Intellectual Property-Related Preferential Trade Agreements and the Composition of Trade*

Keith E. Maskus†
Department of Economics
University of Colorado

William Ridley‡
Department of Economics
University of Colorado

July 11, 2017

Abstract

We study how preferential trade agreements (PTAs) with complex chapters covering intellectual property rights (IPRs) affect the composition of trade. Despite the proliferation of PTAs with strong IPRs standards, their effects on the trade of member countries has not been studied. Our identification framework finds that such PTAs, where one partner is a major developed economy or region, have significant impacts. We control for the timing of PTAs relative to compliance with global IPRs rules. The results are broken down by income groups and trade in IP-sensitive sectors. We find that regulatory aspects of trade agreements have important cross-border impacts.

JEL codes: F14, F15, O34
Keywords: trade agreements, intellectual property rights, high-technology trade

*We gratefully acknowledge the creators of the Design of Trade Agreements Database (DESTA) available at http://www.designoftradeagreements.org, whose work facilitated this research. We also thank Carsten Fink, Olena Ivus, Tristan Kohl, and Walter Park for comments on an earlier draft.

†Department of Economics, UCB 256, University of Colorado, Boulder, CO 80309-0256; Email: keith.maskus@colorado.edu

‡Department of Economics, UCB 256, University of Colorado, Boulder, CO 80309-0256; Email: william.ridley@colorado.edu

1 Introduction

The international framework for protecting intellectual property rights (IPRs) has evolved considerably in recent decades, with these changes amounting to the most dramatic globalization of rights to knowledge in history (Maskus, 2012). A systematic negotiating effort, primarily led by the United States and the European Union (EU), has instituted significant changes in how developing and emerging countries regulate the rights to use industrial knowledge assets and creative works through IPRs, meaning patents, copyright and related rights, trademarks, and related constructs. The basis of this campaign was the multilateral Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), a foundational component of the World Trade Organization (WTO). TRIPS requires WTO member countries to provide minimum standards of protection and coverage for comprehensive aspects of IPRs.

These WTO rules are just part of the story, however. In the period since TRIPS was ratified, the United States, the European Free Trade Association (EFTA), and the EU increasingly have demanded even stronger protection for IPRs in their bilateral and regional preferential trade agreements (PTAs).[1] For example, the United States has concluded PTAs with Jordan, Peru, Australia, South Korea, and other countries that feature elevated patent protection for pharmaceuticals and chemicals, stronger regulations governing copyrights in digital goods, and expanded penalties for trademark infringement. Thus, these agreements generally provide far-reaching and specific coverage requirements that were not considered at the WTO. The recently negotiated 12-country Trans-Pacific Partnership (TPP) calls for yet stronger IPRs, including rigorous rules for protecting trade secrets. Still under negotiation is the Transatlantic Trade and Investment Partnership, which would link IPRs standards more tightly between Europe and North America. All of this suggests that the role of PTAs in determining how the international intellectual property environment takes shape will expand even further.[2]

The TRIPS Agreement has received attention in the empirical literature regarding the effects of changes in international IPRs policy on such economic outcomes as trade, FDI, and knowledge transfer. The role of PTAs that feature strong IPRs rules has so far been neglected, however. These agreements, which have grown steadily in number since the mid-1990s, are an important means by which IPRs policy is set at the international level. In turn, they are a potentially significant determinant of trade and investment patterns, innovation activities, and other important economic outcomes. As such, they deserve systematic study, which we initiate in this paper. Specifically, we consider the impact of national membership in PTAs with

[1] The EU negotiates trade agreements as a single entity. While EFTA members (Iceland, Liechtenstein, Norway, and Switzerland) are empowered to strike bilateral deals, they share a coordinated trade policy that favors bargaining as a single bloc. Further, EFTA countries participate in the EU's single market.

[2] The recent US presidential election called into question the viability of TPP and TTIP but it remains to be seen whether they will be reconstituted in some form in the future.

substantive chapters governing IPRs regulation, where one partner is the US, the EU, or EFTA, on the value and composition of member countries' aggregate and sectoral trade.

As discussed in Section 2 below, the relationship between strengthened IPRs and the volume and composition of trade, both imports and exports, is ambiguous for numerous reasons. Put simply, rules governing IPRs are different from import barriers. A cut in a particular import tariff is effectively a reduction in trade costs, implying higher trade. Much the same may be said about across-the-board reductions in trade taxes, which expand trade overall even as there may be some unanticipated decreases in imports of some goods due to product-interaction effects. Tariff cuts generally expose domestic firms to competition, destroying market power. Intellectual property rights, however, create temporary monopolies in the use, including trade, of particular technologies and goods. The exclusive rights offered by patents, copyrights, and trademarks permit rights-holders to decide where, when, and how they will produce and sell protected products and license patented technologies and digital goods.

Because multiple and contradictory theoretical predictions about potential effects of IPRs on trade, foreign direct investment (FDI), licensing, and pricing are possible, the issue is ultimately empirical. In this context, numerous studies, beginning with Maskus and Penubarti (1995), have analyzed the impacts on either aggregate or broad sectoral imports, focusing mainly on simple cross-country and temporal variations in indexes of legal patent protection. While the results of early studies, using data prior to TRIPS, were mixed (Co, 2004; Smith, 2001), they found evidence that countries with stronger patent rights attracted increased imports of high-technology goods, especially in emerging countries with a notable ability to absorb and imitate international technologies. Using micro-level data on the affiliates of US multinational enterprises, Branstetter et al. (2011) detected significantly positive impacts of domestic patent reforms in several emerging economies on local R&D, employment, and exports at the extensive margin.

More recent papers have focused on the effects of TRIPS. Thus, Ivus (2010) found that one group of developing countries, which were obliged by the WTO agreement to adopt stronger patent reforms than a similar group, experienced significantly higher import growth in high-technology products. Using a more comprehensive sample, Delgado et al. (2013) studied the dates at which developing countries implemented the TRIPS patent rules and discovered a significant causal effect of reforms on imports of particular patent-intensive goods. Maskus and Yang (2016) found a significantly positive effect of patent reforms in the TRIPS era on the growth and composition of detailed sectoral exports in both emerging and developed economies.

Thus, an evidentiary consensus is emerging around the proposition that strengthening IPRs, particularly as associated with the TRIPS Agreement, has the effect of increasing both imports and exports among developed and middle-income emerging economies, especially in high-technology and IPRs-sensitive goods. As noted above, however, this question has not been studied in the context of the additional strengthening of

IPRs associated with high-protection preferential trade agreements. Indeed, it is possible that these estimated WTO impacts on trade are actually some combination of outcomes from both multilateral (TRIPS) and IP-related regional agreements. In this context, the United States, the EU, and EFTA expend considerable negotiating and political capital to convince their trading partners within PTAs to adopt so-called "TRIPS-Plus" standards for IPRs, arguing that doing so will expand innovation and trade. Because these entities push far more than other nations for such rules, the IP-related agreements featuring one of them as a partner offer an important laboratory for studying their trade effects.

To date, the claim that TRIPS-Plus chapters stimulate trade is based solely on qualitative analysis and anecdotes, for there is no systematic evidence on this question. This is the analytical hole we hope to begin filling with this paper. Specifically, we ask whether PTAs with chapters requiring IPRs standards that exceed TRIPS expectations have some additional impact on the aggregate trade of countries, over and above that of TRIPS. We also ask whether these effects vary by countries broken down into income groups (development levels) and industries broken down into the sensitivity with which they rely on various forms of intellectual property protection. Following Delgado et al. (2013), we pay particular attention to trade in pharmaceuticals, chemicals, and information and communication technologies, for these are the areas in which protective IPRs chapters set down particularly rigorous standards. Pharmaceuticals are particularly contentious in this context, given the potential for stronger patents to limit generic competition, thereby raising prices and limiting access to new drugs (Chaudhuri et al., 2006; Duggan et al., 2016). The latter effect might arise in part due to endogenous decisions of drug companies to limit exports to PTA partner markets.

Thus, our paper contributes to the emerging literature on how "behind the border" regulatory regimes may affect economic activity, including international trade. At the same time, it fits into the literature on the economic effects of PTAs, which certainly can differ from those of basic WTO membership. For example, Rose (2004) asked whether membership in the WTO actually increased a member's trade, finding evidence that it did not and stimulating a literature contesting this result. Whether PTAs, such as NAFTA, actually increase or decrease trade, couched in terms of trade creation or trade diversion, has long been a subject of theoretical and empirical research (Bagwell and Staiger, 1997; Romalis, 2007; Baier and Bergstrand, 2007).

Note that traditional studies of PTAs consider reductions in trade barriers between members to be the main policy impact of free trade agreements. These cuts are necessarily discriminatory in their treatment of members versus non-members. Thus, such studies naturally focus on bilateral or within-agreement trade effects, accounting also for trade diversion from outside. When considering IPRs, however, the logic is different in at least one critical way, arising from the inherent spillover effect created by national IPR regimes. Specifically, when a country strengthens its IPRs as a result of provisions in a PTA, by, for example, enhancing patent protection or bolstering its IPRs enforcement, it must extend this treatment to all WTO members. That is, it cannot discriminate in its treatment of rights-holders from PTA members versus others. Legally, this proscription comes from TRIPS, which demands of any WTO member that its IPRs regulations must be subject to the most-favored nation and national treatment principles. In practical terms, it makes little sense to discriminate across the origins of applications for intellectual property protection. Thus, in principle, rights-holders from countries not party to a PTA are affected legally under the same terms as their counterparts from member countries. This fact suggests that the effects of IPRs chapters in PTAs are spread beyond the agreements' members *de jure*, though it does not preclude the possibility of *de facto* discrimination, an item left for future research.

