THE TRIPS AGREEMENT AS A COERCIVE THREAT: ESTIMATING THE EFFECTS OF TRADE TIES ON IPR ENFORCEMENT

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Abstract

Negotiators from developed countries pushed hard for the inclusion of the TRIPS Agreement in the WTO set of agreements because it was viewed as a potentially effective method of coercing developing countries to strengthen their protection of intellectual property rights (IPR). We investigate whether the threat of cross-agreement retaliation, which could be authorized in disputes regarding the TRIPS Agreement, is effective in changing countries' IPR protection regimes. The results from a panel empirical model suggest that both the TRIPS Agreement and the strength of trade ties with developed countries are important determinants of IPR protection, but that the vulnerability to potential trade losses through cross-agreement retaliation is not a uniformly significant determinant across geo-economic regions. We conclude that the threat of trade retaliation is just one important determinant of countries' institutional protection of IPR.

JEL Classification Codes: O34, F13, F53

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1. Introduction

The introduction of the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) into the World Trade Organisation's (WTO's) set of agreements was viewed by negotiators as a potentially powerful tool in the ongoing efforts of firms from developed countries to extend control of their domestic intellectual property rights (IPR) beyond their national borders (Matthews, 2002). Firms in developed countries that rely on returns to intellectual property (IP) observed weak protection of IPR and high rates of piracy in developing countries (DgCs) (Marron and Steel, 2000) and pushed hard for negotiators to introduce binding IPR protection disciplines on WTO-member countries.

Proponents of the TRIPS Agreement believed that it could be used to coerce WTO-member countries into strengthening protection of developed-country IPR in DgCs. Because the TRIPS Agreement is part of the WTO's single undertaking, countries that are found to be in violation of their TRIPS Agreement obligations are subject to cross-agreement retaliation under one of the WTO's other agreements (usually the General Agreement on Tariffs and Trade, or GATT). Such retaliation would typically take the form of the suspension of tariff preferences, as outlined in the GATT.

We investigate the effectiveness of the cross-agreement retaliation threat as a means of coercing changes in regulatory protection of IPR. We hypothesise that WTO-member countries that have strong trade ties with IP-abundant countries made larger changes to their domestic IPR protection regimes in response to the TRIPS Agreement than WTO-member countries that do not trade intensively with IP-producing countries. Countries with weak IPR frameworks that have strong trade ties with IP-abundant countries could be vulnerable to cross-agreement retaliation

through the GATT and may take threats from IP-abundant countries seriously. The stronger are the trade ties (measured as export value), the larger is the "stick" with which a country can be threatened, and the more the respondent country stands to lose in the event of trade sanctions. We suggest that such vulnerability should manifest as larger changes to domestic IPR protection regimes in response to the TRIPS Agreement.

Our hypothesis is investigated in a panel empirical model that identifies the effects of two factors on the evolving strengths of countries' IPR protection regimes; accession to the TRIPS Agreement, and the importance of trade with IP-abundant countries. Our empirical model allows us to determine if trade ties magnify the effects of the TRIPS Agreement on IPR protection regimes - that is, do countries that rely heavily on exports to proponent-countries of the TRIPS Agreement respond to the potential threat of cross retaliation once they are bound by the TRIPS Agreement? We control for important domestic determinants of IPR protection regimes and estimate the model over a range of aggregation strategies.

We also investigate alternative motivations for changing IPR regimes. There may be other incentives for tighter protection of foreign firms' IPR if the threat of trade retaliation is not always a significant determinant of IPR regimes. We consider the role of foreign direct investment (FDI) in our analysis.

We find that both the TRIPS Agreement and the strength of trade ties with developed countries are important determinants of IPR protection, but that the vulnerability to potential trade losses through cross-agreement retaliation is not a uniformly significant determinant across geo-economic regions. Other motivations for improving IPR strength are considered and discussed.

2. The TRIPS Agreement as a Threat

The TRIPS Agreement was made part of the WTO set of agreements in the Uruguay Round (UR) negotiations, and adherence to its disciplines is mandatory for all WTO-member countries.[1] The TRIPS Agreement commits member countries to protect the IPR of firms from other member countries to minimum standards as outlined in the Agreement. The Agreement consists of seven parts that outline the minimum standards of protection and enforcement of IPR that member countries must implement.[2] Members are to provide national treatment to firms from other member countries with respect to IPR, grant copyrights of 50 years and patents of 20 years. Member countries also agree to establish judicial bodies with the authority to issue injunctions and award damages in cases of IPR disputes. If a foreign firm is unsatisfied with the handling of an IPR dispute, then it can lobby its home government to pursue a formal case through the WTO.

