International trade in intellectual property-intensive goods

Paweł Folfas[1]

Andżelika Kuźnar[2]

Warsaw School of Economics

August 2013

Abstract: IP-intensive goods emerged recently as an important component of exports and imports in world trade. They account for the majority of exports and imports in many developed countries and they increase fast its share in emerging economies.

The aim of the paper is to find out what are the main factors that influence bilateral flows of IP-intensive goods. Trade statistics do not tell directly about the IP content of trade, therefore the first task is to identify IP-intensive industries. The pioneer work in this area has been done by the U.S. Department of Commerce which identified industries that are the most patent-, trademark-, and copyright-intensive in the U.S. This set is used as a proxy of IP-intensive industries common for all countries in the world in our research.

We analyze the main trends in international trade in IP-intensive goods: its main exporters and importers, and volume. Then we use a gravity model of bilateral trade flows in order to fish out factors which intensify or reduce trade in IP-intensive goods. Our dependent variable are bilateral trade flows extracted from the United Nations (UN) Comtrade database (ISIC rev. 3 nomenclature). We include standard independent variables, such as: GDPs, distance, language, participation in regional trade agreements, etc. We also identify several factor that may influence trade in IP-intensive goods. These are: expenditures on research and development, number of students in tertiary education and evaluation of intellectual property protection. The first two variables constitute capital and human inputs to IPR environment. The third one is an evaluation of intellectual property protection. We use Hausman-Taylor method of estimation. Gravity models confirm that more intensive export of IP-intensive goods is accompanied by higher expenditure on R&D, higher number of students and stronger protection of intellectual property rights in exporting country. And this accompaniment is tighter for export of IP-intensive goods than for export of all commodities.

Keywords: intellectual property, international trade, gravity model

JEL Codes: F14, O30, O34.

[1] E-mail: pawel.folfas@sgh.waw.pl

[2] E-mail: andzelika.kuznar@sgh.waw.pl

1. Introduction

Ongoing globalization process and fast development of new technologies allow goods and services with high intellectual property rights (IPR) content to move across borders more easily. Depending on the definition of IP-intensive goods, there are different estimates of its importance in world trade. According to Fink and Primo Braga the share of *knowledge-intensive or high-technology products* (understood as IP-intensive industries) in total world trade has doubled between 1980 and 1994 from 12 percent to 24 percent[3]. Pham defined IP-intensive industries in US economy as those with have *higher-than-average annual R&D expenditure per employee*. Her research reveals that so defined industries were responsible for almost 60 percent of total U.S. exports during 2000-07[4]. According to more current estimates published in a report prepared by the U.S. Department of Commerce, in 2010 merchandise exports of IP-intensive industries accounted for 60,7 percent of total U.S. merchandise exports, 69,9 percent of total U.S. merchandise imports and some 19 percent of total U.S. services exports in 2007[5]. This research identified industries that are *the most patent-, trademark-, and copyright-intensive* (i.e. which most intensively use the protection offered by patents and trademarks or are primarily responsible for the creation and production of copyrighted materials[6]). Using the list of industries selected in the cited report (more about data and methodology – see section 2), we calculated the value and share of IP-intensive goods in world trade of commodities (we do not include trade in services) in the last 17 years (Figure 1). The value of world exports of IP-intensive goods totaled 10997 billion USD. Imports reached 12412 billion USD. They account for around 80 percent of world exports and imports of commodities.

---

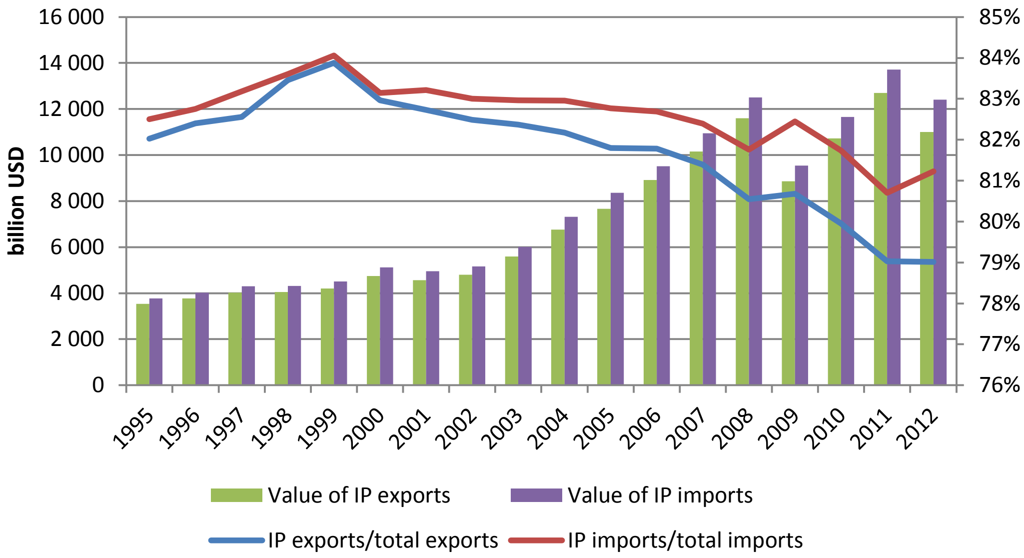
[3] C. Fink, C. A. Primo Braga, *How Stronger Protection of Intellectual Property Rights Affects International Trade Flows* [in:] C. Fink, K.E. Maskus (ed.), *Intellectual Property and Development. Lessons from Recent Economic Research*, The World Bank, New York 2005, p. 33.