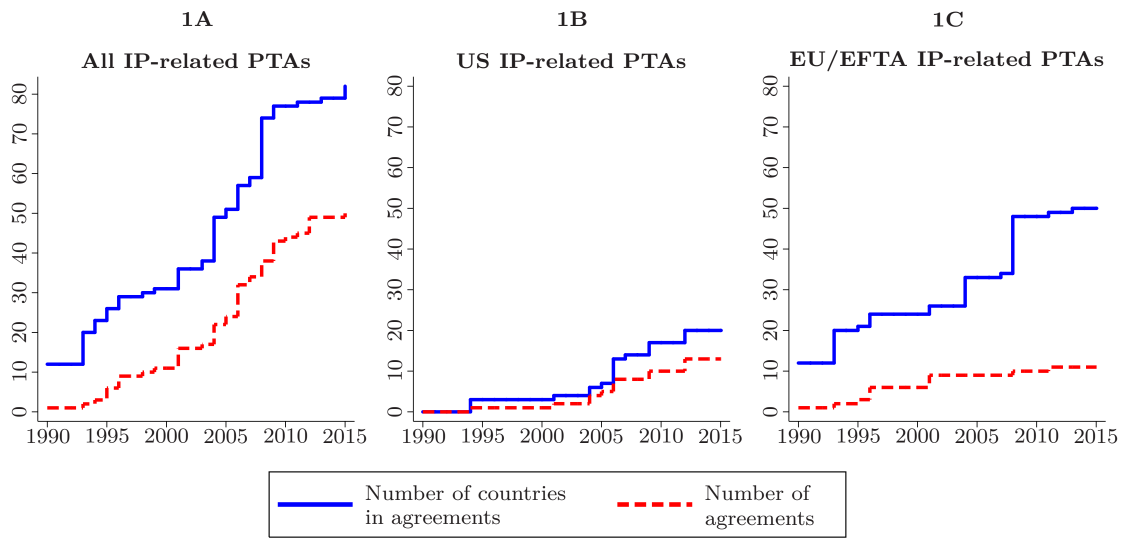
The remainder of the paper is organized as follows. Section 2 provides historical background on the development of PTAs with strong intellectual-property chapters, which we call IP-related PTAs, and gives an overview of their scope and coverage. It also briefly revisits the ambiguous theory surrounding IPRs. Section 3 describes the empirical framework and provides estimates of the effects of IP-related PTAs on aggregate and sectoral imports and exports. Section 4 discusses some implications of the results and presents concluding remarks.

2 Background

The nature and focus of PTAs have changed considerably in recent decades. Their traditional purview was almost exclusively to reduce barriers to trade and expand market access between member countries. This scope was broadened considerably in the mid-1990s, with the creation of the North American Free Trade Agreement (NAFTA) and the negotiation of multiple bilateral treaties between the European Free Trade Association and individual countries, such as Estonia, Latvia, and Mexico. One primary novelty of these trade agreements was to pay greater attention to IPRs. A decade later, the EU followed suit with its own "new trade policy," asking for stringent protection of patents, copyrights, geographical indications and other elements of IPRs in its proliferating PTAs with countries in Eastern Europe and the Middle East, and, more recently, the Caribbean and Latin America.

NAFTA was the first multi-country, large-scale PTA that went far beyond tariff-cutting to set minimum standards, if not harmonization, in key regulatory areas, including nearly every aspect of IPRs. In the patents area NAFTA requires, among other things, minimum patent duration, confidentiality for pharmaceutical trial data, and extensions in patent length to compensate for administrative delays in granting protection. It also requires a minimum copyright length and stipulates what types of works must be protected, including with various neighboring rights. NAFTA calls for protection of geographical names through an effective

Figure 1: Number of IP-related trade agreements and number of countries with membership in one or more IP-related trade agreements by year, 1990 to 2015



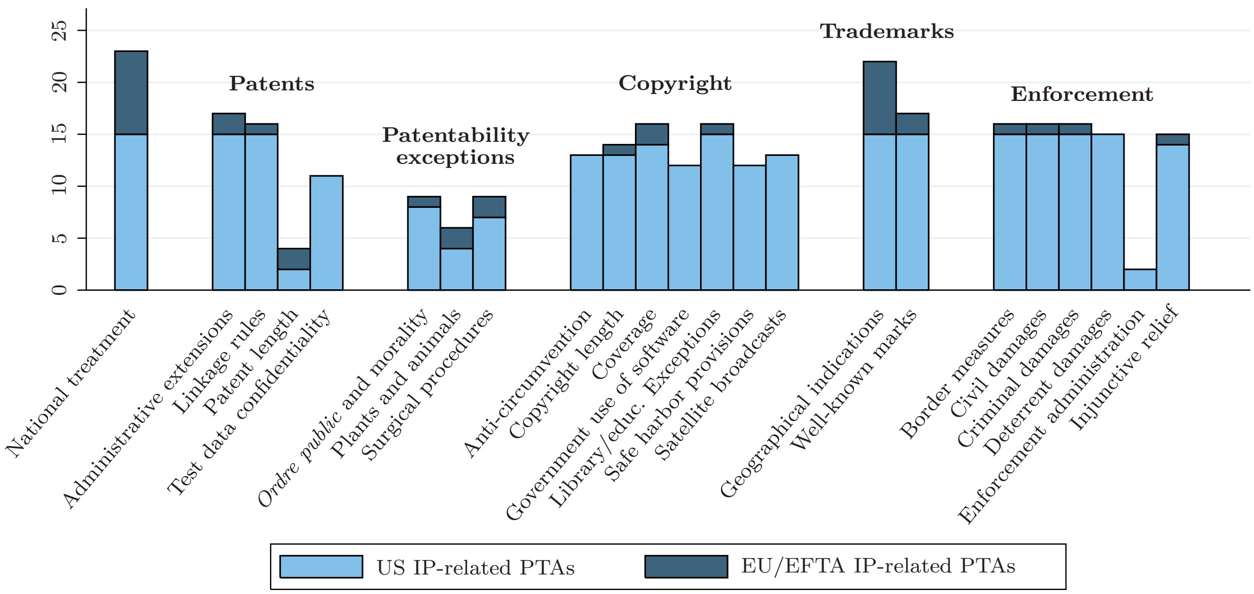
Source: Based on data from Dür et al. (2014)

equivalence with trademarks and collective marks, as well as automatic recognition of internationally well-known marks. The agreements made by the EU and EFTA have similar requirements, though they vary in certain areas of emphasis. These agreements, and those concluded by the United States, also require members to join various international treaties on IPRs.

The evolution of PTAs beyond their traditional scope accelerated after 2000, with subsequent agreements reached by the United States or the EU including strong IPR provisions as a matter of negotiating priority. To be sure, other newly created trade agreements, which do not involve those countries or regions, have been reached by Mexico, Japan, Australia, South Korea, and Chile, among others. These PTAs also include chapters on IPRs, though generally with less rigorous standards in key areas. Figure 1A illustrates the persistent growth after 1993 in the number of PTAs that are "IP-related" according to the definition set out in Dür et al. (2014) and the corresponding expansion in membership. This definition simply requires the existence of an IPRs chapter, no matter how limited or comprehensive, to qualify. As of 2015, 50 such agreements were in place, with 82 different countries claiming membership in at least one of them. Figures 1B and 1C, in contrast, show the growth in IP-related PTAs involving the US, the EU, or EFTA. There were 24 such agreements by 2015, involving 70 countries.[3] Owing to the high degree of standards harmonization in IPRs, we classify the EU itself as an IP-related trade agreement in our sample.[4] As noted, these PTAs

[3]See Appendix Table A2 for the list of US-, EU-, and EFTA-negotiated IP-related agreements and their entry-into-force years.
[4]Our findings are robust to the alternative, in which a country's membership in active IP-related agreements between the EU and another party enters it into the treatment group, but not EU membership by itself.

Figure 2: Number of IP-related trade agreements by presence of specific provisions



Source: Authors' construction

involve more extensive expectations about standards and enforcement. Thus, we focus our analysis on these PTAs, thinking of them as a policy treatment group with respect to potential trade impacts.

It is important to note that while many different trade agreements cover IPRs, they do not treat all elements of intellectual property in the same way, nor do they operate with the same degree of depth. In principle, countries joining PTAs make different decisions about IPRs and other policies based on their own political-economic interests. Japan and South Korea, for example, are concerned about extending patent rights, while Australia prefers weaker standards governing copyrights. Developing countries might be expected to place more importance on sustaining access to international technologies and information, including the rights to diffuse such knowledge widely through imitation or other means. In this context, it is perhaps surprising that these countries increasingly agree to strong IPRs chapters in PTAs, a point we exploit in our econometric analysis. The point here is that different countries likely negotiate agreements to emphasize particular aspects of IPRs.

