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How Intellectual Property Regimes Influence Trade with the United States: An Empirical Approach for 2000 – 2008

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Abstract

Intellectual property rights enforcement has continued to be an important topic of discussion between countries, particularly when forming new trade agreements. There has been much empirical research attempting to understand how changes in intellectual property regime (IPR) strength influence trade flows between countries. This paper attempts to add to this literature by analyzing trade between the United States and 61 foreign countries for the years 2000 – 2008. I find that the IPR strength of foreign countries has a significant impact on attracting exports from the United States. Foreign countries that participate in the U.S. IPR are also associated with exporting more to the United States.

Jel code: D23, F10, Q34.

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1. Introduction

There has been an increasing amount of literature addressing the factors that contribute to international technology diffusion, in particular international trade.[2] International technology diffusion is the process by which technology moves from country to country and is considered to have a significant impact on country income levels. When countries are able to obtain technology from one another it leads to increases in productivity growth, especially for poorer countries that invest less in R&D than more developed nations (Keller, 2001). Since technology transfers between countries is at the heart of this issue it's worthwhile to consider how institutions, such as intellectual property regimes (IPRs), influence international trade and hence technology diffusion. An IPR represents the institution(s) that determine how intellectual property (IP) is protected in a country, such as legal protections, licensing agreements, and structure of patents granted. IPRs matter with respect to international trade and technology diffusion in the following way; a country that has a strong IPR may not want to export its IP goods to a weak IPR. The domestically produced IP good could be reverse

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[2] For a brief background on international technology diffusion see Coe et al. (1997), Keller (2001), Schneider (2005), and Xu and Chiang (2005).

engineered, copied, and produced in the foreign market, at a significantly lower cost since this process foregoes the expensive R&D process, and sold by foreign producers in the foreign market (and possibly back in the domestic market as well). Due to a lack of IP rights in the foreign market the domestic producer may have no recourse. The cost savings from foregoing the R&D process can lead to a lower price for the foreign producer making it difficult for the original IP creator to compete. In this way, the lack of consistent IPRs across countries can hamper international technology diffusion by reducing trade in IP goods. IP enforcement has continued to play a large part in foreign trade agreements (FTAs) in recent years and shows no signs of going away.[3] Therefore, an increased understanding of how IPRs influence trade flows is essential to developing constructive trade policy that benefits all the countries involved in an agreement.

In this paper I estimate models using recent data for the U.S. and foreign countries from 2000 – 2008. I have two main goals in doing so; first, to consider the IPR strength of both trading partners, rather than the IPR of just one, to analyze how *relative* IPR strength influences trade flows. The motive for this is the following: If a country's IPR is strengthened but still remains relatively weak compared to other countries, the country may not expect to see a significant shift in trade flows. However, a strengthened IPR that becomes relatively stronger or similar to other countries is hypothesized to experience more significant changes in trade flows. Thus, analyzing this hypothesized non-liner relationship between trade flows and *relative* IPR strength is the main focus of this paper. The second goal is to investigate how model specification can influence estimation results. I find evidence that model specification does have significant impacts on the estimated coefficients. Also, I find evidence that the IPR of a foreign country has a significant effect attracting exports from the United States, a result similar to those in the literature. I also find significant effects when including the IPR of both trading partners.

2. Literature Review

This area of research has its foundations in the work by Maskus and Penubarti (1995). In their paper they offer two counter-acting explanations for how IPRs influence trade flows. The market-power effect results from the monopolistic characteristics granted by the IPR. By granting monopoly rights for patentable products in the domestic market, foreign firms export less due to a reduced elasticity of demand. They also address the market-expansion effect which results from a more "fair" market. By strengthening an IPR foreign firms can feel more confident exporting since there is a legal system protecting their IP. They state that the theoretical effects are indeterminate and that empirical analysis can provide better insight. They estimate a two stage econometric model and conclude that increasing IPR strength has a positive impact on imports for foreign countries.

Ferrantino (1993) had previously found evidence contrary in part to Maskus and Penubarti (1995) that IPRs don't influence exports in general, but rather they influence exports to foreign affiliates. Co (2004) estimates a two-way random effects model and concludes that an increase in IPRs matter with respect to the importing countries ability to imitate imports. In this manner, IPRs do increase United States exports of R&D intense goods and decrease non-R&D intense goods. Falevy et al (2009) estimate a gravity equation which also includes a measure of IPR strength using an index estimated by Ginarte and Park (1997). They find statistical evidence for the importance of the importers ability to imitate imports

[3] Most notably the TRIPS agreement from the Uruguay Round in 1994, but more recently the Trans-Pacific Partnership Agreement, U.S. – Colombia FTA, and U.S. – Panama FTA all address strengthening IP rights (United States Trade Representative).

and the market size of the importing country, as well as a non-linear relationship between trade flows and IPRs.