Article 22 of the WTO's Dispute Settlement Understanding (DSU) outlines member countries' rights and obligations in the event of trade disputes. If a member country is found to be in violation of its obligations, then it is called on to follow the panel or Appellate Body's recommendations, or pay compensation to the complainant.[3] If the conflict remains unresolved, then the complainant country is authorised to retaliate by suspending trade preferences to the offending member country in the pecuniary amount of injury deemed to have been done by the original violation. The DSU allows for three types of retaliation, to be pursued in the following order (Spadano, 2008): 1) retaliation in the same sector in which the original violation occurred, 2)

[1] The TRIPS Council granted implementation delays to developing WTO-member countries, and least-developed member countries are not subject to the agreement until 2013 (WTO, 2005; WTO, Undated).

[2] We provide a very brief discussion of the most relevant TRIPS Agreement components here. See Gervais (2008) for a comprehensive treatment of the TRIPS Agreement.

[3] Compensation is unlikely to be chosen in disputes over IP because the incentives to pay compensation in lieu of accepting retaliation decline as the size of the pirate industry increases and the costs of enforcement rise (Yampoin and Kerr, 1998).

retaliation in a different sector under the same WTO agreement, and 3) retaliation under a different agreement. Options one and two are the least relevant in our context because most TRIPS-related disputes are likely to feature developed countries as complainants and DgCs (with little IP against which to retaliate) as respondents. Developed countries that prevail in TRIPS disputes are likely to pursue cross-agreement retaliation through another WTO agreement, *i.e.* the GATT.[4]

Jurisprudence in TRIPS-related cases is small relative to other WTO agreements. Only seven panel and Appellate Body reports related to the TRIPS Agreement have been adopted by the WTO's Dispute Settlement Body since 1995 (WTO, 2010). It is noteworthy that four of these cases involved disputes between developed countries, and just three were developed-country members pursuing action against DgC members (two against India and one against China).

The implementation of the TRIPS Agreement was not the first formal framework for trade retaliation in international IPR disputes. Section 301 of the United States (US) Trade Act formalised the process through which the US could impose unilateral trade sanctions against trading partners that were viewed to insufficiently protect US IPR. Section 301 was introduced in 1988 and enhanced the power of the US trade representative's office to impose punitive trade sanctions (higher tariffs and quantitative import restrictions) on trading partners in the event of unresolved IPR disputes (Matthews, 2002). Section 301 was used several times in disputes with US trading partners as some countries were threatened with trade sanctions and others faced new tariff barriers.

[4] An interesting development over the past few years has been DgCs' suspension of TRIPS Agreement obligations in retaliation for GATT-related disputes with developed countries (Abbott, 2009).

There are also a range of other tools of persuasion and coercion that trading partners have used in IPR disputes. The World Intellectual Property Organisation (WIPO) is an advisory organ of the United Nations that oversees the Paris and Berne conventions,[5] and predates the TRIPS Agreement. The WIPO advocates for an international IPR protection system, but has no mechanism for enforcing IPR. Accordingly, the WIPO was viewed by the US as being ineffectual in the extraterritorial protection of IPR (Cordray, 1994). Spadano (2008) emphasises that a range of other factors, such as foreign policy interests and reputation costs, are also important determinants of IPR protection regimes. There may be incentives, beyond lost exports, for avoiding IPR disputes with developed countries. Such factors are very difficult to measure and to identify in an econometric model. We discuss this in our results section below.

Canada has been a respondent to two TRIPS-related complaints since the implementation of the Agreement. Both complaints were based on the length of patent protection; one from the European Communities and one from the US. Despite having been respondents (instead of complainants), the Canadian position is supportive of the maintenance of the TRIPS Agreement in Doha Development Agenda negotiations. Specifically, the official Canadian position (DFAIT, Undated) is to support the implementation of geographic indicators for wine and spirits, and the maintenance of optional *sui generis*[6] protection systems for plant varieties in member countries. Canada has substantial capacity in agricultural Research and Development (R&D), and it could be argued that stakeholders have economic interests in ensuring the protection of their IPR in potential consumer nations in future years.

[5] See Trebilcock and Howse (1999) for details on these conventions.

[6] *Sui generis* protection systems are context-specific protection systems designed by member countries. These systems are not necessarily equivalent to patents.

