DO INTELLECTUAL PROPERTY RIGHTS MATTER FOR THE INTENSIVE AND EXTENSIVE MARGINS OF TRADE: EMPIRICAL INVESTIGATION

by

Ivus Maryna

A thesis submitted in partial fulfillment of
the requirements for the degree of

MA in Economics

Kyiv School of Economics

2010

Thesis Supervisor: _____ Professor Shepotylo Oleksandr

Approved by _____
Head of the KSE Defense Committee, Professor Roy Gardner

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Date _____

Kyiv School of Economics

Abstract

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Economic theory does not have unambiguous prediction about the effects of strengthening intellectual property rights (IPRs) on international trade. In this paper, the empirical evidence is provide on the trade impact of IPRs. The gravity model is adopted, where the extensive margin and the intensive margin of U.S. exports are the outcome variables of interest. The results suggest that the strength of IPRs in an importing country matters for the margins of U.S. exports.

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ACKNOWLEDGMENTS

The author wishes to express thankfulness to her advisor Oleksandr Shepotylo for his supervision, invaluable comments and useful suggestions during the whole year. The invaluable help from Tom Coupe is strongly appreciated. Special words of thanks are devoted to family and friends for their support and encouragement.

GLOSSARY

Intellectual property (**IP**)[1]. The direct product of human creative activity, such as new inventions, design or work of art, which has market value.

Intellectual property rights (IPR). The ownership of the rights to intellectual property given the persons over the creative activity of there minds.

Intensive margin (IM). An expansion of exports on the intensive margin is driven by an increase in the value of goods that have been exported before.

Extensive margin (EM). An expansion of exports on the extensive margin is driven by an increase in the range (variety) of good exported.

[1] Definitions of IP was taken from Dnes (1996)

Chapter 1

INTRODUCTION

The 1994 Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) is an international agreement administered by the World Trade Organization (WTO) that sets down minimum standards of intellectual property (IP) regulation. TRIPS covers several categories of IP rights such as patents, trademarks, copyright (which include the rights of performers, producers of sound recordings and broadcasting organizations), geographical indications, industrial designs; integrated circuit layout-designs, and plant breeders rights. TRIPS requirements are mandatory for all members of the WTO.

Protection of intellectual property rights (IPRs) has become an issue of major importance since 1994. The Agreement on TRIPS was pushed forward by developed countries, who argued that weak IPRs in developing countries prevented innovators from earning a fair return on their inventions, and reduced exports of technologically advanced products to the less developed world. Therefore, IP protection should be strengthened. The Agreement was, however, opposed by developing countries. They argued that stronger IPRs in the developing world would stimulate little, if any, innovation. It will, instead, increase the monopoly power of foreign multinationals and reduce developing countries' access to innovative products and advanced technologies. Central to this dispute is the question of how imports of innovative products into developing countries are affected by the strengthening of their IPRs. Do more product varieties become traded? Do quantities of previously traded products rise or fall? To answer these questions, it is important to examine the relationship between the strength of IP rights and different margins of trade.

The value of imports into a country can change on two margins. It may expand on *the extensive margin*, which occurs when the range of traded goods widens and new varieties of goods become traded. It may also expand on *the intensive margin*, which occurs when goods that have been traded previously are now traded in larger quantities.

The existing literature in the area did not explore whether stronger IPRs affect trade on the intensive or extensive margin. This paper is intended to fill up this gap. It will examine how strengthening IPRs affects imports: does the range of imported goods expand? and does the quantity of existing traded goods rise? If, say, the country improves its patent protection, will it start importing new varieties of manufacturing goods, which were not available on its market before, or will it face an increase in the price of its imports with little, if any, change in varieties? It is crucial to know the answer to this question since for any developing country, the inflows high-tech products are needed for its growth and development.

What about expected results? The preliminary conjecture about the strengthening of IPRs in countries leads to expansion of variety and increasing quantity of exported goods.

To analyze the impact of IPR on extensive and intensive margins of trade the modified version of the gravity model of international trade is applied. The gravity equation is estimated using extensive and intensive margins of trade as the dependent variables. The range of independent includes trading partners' characteristics, such as distance between them, their incomes, population, common border, common language, level of IPR, etc.

The *data* used for the analysis are on value and quantity of U.S. exports into each of its trading partners. These data are available at

http://www.internationaldata.org. The data on country characteristics are taken from Penn World Table 6.1. The data on distance between countries come from the CIA's World Factbook. The stringency of IPRs in an importing country is measured by Ginarte and Park (GP) (2005) index.

The paper is organized as follows. Section 2 reviews the existing literature on trade-related IPR protection, as well as the literature on the importance of breaking down trade into intensive and extensive margins. Section 3 overviews the methodology, discusses the gravity model. Section 4 describes the data. Section 5 presents the results. Section 6 concludes with a discussion of policy implications and suggests directions for future work.

Chapter 2

LITERATURE REVIEW

The debate over the strength of IPRs in developing countries resulted in a great deal of theoretical and empirical work. Most of the empirical studies relate the strength of IPRs in an importing country to the value of trade (imports or exports) in a gravity model framework (see for example, Maskus and Penubarti, 1995; Smith, 1999; Rafiquzzaman, 2002; Feenstra and Spencer, 2006).