Doanh and Heo (2007) focus on IPRs and trade flows in ASEAN countries. Using a gravity model they find a strengthened IPR in non-ASEAN countries is positively associated with ASEAN exports and a strengthened IPR in ASEAN countries is negatively associated with non-ASEAN exports. Rafiquzzaman (2002) finds that IPR strength is an important factor for Canadian exports, and where imitative ability is high stronger IPR induces more Canadian exports and where imitative ability is low stronger IPRs reduce Canadian exports. The results of these two papers provide evidence for the market expansion and market power effects discussed by Maskus and Penubarti (1995).

3. Theoretical Framework

Maskus and Penubarti (1995) stated that the theoretical implications for the effects of IPR on trade are unclear and best explained using empirical tools. Thus, with this in mind I discuss an important aspect of the empirical literature that I feel needs further attention and aim to add to it.

I'll define two countries, Home (H) and Foreign (F). In general, the previous literature will consider an H country (or group of similar countries) and determine how trade is impacted when F (or a group of countries) adjusts its IPR. The conclusions typically state when F strengthens its IPR exports from H to F rise (or fall) based on the effects outlined in Maskus and Penubarti (1995). They suggest it's likely to rise when the market-expansion effect is more dominant, typically in larger countries with more competitive markets, and more likely to fall when the market-power effect is dominant, typically in smaller countries.

What's missing from this analysis is consideration between the two IPRs relative to each other. Let me demonstrate why this is important with a thought experiment. Let H be represented by the United States, F represented by Zaire, and assume they trade to some extent with the market-expansion effect being dominant for simplicity. According to Park (2008) the two countries have an IPR index of 4.88 and 2.23 respectively, where the scale is zero to five, zero representing poor IPR and five representing a very good IPR. Without accounting for both IPRs we may conclude that a hypothetical increase in the IPR index of Zaire to say, 3.23 (approximately a 36% movement toward an index of five) would result in increased U.S. exports to Zaire. But, relatively speaking Zaire still represents a poor IPR for U.S. firms to sell their IP goods when compared to the U.S. domestic market or other foreign markets with a stronger IPR.

With this in mind, let us now consider a case where F is represented by Botswana, which has an IPR index of 3.52 and retain H as the United States.[4] Let us now apply a similar 36% movement of Botswana's index, which would increase it to 4.05. While still inferior to the U.S. index, it is much more *comparable* to the U.S. and thus hypothesized to see more positive trade impacts from the increase in the IPR greater than those experienced by Zaire.

This thought experiment has an important point. Although Zaire and Botswana could make similar structural changes resulting in similar improvements of their regimes, Botswana would appear to be better off than Zaire because their regime becomes more similar to the U.S. whereas the Zaire system would still be weak. Thus the central hypothesis, and motivation for considering both counties IPR, is that an improvement in IPR strength that leaves a country relatively weak with its trading partners is unlikely to realize many gains,

[4] This index is from Park (2008) again.

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whereas an increase in IPR strength that puts the country into a similar IPR range as its trading partners is likely to realize more gains.

Thus the IPR of H and F should be considered together to determine how IPR changes affect trade between countries, not just the IPR of F. I employ two methods for measuring IPR strength of countries. First, I use the index from Park (2008) to characterize the regimes of F. Here F represents a group of 61 countries that trade with the United States.[5] Second, the number of patents that F holds in H measures H's IPR strength, since obviously using the index in Park (2008) for the U.S. would have no variation among foreign countries. Here H represents the United States. When F holds patents in H it's signaling how strong it feels the regime is. An F country holding many patents in H indicates F's comfort level trading its IP goods with H, and thus provides a measure of the IPR strength of the U.S. that will have variation amongst the foreign countries.