For its part, the United States places great emphasis on assuring patent and copyright protection for its own nationals' inventions and creative works in foreign markets and negotiates its international agreements accordingly. The EU and EFTA do so as well but emphasize even more the protection of geographical indications, which protect the rights to use place names in wines, spirits, and other products. Figure 2 sheds light on specific provisions found in IP-related trade agreements reached by these entities, cumulated across them.[5] All of these PTAs specifically mention national treatment, or non-discrimination with respect to the treatment of the intellectual property of foreign nationals. American agreements require administrative extensions for delays in the patent approval process, linkage rules requiring that the originators of a product be notified when a potential producer of an identical generic product applies for marketing approval, and requirements for test data confidentiality for pharmaceuticals and chemicals. These are key components of the "TRIPS-Plus" requirements of IP-related PTAs. The EU and EFTA have begun to demand similar rules. To be sure, there are exceptions to strong patent scope. A small number of US-involved PTAs allow parties to exempt from patentability plants and animals, surgical or therapeutic procedures, or inventions that disrupt *ordre public*. The EU agreements are relatively more lenient in this regard and also tend to exempt microorganisms from patent eligibility, reflecting their domestic legal systems.

With regard to copyrights, the breadth of coverage varies considerably. Most agreements stipulate minimum durations for copyright (generally the author's lifetime plus 70 years, which is in excess of the TRIPS standard of life plus 50 years) and specify what types of works must be eligible for coverage. Inevitably, with the rise of the digital economy, rules preventing circumvention of digital rights management and ending government use of illegally-acquired software have become major concerns. In trademarks, the vast majority of these PTAs require the protection of geographical indications in some fashion, with the EU and EFTA being particularly strict in this area, and recognition of well-known marks. Finally, with regard to enforcement, US-brokered agreements require both criminal and civil penalties for infringement, special border customs measures for dealing with infringing material, injunctive relief, and establishment of within-PTA enforcement administrations or committees. Again, these provisions exceed TRIPS standards. Recent EU agreements have begun to take on similar provisions. All told, there is an increasingly broad scope of IP-related agreements covering a comprehensive range of often controversial issues. This trend suggests that both domestic and foreign rights-holders in countries that are party to US-, EU-, or EFTA-partnered PTAs operate under IPRs regimes that are notably more stringent than those of countries unconnected to such agreements.

Within this complex framework it is worth reconsidering how IPRs, which may seem only indirectly related to comparative advantage, might importantly affect countries' trade. Even at the simplest level the anticipated effects of IPRs policy revisions are theoretically ambiguous. As discussed by Maskus and Penubarti (1995), stronger domestic protection of intellectual property creates several cross-cutting effects. First, the market-expansion effect would increase imports if foreign rights-holders can more easily safeguard their intellectual property, affording them a larger effective market size. This should especially be the case in those sectors most reliant on IPRs. Second, the market-power effect from strengthened IPRs might lead to rights-holders engaging in monopolistic behavior, restricting sales and raising prices in destination markets. Third,

[5] We combine the EU and EFTA agreements because there are far fewer of them in the data than US-partnered PTAs.

a cost-reduction effect could emerge as firms find it less necessary to disguise the technical aspects of their products or become more willing to ship advanced-technology inputs. Note that such effects could reduce both the variable and fixed costs of exporting to particular markets, with a potential increase in both the intensive and extensive margins of trade.

Next, the impacts of patent reforms could interact with firms' choice of modes with which they serve foreign markets. Again, stronger patents, trade secrets and trademarks could lower the fixed costs of entering a market via local production, whether due to reduced legal costs or a more favorable bargaining position with local intermediate suppliers. This should raise the relative level of inward FDI and technology licensing in the market, perhaps at the expense of imports (Vishwasrao, 1994; Nicholson, 2007). Nonetheless, it is possible for both imports and inward FDI to increase as the destination country's market becomes more attractive due to stronger IPRs.

These scenarios refer to reasons why IPRs reforms in destination markets could alter the exports of goods from technology-leading nations to both similar countries and emerging economies. It is also possible for domestic policy changes to affect exports of local firms. On the one hand, the technology access implicit in greater imports can build domestic capacities through adoption, adaptation, and learning spillovers, eventually leading to technology-oriented exports (Branstetter and Saggi, 2011; He and Maskus, 2012). On the other, stronger IPRs potentially limit the ability of local firms to imitate and copy technologies, diminishing their possibilities for exporting domestic versions of advanced or even lower-technology goods. In another vein, stronger patent rights may either incentivize more innovation on the part of domestic firms or raise the costs of follow-on R&D. Available evidence is mixed on this point, though it suggests innovation in emerging countries may be enhanced subject to certain threshold effects in education and competition (Chen and Puttitanum, 2005; Qian, 2007).

There remains the question of why PTAs with strong IPRs chapters may exert an additional influence, positive or negative, on the imports and exports of member nations. To some degree the answer is simply that such agreements increase IPRs protection above the global baseline of TRIPS, so that any primary trade effects could be magnified. Also important, however, are potential interactions of IPRs with the market-size impacts of PTAs. By establishing larger areas within which both trade is liberalized and key elements of intellectual property protection are enhanced, IP-related PTAs could have a dual impact on trade within the region. This effect should arise particularly in goods that intensively rely on various forms of IPRs, a hypothesis we test statistically and for which we find considerable evidence.

Our analysis in this paper addresses just the first of many interesting and relevant questions that could be posed. For example, are there particular interactions between trade and FDI flows within IP-related PTAs? Do such PTAs generate additional channels of learning that induce export growth within or outside the region? Are tendencies toward trade diversion associated with discriminatory tariff cuts offset by the non-discrimination inherent in IPRs, or does this depend on the sector? We leave such questions to later research.

3 Empirical Framework and Estimation Results

Given the extensive changes in national IPRs policy wrought by bilateral and multilateral trade agreements, and the potential mechanisms outlined above through which such reforms could affect trade flows, our objective in the empirical analysis is to uncover what effects membership in IP-related trade agreements has had on countries' aggregate imports and exports.[6] To do this we adopt a treatment-control econometric framework, where we first compare separately countries' aggregate imports or exports across two sectors: an IP-intensive group of commodities (High-IP), and a group of products classified as less reliant on IPRs (Low-IP). We take our definition of IP-intensive and less IP-intensive commodities from Delgado et al. (2013). They classify the traded commodity codes in the Standard International Trade Classification (SITC), Revision 3, into high-IP or low-IP sectoral classifications based on a similar categorization of the Standard Industrial Classification (SIC) codes in the Economics and Statistics Association of the U.S. Patent and Trademark Office's 2012 report on intellectual property.[7] Finally, because the effects of changes in IPRs regimes might vary by countries' comparative development levels, we later allow for any effect of membership in IP-related trade agreements to vary by income groups.

As detailed in Section 2, IP-related PTAs cover multiple aspects of IPRs and vary in their specific regulatory provisions. Therefore, to add depth to the empirical analysis we later break down the sectoral classification. First we classify goods according to the mode of IPRs (patents, copyrights, and trademarks) on which they may rely intensively. Second, we consider specific high-IP industry clusters as noted below.

Table 1 presents the characteristics of "treatment" vs. "control" countries. Here the treatment group is defined as the set of countries that will at some point in the sample period enter into an IP-related PTA. These figures are broken down by income groups at the beginning (1993), middle (2003), and end (2013) of the period. Immediately apparent is that the groups are not identical. The treatment high-income countries tend to be larger in GDP than their control counterparts, a ranking that reverses for middle-income and low-income country groups. Treatment nations have somewhat higher per-capita GDP levels in all groupings.

[6] In later research we intend to examine the role of IPRs in bilateral trade linkages, as in Smith (2001) or Co (2004). Certainly if an origin or destination country in a bilateral pair bolsters its protection of IPRs via the provisions of a PTA, bilateral trade between them could be affected. It would also be of interest to study whether IPRs rules in PTAs generate marginal changes in trade creation or trade diversion. At this point, we rely on the MFN principle embedded in these PTAs and focus on aggregate trade impacts.

[7] For a full listing of the industrial classification and associated SITC Rev. 3 commodities codes, see Appendix Table A3. For details on the original U.S. Patent and Trademark Office industrial classification, see U.S. Department of Commerce (2012), available at http://www.uspto.gov/.