[4] N. Pham, *The Impact of Innovation and the Role of Intellectual Property Rights on U.S. Productivity, Competitiveness, Jobs, Wages, and Exports*, NDP Consulting. April 2010, http://ndpgov.com/docs/NDP_IP_Jobs_Study_Hi_Res.pdf [access: June 2013].

[5] *Intellectual Property and the U.S. Economy: Industries in Focus*, U.S. Department of Commerce, March 2012, http://www.uspto.gov/news/publications/IP_Report_March_2012.pdf [access: June 2013].

[6] The reasoning for using this set of industries as a proxy of IP-intensive industries common for all countries in the world in our research can be found in the following section.

Figure 1. The value (left axis) and share (right axis) of IP-intensive goods in total world exports and imports of commodities, 1995-2012



Source: own calculations based on Comtrade.

Despite differences in coverage of the term "IP-intensive industries[7]" and resulting from it differences in data, there is no doubt that this is an important component of world trade. Therefore it is worth to examine it and to outline some trends and tendencies, as well as the major players in world exports and imports. As protection of the outcome of human intellect is considered an important factor driving innovation and competitiveness, countries exporting lots of IP-intensive goods might be considered leaders of innovation. Additionally, the shift towards the growing share of such products in exports of developing countries may be interpreted as an indication of their move up the innovation ladder.

A great number of empirical studies investigate the influence of IP protection on the volume of international trade, FDI or economics development of countries. They examine how stronger IP rights affect various economics variables. The results are ambiguous[8]. Our study differs from them in this respect that we analyze the factors that influence a subset of international trade flows, i.e. bilateral trade in IP-intensive goods. We selected expenditures

[7] We use this term interchangeably with "IP-intensive goods".

[8] See e.g.: J.C. Chin, G. M. Grossman, *Intellectual Property Rights and North-South Trade*, NBER Working Paper 2769, National Bureau of Economic Research, Cambridge, Mass, 1988; A.V. Deardorff, *Welfare Effects of Global Patent Protection*, "Economica" 59:35–51, 1992; M.J. Ferrantino, *The Effect of Intellectual Property Rights on International Trade and Investment*, "Weltwirtschaftliches Archiv" 129(2):300–31, 1993; E. Helpman, *Innovation, Imitation, and Intellectual Property Rights*, "Econometrica" 61(6):1247–80, 1993; K.E. Maskus, M. Penubarti, *How Trade Related Are Intellectual Property Rights?*, "Journal of International Economics" 39:227–48, 1995; C. Fink, C. A. Primo Braga, *How Stronger Protection…*, op. cit., C.A. Primo Braga, C. Fink, *The Economic Justification for the Grant of Intellectual Property Rights: Patterns of Convergence and Conflict*, [in:] . F. M. Abbott, D. J. Gerber (eds.), *Public Policy and Global Technological Integration*, Dordrecht, Netherlands: Kluwer Academic Publishers, 1997.

on R&D, the number of students in tertiary education and intellectual property protection as the specific factors that may affect such trade. We use a use a gravity model of bilateral trade flows in order to investigate this issue.

The remainder of this study is organized in the following way. The next section characterizes data sources. This is followed by sections 3 and 4 that describe the results of the investigation: the main trends in international trade in IP-intensive goods (its main exporters and importers and volume) and the identification of the factors affecting this trade as a result of the gravity estimation. Section 5 presents conclusions.

2. Data sources and method

As we mentioned above, there are various ways of defining IP-intensive industries. We decided to use the proposal of the U.S. Department of Commerce[9] which developed several industry-level metrics on IP use and employed them to identify a set of industries that find IP protection especially important in U.S. economy. It is reflected in the number of patents, trademarks, and, in case of services, also copyrights.

In case of identifying patent-intensive industries there are several factors that one has to be aware of. First, the patent analysis was limited to patents issued by USPTO[10] to U.S. corporations. But they were responsible for a large share of the patents (about 45 percent of total patents and 87 percent of all U.S.-owned patents issued between fiscal years 2004 and 2008). Another limitation is that only patents issued in manufacturing industry were taken into account. The advantage of such solution was that patents could be associated with North America Industry Classification System (NAICS) codes (there is no concordance system between patents and other than manufacturing industries). The analysis was carried out at the highest possible level of detail (three- and four-digit level of NAICS codes). Third, in other to normalize patenting activity to industry size, the number of patents in each industry was divided by employment in it. Therefore the most patent-intensive industries are those with the most patents per job. While this approach solves one problem, it may lead to inappropriate conclusions in other cases. If an industry employs relatively large number of people but at the same time has a small portfolio of highly valuable patents, it will not be considered as patent-intensive.

