turn reduces the time it takes to grant or register the protection.

-- Insert Table 1 about here --

Secondly, the UM protection is geared towards inventions that do not necessarily involve significant R&D spending, and thus the expected returns on investments tend to be lower than those under patents. Due to this characterization of inventions that fall under UM protection and the easier granting process, the application and renewal fees are usually lower than for an equivalent patent protection.

And thirdly, UM protection tends to apply to a narrower list of subject matters than for patents, although this varies according to countries' legislations. Methods and processes, for example, tend to be excluded from UM protection. This narrower scope of protection ensures that only selected ranges of inventions receive this shorter duration of exclusivity.

While there are differences in UM and patent protections, both of these IP instruments confer similar exclusive rights. This means that both UM and patent owners are able to

[2] We are not aware of any empirical research that has examined the degree to which UM protected inventions are being licensed to third parties.

exercise and enforce their rights in similar manners, regardless of how "extensive" the examination process of the different IP rights were, and raises several important issues. For one, the lack of substantive examination in many UM legislations raises uncertainty as to the validity of the UM protected invention. At least in the case of patented protection – where substantive examination is conducted – the patent owner is relatively sure that her invention is novel. This is not necessarily the case for the UM owner.

In addition, the ease of registering an invention under UM protection could lead to frivolous inventions that should not have been granted protection. These trivial inventions could then be used in anti-competitive manner by preventing others from legitimate commercial endeavors.

2.3 Can UM be used as an innovation indicator?

What is exactly the utility model instrument capturing? We argue that UM provides a different perspective on innovative activities that should be considered alongside country-level analysis of patenting for both developed and less-developed countries.

Aggregating UM and patent filings together gives a more accurate picture of the level of technological activity than in the case of only counting patent filings by residents. While patent counts capture the types of inventive activities that are new, technical and involve an inventive step, UM captures those that are new and technical only. In other words, inventive activities that may not fall under the patentability criteria may be captured by UM. Taken this way, UM and patent protection are complements of one another. In a recently published paper, Torres-Barreto *et al.* (2016) investigated whether UM registration counts are useful to measure the effect of public R&D funds for SMEs in Spain. Using data on both UM and patent filings of these Spanish firms over a ten-year period, they found that these two IP instruments were useful to measure the impact of public R&D funds. Moreover, they suggested that UM were complements to patents in that outputs of the R&D activities that did not meet the patentability criteria were more likely to be registered as UM. Also using the same data, Beneito (2006) distinguished between the types of innovation produced by R&D efforts of Spanish firms by using patent and UM protections as complements. She found that highly innovative inventions, proxied by patent, were usually in-house conducted R&D while contracted R&D activities tend to produce incremental inventions, proxied by UM.

However, to a certain extent, UM and patent protections may be considered substitutes of one another. Essentially patent and UM protections are similar in that they confer an exclusive right over the sale and working of the intellectual asset. They differ by their maximum length of protection. Inventions granted with patents are allowed a maximum of 20 years of protection while UM are given 10 years of protection. Arguably, an inventor may choose to file for protection under UM rather than patent because it is easier and quicker to obtain.

Nevertheless, the substitutability of UM and patent protections is unlikely to play a significant role at the aggregate level. An inventor's choice to choose UM protection over patent protection may simply reflect the nature of product life cycle or business choices. Total technological activity level will remain the same; the difference may lie in the distinction in the types of technological inventions: patented versus UM inventions. Milesi *et al.* (2013) replicated the studies conducted by Cohen *et al. (2000)* and Levin *et al. (1987)* on the importance of different appropriation mechanisms to recover returns to investments in innovation but in the context of Argentina using survey data on 200 firms from five different industrial sectors. Unlike the surveyed conducted in the US, the authors differentiated between three different legal instruments – patents, UM and industrial design. They found that instead of patents, UM and industrial design protections were more predominantly used by firms operating in industries using medium-low technologies.

3 What does UM data tell us?

Our paper sets out to examine how UM statistics add to measures of innovative activities by comparing this IP instrument to patents. Using data collected from WIPO's Statistical Database as well as the EPO's PATSTAT data, we exploit the differences and similarities between these two IP instruments to better understand how they relate to one another, and to better get a sense of what types of inventions are being captured by UM.

Like patent document that contain many useful data that relate to innovative activities, UM documents reveal some interesting insights into a country's and their firms' innovative competitiveness. In particular, it should reveal insights into how firms that engage in incremental innovation build their core competencies and how sophisticated they may be in using the IP system. For example, some jurisdictions allow for patent families to contain patents and UMs alike. The ability to use UM filing for priority date may provide useful insights into how firms rely on the different form of IP protection to protect their innovative, and maybe even creative, outputs.

3.1 Who uses UM?

During 2000-2014, residents filed domestically one utility model application for every three patent filings on average worldwide (Table 2). China largely influences this pattern by totalling 80% of global utility model applications. Moreover, China has intensively used UM protection by filing more than one utility model per patent during this period. If we excluded China in the global statistics, the world filed on average one utility model for every eleven patent applications. Still, this figure is likely an underestimation as it includes patenting activity from countries without UM protection such as the United States.

Regions and income groups file and use UM protection to varying degrees. Typically, the upper and lower middle-income countries seem to rely more intensively on UM than high- and low-income ones (Table 2). Historically, upper middle-income countries have been more intensive UM users on average than other countries (Figure 1). In the last decade, lower middle-income countries have increased their average intensity, taking over upper middle-income countries (excluding China).