Table 1: Characteristics of treatment versus control countries by income group and year

		1993		2003		2013	
		(1)	(2)	(3)	(4)	(5)	(6)
	Income Group	Treatment	Control	Treatment	Control	Treatment	Control
GDP	High	735.18	483.63	1,059.45	413.10	1,628.17	791.72
		(1502.89)	(1314.32)	(2383.91)	(1142.95)	(3454.10)	(1548.62)
	Middle	44.54	76.24	55.88	68.88	134.04	273.07
		(107.04)	(104.36)	(127.16)	(116.55)	(243.91)	(509.69)
	Low	2.62	60.52	4.73	62.26	6.92	316.64
		(1.22)	(132.89)	(3.73)	(262.07)	(5.56)	(1498.35)
GDP per capita	High	20,601.38	18,737.09	32,654.37	26,129.71	51,486.49	51,899.92
		(7036.69)	(7249.36)	(11728.63)	(6593.10)	(22952.75)	(20793.19)
	Middle	3,625.45	2,930.95	6,420.49	2,798.18	12,528.55	7,537.45
		(2485.29)	(1959.61)	(4271.78)	(1889.26)	(6587.07)	(5071.73)
	Low	524.60	390.14	1,071.16	553.87	2,761.92	1,829.24
		(183.74)	(162.37)	(136.19)	(411.10)	(1382.25)	(1769.89)
Ginarte and Park Index	High	3.42	3.00	4.35	4.13	4.41	4.13
		(0.90)	(0.59)	(0.38)	(0.45)	(0.37)	(0.45)
	Middle	1.49	1.64	3.12	2.87	3.72	3.26
		(0.73)	(0.65)	(0.64)	(0.75)	(0.44)	(0.59)
	Low	0.92	1.72	1.97	2.26	2.38	2.83
		(0.47)	(0.55)	(0.69)	(0.49)	(1.01)	(0.51)
TRIPS	High	0.00	0.00	1.00	0.86	1.00	0.80
		(0.00)	(0.00)	(0.00)	(0.36)	(0.00)	(0.42)
	Middle	0.00	0.00	1.00	0.50	1.00	0.68
		(0.00)	(0.00)	(0.00)	(0.51)	(0.00)	(0.47)
	Low	0.00	0.00	1.00	0.27	1.00	0.39
		(0.00)	(0.00)	(0.00)	(0.45)	(0.00)	(0.49)
High-IP imports	High	44.40	19.37	85.98	29.99	137.28	69.14
		(55.56)	(29.51)	(116.31)	(54.64)	(182.64)	(99.06)
	Middle	3.49	6.14	8.02	7.11	20.67	23.49
		(7.13)	(7.20)	(17.79)	(11.73)	(37.37)	(35.50)
	Low	0.40	4.79	0.74	6.71	1.21	20.36
		(0.16)	(12.78)	(0.54)	(35.72)	(0.89)	(94.10)
Low-IP imports	High	19.12	11.25	27.11	10.79	53.33	27.45
		(22.16)	(21.36)	(34.38)	(21.62)	(63.26)	(43.58)
	Middle	1.37	2.32	2.75	2.23	7.98	10.00
		(2.22)	(2.63)	(4.79)	(3.10)	(11.18)	(14.14)
	Low	0.15	2.87	0.26	2.11	0.52	9.02
		(0.04)	(7.28)	(0.16)	(8.46)	(0.42)	(34.76)
High-IP exports	High	47.20	28.47	89.02	35.96	152.51	69.34
		(59.54)	(59.28)	(106.19)	(77.53)	(185.22)	(114.87)
	Middle	1.83	3.48	5.60	5.09	16.22	12.29
		(4.98)	(6.10)	(13.71)	(11.47)	(30.98)	(21.33)
	Low	0.03	2.66	0.07	5.23	0.43	27.55
		(0.02)	(8.66)	(0.05)	(30.71)	(0.58)	(149.73)
Low-IP exports	High	17.75	7.71	22.82	8.03	48.40	19.28
		(16.38)	(11.87)	(23.37)	(14.09)	(51.55)	(28.85)
	Middle	1.55	3.99	2.38	3.81	7.41	12.73
		(2.06)	(4.75)	(3.50)	(6.00)	(9.78)	(19.96)
	Low	0.25	3.62	0.38	3.33	1.20	14.99
		(0.11)	(8.20)	(0.16)	(14.82)	(1.23)	(67.80)

Notes: Each entry reports the average and (in parentheses) standard deviation for a given variable by treatment and income group for the respective sample year. GDP, imports and exports are measured in current billion USD, and GDP per capita in current USD. For data sources, see Appendix Table A1.

[1] The value for each sample year portays the most recently calculated version of the Ginarte and Park index for each country. Since the index is not calculated for every country, the reported values only pertain to sample countries with existing values for the index.

The high-income treatment countries undertake more of both high-IP and low-IP imports and exports. The picture is more nuanced at other income levels, but one noteworthy finding is that treated middle-income countries saw considerably larger growth in high-IP exports than the corresponding control countries.

Two other variables are listed in the table. First, to get a sense of the legal protection of patents in each country group we list statistics for the Ginarte-Park (GP) index of patent-law provisions, which we discuss further below. This index was first developed in Ginarte and Park (1997), with later updates. Interestingly, middle-income treatment countries on average have a lower value of the GP index at the start of the sample period, suggesting that the countries that enter into an IP-related FTA had weaker patent rights than their counterparts early on, a difference that accords with earlier descriptions (Maskus, 2012). Within this group, however, the treatment countries saw relatively greater increases in this index. Second, we define a variable capturing adherence with TRIPS. This is a binary variable taking a value of 1 for countries which are in compliance with TRIPS in a given year and 0 otherwise. TRIPS compliance rates between the two groups differ throughout the period, with higher compliance rates for treatment countries. Countries identifying as least-developed received an exemption from complying with TRIPS until 2013; thus, our TRIPS variable is zero for countries classified as least-developed.

From the table it is difficult to decipher whether the (economy size-adjusted) gap between treatment and control countries in IP-intensive imports and exports has grown. Even more difficult is assessing whether it has grown more than the corresponding gap in low-IP imports and exports and how much of any such growth may be attributed to the creation of IP-related PTAs over the period. Whether any such effect is attributable to the IPRs provisions of PTAs or to some concurrent and perhaps more important policy shift, such as TRIPS, is the empirical question to be addressed.

In this context, our identification relies on two types of variation. First, during our sample some countries entered into IP-related trade agreements, as we define them below, while others did not (note that countries rarely exit PTAs once they have joined). We also distinguish among countries at varying income levels, noting that both their membership decisions and their economic responses to such agreements may vary. Second, as already noted we distinguish between sectors in terms of their apparent relative usage of intellectual property, comparing high-IP industries with the low-IP reference group, with increasingly more specific definitions of IP-using industries as we go forward.[8] This distinction is important, for if IP chapters matter for trade, in comparison with just the impacts of membership in an FTA generally, the effects should show up in relatively greater impacts in the high-IP set of industries.

An obvious challenge to this identification strategy arises if the causality between trade and IPRs works

[8]Note that while we refer to our regressions as "aggregate trade" the analysis is done with particular sectoral breakdowns. We use the term aggregate because we do not focus here on bilateral trade impacts between country pairs.

in two directions. On the one hand, IP-related PTAs might increase members' trade over and above TRIPS, the basic effect we seek to identify. On the other hand, member nations may form such agreements because they already undertake a relatively high level of trade in high-IP goods. While this is a potential concern, the threat of an endogenous relationship between high-IP trade and the formation of high-IP PTAs is limited by a critical factor in how such agreements arise. The primary purpose of PTAs is to liberalize within-agreement trade through cuts in border taxes and other trade barriers. Where strong IPRs chapters are included it is typically at the insistence of a single negotiating party. This is especially the case where IP-related PTAs involve both technologically advanced countries that have a strong comparative advantage in creating IP-intensive goods and developing or emerging countries that produce relatively little intellectual property. Indeed, this situation accurately characterizes the bulk of the IP-related PTAs in our sample, with one partner being the United States, EFTA, or the EU. Moreover, these developed partners typically bring greater bargaining power to the negotiating table. Thus, it is highly likely that low-income and middle-income countries that join PTAs with higher-income countries primarily agree to significantly stronger IPRs rules in order to obtain greater and more secure export access to major foreign markets.[9] Put differently, for such countries IPRs are second-order negotiating concessions that they would not ordinarily select as a matter of endogenous policy.[10] While this factor does not ensure that the IPRs effect we examine is necessarily exogenous to countries' trade, it is reasonable to expect that, at least for low-income and middle-income countries, the policy is effectively randomly assigned.

We incorporate a third element that is important for identification. As noted above, most countries in our sample became compliant with TRIPS at some point in the period, which may have happened before or after their joining an IP-related PTA. In order clearly to isolate the PTA effect, therefore, our preferred specification defines treatment countries as those which joined IP-related PTA only after they complied with TRIPS. We now turn to the estimation of our relationships of interest.

[9] This can readily be true for rich countries as well. Canada, for example, has objected to many of the patent and copyright provisions in TPP, while Australia's negotiators expressed reservations about elements of pharmaceuticals protection in their FTA with the United States (Maskus, 2012).

[10] A similar argument about developing countries taking on TRIPS obligations as an exogenous policy change within the broader market opportunities of the WTO is central to the identification in Delgado et al. (2013).