In case of trademarks the biggest advantage of the American study is that, according to its authors, "it may be the first comprehensive analysis of trademark use by U.S. industries

[9] *Intellectual Property and the U.S. Economy…*, op. cit.
[10] USPTO – United States Patent and Trademark Office.

that is grounded in original research, data, and measurement theory". Moreover, it takes into account trademarks protecting both goods and services. Unlike in case of patents, there is no straightforward way to associate trademark registrations with industries, so indirect ways had to be employed to identify them. Then, similarly to patents, the intensity of trademarks was calculated as the ratio of trademark registrations to employment in each industry and those with scores higher than average were selected for further analysis.

The last IPR category covered by the U.S. study is copyright. In order to designate copyright-intensive industries, the WIPO's list[11] of industries that are primarily responsible for the *creation or production* of copyrighted materials was used. Industries whose primary purpose is to distribute copyright materials were excluded from the analysis (it allows for closer consistency with patent- and trademark-intensity approach which concentrates on industries responsible mainly for production of the protected IP). Contrary to previous two categories, all industries associated with production of copyrighted materials were defined as copyright-intensive (and not those with the best intensity scores).

As a result, among 313 total four-digit NAICS industries, 75 were identified as IP-intensive, i.e. they used the protection offered by intellectual property rights most intensively. Among them we have taken into account 49 goods-producing and wholesale and retail trade industries. We had to limit our analysis to this set because of availability of detailed trade statistics in Comtrade database (Comtrade database does not include trade in services). We have used the IP-intensive industries identified for the U.S. economy as a proxy of this industry for all countries. We believe this is justified due to the high level of development of IP protection rights in the United States and presence of the largest multinational companies on this market (and they are the most important players on IP scene).

Having the selection of four-digit NAICS industries we have used the correspondence table[12] to find a direct relationship between this nomenclature and ISIC rev. 3.1 which was essential for the next step of our analysis.

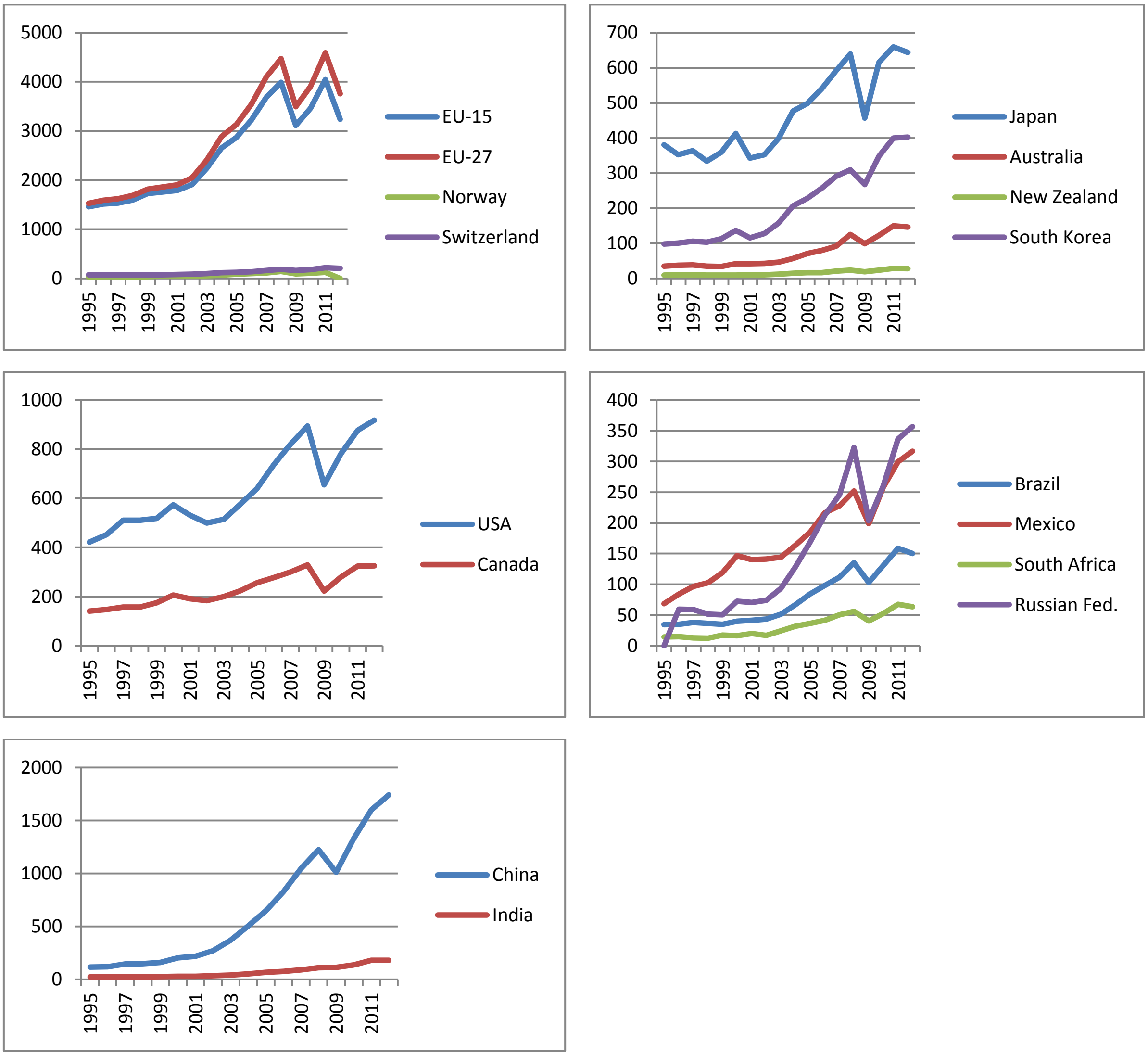
[11] *Guide on Surveying the Economic Contribution of the Copyright-based Industries*, World Intellectual Property Organization 2003.