-- Insert Table 2 & Figure 1 about here --

This heterogeneous pattern becomes more apparent when looking at across regions. Europe, Latin America and the Caribbean and Oceania make a relatively more intensive use of UM protection in comparison to Asia (excluding China), Africa and North America

(Table 2) as a whole.[3] Latin American and the Caribbean countries were on average the most intensive region, only taken over by Asia in the last five years (Figure 2).

-- Insert Figure 2 about here --

Asia's recent uptake of UM use is most likely explained by the high dynamism observed in Asian countries (Figure 3). As well documented in the existing literature (Kumar, 2003; World Bank, 2002; Yu, 1998), some Asian economies have relied on UM filings to build their technological capacities before becoming patent users in the later years. We observe a similar pattern where an increase of domestic UM filings is followed first by an equivalent increase patent filings; the later eventually outnumbers the former. Such pattern has been observed for Japan in the 1970s, the Republic of Korea in the 1980s and China in the 1990s. A similar pattern – although with less amplitude – can be observed in other regions as well such as Spain, Greece and Brazil, albeit to a different degree.

-- Insert Figure 3 about here --

However, countries from all regions and degree of development make considerable use of UM protection both in relative and absolute terms (Table 3). For instance, the absolute numbers of Japanese UM filings have dropped substantially after regulatory changes in 1994, reducing its relative use with respect to patents even more. However, Japan still is within the top 5 countries for the period 2000-2014, filing thousands of UM a year. Indeed, most top 20 countries in resident patent applications – such as South Korea, Germany, Russia, and Italy – that allow for UM protection have filed thousands of UM a year, scoring UM-to-patent ratio above the world's average (excluding China and the US). The only notable exception is France, totalling about a hundred applications a year.

-- Insert Table 3 & Table 5 about here --

Part of the explanation might well be different uses of IP per industries. A disaggregation of UM and patent use per technological field already indicate considerable differences across industries (Table 5). The main pattern observed is that ICT and pharmaceutical related technologies have a lower use of UM if compared to

[3] As mentioned, the US and Canada do not have an IP instrument equivalent to UM.

patents. This may well reflect the high use of patents that these technologies typically represent. Nevertheless, some technologies totalling high shares of patents – such as Transport (6%), Electrical machinery (7%) and Civil engineering (5%) – do make a relatively intense use of UM as well.

-- Insert Figure 4 about here --

In consequence, the different industrial specialization of countries may well explain the differences found across countries. However, as depicted in Figure 4, the country specific industrial composition may not explain all of the different IP usages. Some countries such as China or Brazil have a higher frequency of UM use across several industries over time, especially if compared to countries such as Republic of Korea or Germany where there is substantially less use of UM across industries. Notwithstanding, some industries have a strong preference of a given IP – like pharmaceuticals with patents – which holds across all countries.

3.2 A multivariate analysis

As a follow-up of the descriptive analysis of the previous section, we propose as follows a basic framework for a multivariate analysis on the choice between patent and UM protection. We model the probability of a given invention to be protected with UM, as opposed to be protected with a patent. This probability is tested as function of a given set of determinants capturing the above depicted trends and other determinants at level of the invention. We estimate the model by the means of a linear probability model.[4] The results of the estimated models are summarized in Table 6, Table 7 and Table 8.

The main determinants are country fixed-effects, technology fixed-effects and time trend. We add the following country time variant variables of interest: GDP per capita and the ratio R&D/GDP, both measured as PPP and constant prices. In addition, we include information on the following variables: (i) international scope of the protection, proxied by patent families; (ii) the invention potential value, proxied by forward

[4] We have also tested estimating the model with Logit and Probit methods. Unfortunately, converge of different maximum-likelihood estimation algorithms have proven difficult. We are currently investigating this issue for a revised version. For those cases where convergence was achieved, results remained qualitatively similar to the LPM ones.

citations; (iii) the invention's collaborative nature, proxied by number of inventors; and, (iv) the ownership complexity, proxied by the number of applicants.

We limit the sample to countries were there exists UM protection and available data. We source the unit-record data from the WIPO Statistics Database and PATSTAT. The final list of countries include: Argentina, Austria, Bulgaria, Brazil, Chile, China, Colombia, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, Georgia, Hungary, Italy, Moldova, Peru, Philippines, Poland, Portugal, Serbia, Slovakia, Turkey, Ukraine, Uruguay. We also limit the years to the period 2000-2014. However, some country-year data may be missing due to unavailable data for dependent variables such as technological field, R&D or GDP. The final sample contains information on 3,194,259 different technologies, out of which 43% have sought UM protection. As Chinese applications represent virtually half of our sample, we also provide estimations for a sample excluding these applications.

The underlying model for the multivariate analysis makes the following assumptions. First, the choice is only for inventions for which IP protection is sought. Therefore, the model does not contemplate for non-patentable inventions or the decision to not protect with either patents or UMs. Second, the model neither takes into account the potential reverse causality or simultaneity between some independent variables and the dependent one. For instance, some decisions – e.g. patent family size – may well happen after the decision between the IP protections and not before. Third, the decision to exclude countries without UM protection implicitly assumes that such absence is purely exogenous. It may well be that the decision to provide or not such protection correlates to levels of development and given industrial structures.