Maskus and Penubarti (1995) provide empirical evidence on whether differing international patent systems affect trade flows using data on 28 manufacturing sectors across OECD countries for the year 1984. The results suggest that the level of development of an importing country is an important determinant of the relationship between IP protection and trade flows. More stringent patent procedures in larger developing countries increase their import. For small, low-income developing countries, this positive effect is of lower magnitude. The study by Ferrantino (1993) shows positive empirical evidence of the effect of membership in intellectual property treaties on the context of U.S. exports. Estimation indicates relationship between patent rights and trade of U.S. Lately Ferrantino's research was updated by Smith (1999). She applies data on state-to-country U.S. manufacturing exports in 1992 and shows that threat of imitation the importing country possesses is a crucial factor which helps to explain the sensitivity of U.S. exports to national differences in the levels of IP protection. Stronger IP protection induces U.S. innovating firms to export relatively more to countries that pose a strong imitative threat than to countries with low imitative abilities. In more recent research Smith (2001) analyzes the effect of foreign patent rights on US exports, affiliate sales, and licensing. The results suggest that

strong foreign patent rights increase US combine sales and licensing, especially across countries with strong imitative abilities. Shevtsova (2004) shows that strengthening of IRP protection in transition countries increases international trade on the aggregate as well as industry level. Falvey, Foster and Greenaway (2009) adopted the gravity model setting to examine the trade impact of IPRs for the aggregate of manufacturing industries as well as the individual industry level. It was concluded that the trade impact of IPR protection critically depends on a country's level of development, its imitative ability, and the size of its market.

All of the mentioned above papers suggest that the strength of IPRs matters for trade. None of them, however, have explored whether stronger IPRs affect the volume of trade intensively or extensively. At the same time, a number of empirical papers proved the importance of accounting for the extensive and intensive margin of trade in analyzing a wide range of trade-related factors.

Broda and Weinstein (2004), for example, show that the number of product varieties imported into the U.S. has increased by a factor of four, which had a significant effect on the range of goods traded in the US economy. The impact of new imported varieties on the global economy is also evaluated in Broda, Greenfield and Weinstein (2006), where it is found that new varieties of imported products explain about 15% of country's productivity growth. Another valuable contribution to empirical literature in this area is by Hummels and Klenow (2005), who examined whether larger countries export larger quantities of goods (intensive margin of trade) or wider range of goods (extensive margin of trade). It was found that the extensive margin of trade accounts for about 60% of the difference in exports between larger and smaller countries. Not least important is the contribution made by Feenstra and Spencer (2006), who explored the relationship between the proximity of buyers and sellers. It was found that a country which is less distant from a low-wage country gains from lower trade

costs and experiences an increased variety of imported goods. Furthermore, Debaere and Mostashari (2002) found that a reduction in tariffs brings about new good being traded, which means trade expands on the extensive margin. This explains why world trade has been growing strongly despite only moderate reductions in tariffs. Last, Felbermayr and Kohler (2009) found that while the membership in WTO increases the probability of trade between countries, it has no strong or systematic effect on the extensive margin of trade.

Despite the wide range of works concerning IPRs, it can be concluded that some aspects of trade-related IPR protection are left unexamined. In particular, no empirical evidence on the importance of IPRs for the extensive or intensive margins of trade has been provided yet.

Chapter 3

METHODOLOGY

Empirical analysis of extensive and intensive margins of trade requires a suitable theoretical framework of world trade. To analyze the impact of various trade policies on bilateral trade flows, the gravity model is widely used. This model is a "workhorse" tool for analyzing a broad range of issues. The model is commonly used to estimate the trade impact of various policies, such as trade agreements, currency unions, trade barriers, exchange rates. "Natural" causes of trade can be controlled for by including variables on common border, currency, language, etc. into the gravity equation.

Following the literature to analyze the impact of IPR on trade margins, the gravity model of international trade is applied. The specification of the model can vary, in our case the gravity equation is estimated using extensive and intensive margins of trade as dependent variables. The range of independent variables includes countries' characteristics that can restrict or expand bilateral trade, such as distance between trading partners, incomes, population, common border, common language, the strength of IPR, etc. All variables, except IPR index and dummy variables are in natural logs, which can be interpreted as elasticities. The resulting expression is:

$$\ln(EM_{jt}) = \beta_0 + \beta_1 \ln(Q_{jt}) + \beta_2 \ln(N_{jt}) + \beta_3 \ln(D_j) + \beta_4 \ln(IPR_{jt}) + \beta_5 L_j + \beta_6 E_j + e_{jt}, \quad (1)$$

$$\ln(IM_{jt}) = \beta_0 + \beta_1 \ln(Q_{jt}) + \beta_2 \ln(N_{jt}) + \beta_3 \ln(D_j) + \beta_4 \ln(IPR_{jt}) + \beta_5 L_j + \beta_6 E_j + e_{jt}, \quad (2)$$

where *j* denotes importer country; EM_{jt}, IM_{jt} stand for the extensive and intensive margins of exports into a destination country j; Q_{jt} stands for GDP of country j; N_{jt} population of importer; D_{jt} distance to the U.S.; E_{jt} is the dummy variable which equals 1 if the U.S. and country *j* share a common border and 0 otherwise; L_{jt} is the dummy variable which equals 1 if the U.S. and country *j* share a common language and 0 otherwise; IPR_{jt} is the level of patent protection in country j, and e_{jkt} is the log normally distributed error term.