Consider an example that demonstrates the idea above. Park (2008) has the following IPR index values for four countries which are listed in table 1.[6] Still considering the U.S. as the H country (IPR index: 4.88 as discussed earlier), it's observed that Egypt and Guatemala make the largest strides of these four countries with respect to improving their regime from 2000 to 2005. Portugal and Poland make modest strides while compared to the other two, but what are important are their strides relative to the United States. Portugal and Poland's IPRs improved *and* became more similar to the United States, whereas Egypt and Guatemala's only improved; they are still relatively inferior to the United States IPR. Table 2 calculates the yearly percentage increase (or decrease) in exports received from the United States to each country, with the yearly average given in the final column. Portugal and Poland experience considerably more yearly average gains in exports from the United States, particularly large climbs in 2006 and 2007. In contrast, only once did Egypt or Guatemala experience a yearly gain of over 20% in exports from the United States. These data are graphed in figure 1, which shows large spikes in the growth of exports from the U.S. for Portugal and Poland after 2005, whereas Egypt and Guatemala's growth rates remain relatively constant during the time period.

Table 1. IPR increases for four countries, 2000 – 2005.

Country	2000	2005
Egypt	1.86	2.77
Guatemala	1.28	3.15
Portugal	4.01	4.38
Poland	3.92	4.21

Table 2. Yearly growth rates of exports from the United States.

	2001	2002	2003	2004	2005	2006	2007	2008	Yr. Avg.
Egypt	.085	-.189	-.196	.230	.056	.184	.182	.039	.049
Guatemala	-.062	.108	.044	.072	.150	.191	.216	.030	.094
Portugal	.299	-.408	-.038	.415	.089	.345	.694	.072	.184
Poland	.034	-.121	.105	.196	.417	.609	.602	.257	.262

[5] See table 4 for a list of these countries.
[6] The index data are available in five year increments from 1960 up to 2005.

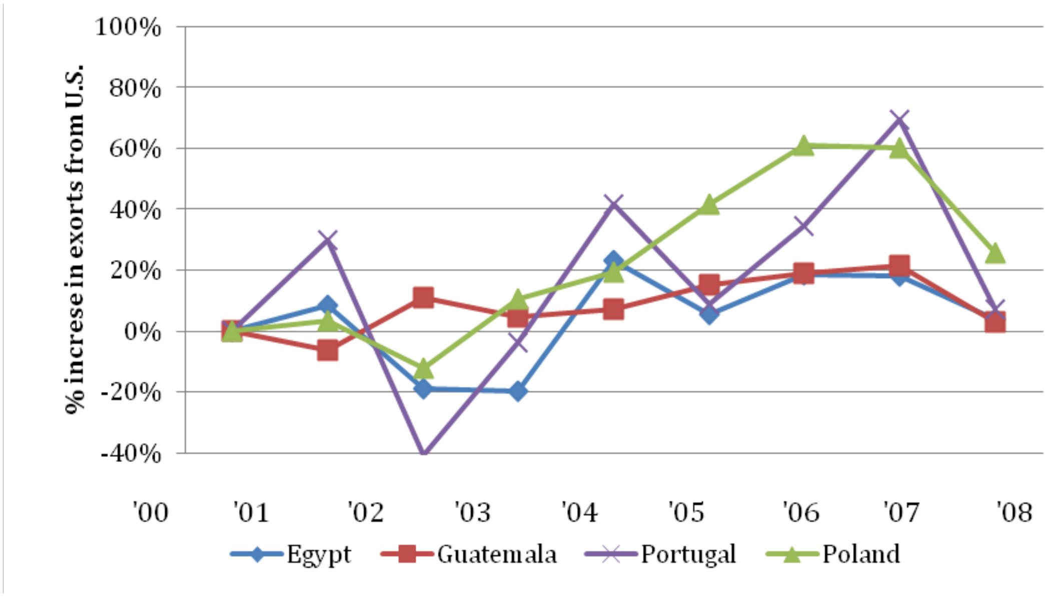

Figure 1. Yearly growth rates of exports from the United States.

4. Methodologies and Data Description

4.1. Gravity Model of Trade

The gravity model of trade is typically represented by the following:

$$F_{ij} = k\frac{M_i M_j}{D_{ij}} \quad (1)$$

where F_{ij} is trade flows between country *i* and *j*, *M* represents the economic mass of each country, typically represented by GDP or GNP, D_{ij} is the physical distance between country *i* and *j* and *k* is a constant. Intuitively, larger economic mass is expected to be associated with increased trade flows due to higher income levels and demand. Increased distance is associated with less trade flows due to higher transportation costs and other obstacles such as cultural and market information barriers. Given the large empirical work justifying this relationship between trade flows and economic mass/distance, this model is extended to include measures of IPR strength to analyze how it is associated with trade flows. The gravity variables (mass and distance) are essentially control variables in the below described models as independent variables. To estimate the gravity model it is common to take the natural log of each side to produce a log-log model of the form:

$$\ln(F_{ij}) = \beta_1 + \beta_2 \ln(M_i) + \beta_3 \ln(M_j) + \beta_4 \ln(D_{ij}) + \varepsilon_{ij} \quad (2)$$

where the constant *k* becomes part of the intercept term. This logarithmic relationship between trade flows and the gravity variables is demonstrated graphically in figures 2 and 3 in the appendix. The gravity model is estimated in its different forms according to (1) and (2) with extensions for IPR strength.