-- Insert Table 6, Table 7 and Table 8 about here --

The first result of the econometric estimation is that the general trends described in the previous section hold. Keeping everything else constant, there are statistically significant country and industry effects on the decision to use UM protection (see Table 7 and Table 8). As expected, some countries – such as China or Germany, if the former is not included in the sample – have a higher probability to use UM protection even if everything else is held constant, while others – such as France or Italy – are less likely to use it. A similar trend is found for technological fields, where *pharmaceuticals* are less likely to use UM protection and engineering fields – such as *Civil engineering* or *Handling* – are more likely to use it, which is line with previous literature (Evenson, 1984).

Second, we find that higher GDP per capita and R&D/GDP ratio correlates negatively with the probability of using UM protection.[5] It is however hard to disentangle if such results reflect the degree of overall development (GDP per capita) or the one of the national innovation system (R&D/GDP ratio). In addition, note that these variables are country and time-variant only, which are then affected by the country fixed-effects and give no information on the cross-country variability.

Third, we find additional and interesting results at the observation level data. As expected, we find that patent families are negatively correlated with UM protection which suggests that the perceived international potential of a given technology affects the IP decision. We find similar results on the invention's potential value (proxied by forward citations), although this is to be taken with caution due the extremely skewed distribution of this variable.[6] As expected, number of inventors and applicants seems also to correlate negatively with UM protection. As applicants turn to be positively related when excluding China from the sample, a full-fleshed interpretation still requires further investigation. However, it does seem that smaller entities which are unlikely to have large R&D personnel or to engage in R&D joint-ventures may be prone to use UM protection (Evenson, 1984).

4 Conclusions & Policy implications

This paper explores conceptually and empirically the potential of utility model data as an innovation indicator, which could complement the patent related ones. The paper surveys how this IP right has been implemented in at least 75 countries and provides descriptive statistics and multivariate analysis of the existing data from WIPO's Statistics Database and EPO's PATSTAT.

[5] Note that these two variables are highly correlated in our sample (r = .83). When introduced separately, they are both significantly and negatively related to our dependent variable.
[6] We intend to improve this measure in future revisions.

Our theoretical review of the UM instrument suggest that UM data can provide a complementary perspective on innovative activities both at the aggregate and micro levels, which is later substantiated by our empirical analyses for the available data. First, we found considerable differences in the use of UM across countries and industries. Second, we also found differences correlated with the level of economic development and R&D intensity. All of these hold when the analyses are carried at the unit-record level in a multivariate setting. In addition, we found that technologies which are more local, less valuable, and developed by smaller and more isolated entities are more prone to use UM protection, all things being equal.

The policy implications are manifolds. Firstly, including UM measure into innovative activities enables a more comprehensive measurement of innovative activities in a country, regardless of whether the activity is new-to-the-world technology or not. Secondly, examining the types of innovation as well as which technological classification are filed under UM protection would allow for further inferences on how the different IP instrument used affect the different economic activities across countries. Moreover, the results at the unit-record level suggest that policies targeting innovative micro and small companies which struggle to have an international scope or to insert themselves in the innovation environment can make use of UM data for evidence based policy-making.

Tables and figures

Table 1 - Comparison between UM and Patent Protections

Scope	Utility Model	Patent
Criteria for protection	Novelty and industrial application	Novelty, non-obviousness (or inventive step), and industrial application
Examination requirement	Usually only formality[1]	Formality and substantive examinations
Term of protection	Between four to ten years[2]	20 years

Note [1]: Some countries also require substantive examination; [2] Brazil grants 15 years of protection while Malaysia grants 20 years.

Table 2 - Resident utility model and patent applications by income and regions (2000-2014)

	Resident				UM/patent
	Utility models		Patents		ratio
World	6,212,500	100.0%	17,737,600	100.0%	0.3502
High-income	991,193	16.0%	13,351,200	75.3%	0.0742
Upper middle-income	5,062,644	81.5%	4,109,100	23.2%	1.2321
Lower middle-income	109,015	1.8%	194,100	1.1%	0.5616
Low-income	414	0.0%	83,200	0.5%	0.0050
Asia	5,489,093	88.4%	10,941,800	61.7%	0.5017
Europe	596,355	9.6%	3,172,800	17.9%	0.1880
Latin America and the Caribbean	62,238	1.0%	97,400	0.5%	0.6390
Oceania	14,704	0.2%	62,600	0.4%	0.2349
Africa	876	0.0%	29,100	0.2%	0.0301
China	4,939,466	79.5%	3,760,562	21.2%	1.3135
World (w/o China)	1,273,034	20.5%	13,977,038	78.8%	0.0911
Upper middle-income (w/o China)	123,178	2.0%	348,538	2.0%	0.3534
Asia (w/o China)	549,627	8.8%	7,181,238	40.5%	0.0765