According to the theory behind the gravity model, distance between trading countries should have a negative effect on trade since it increases the costs of transportation. The GDP of an importing country is expected to have a positive effect on its imports, since higher GDP implies higher demand for imports. The direction of impact of population variable is ambiguous. On one hand, larger population implies larger size of the country and hence, higher demands for imports. On the other hand, larger population implies larger domestic production and hence, higher level of self-sufficiency and lower demand for imports. Common language facilitates negotiations with trade partners and hence, reduces barrier to bilateral trade.

To measure the trade margins, we follows the approach described in Feenstra and Spencer (2006). The extensive margin reflects changes in the categories of goods imported (varieties), and the intensive margin reflects changes in the value of goods originally traded.

Let X_{ijt} represent the value of U.S. exports of good *i* into a destination country *j* in year *t*. Then $X_{it} = \sum_j X_{ijt}$ represents the total value of U.S. exports of good *i* to the world in year *t*.

$$\mathrm{EM}_{\mathrm{jt}} = \frac{\sum_{i \in Ijt} X_{it}}{\sum_{i \in It} X_{it}} \tag{3}$$

where I_{jt} is the set of goods exported to country *j* in year *t* and $\mathrm{I}_{\mathrm{t}} = \bigcup_j I_{jt}$ is the entire set of goods exported from U.S. in year *t* (3).

The *EM* of exports into a country *j* equals the total value of U.S. exports summed over the set of goods exported to *j* relative to the total value of U.S. exports summed over the entire set of goods, thus the difference in numerator and denominator is only in the set of goods exported from U.S.

$$\mathrm{IM}_{\mathrm{jt}} = \frac{\sum_{i \in Ijt} X_{ijt}}{\sum_{i \in Ijt} X_{it}} \tag{4}$$

The *IM* of exports into a country *j* equals the value of U.S. exports into a country *j* summed over the set of goods exported to *j* relative to the total value of U.S. exports summed over the same set of goods (4). So IM measures the amount exported by U.S. to each destination country, relative to the country total, in consideration of equal set of goods.

$$\mathrm{EM}_{\mathrm{jt}} IM_{jt} = \frac{\sum_{i \in Ijt} X_{ijt}}{\sum_{i \in It} X_{it}} \tag{5}$$

The product of the extensive and the intensive margins equals the ratio of the total value of U.S. exports into a country *j* to the total value of U.S. exports into the world (5). So the EM and IM are a decomposition of the export from U.S. to each country into their variety and volume, as it was mentioned above.

The determination of EM and IM is described in Table A1. The U.S. exports various goods (i=1…5) to different countries (j=1…5). For example, U.S. exports into country #1 consists of goods in the 1st, 3rd, 4th, and 5th categories…; U.S. exports into country #2 consists of goods in the 1st, 2nd, and 4th categories only. As such, across the two countries, category 2 products are exported into country 2 only, but category 3 and 4 products are exported into country 1. In this manner, the categories (or varieties) of goods differ across importing countries. This difference will be reflected in the extensive margin of trade.

The *EM* of U.S. exports into a country j is defined as the total value of U.S. exports summed over the set of goods exported to country j (categories 1, 3, 4, 5 when j=1) relative to the total value of U.S. exports summed over the entire set of goods (categories 1-5).

$$EM_j = \frac{\sum_j X_{j1} + \sum_j X_{j3} + \sum_j X_{j4} + \sum_j X_{j5}}{\sum_j \sum_i X_{ji}} \tag{6}$$

Changes in the value of goods originally traded will be reflected in the intensive margin. The *IM* of U.S. exports into a country *j* equals the value of U.S. exports into a country *j* summed over the set of goods exported to j (goods 1,3,4,5 when j=1) relative to the total value of U.S. exports summed over the same set of goods (goods 1, 3, 4, 5).

$$IM_j = \frac{\sum_i X_{1i}}{\sum_j X_{j1} + \sum_j X_{j3} + \sum_j X_{j4} + \sum_j X_{j5}} \tag{7}$$

Multiplication of *EMj* and *IMj* gives the ratio of the total value of U.S. exports into a country j to the total value of U.S. exports into the whole world.

$$IM_j EM_j = \frac{\sum_i X_{1i}}{\sum_j \sum_i X_{ij}} \tag{8}$$

Chapter 4

DATA DISCRIPTION

Most of the studies mentioned above estimated the trade impact of IPRs using cross sectional data. In this work, panel data are employed. The advantage of adopting a panel data setting is that it allows an effective control of any country specific effects that do not vary with time. In addition, long-term or cumulative effects of IPRs on trade can be analyzed, which cannot be done in a cross-sectional study.

The trade data for the analysis are on the value and quantity of U.S. exports to each of 101 countries over the 1990-2005 period. The data are highly detailed and organized by 10-digit Harmonized System codes. These data are available at http://www.internationaldata.org/.