Aggregate imports and exports of high-IP goods

Equation (1) describes the baseline regression approach, which is estimated separately for aggregate imports and aggregate exports:

$$\log(TR_{ist}) = \beta_1 \log(GDP_{it}) + \beta_2 High\text{-}IP_s \times \log(GDP_{it}) + \beta_3 IPA_{it} + \beta_4 High\text{-}IP_s \times IPA_{it} \quad (1)$$
$$+ \beta_5 TRIPS_{it} + \beta_6 High\text{-}IP_s \times TRIPS_{it} + \alpha_{gst} + \alpha_i(\alpha_{it}) + \varepsilon_{ist}$$

The dependent variable, $\log(TR_{ist})$, represents country i's aggregate imports or exports (in million US dollars) in sector s (high-IP or low-IP in the baseline specification) in year t. To capture the continual introduction of IP-related FTAs that has occurred in recent decades as well as contemporaneous changes in IPR policy at the international level, the sample period covers the years 1993 to 2013.[11] Because of the positive relationship between economic size and trade volume, we include $\log(GDP_{it})$, country i's GDP in year t. We also allow for the trade elasticity with respect to size to vary across sectors via the inclusion of $High\text{-}IP_s \times \log(GDP_{it})$. We obtain our data on countries' yearly trade flows and national income levels from, respectively, UN Comtrade (2016) and World Bank (2016).[12]

Our key variable is designed to incorporate cross-country differences in accession to IP-related trade agreements. For this purpose, we introduce the variable IPA_{it} (for IP-related agreement), which takes a value of 0 for the years in which country i is not party to an IP-related PTA (which has entered into force) with the US, EU, or EFTA, and 1 for each year in which they are party to at least one such agreement. With respect to the time dimension, most IPRs chapters in these agreements require specific compliance dates, upon or soon after the date of a treaty's entry into force. In this context, the binary nature of this policy variable is appropriate. Our initial regressions define the treatment group in two ways. First is to use countries that enter an IP-related PTA at any time in the period, a case we label "contemporaneous". Second is to use countries that enter such an agreement after they come into compliance with TRIPS, a case we label "post".[13] In these baseline specifications IPA_{it} is interacted with $High\text{-}IP_s$. Our estimation thus yields the coefficients of greatest interest: β_3, the difference in low-IP trade for IP-related PTA members compared to those not party to such an agreement, and β_4, capturing the difference within such agreements between high-IP and low-IP goods trade..

Recalling that our central question is whether IP-related PTAs have an impact on trade beyond what

[11] The beginning of this interval precedes the ratification of the first IP-related PTAs, such as NAFTA, as well as the introduction of TRIPS and countries' subsequent compliance decisions. Furthermore, the interval extends sufficiently forward in time to incorporate even the most recent IP-related PTAs.

[12] For a full list of data descriptions and sources, see Appendix Table A1.

[13] We also run a full set of regressions permitting the full set of IPA interactions where we distinguish between agreements in force before ("pre") and after ("post") TRIPS, which yield consistent results and are available on request.

would be driven by multilateral IPRs reforms, each specification contains an analogous set of controls for each country's compliance with the TRIPS agreement. Note that accession to and compliance with TRIPS are generally not the same. This is because the WTO pact gave developing countries certain transition periods within which to come into TRIPS compliance after ratifying the agreement itself (Deere, 2009). Thus, we estimate the date of TRIPS compliance using the methodology employed by Delgado et al. (2013), based on Ginarte and Park (1997), Park (2008), and Hamdan-Livramento (2009). High-income countries generally implemented TRIPS in 1995 (with some exceptions, such as Portugal and Iceland, which attained compliance in 1996), while middle-income countries were generally granted extended deadlines through 2000 or later. The least-developed countries were given exemptions which effectively delayed their mandatory TRIPS compliance past 2013. Similarly, numerous low-income economies had not come into compliance by that date. Thus, we model these countries as not having adhered to TRIPS for the duration of our sample. These TRIPS-related controls and interactions allow us to separate the variation in aggregate trade attributable to IP-related PTAs from that attributable to TRIPS compliance. Note the key difference here between the contemporaneous and post cases in the treatment groups: the latter excludes early agreements, such as NAFTA.

Finally, we control for unobservable factors that may affect aggregate trade volumes and may be correlated with our IPA policy variable. First, we account for idiosyncratic variables that may exist across country development levels, IPRs intensity of goods, and time by including group-sector-year fixed effects α_{gst}, where these income groups are defined in the next paragraph. Note that the definition of sector or commodity type s will vary with the particular specification, as discussed below. We also incorporate country fixed effects α_i to account for any time-invariant country-specific unobservable variables. As an alternative we use country time trends α_{it}, which control for national factors affecting trade over time. We see this case, used with the post-TRIPS treatment definition, as the superior specification and will rely on it in the extended regressions we describe next.

Both logic and empirical results from the literature suggest that the effects of IPRs on trade are likely to vary across levels of economic development, which we proxy here with our selection of three income groups. Thus, in our second specification we consider whether the effects of membership in IP-related PTAs, as well as TRIPS compliance, are heterogeneous across income levels in addition to sectoral dependence on IPRs. To define income groups we take the World Bank's classification of economies as low-income, middle-income (which includes both lower-middle and upper-middle), and high-income. It is important to fix each country's income group in the sample to avoid the possibility that IPRs-related changes in economic activity endogenously change these selections over time. Therefore, for the econometric analysis, we assign each country to a single income group for the entire 21-year sample based on their income classification in 1995, near the the beginning point of the sample. Interacting the relevant policy variables to allow for income-group heterogeneity yields equation (2), where $Group_i$ indexes country i's income group:

$$\begin{aligned}\log(TR_{ist}) = {} & \beta_1 \log(GDP_{it}) + \beta_2 High\text{-}IP_s \times \log(GDP_{it}) \\ & + \beta_3 IPA_{it} + \sum_g \beta_{4g} Group_i \times IPA_{it} + \sum_g \beta_{5g} Group_i \times High\text{-}IP_s \times IPA_{it} \\ & + \beta_6 TRIPS_{it} + \sum_g \beta_{7g} Group_i \times TRIPS_{it} + \sum_g \beta_{8g} Group_i \times High\text{-}IP_s \times TRIPS_{it} \\ & + \alpha_{gst} + \alpha_{it} + \varepsilon_{ist}\end{aligned} \quad (2)$$

Equation (2) differs from equation (1) in that the main effects of IPA (post) and $TRIPS$ and the $High\text{-}IP_s$ policy interactions now vary with income group. Specifically, high-income, middle-income, and low-income countries are permitted to have different effects of membership in IP-related trade agreements. Thus, note that β_{4g} represents the direct effect of the IPA variable for income group g and β_{5g} captures the high-IP interaction effect with the policy treatment IPA. Coefficients β_{7g} and β_{8g} represent the corresponding effects of TRIPS compliance.[14]

We report the regression results for equation (1) and equation (2) for aggregate imports in Table 2. In all regressions we list robust standard errors, which are clustered by country. The first three regression columns permit entry into IP-related PTAs at any date, which we label "contemporaneous entry", while column (4) restricts the treatment group to PTA entry after TRIPS compliance. The first column is the simplest specification, focusing solely on IP-related agreements and TRIPS. We then extend the model to include country groupings in regression (2), adding country time trends in regression (3). Clearly market size, given by GDP of the importer, matters greatly for trade. It is interesting that there is a significantly positive interaction of GDP with our indicator for high-IP goods, suggesting that such imports are more elastic with respect to total demand than are low-IP imports. Regarding our primary question, the coefficients on IPA in column (1) are essentially zero. However, those on $TRIPS$ compliance suggest that the direct effect of TRIPS on low-IP trade is negative, while the impact on high-IP trade is positive. The latter finding comports well with the existing literature.

Permitting different effects across income groups in columns (2), however, generates novel findings. We find little direct effect of IPA but a negative and significant interaction effect between IPA and low-income status. It appears from these coefficients that when such countries join an IP-related PTA they tend to see diminished imports of products that are less dependent on IPRs. However, there is a significantly positive

[14]To avoid the interactions $Group_i \times IPA_{it}$ and $Group_i \times TRIPS_{it}$ spanning the same linear space as the main policy variables IPA_{it} and $TRIPS_{it}$, we omit the first interactions for high-income countries from the regression analysis.

impact in high-IP goods in the triple interaction for the low-income group, implying that imports of such goods are affected positively by these agreements relative to the benchmark industries. In contrast, for middle-income economies there is no evidence of an impact of IP-related PTAs on imports of either low-IP or high-IP manufacturing goods.

Notice next that the coefficient in column (2) on the direct effects of TRIPS is positive but insignificant. However, there are significantly negative interactions for both middle-income and low-income economies, suggesting that TRIPS has diminished imports in low-IP sectors, controlling for the existence of IP-related PTAs. Here, this negative effect is largely offset by the positive interaction for high-IP goods in middle-income countries, suggesting that the conditionally negative outcome of TRIPS is much smaller for such products in emerging economies. Column (3) lists the results of a specification with country time trends, which yields virtually identical results. Finally, column (4) redefines the treatment countries to those entering an IPA-related trade agreement after coming into TRIPS compliance, which should be better at sorting out the marginal effects of such PTAs. Again, the results are highly consistent. Thus, our initial evidence suggests that, controlling for TRIPS, IP-related PTAs, whatever their date of entry into force, diminish low-IP imports in developing countries, but the effect is considerably attenuated or even positive in high-IP industries.

Table 3 presents the results for the aggregate export regressions. Here GDP refers to output in the exporter, making it a capacity variable. Again, it has strong impacts on trade in both types of goods, with a significantly higher capacity elasticity for high-IP sectors. The OLS coefficients in column (1) suggest that exports of low-IP commodities are somewhat diminished by IPA. This is more than offset by the positive impact on IPRs-intensive goods, though the coefficient is not significant. It is noteworthy in this case that the IPA and $TRIPS$ effects are similar. Breaking the result down into income groups in column (2), however, reveals that it is middle-income countries that experience these effects most significantly. The main effect in the $Middle\text{-}inc. \times IPA$ interaction is negative but insignificant. However, the significantly positive estimate on $Middle\text{-}inc. \times High\text{-}IP \times IPA$ reveals that such economies that are party to IP-related PTAs on average exhibit 56 percent higher exports in IP-intensive commodities than in low-IP commodities. If the effects of IPA and $Middle\text{-}inc. \times IPA$ were indeed zero, this interaction would constitute a sizable difference in high-IP exports between middle-income countries that are in IP-related PTAs compared to those that are not. In contrast, there is evidence of a negative impact of such membership on the high-IP exports of low-income countries. Column (3) shows the corresponding estimates using country time trends, again yielding identical results. Finally, column (4) presents results with Post-TRIPS as the treatment selection. Again, we find a highly significant and positive impact of IP-related preferential trade agreements on high-IP exports of middle-income countries. The negative impact on low-income countries is unchanged from column (2), albeit imprecisely estimated. To summarize these findings, IP-related PTAs with the US, EU, and EFTA seem to bolster imports and reduce exports of high-IP goods in lower-income economies while raising such exports in middle-income economies. This result is novel in this literature.