By foreign country *j*, sector *k*, and at year *t*, import and export data are converted into a percentage for each country that represents the *xShare* and *mShare* variables. Exports are United States exports to foreign countries and imports are received by the United States. Thus, these two variables represent the percentage of exports or imports attributable to a country relative to the other countries in the sample for each sector and year. For example, for foreign country *j* an *xShare* of .32 indicates that country *j* received 32% of the exports from the United States in sector *k* and at year *t*. An *mShare* of .54 would indicate that 54% of imports received in the United States came from country *j*, in sector *k*, and at year *t*. The

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PatentShare variable is constructed in a similar fashion from the patent data described below. *Index* represents the IPR index in Park (2008). This index, reported every five years, is an unweighted sum of five scores covering the following areas: coverage (inventions that are patentable), membership in international treaties, duration of protection, enforcement mechanisms, and restrictions (Park, 2008). Data for these five areas was obtained from Park to test the robustness of the IPR index by replacing the *index* variable with five variables, each representing one of the scores listed above.[7] Including these disaggregated data, rather than the index, does not dramatically change estimated coefficients or significance levels. A key insight is that the duration of protection may be the main contributor to the index with respect to trade, given its large coefficient. The disaggregated index data has a high amount of multicollienearity that exists amongst them that can bias estimation results.[8] Thus using the aggregated index avoids this problem and also allows for a more general discussion of IPR strength than analyzing the five specific disaggregated measures. Taking the natural log of the typical gravity model (as in equation 2) gives the additive form consisting of the distance, U.S. GDP, and foreign GDP represented by *Distance*, *USGDP*, and *ForeignGDP* respectively. *Gravity* is represented by these same variables when the calculation for the right hand side of equation (1) is carried out assuming that $k = 1$. *S*, *C*, and *Y* represent manufacturing sector, country, and year fixed effects respectively. ε is an error term. Summary statistics for the described variables are in table 3. Using these variables the basic gravity model of trade is expanded to include measures of IPR strength and the following equations are estimated:

$$xShare_{jkt} = \beta_1 + \beta_2 Gravity_{jkt} + \beta_3 Index_{jk} + S + C + Y + \varepsilon_{jkt} \quad (3)$$

$$xShare_{jkt} = \beta_4 + \beta_5 Gravity_{jkt} + \beta_6 Index_{jk} + \beta_7 PatentShare_{jkt} + S + C + Y + \varepsilon_{jkt} \quad (4)$$

$$\ln(xShare_{jkt}) = \beta_8 + \beta_9 \ln(Distance_j) + \beta_{10} \ln(USGDP_{jkt}) + \beta_{11} \ln(ForeignGDP_{jkt}) + \beta_{12} Index_{jk} + S + C + Y + \varepsilon_{jkt} \quad (5)$$

$$\ln(mShare_{jkt}) = \beta_{13} + \beta_{14} \ln(Distance_j) + \beta_{15} \ln(USGDP_{jkt}) + \beta_{16} \ln(ForeignGDP_{jkt}) + \beta_{17} PatentShare_{jkt} + S + C + Y + \varepsilon_{jkt} \quad (6)$$

The subscript *t* is not included on the *Index* variable since only the 2005 data from Park (2008) are used. Alternatively, the index for 2000 can be used for years 2000-2004 and the index for 2005 used for years 2005-2008. The results of doing this are very similar to the results when only the year 2005 is included.[9] Since every country's regime does not experience a change in its IPR index between 2000 and 2005, only the IPR index for 2005 was used so that all countries would have a single value for their IPR index. Otherwise, some countries would have two values (those that experienced a change) and others would only have one (those that don't experience a change). Equations (3) and (4) use the gravity model specification given in (1) extended for IPR strength and are estimated using a generalized linear model since the dependent variable is between zero and one. Equations (5) and (6) are estimated using seemingly unrelated regressions and represent the specification in equation (2) extended for IPR strength.