The data on country characteristics, such as income, population, openness, etc. are taken from Penn World Table 6.3. The data on distance between countries come from the CIA's World Factbook.

The stringency of IPRs in an importing country is measured by Ginarte and Park (GP) (2005) index. The index covers 5-year time periods from 1960 to 2005. It is based on laws on books and measures five aspects of patent laws: the extent of patent coverage, membership in international patent agreements, provisions for loss of protection, enforcement mechanisms, and the duration of protection.

The descriptive statistics of the data over the period of 1990-2005 is provided in Table 1. Further, the data for the individual years of 1995 and 2005 are summarized in *Table 2*.

Table 1[2] Summary statistics over the 1990-2005 period

VARIABLE	OBSERV.	MEAN	ST. DEVIATION	MIN	MAX
Intensive margin	1611	0.010	0.028	0.00001	0.251
Extensive margin		0.543	0.295	0.0002	0.986
IPR		2.628	1.062	0	4.67
Population, mil		45.146	155.18	0.254	1304.5
GDP, mil $		198.372	544.225	0.132	5283.062
Distance, km		5848.729	2215.801	1076.356	10470.38

Table 2 Summary Statistics for the 1990 and 2005 years

THE YEAR 1990	MEAN	MAX	MIN
Intensive margin	0.010	0.233	0.00003
Extensive margin	0.517	0.976	0.060
GDP, mil $	142.781	3039.692	0.3844
Population, mil $	40.463	1135.185	0.255
IPR	2.036	4.34	0
Distance, km	5848.729	10470.38	1076.356
THE YEAR 2005	**Mean**	**Max**	**Min**
Intensive margin	0.010	0.246	0.0001
Extensive margin	0.551	0.983	0.034
GDP, mil $	288.815	4505.915	0.548
Population, mil $	49.598	1304.5	0.295
IPR	3.391	4.67	1.6
Distance, km	5848.729	10470.38	1076.356

[2] *Notes:* Number of importing countries (101) multiplied by 16 years = number of observations (1611). For definitions of each margin, see equations (1), and (2).

The mean value of EM tends to increase with time, which means that the variety of goods imported from the U.S. has been expanding. The mean value of IM is almost unchanged. This suggests changes in exports are brought by changes in the variety of goods rather than changes in the value of existing goods. The values of IPR index increases with time; its standard deviation, however, declines. This suggests that countries converge to higher standards of IPR.

In Figures B1 and B2 the extensive and intensive margins are plotted against the level of GDP for each of 101 countries in 2005. The variables are measured in logs. The results indicate that larger economies import from the U.S. higher value and larger variety of goods. I now proceed with examining how the margins of trade vary across countries according to the strength of their IPR.

Chapter 5

EMPIRICAL RESULTS

This section is aimed to estimate gravity equation of bilateral trade flows between U.S. and the set of 101 countries all over the world during 1990-2005 years. For each importing country the intensive margin and the extensive margin were constructed according to (3) and (4). Then the natural log of each margin was regressed on the importer's log of GDP, log of population, log of distance, IPR, common language and common border dummy variables.

Maskus and Penubarti (1995) mentioned that trade volumes may determine the stringency of IPR, not vice versa. In this case, trade volumes and the stringency of IPR are endogenously determined. To address this concern, we follows the approach outlined in Co (2004). We regress future values of export data on past values of IPRs variable. For example, the value of the IPR index in 1990 is used to explain exports in each year from 1991 to 1994; and the value of the IPR index in 1995 is used to explain exports in each year from 1996 to 2000. Tables 3 presents the results of the OLS regression for 101 countries imported from U.S. Each regression has 1611 observations, one for each exporting country in each of 16 years. The results for the core variables of the gravity equation are as anticipated. The coefficient on distance is negative, which means that trade falls with distance The coefficient on GDP is positive and significant, while the coefficient on population of the importing countries is negative. Common language, as was mentioned early, increases exports on both margins. The coefficient on the common border dummy is negative in the EM equation but positive in the IM equation. This suggests that neighbor countries trade smaller

variety of goods. Most of the coefficients in the table are highly statistically significant (p-values below 1%),. The independent variables explain the variation in the exports margins quite well, as evidenced by high confidents of determination: R-squared is 0.84 for EM and 0.8 for IM.

Of the primary interest is in the effect of strengthening of IPR on the margins. We hypothesized that strengthening of IPR expands both the variety of goods in the U.S. export and the value of already exported goods The results presented in columns (1) and (2) of Table 3 suggest that stronger IPRs reduce exports on the EM but increases exports in the IM. A 1 point increase in the IPR index decreases the EM by 1.6% and increases the IM by 0.2%.The negative impact on the variety of goods in U.S. exports is unanticipated. It suggests that stronger IPRs in destination countries do not encourage U.S. exporters to expand the range of goods exported. This would occur if stronger IPR did not increase the profitability of exporting.