[12] Available at: http://www.census.gov/eos/www/naics/concordances/2002_NAICS_to_ISIC_3.1.xls (access July 2013].

3. **Trends in international trade in IP-intensive goods**

Figure 2 displays value of exports of IP-intensive industries from Triad countries and selected emerging economies. In all but one case (of India) the effects of global economic crisis is well visible in exports data.

Figure 2. Exports of IP-intensive goods from groups of countries, 1995-2012, in billion USD.



Source: own calculations based on Comtrade.

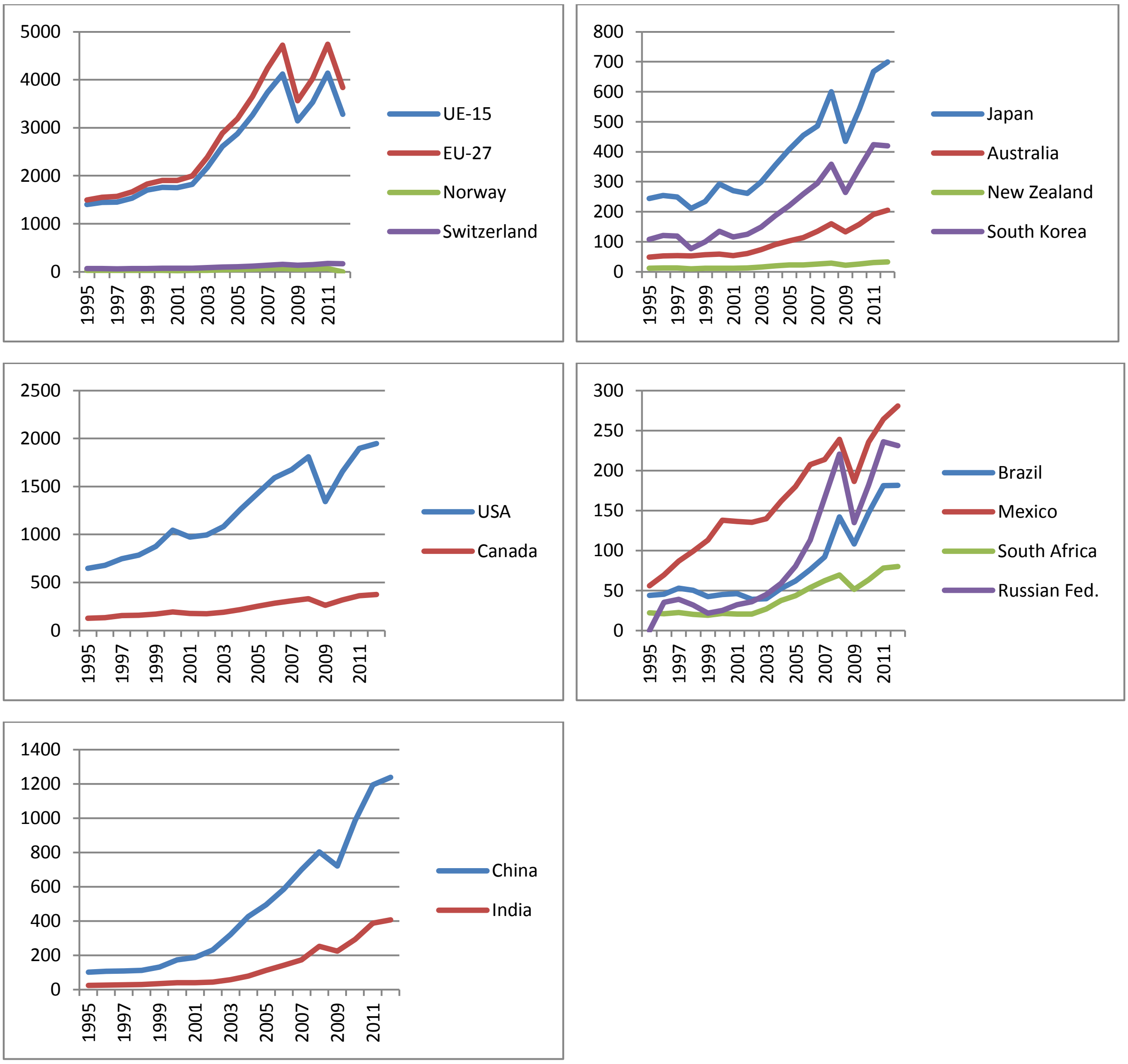
In 2012 merchandise exports of IP-intensive industries from EU-27 countries totaled 3758 billion USD, which accounted for 34,2% of world exports of these industries (43,3% in 1995). From 1995 to 2012, exports of IP-intensive goods from EU-27 was increasing 5,4% on average annually. USA's merchandise exports of IP-intensive industries reached almost