The difference in these results with the effects of TRIPS in Table 3 is striking. The TRIPS compliance interaction is strongly negative for both the middle-income and low-income countries, suggesting that adherence to that agreement is suppressing exports of lower-IP goods. However, the triple-interaction coefficients are positive for both sector types (significantly so for the middle-income group), implying that the negative effect of TRIPS on exports is smaller in the high-IP sectors in developing countries. There also is weak evidence of a negative effect on high-IP exports from developed economies. This finding departs from the prior literature, which did not account for preferential trade agreements. Again, our results carry through to the final specification in column (4), indicating that the trade impacts of IP-related PTAs are the same whether we consider contemporaneous or post-TRIPS entry for each country.

Table 2: Aggregate imports of IP-intensive commodities

	(1)	(2)	(3)	(4)
		Contemporaneous entry		Post-TRIPS entry
	Homogeneous effects	Country FEs	Country time trends	Country time trends
log (GDP)	0.743***	0.736***	0.731***	0.732***
	(0.0593)	(0.0594)	(0.0593)	(0.0594)
High-IP× log (GDP)	0.0890***	0.0923***	0.0923***	0.0920***
	(0.0119)	(0.0117)	(0.0117)	(0.0112)
IPA	-0.0463	-0.0937	-0.0945	0.0305
	(0.0592)	(0.0901)	(0.0907)	(0.0859)
High-IP×IPA	-0.0267			
	(0.0644)			
Mid-inc.×IPA		0.111	0.111	-0.0628
		(0.111)	(0.111)	(0.112)
Low-inc.×IPA		-0.470**	-0.472**	-0.596***
		(0.210)	(0.210)	(0.208)
High-inc.×High-IP×IPA		0.0367	0.0367	0.0248
		(0.122)	(0.122)	(0.107)
Mid-inc.×High IP×IPA		-0.105	-0.105	-0.0410
		(0.0679)	(0.0679)	(0.0716)
Low-inc.×High IP×IPA		0.660***	0.660***	0.659***
		(0.103)	(0.103)	(0.103)
TRIPS	-0.153***	0.122	0.122	0.100
	(0.0575)	(0.108)	(0.108)	(0.106)
High IP×TRIPS	0.200***			
	(0.0487)			
Mid-inc.×TRIPS		-0.327**	-0.327**	-0.296**
		(0.134)	(0.134)	(0.132)
Low-inc.×TRIPS		-0.286*	-0.288*	-0.266*
		(0.152)	(0.152)	(0.150)
High-inc.×High IP×TRIPS		-0.114	-0.114	-0.102
		(0.145)	(0.145)	(0.140)
Mid-inc.×High IP×TRIPS		0.292***	0.292***	0.269***
		(0.0538)	(0.0538)	(0.0530)
Low-inc.×High IP×TRIPS		0.142	0.142	0.142
		(0.0959)	(0.0959)	(0.0958)
Observations	6,176	6,176	6,176	6,176
R^2	0.981	0.981	0.981	0.981
Income group-sector-year FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	No	No
Country trends	No	No	Yes	Yes
Number of countries	185	185	185	185

Notes: Robust standard errors clustered by country are reported in parentheses. The omitted IPA and TRIPS dummies in columns (3) and (4) are High-inc.×IPA and High-inc.×TRIPS. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3: Aggregate exports of IP-intensive commodities

	(1)	(2)	(3)	(4)
		Contemporaneous entry		Post-TRIPS entry
	Homogeneous effects	Country FEs	Country time trends	Country time trends
log (GDP)	0.449***	0.448***	0.442***	0.438***
	(0.133)	(0.134)	(0.133)	(0.132)
High-IP× log (GDP)	0.209***	0.219***	0.219***	0.225***
	(0.0644)	(0.0646)	(0.0646)	(0.0641)
IPA	-0.231*	-0.208	-0.207	-0.236
	(0.134)	(0.238)	(0.237)	(0.237)
High-IP×IPA	0.346			
	(0.211)			
Mid-inc.×IPA		-0.129	-0.132	-0.210
		(0.285)	(0.284)	(0.283)
Low-inc.×IPA		0.382	0.377	0.402
		(0.356)	(0.355)	(0.353)
High-inc.×High IP×IPA		0.387	0.387	0.359
		(0.464)	(0.464)	(0.414)
Mid-inc.×High IP×IPA		0.561***	0.561***	0.785***
		(0.211)	(0.211)	(0.217)
Low-inc.×High IP×IPA		-0.610*	-0.610*	-0.601
		(0.367)	(0.367)	(0.365)
TRIPS	-0.367**	0.374	0.378	0.364
	(0.156)	(0.313)	(0.312)	(0.295)
High IP×TRIPS	0.451*			
	(0.273)			
Mid-inc.×TRIPS		-0.825**	-0.831**	-0.810**
		(0.381)	(0.381)	(0.368)
Low-inc.×TRIPS		-0.870**	-0.882**	-0.864**
		(0.415)	(0.414)	(0.402)
High-inc.×High IP×TRIPS		-1.074*	-1.074*	-1.036*
		(0.587)	(0.587)	(0.547)
Mid-inc.×High IP×TRIPS		0.700*	0.700*	0.678*
		(0.408)	(0.408)	(0.404)
Low-inc.×High IP×TRIPS		0.602	0.602	0.595
		(0.372)	(0.372)	(0.372)
Observations	6,139	6,139	6,139	6,139
R^2	0.918	0.920	0.920	0.920
Income group-sector-year FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	No	No
Country trends	No	No	Yes	Yes
Number of countries	186	186	186	186

Notes: Robust standard errors clustered by country are reported in parentheses. The omitted IPA and TRIPS dummies in columns (3) and (4) are High-inc.×IPA and High-inc.×TRIPS. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Imports and exports of high-IP goods by mode of IPRs-intensiveness

As previously discussed, a critical feature of existing IP-related trade agreements is the breadth of their coverage across different forms of intellectual property rights. Notably, IPRs chapters generally cover provisions pertaining to patents, copyrights and related rights, and trademarks. The fact that many of the agreements considered here include requirements in all three areas implies that any policy effects might, in reality, differ across sectoral lines. We now examine heterogeneous sectoral effects as defined by the nature of IPR-intensiveness of industries, referring to the type of IPRs on which certain commodities are particularly reliant. Equation (3) describes the regression framework with which we can test the hypothesis that treatment effects vary not only across income groups and high-IP versus low-IP sectoral composition, but also across different modes of IPRs-intensity. The variable $Type_s$ denotes whether an industry is patent-intensive, copyright-intensive, or trademark-intensive (denoted, respectively, High-pat., High-CR, and High-TM in the regression tables). These sectoral definitions are taken from Delgado et al. (2013) based on U.S. Department of Commerce (2012). The reference group remains the set of low-IP industries. Further, from this point forward, in order to save space, we report only results using the post-TRIPS selection of IPA-related agreements and country time trends, which we consider our preferred specification.[15]

$$\begin{aligned}\log(TR_{ist}) = {} & \beta_1 \log(GDP_{it}) + \sum_s \beta_{2s} Type_s \times \log(GDP_{it}) \\ & + \beta_3 IPA_{it} + \sum_g \beta_{4g} Group_i \times IPA_{it} + \sum_g \sum_s \beta_{5gs} Group_i \times Type_s \times IPA_{it} \\ & + \beta_6 TRIPS_{it} + \sum_g \beta_{7g} Group_i \times TRIPS_{it} + \sum_g \sum_s \beta_{8gs} Group_i \times Type_s \times TRIPS_{it} \\ & + \alpha_{gst} + \alpha_{it} + \varepsilon_{ist}\end{aligned} \qquad (3)$$

Estimation results are in Tables 4 and 5, permitting analysis of the degree to which differences in sectoral trade by country group can be attributed to IP-related trade agreements. Note carefully that each table reports the results from a single regression, wherein each column reports the coefficients for the relevant sectoral interactions. For instance, column (1) of Table 4, which covers imports, reports the coefficient estimates on the GDP variables and all of the IPA-related interactions. Column (2) is a continuation of the regression and lists the full set of coefficients regarding TRIPS compliance. Thus, each table represents a single regression that is an expanded version of column (4) in Tables 2 and 3, with the additional sectoral breakdown generating larger sample sizes. With this expanded specification, we again see an insignificant effect of IPA membership on low-IP imports in column (1). The interaction term for low-income economies

[15] As suggested by Tables 2 and 3, the results are very similar when using alternative specifications. These regressions are available on request.