Table 3: OLS estimation of Extensive and Intensive margins

Variables	lnEM	lnIM
IPR	-0.016 (0.003)**	0.002 (0.000)**
ln of GDP	0.092 (0.002)**	0.004 (0.000)**
ln of POP	-0.022 (0.002)**	-0.000 (0.000)
Ln of Distance	-0.175 (0.005)**	-0.000 (0.001)
Common Language Dummy	0.090 (0.005)**	0.004 (0.001)**
Land Border Dummy	-0.248 (0.017)**	0.139 (0.002)**
Constant	0.575 (0.045)**	-0.060 (0.007)**
Observations	1611	1611
R-squared	0.84	0.80

In order to account for year specific effects, to estimate strengthening of IPR across each year let's introduce another specification – dummy variables for each year. The results, shown in Table C1, remain similar. The magnitude of the coefficients changes slightly, but the direction of the impacts is unchanged. The previous results relied on OLS method of estimation. In addition, we consider random or fixed effects estimation techniques. Several studies (Rafiguzzman (2002), Falvey, Foster and Greenaway (2009), for example) argued in favour of the fixed effects technique for estimating the impact of IPRs in a gravity model setting. Co (2004), in contrast, argued in favour of random effects model. In the fixed effects model, time-invariant variables (such as distance, common border, and language) are removed. On this account, random effects model is preferred. Most importantly, however, random effects estimator is biased and inconsistent if regressors are correlated with unobserved country- or time- effects. In this case, the fixed effects estimator is unbiased and consistent. We use the Hausman test to decide whether the random effects or fixed effects model should be adopted. Under the null hypothesis, the correlation of the errors with the regressors is zero and hence, both estimators and consistent

First we compared OLS and random effects using Breusch-Pagan Lagrange multiplier (LM) test. The results of the test indicate that random effects estimation is much preferred to OLS (as Prpb>chi2 =0.0000). Second, we ran the Hausman test. For the EM equation, the null hypothesis that random effects model provides a consistent estimates is rejected. (Prob>chi2 = 0.0000). For the IM equation, however, the null hypothesis cannot be rejected (Prob>chi2 =0.7402)

Table D1 presents significant estimates of these two effects for the 1990-2005 years. The coefficients show that for an average importing country, strengthening

IPR protection has significant positive impact on both margins. Augmentation of IPR by 1 increases the EM by 1% and the IM by 0.1%.

From this results we can conclude, that strengthening of IPR primarily promotes trade on the extensive margin. The impact of the IM is smaller. The GDP of the importing country, as was expected, has a positive impact on both margins, which confirms that a larger economy imports more on both margins. Larger population has a negative effect on the EM but a positive effect on the IM.

The gravity equation is also estimated at the industry level. We consider 20 manufacturing industries as defined by the Standard Industrial Classification system. The results are presented in Table E1. The coefficients on GDP, population, distance, common border and common language are similar to those reported before. The coefficient of IPR varies with industries. For example, the US exports in Transportation Equipment industry decreases on the IM as well as on the EM by about 0.1% with a unit increase in the IPR index.

Chapter 6

CONCLUSION

The theoretical ambiguity concerning the effects of strengthening IPRs on exports has been much emphasized in the literature and has led to several attempts at its empirical resolution. Most of the empirical studies relate the strength of IPRs in an importing country to the value of trade (imports or exports). No empirical evidence on the importance of IPRs for the extensive or intensive margins of trade has been provided yet.

The gravity equation was used to examine the impact of IPR protection on the extensive and the intensive margins of U.S. exports. The data included 101 countries for each year from 1990 till 2005. The model was estimated at the aggregate as well as at the individual industry level.

The results showed that strengthening IPR protection has a significant positive impact on both margins. Augmentation of IPR by 1 increases the EM by 1% and the IM by 0.1%. As such, strengthening IPR affects the extensive margin more.

The results of estimation at the industry level suggested important differences in the impact of IPRs across industries. For some industries, the impact of stronger IPRs on both margins is negative. The IM and the EM fall by about 0.1% with a unit increase in the IPR index.

The paper demonstrated when reforming IPR in country, it is important to consider a given industry in isolation, since the trade impact of IPRs is industry specific and does not generalize to all industries.

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APPENDIX A

Table A1: Determination of EM and IM

	GOODS (i)						
COUNTRIES (j)	#	1	2	3	4	5	
	1	***X11***	*0*	***X13***	***X14***	***X15***	$\sum_i X_{1i}$
	2	*X21*	*X22*	*0*	*X24*	*0*	$\sum_i X_{2i}$
	3	*0*	*X32*	*X33*	*X34*	*0*	$\sum_i X_{3i}$
	4	*X41*	*X42*	*X43*	*0*	*X45*	$\sum_i X_{4i}$
	5	*X51*	*X52*	*0*	*X54*	*X55*	$\sum_i X_{5i}$
		$\sum_j X_{j1}$	$\sum_j X_{j2}$	$\sum_j X_{j3}$	$\sum_j X_{j4}$	$\sum_j X_{j5}$	$\sum_j \sum_i X_{ji}$