3. Data and Empirical Model

Our dependent variable is derived from Park's (2008) index of patent strength, which is calculated every five years from 1960 to 2005. This index measures: 1) coverage of a range of products, 2) membership in international treaties, 3) protection for innovators against the loss of patent rights, 4) the presence of legal enforcement mechanisms, and 5) duration of patent. We modify the original index by subtracting 0.04 to account for the contribution of WTO membership in the calculation of Park's index.

A country is only subject to cross retaliation under the WTO DSU if it is bound by the TRIPS Agreement. We use a binary variable to indicate whether a country has acceded to the TRIPS Agreement. Our sample contains countries that are not members of the WTO and countries that were granted delays in implementing the TRIPS Agreement requirements. The sample also includes observations in 1990, which is prior to the implementation of the TRIPS Agreement. Table A1 of the Appendix contains the list of countries in our dataset. Our primary measure of international trade ties is the value of exports between trading partners. These data come from the United Nations' Comtrade database and use the Standard International Trade Classification, Revision 2 (SITC, Rev. 2). We use the International Monetary Fund's (IMF's) definitions of "advanced" economies and "emerging and developing" economies to categorize developed countries and DgCs, respectively.

Domestic determinants of IPR are controlled for by variables that have been shown to be important in other analyses of IPR strength (for example, Ginarte and Park, 1997; Lerner, 2002; Shadlen, 2005; Cardwell and Ghazalian, 2012). Real Gross Domestic Product (GDP) per Capita (GDPC) proxies for a country's level of economic development, with lnGDPC depicting its natural

logarithm. The GDPC dataset is taken from the IMF's World Economic Outlook Database. The presence of domestic IP generation in each country is measured by the number of researchers and technicians per million people, which is represented by the variable RT. The corresponding data are taken from the United Nations Development Programme's (UNDP's) Human Development Report (various editions). We also include countries' education rates using the Human Development Report's measure of combined first-, second- and third-level enrolment rates which is represented by the variable EDUC. Data for inward FDI stock are used in an alternative specification of the model (discussed below) and are sourced from the United Nations Conference on Trade and Development's (UNCTAD's) World Investment Report Database.

The value of exports to developed countries is represented by the variable EXP with lnEXP depicting its natural logarithm. The value of inward FDI stock is represented by the variable IFDI with lnIFDI depicting its natural logarithm.

Summary statistics are presented in Table 1 and the panel dataset runs from 1990 to 2005. Park's (2008) index is reported every five years, and observations for other variables are taken from corresponding years.[7]

The benchmark estimating empirical equation is:

$$IPR_{it} = \alpha_0 + \alpha_1 TRIPS\left(DgCs\right)_{it} + \alpha_2 TRIPS_{it} + \alpha_3 TRIPS\left(DgCs\right)_{it} \times \ln EXP(DgCs)_{it} + \alpha_4 \ln EXP(DgCs)_{it} + \alpha_5 \ln EXP_{it} + \alpha_6 RT_{it} + \alpha_7 EDUC_{it} + \alpha_8 \ln GDPC_{it} + \varepsilon_{it} \quad (1)$$

Variables are as described above, with subscript *i* indicating country i, subscript *t* indicating time period t, and ε_{it} is the stochastic error term. Bracketed terms indicate the group of countries

[7] The UNDP's Human Development Reports provide RT data in five-year blocs; for example, the value for 2000 is the latest observation from the 1996-2000 period. These data are not updated every year, and most of our observed values appear more than once over the reported five-year period. This implies that many of our RT observations are lagged.

considered in the corresponding variable (*i.e.*, DgCs). Accordingly, the variable TRIPS(DgCs) is constructed as an interaction between the binary variable TRIPS and a binary variable that takes the value of one for DgCs and zero otherwise. Also, the variable lnEXP(DgCs) is constructed as an interaction between lnEXP and a binary variable that takes the value of one for DgCs and zero otherwise.

The reference group for the TRIPS binary variable is the group of countries that has not acceded to the TRIPS Agreement; this includes all countries in 1990 and select DgCs that are not bound by the TRIPS Agreement thereafter. The reference group for the DgCs binary variable is all developed and DgCs in the sample. The parameter α_2 estimates the average marginal effect of the TRIPs Agreement on IPR strength, *ceteris paribus*. The parameter α_1 estimates the difference between the average marginal effect of the TRIPs Agreement in DgCs and the effect in all countries that are bound by the TRIPS Agreement, *ceteris paribus*.