918 billion USD in 2012 (8,3% of world total, while in 1995 it accounted for 11,9% of world total). Average annual growth rate (*aagr*) in the years 1995-2012 achieved 4,7%.

In 2012 Japanese and South Korean exports of IP-intensive industries amounted to 644 and 402 billion USD respectively. While the share of the first country in world exports decreased from 10,8% in 1995 to 5,9% in 2012 (*aagr* = 3,8%), the share of South Korea increased from 2,8% to 3,7% (*aagr* = 8,6%) in the same period. Other Asian countries, China and India noted much more remarkable growth rates. China's merchandise exports of IP-intensive goods in 2012 totaled 1740 billion USD, which accounted for 15,8% of world total (almost twice the share of the U.S.). Since 1995 the value of IP-intensive exports was growing at the average annual rate of 17,3%. In case of India the value of analyzed exports group is still relatively low (about 179 billion USD in 2012, or 1,6% or world's total), but the average annual growth rate in the years 1995-2012 reached 12,9%. Among other developing countries Brazil, Mexico, South Africa and Russian Federation noted average annual growth rates above 9% and shares in world exports of IP-intensive industries ranging from 0,6% (South Africa) to 3,2% (Russian Federation) in 2012. Higher than world average annual growth rates (6,9%) observed in emerging countries suggest that these economies quickly catch up with current leaders in innovation and become significant exporters of IP-intensive goods.

Similar tendencies can be observed on imports side (Figure 3). The biggest importers of IP-intensive industries are EU-27 countries. Altogether they imported 3856 billion USD worth IP-intensive goods in 2012 (30,9% of world IP-intensive imports). This result makes EU-27 a net importer (-78 billion USD in 2012). At the same time USA's imports reached 1948 billion USD (15,7% of world IP-intensive imports). It was over 1030 billion USD more than exports of the IP-intensive industries. The *aagr* in 1995-2012 was below world average in both cases (5,7% and 6,7% respectively compared to 7,3%). Japan and South Korea are also substantial importers of IP-intensive industries. In 2012 Japanese imports reached almost 700 billion USD (5,6% of world's share), while Korean – 419 billion USD (3,4% share). In the second case the *aagr* in the years1995-2012 exceeded 8,3%. Both countries were net importers of IP-intensive industries in 2012 (-56 and -17 billion USD respectively). In the past Japan was a net exporter, but it has changed in 2011. The situation in this regard in South Korea fluctuates. On the other hand, China's surplus of exports over imports of IP-intensive industries constantly grows and it reached over 500 billion USD in 2012. The value of country's imports of the analyzed industry was 1238 billion USD in 2012 (almost 10% share of world IP-intensive imports) and the *aagr* since 1995 was 15,9% (over twice the average world's rate). India recorded in the value of *aagr* as it was 18,1% in the years 1995-2012. Its imports reached the value of 406 billion USD (3,3% of world IP-intensive imports) and was over 227 billion USD larger than exports. This deficit increases since the beginning of analyzed period of time. Other developing economies noted higher than average annual growth rates (between 7,9% in South Africa and 11,7% in Russian Federation). Their shares in world imports of IP-intensive industries ranged from 0,6% in South Africa to 2,3% in Mexico. Russian Federation and Mexico are large net exporters of IP-intensive industries (126 and 36 billion USD in 2012 respectively), while Brazil and South Africa are net importers (31 and 17 billion USD respectively).

Figure 3. Imports of IP-intensive goods to groups of countries, 1995-2012, in billion USD.



Source: own calculations based on Comtrade.