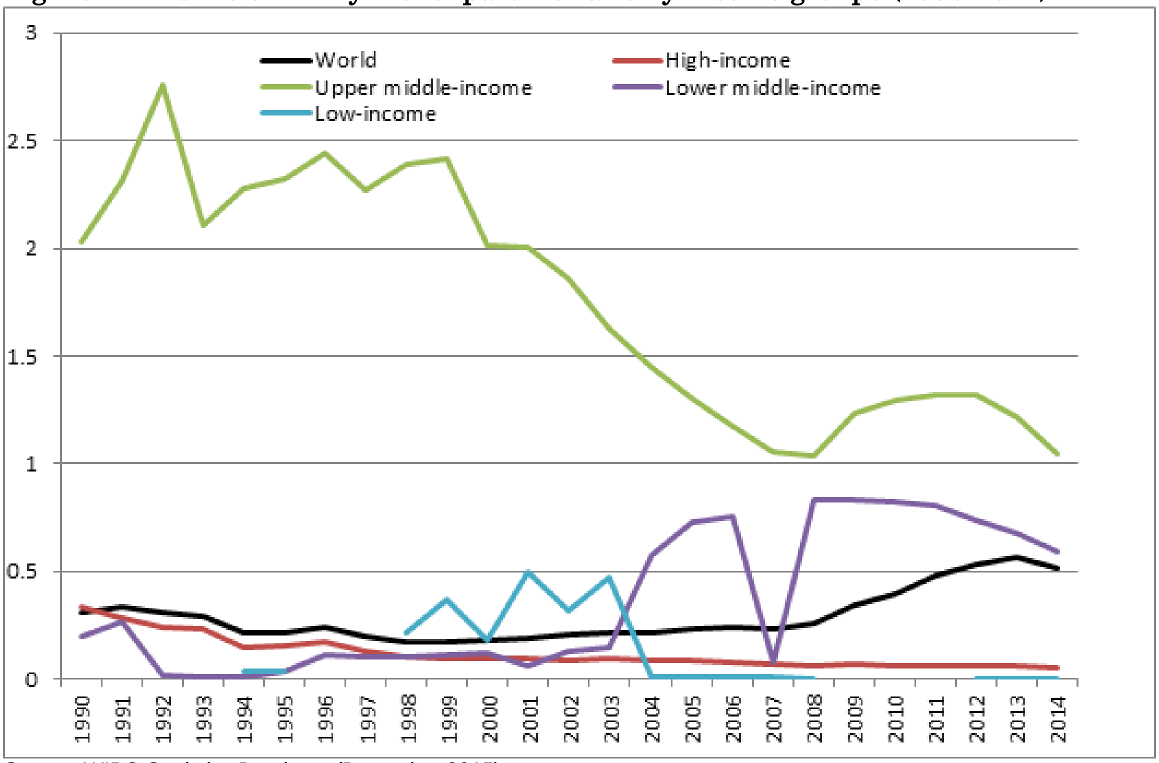
Source: WIPO Statistics Database (December 2015).

Table 3 - Top resident utility model countries (2000-2014)

		Resident				UM/patent
		Utility models		Patents		ratio
	World	6,212,500	100.0%	17,737,600	100.0%	0.3502
1	China	4,939,466	79.5%	3,760,562	21.2%	1.3135
2	Republic of Korea	372,111	6.0%	1,791,499	10.1%	0.2077
3	Germany	224,926	3.6%	723,080	4.1%	0.3111
4	Russian Federation	140,015	2.3%	388,918	2.2%	0.3600
5	Japan	107,682	1.7%	4,935,127	27.8%	0.0218
6	Ukraine	91,018	1.5%	48,874	0.3%	1.8623
7	Brazil	47,434	0.8%	62,103	0.4%	0.7638
8	Spain	40,042	0.6%	46,572	0.3%	0.8598
9	Turkey	27,899	0.4%	31,442	0.2%	0.8873
10	Thailand	19,970	0.3%	13,873	0.1%	1.4395
11	Czech Republic	19,164	0.3%	10,753	0.1%	1.7822
12	Italy	18,920	0.3%	77,552	0.4%	0.2440
13	Australia	14,704	0.2%	37,349	0.2%	0.3937
14	Austria	11,042	0.2%	32,653	0.2%	0.3382
15	Belarus	10,697	0.2%	19,294	0.1%	0.5544
16	Poland	10,687	0.2%	43,202	0.2%	0.2474
17	Philippines	7,097	0.1%	2,855	0.0%	2.4858
18	Finland	6,965	0.1%	28,263	0.2%	0.2464
19	Mexico	5,863	0.1%	11,584	0.1%	0.5061
20	Slovakia	4,065	0.1%	3,117	0.0%	1.3041

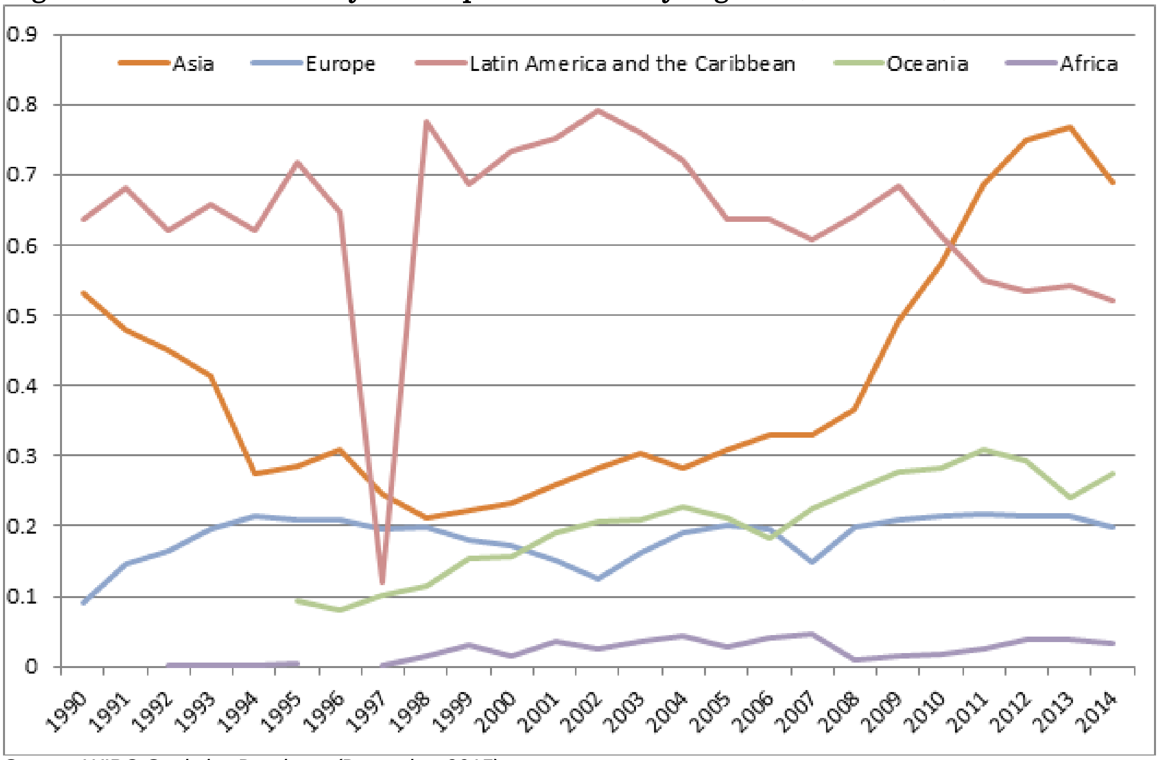
Source: WIPO Statistics Database (December 2015).