The empirical model controls for country-specific and time-specific effects. We anticipate non-spherical errors in the estimation process. Panel sets may be contemporaneously correlated because countries in close geographic proximity may experience common time-specific shocks. Also, the heterogeneity of countries in our dataset is likely to result in heteroskedasticity. Most developed countries did not have to make significant changes to their IPR protection regimes to be compliant with the TRIPS Agreement, but many DgCs were expected to markedly increase IPR protection. These issues are managed using the panel-corrected standard error estimator[8] (Beck and Katz, 1995, 1996), and the Prais and Winsten (1954) method controls for AR(1) type of autocorrelation.

[8] The number of panels exceeds the number of time periods in our dataset so feasible generalized least squares (FGLS) estimation cannot account for contemporaneously correlated panel sets.

4. Results

Column (i) of Table 2 presents the basic empirical results. The estimated coefficient on the TRIPS binary variable for DgCs, TRIPS(DgCs), is positive and statistically significant at the 1% level and the coefficient on the TRIPS binary variable (for all countries in the data set) is not statistically significant. These results are consistent with Cardwell and Ghazalian (2012), and imply that the implementation of the TRIPS Agreement primarily affected patent strength indices in DgCs. The estimates suggest that the implementation of the TRIPS Agreement increased the patent strength index of DgCs by an average of 0.74 points, *ceteris paribus*. Other results show that the estimated coefficient on RT is positive and statistically significant at the 10% level. The estimated coefficients on the other variables depicting the level of economic development (*i.e.*, lnGDPC) and the relative endowment in human capital (*i.e.*, EDUC) are not statistically significant.[9]

Column (ii) of Table 2 presents the empirical results from an augmented empirical specification that includes the interaction variable TRIPS(DgCs)×lnEXP(DgCs), and the variables lnEXP(DgCs) and lnEXP. The estimated coefficient on TRIPS(DgCs)×lnEXP(DgCs) is a measure of how trade ties between DgCs and developed countries augment the effect of the TRIPS Agreement on IP strength in DgCs. This estimated parameter is positive but it is not statistically significant. This suggests that the level of exports to developed countries does not augment the effect of the TRIPS Agreement on the patent strength indices of all DgCs on average. The estimated coefficient on lnEXP(DgCs) is positive and statistically significant at the 1% level, but the coefficient on lnEXP is not statistically significant. This suggests that DgCs that export more to developed countries increased their patent strength indices irrespective of the TRIPS Agreement. For example, a given

[9] This is consistent with Ginarte & Park (1997), which finds that determinants of income, and not necessarily income itself, are important in determining IPR protection strength.

DgC with four times more exports to developed countries than another DgC has a higher patent strength index by 0.32×ln(4)=0.44 points, *ceteris paribus*. It appears as though export value has a direct effect on protection of IPR, but not an indirect effect through magnifying the impact of the TRIPS Agreement. It is also possible that other factors, including the precedents of Section 301 from the US and other international-relations factors, influenced DgCs' IPR protection regimes prior to the implementation of the TRIPS Agreement.

Column (iii) of Table 2 reports the corresponding empirical results when narrowing down the list of export-destination developed countries to the initial proponents of the TRIPS Agreement (*i.e.*, EXP is defined as exports to the United States, the European Union, and Japan). The empirical results and inferences are equivalent to those in column (ii).

Column (iv) of Table 2 presents the results from an empirical specification that measures the relationship strength between DgCs and developed countries using inward FDI stock instead of export value.[10, 11] The estimated coefficient on TRIPS(DgCs)×lnIFDI(DgCs) is positive and statistically significant at the 1% level, taking the value of 0.12.[12] These results imply that the TRIPS Agreement had a larger positive effect on the patent strength indices of DgCs with higher levels of inward FDI stock. For example, a given DgC that holds four times more inward FDI stock than another DgC responded to the TRIPS Agreement by 0.12×ln(4)=0.17 more points, *ceteris paribus*. Furthermore, the estimated coefficient on lnIFDI(DgCs) is also positive and statistically significant at the 1% level, taking the value of 0.13. This outcome implies that DgCs with higher levels of

[10] The correlation coefficient between inward FDI stock and exports to developed countries variables is approximately 0.80.

[11] Developed countries are the principal suppliers of FDI stock through the time period covered in our analysis, accounting for approximately 90% of worldwide outward FDI stock (UNCTAD, 2003).