4. Factors affecting trade in IP intensive goods

In order to find factors affecting trade in IP intensive goods, we analyze export of IP-intensive goods using gravity models (we do not analyze import as its value is often distorted by trade barriers, especially by tariffs). We include in gravity models variables concerning *expenditures on R&D, the number of students in tertiary education and intellectual property protection* as we believe these kinds of factors might affect trade in IP-intensive goods. The first two variables constitute capital and human inputs to IPR environment. The third one is an evaluation of intellectual property protection. We use the Intellectual Property Rights (IPR) component of International Property Rights Index (IPRI)[13]. It assesses protection of patent and copyrights in 130 countries on a scale from 0 to 10. It consists of three components: protection of IPR (evaluation based on opinion surveys), patent protection (strength of patent laws based on five criteria: coverage, membership in international treaties, restrictions on patent rights, enforcement, and duration of protection), and copyright piracy (the effectiveness of protecting IPR assessed by the level of piracy in IP sector).

Gravity models appear as an adaptation of the law of universal gravitation[14] for socioeconomic phenomena. In 1960s gravity models were applied to analyzing international trade flows. Pioneers in these studies were: Linemann, Pöyhönen, Pullainen and Tinbergen[15]. They were conducting independent and simultaneous studies which brought similar results. However the most known is Tinbergen's study. Author himself was announced as a discoverer of gravity law (gravity equation) in international economics. Since Tinbergen's study, the gravity equation has been one of the most popular empirical equations that has been successfully used to analyze the wide spectrum of interactions in international economics. The gravity equation postulates that the amount of flow between

---

[13] The International Property Rights Index measures the significance of physical and intellectual property rights and their protection for economic well-being. It has been developed by Property Rights Alliance. The index is comprised of a total of 10 variables, which are divided into the three main components: Legal and Political Environment, Physical Property Rights. and Intellectual Property Rights, http://www.internationalpropertyrightsindex.org/ [access July 2013].

[14] In 1687, Newton proposed the law of universal gravitation which states that every point mass in the universe attracts every other point mass with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

[15] H.Linnemann, *An Econometric Study of International Trade Flows*, North-Holland Publishing Company, Amsterdam 1966; K. Pöyhönen., *Towards a General Theory of International Trade*, "Ekonomiska Samfundet Tidskrift", No. 16, s. 69–78, 1963; K. Pulliainen., *A World Trade Study. An Econometric Model of the Pattern of Commodity Flows in International Trade in 1948–1960*, "Ekonomiska Samfundet Tidskrift", No. 2, s. 78–91, 1963; J. Tinbergen, *Shaping The World Economy Suggestions for an International Economic Policy*, The Twentieth Century Fund, New York 1962

two locations increases in their economic sizes and decreases in the cost of transportation between them as measured by the distance between economic centers of locations.

Gravity model has become one of the most popular and successful analytical tools in international economics, especially due to the high explanatory power and easily available data in studies concerning international trade of goods. In consequence, there are many versions of gravity equation. The spectrum of independent variables in gravity model of trade seems to be unlimited. In our empirical studies we use gravity models to analyze export (*X*) from all countries (*i*) to all countries (*j*) in the world during period 1995–2012 – see equation (1). We include standard independent variables such as: exporter's and importer's GDPs (total and *per capita*), and geographic distance between capitals of countries. Therefore, gravity models encompass two dummy variables illustrating common official language and membership in regional trade agreement. Finally, we include in gravity models the exchange rate volatility.

$$(1)\quad \ln(1+X_{ijt}) = \propto_0 + \propto_1 lnGDP_{it} + \propto_2 lnGDP_{jt} + \propto_3 lnD_{ij} + \propto_4 ln|gdppc_{it} - gdppc_{jt}| + \propto_5 language_{it} + \propto_6 rta_{ijt} + \propto_7 volatility_{ijt} + \beta_1 lnGERD_{it} + \beta_2 lnGERD_{jt} + \gamma_1 lnstud_{it} + \gamma_2 lnstud_{jt} + \delta_1 lnIP_i + \delta_2 lnIP_j + c_{ij} + e_{ijt}$$

where:

Abbreviation	**Description**	**Data source**
X	export (current prices and exchanges rates, USD)	COMTRADE, The World Bank, http://wits.worldbank.org, [access: June 2013]
GDP	Gross Domestic Product (current prices and exchanges rates, USD)	WDI, The World Bank, http://data.worldbank.org/data-catalog/world-development-indicators, [access: June 2013]
D	geographic distance between capitals (km)	CEPII, http://cepii.fr [access: June 2013]
gdppc	Gross Domestic Product *per capita* (current prices and exchanges rates, USD)	WDI, The World Bank, http://data.worldbank.org/data-catalog/world-development-indicators, [access: June 2013]
language	dummy variable that takes value 1 if exporter and importer use common official language and 0 otherwise	CEPII, http://cepii.fr [access: June 2013]
rta	dummy variable that takes value 1 if both trading countries are members of regional trade agreement	WTO, http://rtais.wto.org, [access: June 2013]
volatility	exchange rate volatility measured as a standard deviation of first differences of natural logarithms of bilateral exchange rates (based on monthly average exchange rates in SDR)	IFS, International Monetary Fund, http://elibrary-data.imf.org/, [access: June 2013]
GERD	gross domestic expenditure on R&D (% of GDP)	UNESCO, http://stats.uis.unesco.org/ [access: July 2013]
stud	number of students (tertiary education) per 1000 inhabitants	UNCTAD, http://unctadstat.unctad.org/, [access: July 2013]