[7] These disaggregated results are shown in table 9 of the appendix.
[8] The correlations between these five variables can be found in table 10 of the appendix.
[9] See table 11 in the appendix for these results. The main difference is that the *index* coefficient changes in magnitude, but not sign or statistical significance.

Table 3. Summary Statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
xShare	6278	0.0332336	0.088826	0	0.9793781
mShare	6278	0.0366419	0.0951411	0	0.9905449
Distance	6278	5217.4	2244.5	462	10160
USGDP	6278	12010.58	1537.81	9951.48	14291.55
ForeignGDP	6278	485.42	803.68	1.389	4879.84
ln(Distance)	6278	8.446239	0.5063157	6.135565	9.226213
ln(USGDP)	6278	9.385824	0.127977	9.205477	9.567424
ln(ForeignGDP)	6278	5.115882	1.530993	0.528862	8.492867
IPR Index	5716	3.975478	0.6148104	2.15	4.67
PatentShare	6278	0.0177185	0.0609566	0	0.6268546

All data is for 2000-2008, inclusive. The 61 countries used as trading partners with the U.S. are listed in table 4. Data for imports and exports between the U.S. and these countries for 13 manufacturing sectors (3-digit NAICS level) are obtained from the U.S. Census Bureau and listed in table 5.[10] Distance and GDP data are collected to incorporate and control for a gravity model of trade in the analysis. Distance is calculated using the distance between Washington, DC and the capital city of each country.[11] GDP data is collected using the IMF's World Economic Outlook database. The updated index in Park (2008) is used for foreign countries IPR index. Patent data that measures the number of patents held in the U.S. by foreign entities is collected from the U.S. Patent and Trademark Office.[12]

Table 4. Countries receiving U.S. exports.

Argentina	Denmark	India	Netherlands	Spain
Australia	Ecuador	Indonesia	New Zealand	Sri Lanka
Austria	Egypt	Ireland	Norway	Sweden
Belgium	Fiji	Israel	Peru	Switzerland
Bolivia	Finland	Italy	Philippines	Thailand
Brazil	France	Japan	Poland	Turkey
Bulgaria	Germany	Kenya	Portugal	Ukraine
Canada	Greece	Lebanon	Romania	U.A.E
Chad	Guatemala	Luxembourg	Russia	United Kingdom
Chile	Honduras	Malawi	Saudi Arabia	Uruguay
China	Hungary	Malaysia	Singapore	Uzbekistan
Colombia	Iceland	Mexico	South Africa	Venezuela
				Zimbabwe

Table 5. Manufacturing sectors.

311 – Food	331 – Primary Metal
312 – Beverage and Tobacco	332 – Fabricated Metal
321 – Wood Product	333 – Machinery
325 – Chemical	334 – Computer and Electronic
326 – Plastics and Rubber	335 – Electrical Equipment, Appliance and Component
327 – Nonmetallic Mineral	336 – Transportation Equipment
	337 – Furniture and Related Product

[10] http://www.census.gov/foreign-trade/statistics/country/
[11] http://www.chemical-ecology.net/java/capitals.htm
[12] http://www.uspto.gov/web/offices/ac/ido/oeip/taf/reports.htm#by_indus

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Endogeneity concerns for the estimated equations can come in many forms. The political environment with respect to trade in countries, such as negotiations of FTAs, is omitted from the model. The signing of FTAs is a relatively rare event and generally only impact particular sectors noticeably. The inclusion of sectorial fixed effects is an attempt to minimize the influence FTAs can have in the model. Tariffs obviously influence trade between countries and are another possible source of endogeneity. Country fixed effects are included to capture the variation between countries, thus the general level of tariff protection can be captured in these fixed effects. Exchange rates are another important influence on trade flows that are omitted from the models here, but in a similar fashion as tariffs, country fixed effects may capture these differences. Technology differences between countries and global shocks, such as global recessions, oil shocks, and natural disasters are also omitted and can influence trade flows, but including variables for these effects in the model may introduce too much noise to be beneficial. Residuals were estimated so that correlations between the residuals and the variables could be calculated to observe the level of endogeneity. All the correlations were nearly zero with the exception of mild residual correlation with *exportShare* (.47) indicating endogeneity in the model is likely minimal and not greatly influencing the results presented.