[12] The variable lnIFDI(DgCs) is constructed as an interaction between the variable lnIFDI and a binary variable that takes the value of one for DgCs and zero otherwise.

inward FDI stock had higher patent strength indices irrespective of the TRIPS Agreement. Combining the effects of inward FDI stock, a DgC that has four times more inward FDI stock than another DgC ended up with a patent strength index that is (0.12+0.13-0.04)×ln(4)=0.29 points higher, *ceteris paribus*.[13]

Empirical Results for Different Geo-Economic Regions

We examine the importance of trade relations for a range of disaggregated geo-economic regions of DgCs: South and Central America (SCA), Middle East and North Africa (MENA), and ASIA. Note that ASIA covers Asian DgCs and, hence, does not include Japan and Republic of (South) Korea. Let the generic term "R" be the geo-economic region under consideration through the empirical analysis. Table 3 reports the empirical results when distinguishing DgCs according to their geo-economic regions. Column (i) of Table 3 replicates the benchmark empirical results presented in column (ii) of Table 2. Column (ii) of Table 3 shows the empirical results for DgCs when R=SCA. The comparison group for a regional binary variable is all DgCs; *i.e.* the parameter on the TRIPS(R) variable estimates the average marginal effect of the TRIPS Agreement on countries in the R aggregation relative to all DgCs that are bound by the TRIPS Agreement. The estimated coefficients on both TRIPS(SCA) and TRIPS(SCA)×lnExp(SCA) are positive but are not statistically significant. Also, the estimated coefficient on lnExp(SCA) is negative but it is not statistically significant. This suggests that the marginal effects of the TRIPS Agreement and of trade ties on the patent strength index of SCA countries are equivalent to the average effects on all DgCs.

Column (iii) of Table 3 presents the results for DgCs when R=MENA. The estimated coefficient on TRIPS(MENA) is positive but not statistically significant, and the estimated

[13] Parameters that are estimated using lagged exports and lagged inward FDI are comparable to those that are estimated using current values. This is anticipated given the close correlation between current and lagged values of exports and of inward FDI.

coefficient on TRIPS(MENA)×lnExp(MENA) is negative and statistically significant at the 10% level. This suggests that MENA countries with higher levels of exports to developed countries made smaller changes to their patent strength indices in response to the TRIPS Agreement than DgCs with lower levels of exports to developed countries. Conversely, countries in the MENA aggregation with more exports to developed countries increased their patent strength indices outside the effects of the TRIPS Agreement.

Column (iv) of Table 3 shows the empirical results for DgCs when R=ASIA. The estimated coefficient on TRIPS(ASIA) is negative and statistically significant at the 1% level, and the estimated coefficient on TRIPS(ASIA)×lnExp(ASIA) is positive and statistically significant at the 1% level. The results imply that the effect of the TRIPS Agreement on the patent strength index is positive for Asian DgCs that have export levels to developed countries above EXP(R)=exp(1)=2.72 billion US dollars. They indicate that the TRIPS Agreement led to considerable increases in patent strength indices of Asian DgCs that have large export levels to developed countries (*e.g.*, China, India, and Thailand).[14] Moreover, the results reveal that DgCs of ASIA with higher export levels to developed countries have responded more to the TRIPS Agreement than other DgCs in the ASIA aggregation. This is consistent with the hypothesis that coercive threats from export-destination developed countries affected behaviour. For example, an Asian DgC that exports four times more to developed countries than another Asian DgC increased more its patent strength index by 0.29×ln(4)=0.40 points irrespective of the TRIPS Agreement and by 0.27×ln(4)=0.37 points following the implementation of the TRIPS Agreement for a total of 0.77 points, *ceteris paribus*.

[14] There are few observations for Asian DgCs (Jordan and Sri Lanka) where exports to developed countries are below 2.72 billion US Dollars.

Table 4 presents the empirical results when measuring international ties with inward FDI stock for DgCs of different geo-economic regions. Column (i) of Table 4 replicates the benchmark empirical results that correspond to column (iv) of Table 2. Column (ii) of Table 4 shows the empirical results for DgCs of the SCA aggregation. The estimated coefficients on TRIPS(SCA), TRIPS(SCA)×lnIFDI(SCA), and lnIFDI(SCA) are not statistically significant. Inferences for SCA when using inward FDI stock are equivalent to those derived when using exports - they both resemble the average effects for all DgCs.