IP	protection of intellectual property rights (from 0–low to 10–strong)	IPR, http://www.internationalpropertyrightsindex.org/data, [access: July 2013]
c	individual country-pair effect	-
e	error term	-
i, j, t	subscripts for exporter, importer and year	-

Gravity models are estimated in terms of natural logarithms (*ln*). In order to include observations with zero export, we apply *ln(1+value of export).* Including in specification country-pair effect (c_{ij}) suggests application one of the typical panel data based estimators, namely fixed or random effects approach. However, the fixed effects approach is not adequate for models including time invariant variables – for example distance, which is one of the fundamental variables. On the contrary, random effects approach is available also for models with time invariant variables. Additionally, this approach needs zero correlation between the individual effects and the independent variables in the model. Unfortunately, in specification illustrated by equation (1) this assumption does not hold. Models encompass independent variables $ln|gdppc_{it}-gdppc_{jt}|$ and rta_{ij} which characterize the pair of countries. These variables are potentially correlated with individual effect, consequently approach based on random effects is also not proper. In this situation there is still one solution to be applied – Hausman-Taylor estimation method. It allows using of both time-varying and time invariant variables and some of them can be endogenous in the sense of correlation with individual effect, but remain exogenous with respect to error term[16].

Firstly, we estimate gravity model (see model (1) in table 1) explaining export of IP-intensive goods. Secondly, in order to fish out specific factors affecting IP-intensive trade, we also estimate model for export of all commodities (see model (2) in table 1) and compare the results from both models.

In both models all standard variables (GDPs, difference in GDPs *per capita* and distance) are statistically significant. Positive coefficient values concerning GDPs prove that trade is more intensive between bigger countries, whereas negative coefficient value referring to distance and difference in GDPs *per capita* shows that trade decreases with the geographic as well as economic distance.

Therefore, former colonial links and positive role of cultural similarity in international trade are confirmed by the significance of variable illustrating common official

[16] E. Czarny, K. Śledziewska, B. Witkowski, *Does monetary integration affect EU's trade?*, http://www.etsg.org/ETSG2010/ETSG2010Programme.html, 2010.

language. Regional trade agreements intensify export, thus the model confirms the trade creation effect. On the contrary, the variable concerning exchange rate volatility is not statistically significant. It does not confirm regularity that fluctuations in exchange rates diminish the trade.

Table 1. Gravity models explaining export of IP intensive goods and export of all commodities

Variable	Type of variable	**Model (1): IP intensive goods** Coefficient (standard error)	**Model (2): all commodities** Coefficient (standard error)
ln GDP_{it}	exogenous, time variant	0.7479903 *** (0.0192805)	0.7092055 *** (0.0173711)
ln GDP_{jt}	exogenous, time variant	0.6799398 *** (0.0190148)	0.6796988 *** (0.0171379)
ln D_{ij}	exogenous, time invariant	-1.350024 *** (0.0490677)	-1.299143 *** (0.0454382)
$ln\|gdppc_{it}-gdppc_{jt}\|$	endogenous, time variant	-0.0517029 *** (0.0124181)	-0.048222 *** (0.0108869)
$language_{ij}$	exogenous, time invariant	0.9827571 *** (0.1623083)	0.9659388 *** (0.1505408)
rta_{ijt}	endogenous, time variant	0.1828715 *** (0.0341963)	0.119799 *** (0.0299567)
$volatility_{ijt}$	exogenous, time variant	-0.0005053 (0.0097984)	0.0035053 (0.0086705)
$lnGERD_{it}$	exogenous, time variant	0.304527 *** (0.0289575)	0.2826772 *** (0.0257356)
$lnGERD_{jt}$	exogenous, time variant	0.0494675 *** (0.0283057)	0.070848 ** (0.0251524)
$lnstud_{it}$	exogenous, time variant	0.2032586 *** (0.0384459)	0.167396 *** (0.0342244)
$lnstud_{jt}$	exogenous, time variant	0.0610235 (0.0383958)	0.0666503* (0.0342244)
$lnIPR_{i}$	exogenous, time invariant	1.189017 *** (0.168279)	0.9019943 *** (0.1552726)
$lnIPR_{j}$	exogenous, time invariant	-0.0042566 (0.1672995)	-0.01942 (0.1545148)
Constant	-	-12.31484 *** (0.7820447)	-10.4887 *** (0.7095593)
Number of country-pairs Number of observations		6432 36479	6432 36479

***p<0.01, ** p<0.05, * p<0.1

Source: Own study based on estimations conducted in STATA

Additionally, more intensive export of IP-intensive industries is accompanied by higher gross expenditures on R&D in exporting as well as in importing country (but the coefficient concerning expenditures in exporting country is much higher than parameter referring to expenditure in importing country). Also more intensive export of all commodities goes together with bigger spending on R&D, however the coefficient is lower (0.2826772 < 0.304527 – in the case of exporting country) or the statistical significance is weaker (in the case of importing country). Consequently, gross expenditures on R&D appear to affect export of IP-intensive industries stronger than export of all commodities.