Figure 1 - Trends of utility model/patents ratio by income groups (1990-2014)



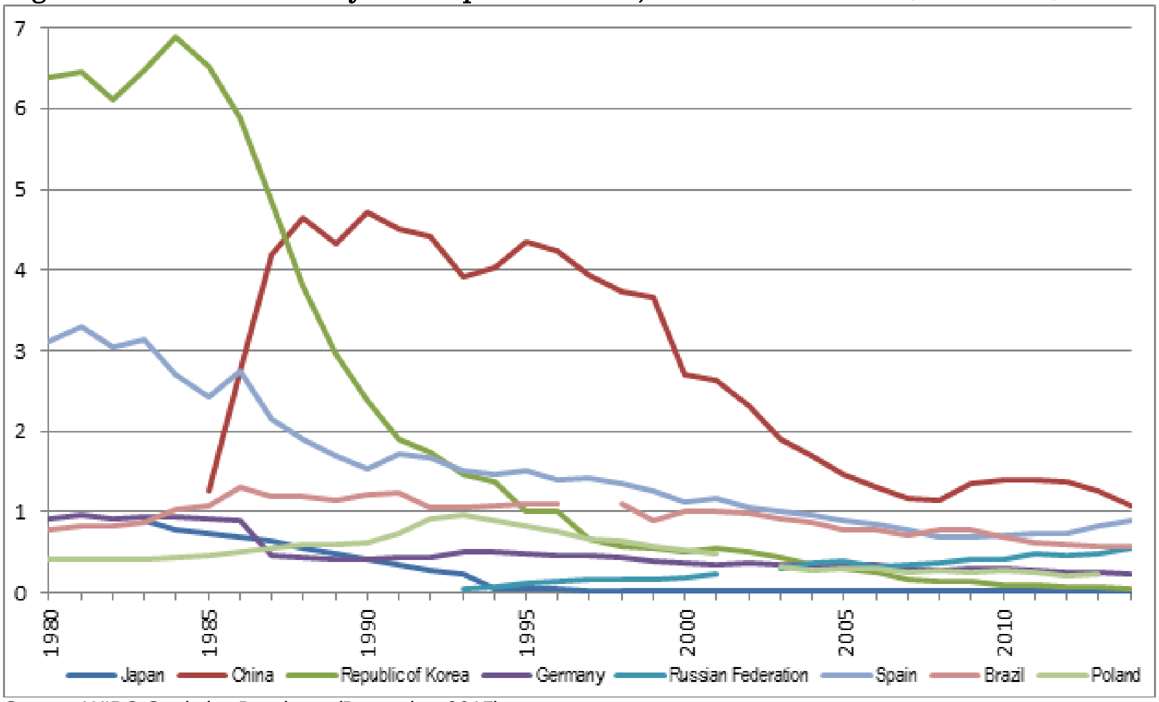
Source: WIPO Statistics Database (December 2015).

Figure 2 - Trends of utility model/patents ratio by regions (1990-2014)



Source: WIPO Statistics Database (December 2015)

Figure 3 - Trends of utility model/patents ratio, selected countries (1980-2014)



Source: WIPO Statistics Database (December 2015).

Table 4 - Trends for resident utility model/patent ratio by income and regions (1980-2014)