Column (iii) of Table 4 displays the results for DgCs of MENA. The estimated coefficient on TRIPS(MENA) is positive and statistically significant at the 5% level and the estimated coefficient on TRIPS(MENA)×lnIFDI(MENA) is negative and statistically significant at the 5% level. The estimated coefficient on lnIFDI(MENA) is positive and statistically significant at the 5% level. The effects of inward FDI stock on the patent strength indices of DgCs of MENA are larger than the average effect for DgCs. Countries in the MENA aggregation with higher levels of inward FDI stock increased their patent strength indices irrespective of the TRIPS Agreement. The corresponding effect (0.29+0.13=0.52) is higher than for all DgCs (0.13), however DgCs of MENA with lower levels of inward FDI stock responded more significantly to the TRIPS Agreement by increasing their patent strength indices. The inferences are comparable to those derived from the specification that uses export values as measures of international ties.

Column (iv) of Table 4 presents the empirical results for DgCs of ASIA. The estimated coefficient on TRIPS(ASIA) is negative and statistically significant at the 1% level, whereas the estimated coefficient on TRIPS(ASIA)×lnIFDI(ASIA) is positive and statistically significant at the 1% level. The results indicate that the effect of the TRIPS Agreement is positive for the patent strength

of Asian DgCs which have inward FDI stocks above IFDI(R)=exp(1.40)=4.06 billions of US dollars. Also, they suggest that higher levels of inward FDI stocks augmented the effects of the TRIPS Agreement on patent strength for Asian DgCs. For example, an Asian DgC that hosts four times more inward FDI stock than another Asian DgC has a higher patent strength index by 0.11×ln(4)=0.15 points irrespective of the TRIPS Agreement and by (0.23+0.11)×ln(4)=0.47 points in total following the implementation of the TRIPS Agreement, *ceteris paribus*. These results also correspond to those derived when measuring international ties with export value.

5. Discussion

A cursory empirical analysis of the data confirms the findings of Cardwell and Ghazalian (2012) that the TRIPS Agreement was a significant factor in strengthening regulatory protection of IPR in DgCs. The same cursory analysis suggests a positive correlation between a DgC's level of exports to developed countries and its protection of IPR. However, it is not immediately apparent that the strength of trade ties magnifies the effect of the TRIPS Agreement on a country's determination of regulatory IPR protection. Put another way, the potential of retaliatory trade sanctions does not appear to provide added incentives for DgCs to modify their IPR regimes through the TRIPS Agreement; at least not in our baseline model.

Closer analyses of the data reveal a more nuanced story. Estimation through a specification that disaggregates the effects by geo-economic regions reveals that the importance of the threat of trade retaliation is not uniform across regions. The threat of trade retaliation did affect the magnitude of the response of Asian DgCs to the TRIPS Agreement. Those Asian DgCs that export more to developed countries made relatively larger changes to their patent strength indices. MENA countries that export more to developed countries made relatively larger changes

to their patent strength indices irrespective of the TRIPS Agreement. However, these countries made relatively smaller changes to their patent strength indices as a response to the TRIPS Agreement. Developing countries in the SCA aggregation increased their IPR protection regimes in response to the TRIPS Agreement and in response to exports to developed countries, but not significantly differently from other DgCs.

The effects of export ties to developed countries are valuable in measuring the importance of retaliatory trade threats. However, there are a host of other international-relations factors that could impact governments' decisions on regulatory protection of IPR. Measuring international ties through inward FDI stocks yields similar results to the models that use export values. This suggests that commercial relationships developed through FDI (and perhaps a host of other factors) are also important determinants in IPR protection decisions in DgCs. Though we do not explicitly model them here, other international-relations factors could include reputational considerations, diplomatic and military relations, and goodwill adherence to international obligations (especially the WTO set of agreements).

What can we say about the effectiveness of cross-agreement retaliation in the context of the TRIPS Agreements? If threats of such retaliation were effective, then exports to developed countries should significantly impact the effect of the TRIPS Agreement on protection of IPR. This is not always the case. Developing countries generally increase IPR protection regimes in response to trade flows and in response to the TRIPS Agreement, but these effects are only complimentary in some geo-economic regions. Some regions/countries change their domestic IPR protection regimes in response to other types of commercial ties, diplomatic relations, or goodwill adherence to their WTO obligations.