Moreover, the higher number of students in exporting country accompanies more intensive export of IP-intensive goods and also export of all commodities. But again, the coefficient is higher in model explaining export of IP-intensive goods (0.2032586 > 0.167396). Unfortunately, estimation results concerning number of students in importing country are confusing as only in model explaining export of all commodities this variable is weakly statistically significant with positive parameter.

Finally, stronger protection of intellectual property, but only in exporting country, goes together with more intensive export of all commodities as well as export of IP-intensive goods. However, the coefficient in model (2) is lower than in model (1) – 0.9019943 < 1.189017, thus IP protection seems to be a factor which affects export of IP intensive-goods stronger than total export.

5. Conclusions

IP-intensive goods constitute large share of world trade. Emerging economies increase their share in world exports and imports of these goods faster than world average, which may be one more indicator of their success in economic development. Gravity models confirm that more intensive export of IP-intensive goods is accompanied by higher expenditure on R&D, higher number of students and stronger protection of intellectual property rights in exporting country. And this accompaniment is tighter for export of IP-intensive goods than for export of all commodities.

References

1. CEPII, http://cepii.fr [access: June 2013].
2. Chin J. C., Grossman G. M., *Intellectual Property Rights and North-South Trade*, NBER Working Paper 2769, National Bureau of Economic Research, Cambridge, Mass, 1988.
3. COMTRADE, The World Bank, http://wits.worldbank.org, [access: June 2013]
4. Czarny E., Śledziewska K., Witkowski B., *Does monetary integration affect EU's trade?*,http://www.etsg.org/ETSG2010/ETSG2010Programme.html, [access: 15.11. 2011]
5. Deardorff A. V., *Welfare Effects of Global Patent Protection*, "Economica" 59:35–51, 1992.
6. Ferrantino M. J., *The Effect of Intellectual Property Rights on International Trade and Investment*, "Weltwirtschaftliches Archiv" 129(2):300–31, 1993.
7. Fink C., Primo Braga C. A., *How Stronger Protection of Intellectual Property Rights Affects International Trade Flows* [in:] C. Fink, K.E. Maskus (ed.), *Intellectual Property and Development. Lessons from Recent Economic Research*, The World Bank, New York 2005.
8. *Guide on Surveying the Economic Contribution of the Copyright-based Industries*, World Intellectual Property Organization 2003.
9. Helpman E., *Innovation, Imitation, and Intellectual Property Rights*, "Econometrica" 61(6):1247–80, 1993.
10. IFS, International Monetary Fund, http://elibrary-data.imf.org/, [access: June 2013].

11. *Intellectual Property and the U.S. Economy: Industries in Focus*, U.S. Department of Commerce, March 2012, http://www.uspto.gov/news/publications/IP_Report_March_2012.pdf [Access: June 2013].
12. IPR, http://www.internationalpropertyrightsindex.org/data, [access: July 2013].
13. Linnemann H., *An Econometric Study of International Trade Flows*, North-Holland Publishing Company, Amsterdam 1966.
14. Maskus K. E., Penubarti M., *How Trade Related Are Intellectual Property Rights?*, "Journal of International Economics" 39:227–48, 1995.
15. Pham N., *The Impact of Innovation and the Role of Intellectual Property Rights on U.S. Productivity*, Competitiveness, Jobs, Wages, and Exports, NDP Consulting. April 2010, http://ndpgov.com/docs/NDP_IP_Jobs_Study_Hi_Res.pdf [Access: June 2013].
16. Pöyhönen K., *Towards a General Theory of International Trade*, "Ekonomiska Samfundet Tidskrift", No. 16, s. 69–78, 1963
17. Primo Braga C. A., Fink C., *The Economic Justification for the Grant of Intellectual Property Rights: Patterns of Convergence and Conflict*, [in:] . F. M. Abbott, D. J. Gerber (eds.), *Public Policy and Global Technological Integration*, Dordrecht, Netherlands: Kluwer Academic Publishers, 1997.
18. Pulliainen K., *A World Trade Study. An Econometric Model of the Pattern of Commodity Flows in International Trade in 1948–1960*, "Ekonomiska Samfundet Tidskrift", No. 2, s. 78–91, 1963
19. Tinbergen J., *Shaping The World Economy Suggestions for an International Economic Policy*, The Twentieth Century Fund, New York 1962.
20. UNCTAD, http://unctadstat.unctad.org/, [access: July 2013].
21. UNESCO, http://stats.uis.unesco.org/ [access: July 2013].
22. WDI, The World Bank, http://data.worldbank.org/data-catalog/world-development-indicators, [access: June/July 2013].