Year	World	High-income	Upper middle-income	Lower middle-income	Low-income	Asia	Europe	LAC	Oceania	Africa
1980		0.6812	0.1192	0.5032		1.1754	0.1236	0.3355		
1981		1.4182	0.1208	0.5341		55.0817	0.1414	0.3923		
1982		1.4203	0.1226	0.3331		52.6857	0.1307	0.4441		
1983		0.6262	0.1213	1.2101		0.9317	0.1355	0.4097		
1984		0.5821	0.1319	0.3255		0.8252	0.1394	0.4311		
1985	0.4229	0.5888	0.4236	0.2972	0.0317	0.7988	0.1337	0.7097		0.0005
1986	0.4201	0.5729	0.6981	0.2535		0.7818	0.1302	0.8436		
1987	0.3795	0.5104	1.0073	0.0007	0.0125	0.7463	0.0747	0.8115		0.0002
1988	0.3374	0.4361	1.2128	0.0013		0.6655	0.0743	0.8832		
1989	0.3127	0.3842	1.0870	0.2458	0.0488	0.5832	0.0793	0.7669		0.0004
1990	0.3087	0.3376	2.0330	0.1983	0.0175	0.5316	0.0905	0.6377		0.0006
1991	0.3318	0.2863	2.3122	0.2680		0.4788	0.1468	0.6816		
1992	0.3070	0.2414	2.7547	0.0198	0.0294	0.4495	0.1634	0.6202		0.0015
1993	0.2923	0.2278	2.1034	0.0079		0.4124	0.1946	0.6570		0.0007
1994	0.2156	0.1463	2.2794	0.0120	0.0357	0.2756	0.2149	0.6207		0.0027
1995	0.2186	0.1560	2.3227	0.0367	0.0364	0.2845	0.2079	0.7183	0.0922	0.0045
1996	0.2389	0.1699	2.4372	0.1133		0.3081	0.2081	0.6473	0.0814	
1997	0.1980	0.1261	2.2688	0.1050		0.2449	0.1948	0.1199	0.1005	0.0020
1998	0.1702	0.1016	2.3865	0.1005	0.2128	0.2105	0.1983	0.7767	0.1147	0.0137
1999	0.1724	0.0982	2.4118	0.1128	0.3654	0.2232	0.1807	0.6856	0.1538	0.0302
2000	0.1775	0.0967	2.0094	0.1218	0.1800	0.2338	0.1721	0.7342	0.1553	0.0135
2001	0.1884	0.0940	2.0074	0.0626	0.5000	0.2588	0.1516	0.7519	0.1905	0.0365
2002	0.2045	0.0850	1.8562	0.1287	0.3200	0.2831	0.1262	0.7907	0.2067	0.0242
2003	0.2158	0.0939	1.6306	0.1496	0.4700	0.3041	0.1620	0.7612	0.2095	0.0347
2004	0.2121	0.0889	1.4500	0.5761	0.0105	0.2818	0.1894	0.7211	0.2276	0.0447
2005	0.2286	0.0882	1.3011	0.7323	0.0073	0.3077	0.2005	0.6378	0.2102	0.0284
2006	0.2385	0.0817	1.1764	0.7514	0.0094	0.3287	0.1955	0.6357	0.1834	0.0416
2007	0.2340	0.0663	1.0550	0.0791	0.0106	0.3299	0.1482	0.6077	0.2252	0.0450
2008	0.2615	0.0648	1.0330	0.8348	0.0003	0.3675	0.1982	0.6421	0.2498	0.0100
2009	0.3401	0.0696	1.2320	0.8298		0.4914	0.2096	0.6832	0.2775	0.0153
2010	0.3931	0.0641	1.2908	0.8247	0.0004	0.5734	0.2135	0.6128	0.2815	0.0172
2011	0.4819	0.0609	1.3234	0.8073		0.6857	0.2163	0.5488	0.3087	0.0260
2012	0.5345	0.0595	1.3158	0.7381	0.0014	0.7494	0.2141	0.5347	0.2939	0.0377
2013	0.5625	0.0563	1.2156	0.6771	0.0011	0.7684	0.2137	0.5429	0.2406	0.0395
2014	0.5175	0.0515	1.0428	0.5904	0.0001	0.6885	0.1983	0.5216	0.2732	0.0340

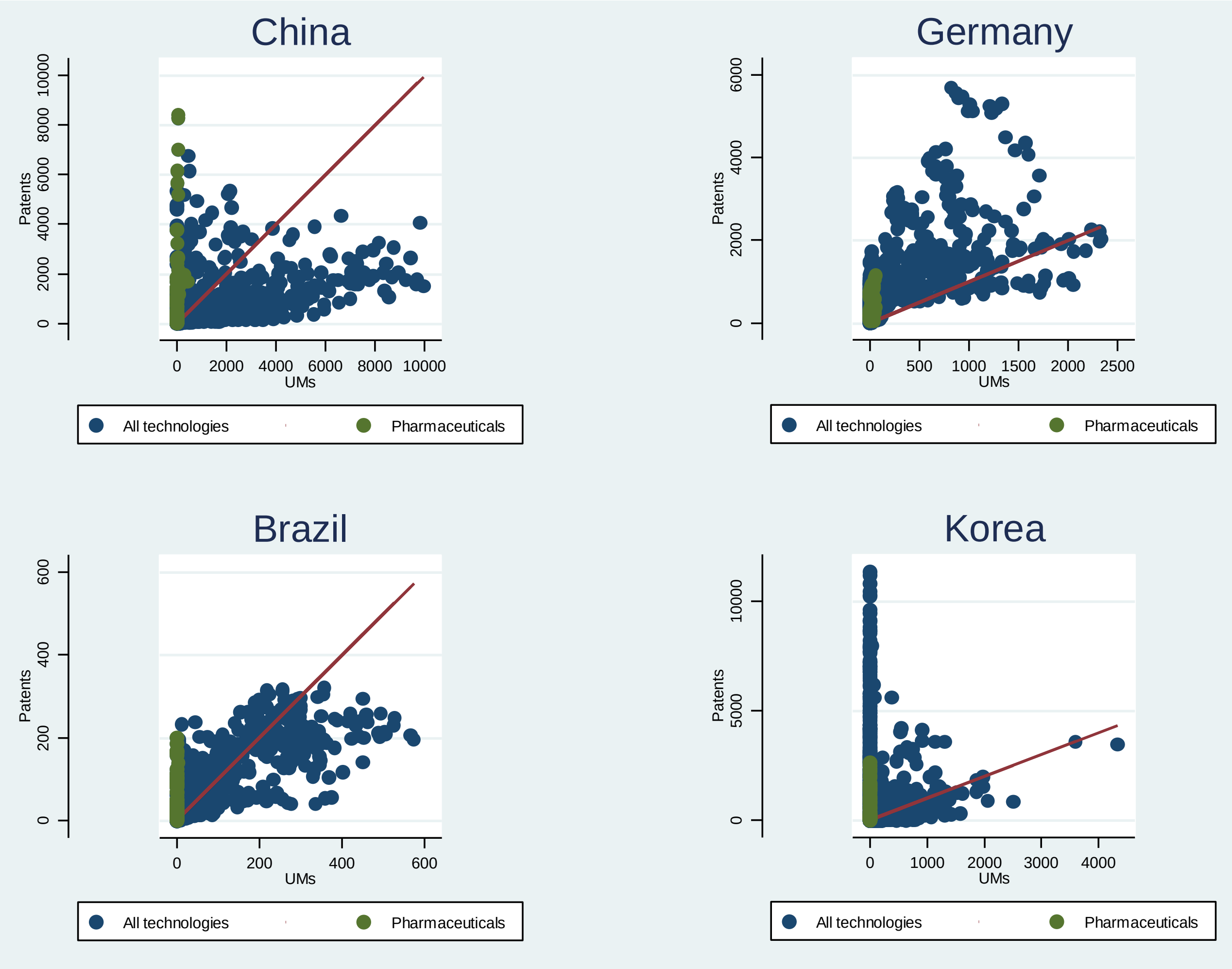
Source: WIPO Statistics Database (December 2015).