APPENDIX B

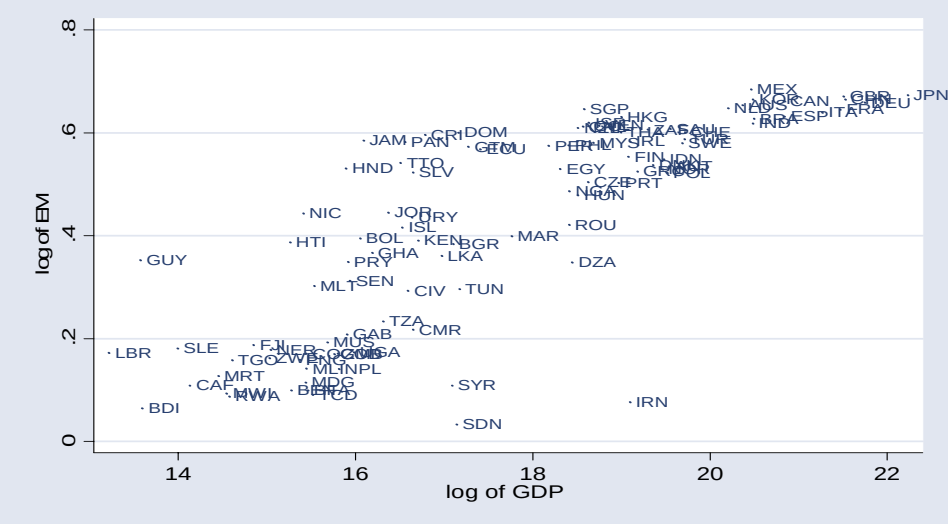

Figure B1: **Extensive margin against GDP, 2005 year**

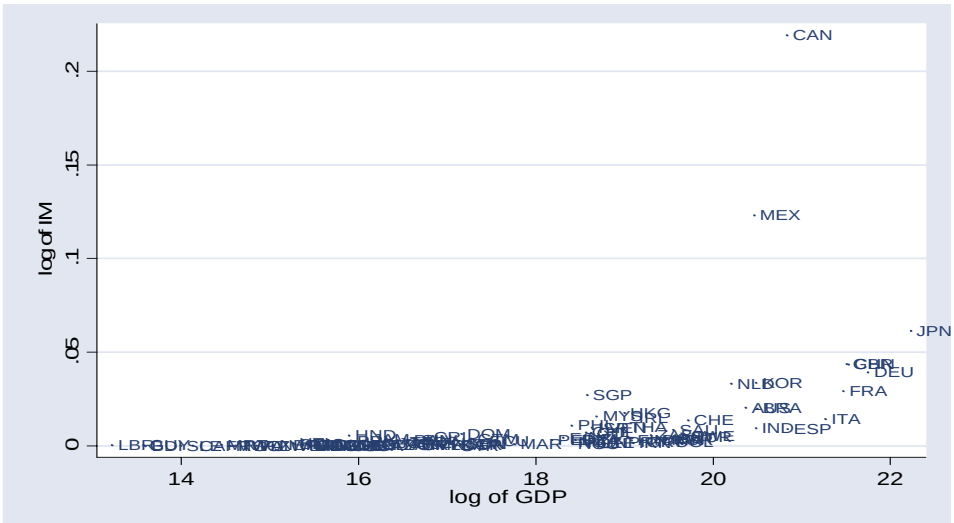

Figure B2: **Intensive margin against GDP, 2005 year**

APPENDIX C

Table C1: OLS estimation of Extensive and Intensive margins using dummies for each year

Variables	ln EM	ln IM
IPR	-0.014 (0.003)**	0.003 (0.000)**
ln of GDP	0.091 (0.002)**	0.003 (0.000)**
ln of Population	-0.022 (0.002)**	0.000 (0.000)
ln of Distance	-0.175 (0.005)**	-0.000 (0.001)
Common Language	0.089 (0.005)**	0.004 (0.001)**
Common Border	-0.249 (0.017)**	0.139 (0.002)**
1990	0.024 (0.012)*	0.007 (0.002)**
1991	0.024 (0.012)*	0.007 (0.002)**
1992	0.025 (0.012)*	0.007 (0.002)**
1993	0.031 (0.012)**	0.006 (0.002)**
1994	0.037 (0.012)**	0.006 (0.002)**
1995	0.041 (0.011)**	0.004 (0.002)*
1996	0.027 (0.011)*	0.004 (0.002)*

Table C1: OLS estimation of Extensive and Intensive margins using dummies for each year (cont.)

Variables	ln EM	ln IM
	(0.011)*	(0.002)*
1998	0.030	0.004
	(0.011)**	(0.002)*
1999	0.029	0.004
	(0.011)*	(0.002)*
2000	0.036	0.002
	(0.011)**	(0.002)
2001	0.035	0.002
	(0.011)**	(0.002)
2002	0.024	0.002
	(0.011)*	(0.002)
2003	0.012	0.002
	(0.011)	(0.002)
2004	0.002	0.001
	(0.011)	(0.002)
Constant	0.550	-0.063
	(0.045)**	(0.007)**
Observations	1611	1611
R-squared	0.84	0.80