4.2. Generalized Linear Model (GLM)

OLS and other methods have particular limitations when the dependent variable is a ratio, thus a generalized linear model as suggested by Papke and Wooldridge (1996) will be estimated.[13] The model is estimated by specifying a functional form of an OLS model. Thus I'll use GLM to estimate a model of the following form for equations (3) and (4):

$$xShare_{jkt} = G[\beta_1 + \beta_2 Gravity_{jkt} + \beta_3 Index_{jk} + S + C + Y + \varepsilon_{jkt}] \quad (3b)$$

$$xShare_{jkt} = G[\beta_4 + \beta_5 Gravity_{jkt} + \beta_6 Index_{jk} + \beta_7 PatentShare_{jkt} + S + C + Y + \varepsilon_{jkt}] \quad (4b)$$

where $G[*]$ is the *link* function and chosen such that $0 < G(a) < 1 \ \forall a \in \mathrm{R}$. A natural choice for the link function is the logistic function and is commonly used. Doing so will guarantee that the predicted values are in the interval zero to one (Papke and Wooldridge, 1996).

4.3. Seemingly Unrelated Regressions (SUR)

I estimate equations (5) and (6) using the seeming unrelated regressions (SUR) model. Under SUR each regression can be estimated individually using OLS. But, unlike OLS, SUR assumes that the error terms of each equation are correlated which is likely true given the nature of these data. The intuition is that trade shocks (which are captured in the error term) that influence imports likely also influence exports and vice-versa. Equations (5) and (6) were initially estimated separately using OLS and the residuals estimated for each equation. A correlation coefficient was calculated between the two residual terms. Upon inspection of the residuals I find they are mildly correlated (.29).

5. Results

All regression results include sectoral, country, and year fixed effects but are omitted from the results presented. The GLM is used to estimate equations (3) and (4) and the results are given in table 6. In the GLM the *Gravity* variable is not statistically significant. The GLM estimates a positive and highly significant association between the IPR *Index* and exports to the foreign country from the United States. This is evidence that the IPR of foreign countries has a

[13] See page 620 of Papke and Wooldridge (1996) for a detailed explanation of these limitations.

significant impact in attracting exports from the United States. Thus, a foreign country that increases its IPR *Index* by one point would on average see an increase of U.S. manufacturing exports to their country by approximately 5.65%, all else equal. Equation (4) adds the *PatentShare* variable to equation (3). With the addition of the *PatentShare* variable the model is now capturing the concept that the H IPR must be considered along with the F regime to determine how IPR affects trade. The IPR of the F country is hypothesized to have a smaller impact on exports from the H country if the F country holds a large share of patents in the H country. Equation (4) provides statistical evidence of this relationship. A positive and highly significant coefficient on the IPR *index* indicates strengthening the IPR is associated with increased exports from the United States. The effect on the IPR index is the same as before, a one point increase is associated with a 5.66% increase in manufacturing exports from the U.S., all else equal. A negative and highly significant coefficient on the *PatentShare* variable is evidence that as F countries hold a larger share of patents in the United States they experience a decrease in United States exports, presumably because they are importing to the U.S. since they value the IPR there. A 1% increase in the *PatentShare* by an F country is associated with a 1.45% decrease in exports from the United States.

Table 6. GLM estimations

	GLM	
Dependent Variable	*xShare*	*xShare*
Equation	(3)	(4)
Gravity	-2.3000	-4.01
	(8.64)	(8.74)
Index	5.6493***	5.6605***
	(.5726)	(.5737)
PatentShare		-1.4490**
		(.5320)
Constant	-22.0577***	-22.0996***
	(1.8877)	(1.8918)
N	5716	5716

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

SUR estimates equations (5) and (6) using a log – log form of the gravity model, which is more traditional in the empirical literature. In the SUR model specification I'm also more directly estimating the effects the U.S. IPR has on attracting imports. Similar to equation (3), equation (5) estimates the effects of foreign IPRs on U.S exports, but equation (6) estimates the effects *PatentShare,* a proxy for the U.S. IPR regime, has on imports from foreign countries. These results are in table 7. The gravity model variables are similar between the export and import equations; distance is negatively associated with exports and imports, but not statistically significant in either case. Equation (5) estimates an unexpected negative coefficient with respect to *USGDP*. Falevy et al. (2009) encountered similar results and they found it was driven by the inclusion of fixed effects. Similar to their research, the exclusion of the fixed effects provides the expected coefficients with respect to the gravity variables and thus is unlikely to be of large concern. The IPR *index* is not significantly associated with attracting exports from the U.S. but remains as a positive coefficient. *PatentShare* is statistically significant (.1% level) and positively associated with imports from F countries to the United States, as hypothesized. Thus, when foreign countries value the IPR of the U.S. by holding more patents they import more manufactured goods to the United States.