6. Conclusions

We initially hypothesise that WTO-member countries with strong trade ties to IP-abundant countries made larger changes to their domestic IPR protection regimes in response to the TRIPS Agreement than WTO-member countries that do not trade intensively with IP-producing countries. This is expected because countries that export more to partners that advocated for the TRIPS Agreement have more to lose in the event of retaliatory trade sanctions. This hypothesis is generally rejected when estimating over the entire dataset, and in the case of some disaggregated geo-economic regions. However, this hypothesis holds for other regions such as Asia. Hence, the potential for cross-agreement retaliation does not appear to influence domestic IPR enforcement regimes in all countries. Membership in the WTO (and its resultant obligations under the TRIPS Agreement) and trade ties with TRIPS Agreement advocating countries are separately significant determinants of IPR protection regimes. However the two factors do not reinforce each other in all regions.

Our model does not allow us to identify the range of important international factors (such as diplomacy, reputational concerns and goodwill adherence) that contribute to countries' IPR systems. However, we do identify that non-trade commercial ties, as measured by inward FDI, are important determinants of IPR strength. This suggests that the threat of cross-agreement trade retaliation that is allowed by the TRIPS Agreement is just one tool that IP-intensive firms in developed countries can wield in attempts to extraterritorially enforce their IPR.

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Table 1: Summary Statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
Patent Strength Index, [Park (2008)]	3.13	1.11	0.59	4.84
TRIPS(DgCs), [binary variable]	0.22	0.41	0	1
TRIPS, [binary variable]	0.50	0.50	0	1
EXP(DgCs), [billions of US dollars]	10.10	36.44	0	444.63
EXP, [billions of US dollars]	56.89	104.02	0.01	704.98
IFDI(DgCs), [billions of US dollars]	11.70	33.31	0	272.09
IFDI, [billions of US dollars]	70.68	172.20	0.01	1634.12
RT, [hundreds of researchers and technicians in R&D per million of population]	1.63	1.91	0.01	10.00
EDUC, [combined first-, second-, and third- level enrolment ratios]	0.72	0.20	0.23	1.14
GDPC, [thousands of US dollars]	11.11	13.22	0.10	65.51

Notes: Observations are every five years, from 1990 to 2005. Number of observations is 236.

Table 2: Effects of TRIPS and Trade Ties on IPR Protection

	(i)	(ii)	(iii)	(iv)
TRIPS(DgCs)	0.742***	0.402***	0.298**	0.117
	(0.131)	(0.096)	(0.150)	(0.081)
TRIPS	-0.006	0.221**	0.217**	0.230**
	(0.131)	(0.105)	(0.105)	(0.094)
TRIPS(DgCs)×lnEXP(DgCs)		0.018	0.016	
		(0.025)	(0.025)	
TRIPS(DgCs)×lnIFDI(DgCs)				0.120***
				(0.030)
lnEXP(DgCs)		0.324***	0.317***	
		(0.106)	(0.099)	
lnIFDI(DgCs)				0.133***
				(0.028)
lnEXP		-0.206	-0.197	
		(0.149)	(0.133)	
lnIFDI				-0.039**
				(0.021)
RT	0.047*	0.057**	0.058**	0.049*
	(0.027)	(0.23)	(0.024)	(0.029)
EDUC	0.123	0.168	0.184	-0.164
	(0.297)	(0.228)	(0.230)	(0.241)
lnGDPC	0.252	0.226	0.204	-0.055
	(0.421)	(0.288)	(0.279)	(0.285)
Observations	236	236	236	236
R^2	0.940	0.941	0.942	0.943
ρ	-0.165	-0.161	-0.164	-0.146

Notes: The dependent variable is patent strength index. The standard errors are corrected for heteroskedasticity and contemporaneous correlation using the Panel Corrected Standard Error (PCSE). The Prais-Winsten method is used to control for autocorrelation of type AR(1) of error terms. The standard errors are reported in parentheses. The common AR(1) parameter is denoted by "ρ". The regressions control for country-specific and time-specific effects. The symbols "***", "**" and "*" denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 3: Effects of TRIPS and Trade Ties on IPR Protection - Disaggregated Geo-Economic Regions