Table 5 - Resident utility model and patent applications by technological field (2000-2014)

		Resident				UM/patent
		Utility models		Patents		ratio
	Technological fields	1,375,855	100.0%	3,943,550	100.0%	0.3489
7	IT methods for management	1,106	0.1%	61,880	1.6%	0.0179
17	Macromolecular chemistry, polymers	1,008	0.1%	50,216	1.3%	0.0201
22	Micro-structural and nano-technology	213	0.0%	10,276	0.3%	0.0207
4	Digital communication	3,916	0.3%	161,955	4.1%	0.0242
14	Organic fine chemistry	2,020	0.1%	80,595	2.0%	0.0251
8	Semiconductors	6,834	0.5%	177,264	4.5%	0.0386
15	Biotechnology	3,192	0.2%	64,878	1.6%	0.0492
16	Pharmaceuticals	6,901	0.5%	118,535	3.0%	0.0582
19	Basic materials chemistry	8,576	0.6%	91,793	2.3%	0.0934
18	Food chemistry	10,798	0.8%	101,853	2.6%	0.1060
6	Computer technology	23,187	1.7%	200,311	5.1%	0.1158
9	Optics	16,415	1.2%	123,018	3.1%	0.1334
20	Materials, metallurgy	14,281	1.0%	106,547	2.7%	0.1340
3	Telecommunications	19,115	1.4%	139,383	3.5%	0.1371
5	Basic communication processes	3,865	0.3%	25,872	0.7%	0.1494
11	Analysis of biological materials	4,255	0.3%	22,327	0.6%	0.1906
21	Surface technology, coating	11,788	0.9%	59,783	1.5%	0.1972
2	Audio-visual technology	36,567	2.7%	162,025	4.1%	0.2257
27	Engines, pumps, turbines	37,281	2.7%	130,796	3.3%	0.2850
10	Measurement	57,177	4.2%	166,482	4.2%	0.3434
32	Transport	86,213	6.3%	240,516	6.1%	0.3585
28	Textile and paper machines	22,734	1.7%	61,979	1.6%	0.3668
24	Environmental technology	29,469	2.1%	76,566	1.9%	0.3849
12	Control	26,469	1.9%	64,262	1.6%	0.4119
1	Electrical machinery, apparatus, energy	115,868	8.4%	270,527	6.9%	0.4283
23	Chemical engineering	40,712	3.0%	89,872	2.3%	0.4530
31	Mechanical elements	68,906	5.0%	129,327	3.3%	0.5328
29	Other special machines	73,466	5.3%	136,680	3.5%	0.5375
26	Machine tools	65,627	4.8%	109,652	2.8%	0.5985
13	Medical technology	90,863	6.6%	133,032	3.4%	0.6830
30	Thermal processes and apparatus	65,997	4.8%	92,660	2.3%	0.7122
35	Civil engineering	136,682	9.9%	184,838	4.7%	0.7395
25	Handling	77,004	5.6%	96,252	2.4%	0.8000
34	Other consumer goods	87,256	6.3%	103,536	2.6%	0.8428
33	Furniture, games	120,092	8.7%	98,064	2.5%	1.2246

Source: WIPO Statistics Database and PATSTAT, figures based on data for selected countries: AR, AT, AU, AU, AU, AU, BG, BR, BY, CL, CN, CO, CZ, DE, DK, EE, ES, FI, FR, GE, GR, HR, HU, ID, IT, JP, KR, KZ, MD, MN, MX, MY, PE, PH, PL, PT, RS, RU, SK, TH, TR, UA, UY, UZ, and VN.