APPENDIX D

Table D1: Fixed and Random effect for Intensive and Extensive margins

Variables	RE EM	FE EM	RE IM	FE IM
IPR	0.010 (4.27)**	0.010 (0.002)**	0.001 (0.000)**	0.001 (0.000)**
ln of GDP	0.056 (15.18)**	0.033 (0.005)**	0.003 (0.000)**	0.003 (0.000)**
ln of Population	0.001 (0.25)	-0.055 (0.016)**	0.002 (0.001)*	0.006 (0.002)**
ln of Distance	-0.186 (11.03)**		-0.002 (0.001)	
Common Language	0.082 (5.62)**		0.005 (0.002)*	
Common Border	-0.208 (5.44)**		0.137 (0.041)**	
1990	0.036 (6.51)**	0.003 (0.007)	0.004 (0.001)**	0.005 (0.001)**
1991	0.033 (6.33)**	0.003 (0.005)	0.004 (0.001)**	0.004 (0.001)**
1992	0.035 (6.03)**	0.006 (0.005)	0.004 (0.001)**	0.004 (0.001)**
1993	0.043 (7.47)**	0.015 (0.005)**	0.004 (0.001)**	0.004 (0.001)**
1994	0.049 (8.94)**	0.023 (0.005)**	0.004 (0.001)**	0.004 (0.001)**
1995	0.044 (10.26)**	0.022 (0.004)**	0.003 (0.001)**	0.003 (0.001)**
1996	0.033 (7.68)**	0.013 (0.004)**	0.002 (0.001)**	0.002 (0.001)**
1997	0.035 (8.03)**	0.017 (0.004)**	0.002 (0.000)**	0.002 (0.001)**
1998	0.035 (7.99)**	0.018 (0.003)**	0.002 (0.000)**	0.002 (0.001)**
1999	0.033 (7.62)**	0.017 (0.003)**	0.002 (0.000)**	0.002 (0.000)**
2000	0.030 (7.40)**	0.015 (0.003)**	0.002 (0.000)**	0.002 (0.001)**

Table D1: Fixed and Random effect for Intensive and Extensive margins (cont.)

Variables	FE EM	RE IM	FE IM	RE EM
2001	0.028 (6.90)**	0.015 (0.003)**	0.002 (0.000)**	0.001 (0.000)**
2002	0.019 (4.29)**	0.008 (0.004)*	0.001 (0.000)**	0.001 (0.000)**
2003	0.012 (2.81)**	0.003 (0.003)	0.001 (0.000)**	0.001 (0.000)*
2004	0.005 (1.40)		0.001 (0.000)	
Constant	0.966 (6.23)**	0.324 (0.168)	-0.049 (0.015)**	-0.096 (0.019)**
Observations	1611	1611	1611	1611
Number of countries	101	101	101	101
R-squared		0.18		0.06

APPENDIX E

Table E1: Fixed and Random effects for IM and EM across industries

Variables	Food,		Tobacco Products		Textile		Apparel		Lumber and Wood	
	EM	IM	EM	IM	EM	IM	EM	IM	EM	IM
IPR	0.011	0.000	-0.000	0.000	-0.000	0.000	0.001	0.000	0.001	0.000
	(0.002)**	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)*	(0.000)*	(0.001)	(0.000)
ln of GDP	0.012	0.001	-0.000	0.000	0.002	0.000	0.001	-0.000	0.003	0.000
	(0.003)**	(0.000)**	(0.001)	(0.000)*	(0.001)**	(0.000)**	(0.000)*	(0.000)	(0.002)	(0.000)
ln of Population	-0.027	-0.000	-0.001	-0.000	-0.007	-0.000	-0.010	0.000	0.035	0.000
	(0.008)**	(0.000)	(0.007)	(0.000)	(0.003)*	(0.000)	(0.003)**	(0.000)	(0.007)**	(0.000)
ln of Distance		0.000		0.000		-0.000		-0.000		0.000
		(0.000)		(0.000)		(0.000)**		(0.000)*		(0.000)
Common language		0.000		-0.000		0.000		-0.000		0.000
		(0.001)		(0.000)		(0.000)		(0.000)		(0.000)
Common border		0.023		-0.000		0.003		0.007		0.004
		(0.013)		(0.001)		(0.001)**		(0.002)**		(0.003)
Constant	0.095	-0.017	0.020	-0.006	0.023	-0.000	0.083	0.004	-0.374	-0.007
	(0.087)	(0.005)**	(0.064)	(0.003)*	(0.023)	(0.001)	(0.021)**	(0.002)	(0.068)**	(0.006)
Observations	1150	1150	808	808	624	624	265	265	594	594
R-squared	0.49		0.85		0.69		0.35		0.34	

Table E1: Fixed and Random effects for IM and EM across industries (cont)