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Table 7. SUR estimations

	SUR	
Dependent Variable	*ln(xShare)*	*ln(mShare)*
Equation	(5)	(6)
ln(Distance)	-1.1720	-2.2715
	(1.8702)	(4.9705)
ln(USGDP)	-.2705	.9281
	(2.4466)	(4.6770)
ln(ForeignGDP)	.7355***	.0983
	(.0813)	(.1555)
Index	.9589	
	(2.5292)	
PatentShare		9.1438***
		(.8586)

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

6. Robustness check

A robustness check of these results is conducted by dividing the data into two smaller subsets for which the IPR index variable is available, the years 2000 and 2005. In doing so, the *USGDP* variable is dropped from any analysis; since it's a yearly measure it's constant for each individual year. Table 8 contains the results when estimating the data for 2000 and 2005 using the IPR index for those years. The results for the gravity variables are consistent with economic intuition; all are significant and have the expected sign (positive sign associated with GDP and negative sign with distance). The index variable differs from previous estimates; the variable is only significant in the year 2005 estimation and has an unexpected negative coefficient. The *PatentShare* variable remains highly significant as before and relatively the same size in magnitude with the expected sign. It should be noted that the sample size is dramatically smaller in this example than the more general results presented above.

Table 8. SUR estimations for years 2000 and 2005

	2000		2005	
Dependent Variable	*ln(xShare)*	*ln(mShare)*	*ln(xShare)*	*ln(mShare)*
Equation	(5)	(6)	(5)	(6)
ln(Distance)	-1.1074***	-1.1237***	-1.1371***	-1.5183***
	(.0516)	(.1238)	(.036)	(.0855)
ln(ForeignGDP)	.9494***	.4453*	1.221***	.8802***
	(.1031)	(.18)	(.0884)	(.1944)
Index	-.1595		-.4602**	
	(.1759)		(.1464)	
PatentShare		9.5316***		9.0263***
		(2.3498)		(2.7632)
N	645	645	645	645
R^2	.8613	.7392	.8499	.7293

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

7. Conclusion

Previous research has focused on empirically estimating the role that IPRs have on international technology diffusion via their influence on international trade flows. The goal of this paper was to add to that literature by estimating models using recent data for the U.S. and foreign countries from 2000 – 2008. I find evidence that model specification can have an influence on the estimated association between IPR and trade flows. In particular, GLM provides statistically significant relationships between trade and the IPR of both the United States and F countries. On the other hand, SUR estimates these same relationships but is only statistically significant with respect to the U.S. IPR.

This paper also aimed to highlight the role that IPRs can play with respect to all trading partners, H and F, rather than focusing on how trade is influenced solely by the IPR of the F country. First, this paper provides evidence that foreign countries can increase imports from the United States by improving their IPR. Second, foreign countries are estimated to increase their exports to the U.S. when they increase the share of patents they hold in the United States.

Both of these findings highlight the importance of including IP rights in the discussion of FTAs. Foreign countries can increase the amount of technology diffusion to their country by increasing the strength of their IPR. This can then increase their productivity as well as income. Also, if foreign countries can gain access to the United States market and take advantage of its strong IPR regime it is estimated they will import more to the United States. This could potentially require foreign countries to create or adjust institutions to help their producers take advantage of a new export market and the IPR it presents. Further research could expand the H country to include more than just the United States. Others have also considered the differences between developed and developing countries and the role IPRs and patents play. This would also be beneficial in determining the role IPRs play in trade flows.

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Appendixes

Table 9. GLM estimations, index variable replaced with its components.