Figure 4 - Resident utility model and patent applications by technological field (1980-2014)



Source: WIPO statistics database and PATSTAT. Red line represents equal number of patent and UM applications.

Table 6 – Determinants of the decision to file for UM protection

DV = UM (1/0)	(1)		(2)	
Variables	**coef**	**se**	**coef**	**se**
year	-0.003***	0.000	0.005***	0.000
GDP per capita	2.36E-05***	0.000	-1.55E-07	0.000
GERD/GDP	-0.172***	0.003	-0.347***	0.004
Patent family	-0.008***	0.000	-0.012***	0.000
Citations	-0.006***	0.000	-0.002***	0.000
Applicants	-0.008***	0.000	0.008***	0.000
Inventors	-0.024***	0.000	-0.053***	0.000
Constant	6.255***	0.458	-8.810***	0.444
country FEs	yes		yes	
tecnology FEs	yes		yes	
China included	yes		no	

note: *** p<0.01, ** p<0.05, * p<0.1

Table 7 – Country fixed-effects

	(1)		(2)	
Country FEs	**coef**	**se**	**coef**	**se**
AR	-0.470***	0.005	-0.586***	0.005
AT	-0.465***	0.013	0.366***	0.015
BG	-0.092***	0.010	-0.191***	0.010
CL	-0.439***	0.020	-0.491***	0.019
CN	0.400***	0.003	-	-
CO	-0.447***	0.009	-0.694***	0.006
CZ	-0.012	0.007	0.335***	0.007
DE	-0.393***	0.012	0.443***	0.014
DK	-0.410***	0.013	0.385***	0.015
EE	-0.041***	0.014	-0.063***	0.014
ES	-0.360***	0.009	0.098***	0.009
FI	-0.240***	0.012	0.679***	0.016
FR	-0.579***	0.010	0.099***	0.012
GE	0.098**	0.045	-0.195***	0.041
HU	-0.303***	0.006	-0.191***	0.006
IT	-0.654***	0.010	-0.194***	0.010
MD	-0.170***	0.007	-0.443***	0.007
PE	0.089***	0.021	-0.131***	0.024
PH	-0.347***	0.033	-0.690***	0.021
PL	-0.325***	0.004	-0.263***	0.004
PT	-0.417***	0.010	-0.111***	0.010
RS	-0.258***	0.014	-0.343***	0.014
SK	-0.570***	0.008	-0.490***	0.007
TR	0.127***	0.004	0.140***	0.004
UA	0.397***	0.003	0.317***	0.003
UY	-0.021	0.031	-0.143***	0.031
China included	yes		no	

Reference = BR

note: *** p<0.01, ** p<0.05, * p<0.1

Table 8 – Technology fixed-effects

	Technology FEs	(1) coef	(1) se	(2) coef	(2) se
	No technology	-0.095***	0.003	0.104***	0.003
1	Electrical machinery, apparatus, energy	0.004**	0.002	0.020***	0.002
2	Audio-visual technology	-0.103***	0.002	0.101***	0.003
3	Telecommunications	-0.246***	0.002	-0.044***	0.003
4	Digital communication	-0.531***	0.002	-0.112***	0.002
5	Basic communication processes	-0.246***	0.004	-0.129***	0.004
6	Computer technology	-0.325***	0.002	-0.088***	0.003
7	IT methods for management	-0.452***	0.005	-0.114***	0.006
8	Semiconductors	-0.351***	0.003	-0.106***	0.003
9	Optics	-0.201***	0.003	-0.042***	0.003
10	Measurement	-0.111***	0.002	-0.064***	0.002
11	Analysis of biological materials	-0.252***	0.005	-0.009*	0.005
12	Control	-0.078***	0.002	-0.026***	0.003
13	Medical technology	0.054***	0.002	0.076***	0.003
14	Organic fine chemistry	-0.396***	0.002	-0.022***	0.003
15	Biotechnology	-0.477***	0.003	-0.075***	0.003
16	Pharmaceuticals	-0.587***	0.002	0.000	0.003
17	Macromolecular chemistry, polymers	-0.544***	0.003	-0.078***	0.004
18	Food chemistry	-0.459***	0.003	-0.017***	0.004
19	Basic materials chemistry	-0.466***	0.002	-0.068***	0.003
20	Materials, metallurgy	-0.399***	0.002	-0.083***	0.003
21	Surface technology, coating	-0.232***	0.003	-0.060***	0.004
22	Micro-structural and nano-technology	-0.530***	0.007	-0.131***	0.007
23	Chemical engineering	-0.043***	0.002	0.005	0.003
24	Environmental technology	-0.092***	0.002	0.006*	0.003
25	Handling	0.086***	0.002	0.139***	0.003
26	Machine tools	0.006***	0.002	0.037***	0.003
27	Engines, pumps, turbines	-0.120***	0.002	-0.101***	0.002
28	Textile and paper machines	-0.139***	0.002	-0.071***	0.003
29	Other special machines	-0.012***	0.002	0.068***	0.003
30	Thermal processes and apparatus	0.027***	0.002	0.064***	0.003
32	Transport	-0.031***	0.002	-0.003	0.002
33	Furniture, games	0.162***	0.002	0.275***	0.003
34	Other consumer goods	0.103***	0.002	0.206***	0.003
35	Civil engineering	0.069***	0.002	0.162***	0.002
	China included	yes		no	

Reference = Mechanical elements (tec 31)
note: *** p<0.01, ** p<0.05, * p<0.1

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