	(i)	(ii)	(iii)	(iv)
	Benchmark Results	R=SCA	R=MENA	R=ASIA
TRIPS(R)		0.413	0.398	-1.040***
		(0.274)	(0.371)	(0.314)
TRIPS(DgCs)	0.402***	0.280***	0.324***	0.521***
	(0.096)	(0.087)	(0.122)	(0.121)
TRIPS	0.221**	0.214*	0.223**	0.249**
	(0.105)	(0.112)	(0.111)	(0.102)
TRIPS(R)×lnEXP(R)		0.039	-0.217*	0.270***
		(0.033)	(0.130)	(0.089)
TRIPS(DgCs)×lnEXP(DgCs)	0.018	0.010	0.043	0.026
	(0.025)	(0.028)	(0.027)	(0.041)
lnEXP(R)		-0.110	-0.154	-0.028
		(0.282)	(0.174)	(0.119)
lnEXP(DgCs)	0.325***	0.332***	0.343***	0.289**
	(0.106)	(0.106)	(0.106)	(0.132)
lnEXP	-0.206	-0.193	-0.210	-0.169
	(0.149)	(0.159)	(0.147)	(0.157)
RT	0.057**	0.058***	0.053***	0.060***
	(0.23)	(0.021)	(0.020)	(0.022)
EDUC	0.168	0.070	0.156	-0.200
	(0.228)	(0.195)	(0.224)	(0.252)
lnGDPC	0.226	0.297	0.235	0.049
	(0.288)	(0.364)	(0.286)	(0.192)
Observations	236	236	236	236
R^2	0.941	0.946	0.943	0.948
ρ	-0.161	-0.181	-0.164	-0.181

Notes: The dependent variable is patent strength index. The standard errors are corrected for heteroskedasticity and contemporaneous correlation using the Panel Corrected Standard Error (PCSE). The Prais-Winsten method is used to control for autocorrelation of type AR(1) of error terms. The standard errors are reported in parentheses. The common AR(1) parameter is denoted by "ρ". The regressions control for country-specific and time-specific effects. The symbols "***", "**" and "*" denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4: Effects of TRIPS and FDI on IPR Protection - Disaggregated Geo-Economic Regions

	(i)	(ii)	(iii)	(iv)
	Benchmark Results	R=SCA	R=MENA	R=ASIA
TRIPS(R)		0.337	1.063**	-1.011***
		(0.469)	(0.482)	(0.330)
TRIPS(DgCs)	0.117	-0.010	0.081	0.288**
	(0.081)	(0.104)	(0.089)	(0.113)
TRIPS	0.230**	0.238**	0.222**	0.253***
	(0.094)	(0.101)	(0.092)	(0.090)
TRIPS(R)×lnIFDI(R)		0.007	-0.471**	0.227***
		(0.028)	(0.206)	(0.087)
TRIPS(DgCs)×lnIFDI(DgCs)	0.110***	0.094***	0.124***	0.108***
	(0.030)	(0.031)	(0.032)	(0.031)
lnIFDI(R)		0.029	0.390**	0.014
		(0.299)	(0.193)	(0.074)
lnIFDI(DgCs)	0.133***	0.141***	0.127***	0.127***
	(0.028)	(0.023)	(0.032)	(0.028)
lnIFDI	-0.039**	-0.039**	-0.034	-0.046**
	(0.021)	(0.019)	(0.021)	(0.021)
RT	0.049*	0.051*	0.033	0.051*
	(0.029)	(0.028)	(0.025)	(0.028)
EDUC	-0.164	-0.258	-0.123	-0.442*
	(0.241)	(0.210)	(0.254)	(0.255)
lnGDPC	-0.055	0.034	0.015	-0.125
	(0.285)	(0.341)	(0.266)	(0.245)
Observations	236	236	236	236
R^2	0.943	0.949	0.946	0.949
ρ	-0.146	-0.177	-0.154	-0.168

Notes: The dependent variable is patent strength index. The standard errors are corrected for heteroskedasticity and contemporaneous correlation using the Panel Corrected Standard Error (PCSE). The Prais-Winsten method is used to control for autocorrelation of type AR(1) of error terms. The standard errors are reported in parentheses. The common AR(1) parameter is denoted by "ρ". The regressions control for country-specific and time-specific effects. The symbols "***", "**" and "*" denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Appendix

Table A1: List of Countries in Dataset

Argentina	Germany	Philippines
Australia	Greece	Poland
Austria	Hungary	Portugal
Bangladesh	Iceland	Romania
Belgium	India	Rwanda
Benin	Iran	Senegal
Bolivia	Ireland	South Africa
Brazil	Italy	Spain
Bulgaria	Japan	Sri Lanka
Burundi	Jordan	Sweden
Canada	Korea, Republic of	Thailand
Central African Republic	Madagascar	Togo
China	Malaysia	Tunisia
Cyprus	Mauritius	Uganda
Denmark	Mexico	United Kingdom
Ecuador	Netherlands	United States
Egypt	New Zealand	Uruguay
El Salvador	Norway	Venezuela
Finland	Pakistan	Viet Nam
France	Peru	