Variables	Paper and Allied Products		Printing, Publishing and Allied Industrie		Chemicals and Allied Products		Petroleum Refining and Related Industries		Rubber and Miscellaneous Plastic Products	
	EM	IM	EM	IM	EM	IM	EM	IM	EM	IM
IPR	0.000	0.000	-0.000	-0.000	0.029	0.000	0.004	0.000	0.000	0.000
	(0.001)	(0.000)**	(0.000)	(0.000)	(0.004)**	(0.000)	(0.001)**	(0.000)**	(0.001)	(0.000)**
ln of GDP	-0.006	0.000	-0.001	0.000	-0.006	0.002	-0.003	0.000	-0.001	0.000
	(0.002)**	(0.000)**	(0.001)**	(0.000)*	(0.007)	(0.000)**	(0.002)	(0.000)	(0.001)	(0.000)**
ln of Population	0.038	0.000	0.011	-0.000	-0.226	0.000	-0.010	0.000	0.007	-0.000
	(0.009)**	(0.000)	(0.004)**	(0.000)	(0.019)**	(0.000)	(0.006)	(0.000)*	(0.005)	(0.000)
ln of Distance		-0.000		0.000		-0.000		-0.001		-0.000
		(0.000)**		(0.000)		(0.001)		(0.000)**		(0.000)**
Common language		0.000		0.001		0.002		0.000		0.000
		(0.000)		(0.000)		(0.001)		(0.000)		(0.000)*
Common border		0.004		0.006		0.047		0.009		0.012
		(0.001)**		(0.003)		(0.025)		(0.003)**		(0.002)**
Constant	-0.267	-0.004	-0.071	0.000	2.419	-0.031	0.166	0.002	-0.028	0.000
	(0.084)**	(0.001)**	(0.032)*	(0.000)	(0.217)**	(0.007)**	(0.061)**	(0.001)*	(0.041)	(0.000)
Observations	777	777	272	272	1153	1153	1016	1016	797	797
R-squared	0.84		0.21		0.64		0.39		0.81	

Table E1: Fixed and Random effects for IM and EM across industries (cont)

Variables	Stone, Glass, and Concrete Products		Primary Metal Industries		Fabricated Metal Products		Machinery and Computer Equipment		Electrical Equipment & Components	
	EM	IM	EM	IM	EM	IM	EM	IM	EM	IM
IPR	-0.000 (0.000)**	0.000 (0.000)	-0.001 (0.000)	0.000 (0.000)	-0.001 (0.001)	0.000 (0.000)	0.005 (0.001)**	0.000 (0.000)	-0.001 (0.002)	0.000 (0.000)
ln of GDP	0.001 (0.000)**	0.000 (0.000)**	0.002 (0.001)	0.000 (0.000)**	0.003 (0.001)*	0.000 (0.000)**	0.004 (0.003)	0.002 (0.001)*	0.004 (0.004)	0.001 (0.000)**
ln of Population	0.002 (0.001)*	-0.000 (0.000)**	0.007 (0.004)	-0.000 (0.000)**	0.002 (0.005)	-0.000 (0.000)**	0.036 (0.020)	-0.002 (0.002)	0.052 (0.016)**	-0.000 (0.000)*
ln of Distance		-0.000 (0.000)**		-0.000 (0.000)**		-0.001 (0.000)**		-0.001 (0.002)		-0.002 (0.000)**
Common language		0.000 (0.000)*		0.000 (0.000)*		0.000 (0.000)**		0.004 (0.003)		0.001 (0.001)
Common border		0.002 (0.001)**		0.007 (0.002)**		0.007 (0.002)**		0.057 (0.019)**		0.025 (0.006)**
Constant	-0.032 (0.008)**	-0.000 (0.000)*	-0.106 (0.033)**	-0.000 (0.001)	-0.077 (0.049)	-0.000 (0.001)	-0.346 (0.163)*	0.001 (0.019)	-0.589 (0.147)**	0.001 (0.002)
Observations	891	891	784	784	807	807	289	289	693	693
R-squared	0.54		0.56		0.73		0.31		0.78	

Table E1: Fixed and Random effects for IM and EM across industries (cont)

	Photo/Med/Opt Gds; Watches/Clocks		Miscellaneous Manufacturing Industries		Leather and Leather Products		Transportation Equipment		Furniture	
	EM	IM	EM	IM	EM	IM	EM	IM	EM	IM
IPR	-0.001 (0.000)**	0.000 (0.000)	-0.000 (0.000)*	0.000 (0.000)	-0.001 (0.000)	0.000 (0.000)*	-0.001 (0.000)	-0.000 (0.000)**	-0.001 (0.000)	-0.000 (0.000)**
ln of GDP	0.002 (0.001)*	0.000 (0.000)**	0.001 (0.000)*	0.000 (0.000)**	0.000 (0.000)	0.000 (0.000)*	0.001 (0.001)	0.000 (0.000)**	0.001 (0.001)	0.000 (0.000)**
ln of Population	0.011 (0.003)**	-0.000 (0.000)**	0.004 (0.001)**	-0.000 (0.000)**	0.008 (0.003)*	0.000 (0.000)	0.007 (0.005)	-0.000 (0.000)*	0.007 (0.005)	-0.000 (0.000)*
ln of Distance		-0.000 (0.000)**		-0.000 (0.000)**		-0.000 (0.000)		0.000 (0.000)		0.000 (0.000)
Common language		0.000 (0.000)**		0.000 (0.000)**		0.000 (0.000)		0.000 (0.000)		0.000 (0.000)
Common border		0.007 (0.002)**		0.002 (0.000)**		0.001 (0.001)		0.005 (0.001)**		0.005 (0.001)**
Constant	-0.120 (0.030)**	-0.001 (0.000)*	-0.056 (0.011)**	-0.000 (0.000)	-0.075 (0.031)*	0.000 (0.000)	-0.075 (0.038)	-0.002 (0.002)	-0.075 (0.038)	-0.002 (0.002)
Observations	989	989	805	805	427	427	239	239	239	239
R-squared	0.73		0.68		0.30		0.11		0.11	