remains sharply negative. Perhaps surprisingly, the coefficient on $CR \times \log(GDP)$ for imports is significant and negative, suggesting that imports of copyright-intensive goods are somewhat less responsive to market size than are low-IP products.[16]

Considering the breakdown of IPA effects by mode of IPRs-intensity, some interesting effects surface. Consistent with our earlier high-IP result, we find evidence that patent-intensive imports increase significantly in low-income countries that join IP-related PTAs, in comparison with low-IP goods. This is true also of both copyright-intensive and trademark-intensive products in low-income countries, suggesting that the stimulus to high-IP imports noted in Table 2 carries over to all types of goods embodying high intellectual property content. Thus, our results again suggest that IPRs-sensitive imports are most stimulated by these agreements when the partner is a lower-income developing economy. There is weak evidence that imports of trademark-intensive goods increase in high-income partners of IPA-related PTAs. In contrast, we find no significant evidence that imports of any type of IP-sensitive industries grow in middle-income countries as a result of joining such agreements. For their part, the $TRIPS$ coefficients suggest a direct reduction of imports of control (low-IP) goods in the middle-income group. However, the interaction coefficients between TRIPS compliance and IPRs types are significantly positive for that group in all three types of IP-sensitive industries, again suggesting that any reduction in manufacturing imports associated with TRIPS is far smaller in such goods. This is true also for lower-income countries in trademark-dependent goods. Thus, prior findings in the literature that TRIPS has boosted imports of high-technology goods into developing countries in fact may reflect the combined influence of the WTO agreement and various IP-related PTAs, according to our results.

Table 5 contains results for the export regression and unearths some key differences. There is a strongly positive export response in copyright-intensive goods among high-income members of IP-related PTAs. Moreover, middle-income IPA members exhibit significantly higher exports of PAT, CR, and TM goods, with coefficients on the relevant interactions, respectively, of 0.87, 1.17, and 0.75. In this context, the evident stimulus of such agreements to high-IP exports is spread across high-IP industry types in emerging economies. Again, we find little evidence of any impacts of such agreements on PAT, CR, and TM exports in low-income countries. Turning to the TRIPS agreement, its direct impact on low-IP exports is positive but the interaction effects again show evidence of reduced exports of low-IP goods in both middle-income and low-income countries. For high-income countries, the triple interaction terms are negative for all three sectoral definitions. In contrast, there are positive coefficients on the triple interactions in patent-intensive and trademark-intensive goods in emerging countries and in trademark-intensive sectors for the low-income

[16] This result may be an artefact of the small number of copyright-intensive sectors in the data, as noted in the Appendix. The vast majority of copyright-protected trade comes in cross-border services provision, such as internet transactions, that are not measured in Comtrade data.

Table 4: Aggregate imports by type of IP-intensiveness (single regression)

	(1) IPA		(2) TRIPS
log (GDP)	0.762***		
	(0.0613)		
PAT × log (GDP)	0.110***		
	(0.0117)		
CR × log (GDP)	-0.0927***		
	(0.0223)		
TM × log (GDP)	0.0529***		
	(0.0125)		
IPA	-0.107	TRIPS	0.118
	(0.128)		(0.178)
Mid-inc.×IPA	0.0689	Mid-inc.×TRIPS	-0.379*
	(0.149)		(0.197)
Low-inc.×IPA	-0.596***	Low-inc.×TRIPS	-0.309
	(0.227)		(0.216)
High-inc. × PAT × IPA	-0.0335	High-inc. × PAT × TRIPS	-0.0353
	(0.110)		(0.123)
High-inc. × CR × IPA	0.318	High-inc. × CR × TRIPS	-0.208
	(0.208)		(0.487)
High-inc. × TM × IPA	0.297*	High-inc. × TM × TRIPS	-0.0167
	(0.155)		(0.164)
Mid-inc. × PAT × IPA	-0.0735	Mid-inc. × PAT × TRIPS	0.312***
	(0.0762)		(0.0582)
Mid-inc. × CR × IPA	0.0494	Mid-inc. × CR × TRIPS	0.442***
	(0.126)		(0.147)
Mid-inc. × TM × IPA	0.0938	Mid-inc. × TM × TRIPS	0.160***
	(0.0653)		(0.0590)
Low-inc. × PAT × IPA	0.652***	Low-inc. × PAT × TRIPS	0.121
	(0.121)		(0.105)
Low-inc. × CR × IPA	0.832***	Low-inc. × CR × TRIPS	0.0479
	(0.124)		(0.158)
Low-inc. × TM × IPA	0.737***	Low-inc. × TM × TRIPS	0.267***
	(0.0893)		(0.0912)
Observations			12,335
R^2			0.973
Income group-sector-year FE			Yes
Country time trends			Yes

Notes: Robust standard errors clustered by country are reported in parentheses. The omitted IPA and TRIPS dummies are High-inc.×IPA and High-inc.×TRIPS. Reported coefficiencts are estimated from a single regression of aggregate imports on the set of controls in equation (3). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 5: Aggregate exports by type of IP-intensiveness (single regression)

	(1)		(2)
	IPA		TRIPS
log (GDP)	0.290**		
	(0.142)		
PAT × log (GDP)	0.222***		
	(0.0631)		
CR × log (GDP)	0.147**		
	(0.0598)		
TM × log (GDP)	0.360***		
	(0.0696)		
IPA	-0.582*	TRIPS	0.995**
	(0.315)		(0.459)
Mid-inc.×IPA	-0.0756	Mid-inc.×TRIPS	-1.513***
	(0.360)		(0.520)
Low-inc.×IPA	0.723	Low-inc.×TRIPS	-1.682***
	(0.449)		(0.567)
High-inc. × PAT × IPA	0.547	High-inc. × PAT × TRIPS	-1.086**
	(0.421)		(0.522)
High-inc. × CR × IPA	0.791**	High-inc. × CR × TRIPS	-1.450*
	(0.364)		(0.771)
High-inc. × TM × IPA	0.444	High-inc. × TM × TRIPS	-1.343*
	(0.522)		(0.764)
Mid-inc. × PAT × IPA	0.868***	Mid-inc. × PAT × TRIPS	0.616*
	(0.229)		(0.357)
Mid-inc. × CR × IPA	1.168***	Mid-inc. × CR × TRIPS	0.459
	(0.302)		(0.362)
Mid-inc. × TM × IPA	0.751***	Mid-inc. × TM × TRIPS	0.855**
	(0.222)		(0.408)
Low-inc. × PAT × IPA	-0.662	Low-inc. × PAT × TRIPS	0.496
	(0.411)		(0.376)
Low-inc. × CR × IPA	0.200	Low-inc. × CR × TRIPS	-0.00335
	(0.446)		(0.418)
Low-inc. × TM × IPA	-0.0578	Low-inc. × TM × TRIPS	0.767*
	(0.419)		(0.420)
Observations			12,090
R^2			0.915
Income group-sector-year FE			Yes
Country time trends			Yes

Notes: Robust standard errors clustered by country are reported in parentheses. The omitted IPA and TRIPS dummies are High-inc.×IPA and High-inc.×TRIPS. Reported coefficiencts are estimated from a single regression of aggregate exports on the set of controls in equation (3). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

group. The effects in TM sectors may be attributable to those countries' exports of footwear and furniture, which are trademark-intensive in the classification. Another explanation may be that multinational firms specializing in trademark-intensive products may be more likely to locate foreign production facilities in PTA partner countries with stronger protection for trademarks through their IPRs chapters.

Aggregate imports and exports of high-IP industry clusters

The analysis in the previous section demonstrates how the effects of IP-related PTAs membership interact with income groups and modes of IP-intensity. It is also interesting to examine the details of how such agreements may affect trade in more specific industrial sectors that are particularly sensitive to IPRs. Many IPRs provisions, such as test-data confidentiality, linkage rules for chemicals and pharmaceuticals, and anti-circumvention of digital copyrights, pertain closely to specific products and sectors. Other IPRs-intensive industries might not be the focus of specific standards, but nonetheless could be affected differently. In the next analysis, $Sector_s$ denotes IPRs-intensive industry clusters as defined in Delgado et al. (2013), based on Porter (2003) and U.S. Department of Commerce (2012). Our high-IP industries now are the ones identified as being most reliant on IPRs, and include analytical instruments (AI), biopharmaceuticals (BIO), chemicals (CHEM), information and communications technology (ICT), medical devices (MED), and production technology (PT).

Analogous to equation (3), equation (4) describes the relationship between aggregate sectoral imports or exports and the main effects and interactions for both IPA and $TRIPS$:

$$\begin{aligned}\log(TR_{ist}) = {} & \beta_1 \log(GDP_{it}) + \sum_s \beta_{2s} Sector_s \times \log(GDP_{it}) \\ & + \beta_3 IPA_{it} + \sum_g \beta_{4g} Group_i \times IPA_{it} + \sum_g \sum_s \beta_{5gs} Group_i \times Sector_s \times IPA_{it} \\ & + \beta_6 TRIPS_{it} + \sum_g \beta_{7g} Group_i \times TRIPS_{it} + \sum_g \sum_s \beta_{8gs} Group_i \times Sector_s \times TRIPS_{it} \\ & + \alpha_{gst} + \alpha_{it} + \varepsilon_{ist}\end{aligned} \tag{4}$$

The regression results for equation (4) in Tables 6 and 7 show the different sectoral impacts of IPA membership on imports and exports, respectively. Again, these are results from a single regression in each table, with columns displaying the coefficient estimates for the given sector. The coefficients on $High\text{-}inc. \times Sector \times IPA$ are generally insignificant regarding imports, with the particular exception of biopharmaceuticals. Exports in this sector are also highly responsive to membership of high-income economies in IPA-related PTAs. In this context, it appears that such trade agreements offer a stronger market within which to sell medicines and other biological products and generate growth in two-way trade. This is interesting in light of the focus of many IP-related PTAs on patent and test-data provisions specifically related to pharmaceuticals. There also are positive export effects among such countries in chemicals, medical devices and production technologies. In contrast, there are no effects on ICT trade among high-income economies.