	GLM	
Dependent Variable	*xShare*	*xShare*
Equation	(3)	(4)
Gravity	.0001***	.0001***
	(.00002)	(.00001)
Coverage	2.2000***	2.1968***
	(.3482)	(.3466)
Membership	-1.3196***	-1.3189***
	(.2335)	(.2331)
Loss of Rights	2.3568***	2.3487***
	(.4431)	(.4382)
Enforcement	3.1007***	3.0964***
	(.2584)	(.2561)
Duration	16.407***	16.3991***
	(2.2400)	(2.2401)
PatentShare		.1096
		(.6045)
Constant	-24.3905***	-24.3728***
	(.2.2612)	(2.2604)
N	5716	5716

Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

1. This table is comparable to table (6) with the index replaced by its five components.
2. Membership has an unexpected negative coefficient; however, the overall magnitude is dwarfed by the positive coefficients on the other four components.
3. It's estimated in equation (3) of table 6 that a one point increase in the index is associated with a 5.65% increase in *xshare*. If a similar one point increase is applied to equation (3) for the disaggregated data in this table (0.2 point increase to each component), the estimated effect is an increase in *xshare* by 4.55%. This is also true for equation (4), demonstrating robustness whether the index or its 5 components are used.

Table 10. Correlation coefficients between disaggregated index variables.

	Coverage	*Membership*	*Loss of Rights*	*Enforcement*	*Duration*
Coverage	1				
Membership	0.60	1			
Loss of Rights	0.32	0.21	1		
Enforcement	0.50	0.46	0.04	1	
Duration	0.35	0.18	-0.17	0.52	1

Table 11. GLM estimations, using index value from 2000 for years 2000-2004 and index value from 2005 for years 2005-2008.

	GLM	
Dependent Variable	*xShare*	*xShare*
Equation	(3)	(4)
Gravity	6.35e-7	-1.05e-6
	(8.78e-6)	(8.88e-6)
Index	.4684***	.4745***
	(.1005)	(.1005)
PatentShare		-1.4599*
		(.5242)
Constant	-8.5765***	-8.6047***
	(.4867)	(.4891)
N	5716	5716

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12. Correlation coefficients.

	xShare	*mShare*	*ln(distance)*	*ln(USGDP)*	*ln(ForeignGDP)*	*IPR*	*Patent Share*
xShare	1						
mShare	0.63	1					
ln(distance)	-0.42	-0.30	1				
ln(USGDP)	0.10	0.10	0.04	1			
ln(ForeignGDP)	0.40	0.44	-0.05	0.16	1		
IPR	0.20	0.22	-0.21	-0.03	0.54	1	
PatentShare	0.29	0.45	0.01	-0.02	0.46	0.29	1

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Figure 2. Logarithmic relationship between trade flows, GDP and distance as described in equation (1).

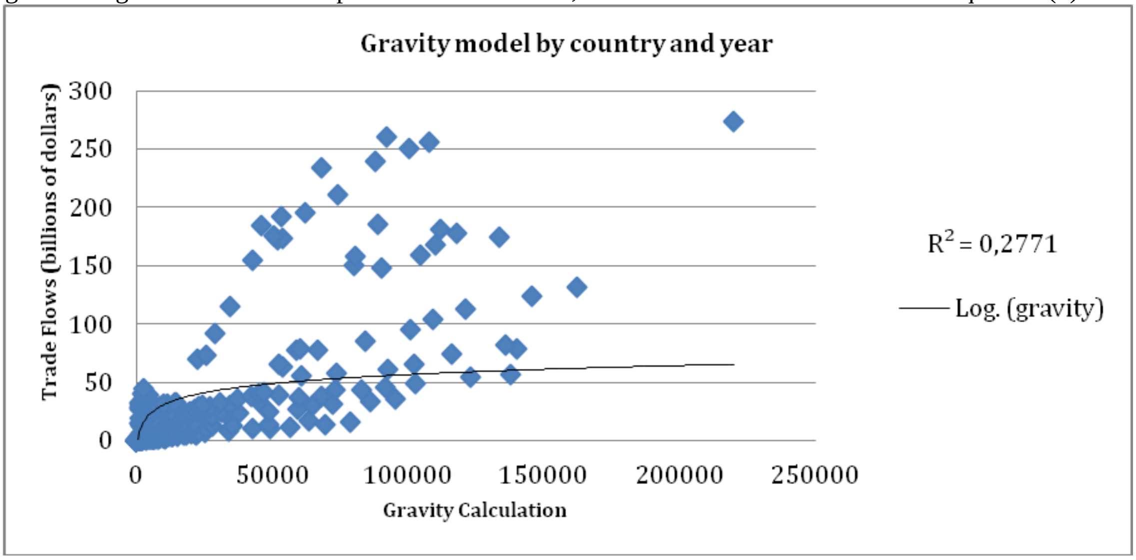

Figure 3. Logarithmic relationship between trade flows, GDP and distance as described in equation (1). The top 50% of trade flows are removed to more easily show the logarithmic relationship.