Triple-interaction estimates on IPA for imports among the middle-income countries are generally negative and insignificant, though there are detectable reductions in imports of chemicals and production technologies. On the other hand, the corresponding export coefficients are uniformly positive and highly significant. Thus, we again find that imports are marginally negatively affected by this form of trade policy, while exports are highly responsive in middle-income countries. This finding accords with prior results in the literature on emerging economies and IPRs in high-technology goods (Maskus and Yang, 2016). However, the result here suggests that it is membership in IP-related PTAs that drives this outcome. For their part, the low-income economies register generally positive and significant impacts in imports across the high-IP clusters, again attesting to the role of such agreements in expanding imports of biopharmaceuticals, medical devices,and other high-technology goods in comparison with low-IP products. In contrast, the impacts are generally negative for exports in these sectors among the low-income countries. The exception is biopharmaceuticals exports, which are increased by PTA membership. This outcome may reflect regional growth in exports of medicines produced in packaging facilities in this industry after the formation of IPR-related PTAs. Overall, these various results suggest that IPR-related PTAs have complex but marked impacts on trade in high-IP goods among member countries, with imports into poor economies generally expanded and exports from middle-income economies strongly increased.

Table 6 demonstrates that the direct effects of TRIPS compliance are negative on imports of low-IP goods in both groups of developing nations (column (2)). However, the triple-interaction coefficients are positive and significant among these high-IP clusters in middle-income countries, again suggesting that TRIPS raises trade in such goods in comparison with low-IP industries. In Table 7 we find broadly similar impacts on exports in both country groups. In any event, our results suggest that IPR-related PTAs have noticeably stronger effects on the trade of developing countries than does TRIPS. Put another way, we find consistent evidence that PTAs are an important determinant of IPRs-induced trade patterns, even after controlling for prior TRIPS implementation. This conclusion offers useful supplemental perspective to the recent empirical literature.

Table 6: Aggregate imports by IP-intensive industry cluster (single regression)

	(1) IPA		(2) TRIPS
log (GDP)	0.664***		
	(0.0711)		
AI× log (GDP)	0.277***		
	(0.0204)		
BIO× log (GDP)	0.0808***		
	(0.0308)		
CHEM× log (GDP)	0.265***		
	(0.0211)		
ICT× log (GDP)	0.140***		
	(0.0189)		
MED× log (GDP)	0.153***		
	(0.0193)		
PT× log (GDP)	0.197***		
	(0.0168)		
IPA	-0.104	TRIPS	0.347
	(0.155)		(0.232)
Mid-inc.×IPA	0.0708	Mid-inc.×TRIPS	-0.683***
	(0.176)		(0.256)
Low-inc.×IPA	-0.512**	Low-inc.×TRIPS	-0.587**
	(0.224)		(0.272)
High-inc. × AI × IPA	-0.0670	High-inc. × AI × TRIPS	0.0121
	(0.158)		(0.300)
High-inc. × BIO × IPA	0.639***	High-inc. × BIO × TRIPS	0.0381
	(0.198)		(0.499)
High-inc. × CHEM × IPA	0.307	High-inc. × CHEM × TRIPS	-0.306
	(0.186)		(0.434)
High-inc. × ICT × IPA	-0.199	High-inc. × ICT × TRIPS	-0.154
	(0.173)		(0.328)
High-inc. × MED × IPA	0.180	High-inc. × MED × TRIPS	-0.144
	(0.137)		(0.244)
High-inc. × PT × IPA	-0.0618	High-inc. × PT × TRIPS	-0.394*
	(0.176)		(0.214)
Mid-inc. × AI × IPA	-0.0817	Mid-inc. × AI × TRIPS	0.389***
	(0.119)		(0.142)
Mid-inc. × BIO × IPA	0.168	Mid-inc. × BIO × TRIPS	0.343**
	(0.123)		(0.162)
Mid-inc. × CHEM × IPA	-0.168*	Mid-inc. × CHEM × TRIPS	0.434***
	(0.0880)		(0.120)
Mid-inc. × ICT × IPA	-0.0138	Mid-inc. × ICT × TRIPS	0.537***
	(0.144)		(0.103)
Mid-inc. × MED × IPA	-0.0876	Mid-inc. × MED × TRIPS	0.240*
	(0.0815)		(0.125)
Mid-inc. × PT × IPA	-0.154*	Mid-inc. × PT × TRIPS	0.193**
	(0.0809)		(0.0898)

Table 6 (cont.)

Low-inc. × AI × IPA	0.342*	Low-inc. × AI × TRIPS	0.322*
	(0.177)		(0.166)
Low-inc. × BIO × IPA	1.363***	Low-inc. × BIO × TRIPS	-0.0576
	(0.200)		(0.196)
Low-inc. × CHEM × IPA	0.352**	Low-inc. × CHEM × TRIPS	0.271**
	(0.147)		(0.122)
Low-inc. × ICT × IPA	0.462***	Low-inc. × ICT × TRIPS	0.174
	(0.0921)		(0.127)
Low-inc. × MED × IPA	0.809***	Low-inc. × MED × TRIPS	-0.0381
	(0.153)		(0.203)
Low-inc. × PT × IPA	0.154	Low-inc. × PT × TRIPS	0.207*
	(0.207)		(0.122)
Observations			21,414
R^2			0.959
Income group-sector-year FE			Yes
Country time trends			Yes

Notes: Robust standard errors clustered by country are reported in parentheses. The omitted IPA and TRIPS dummies are High-inc.×IPA and High-inc.×TRIPS.. Reported coefficients are estimated from a single regression of aggregate imports on the set of controls in equation (4). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 7: Aggregate exports by IP-intensive industry cluster (single regression)

	(1) IPA		(2) TRIPS
log (GDP)	0.300**		
	(0.140)		
AI× log (GDP)	0.313***		
	(0.0674)		
BIO× log (GDP)	0.401***		
	(0.0723)		
CHEM× log (GDP)	0.491***		
	(0.0800)		
ICT× log (GDP)	0.306***		
	(0.0865)		
MED× log (GDP)	0.411***		
	(0.0615)		
PT× log (GDP)	0.265***		
	(0.0548)		
IPA	-0.773*	TRIPS	1.028*
	(0.417)		(0.553)
Mid-inc.×IPA	-0.206	Mid-inc.×TRIPS	-1.598***
	(0.475)		(0.601)
Low-inc.×IPA	1.383**	Low-inc.×TRIPS	-1.503**
	(0.544)		(0.646)
High-inc. × AI × IPA	0.748	High-inc. × AI × TRIPS	-0.520
	(0.502)		(0.701)
High-inc. × BIO × IPA	2.146***	High-inc. × BIO × TRIPS	-1.156
	(0.570)		(0.745)
High-inc. × CHEM × IPA	1.108*	High-inc. × CHEM × TRIPS	-1.216
	(0.571)		(0.761)
High-inc. × ICT × IPA	0.193	High-inc. × ICT × TRIPS	-0.793
	(0.561)		(0.724)
High-inc. × MED × IPA	0.978**	High-inc. × MED × TRIPS	-1.502*
	(0.468)		(0.782)
High-inc. × PT × IPA	0.864**	High-inc. × PT × TRIPS	-1.170*
	(0.426)		(0.644)
Mid-inc. × AI × IPA	1.272***	Mid-inc. × AI × TRIPS	0.743**
	(0.346)		(0.359)
Mid-inc. × BIO × IPA	1.221***	Mid-inc. × BIO × TRIPS	0.0956
	(0.375)		(0.361)
Mid-inc. × CHEM × IPA	0.650***	Mid-inc. × CHEM × TRIPS	0.763*
	(0.243)		(0.390)
Mid-inc. × ICT × IPA	1.418***	Mid-inc. × ICT × TRIPS	0.777
	(0.405)		(0.475)
Mid-inc. × MED × IPA	1.483***	Mid-inc. × MED × TRIPS	0.414
	(0.368)		(0.390)
Mid-inc. × PT × IPA	1.069***	Mid-inc. × PT × TRIPS	0.490
	(0.271)		(0.340)

Table 7 (cont.)

Low-inc. × AI × IPA	-1.473***	Low-inc. × AI × TRIPS	0.298
	(0.343)		(0.410)
Low-inc. × BIO × IPA	1.123**	Low-inc. × BIO × TRIPS	0.366
	(0.524)		(0.492)
Low-inc. × CHEM × IPA	-1.243*	Low-inc. × CHEM × TRIPS	0.354
	(0.751)		(0.537)
Low-inc. × ICT × IPA	0.965	Low-inc. × ICT × TRIPS	0.657*
	(0.855)		(0.351)
Low-inc. × MED × IPA	-0.737**	Low-inc. × MED × TRIPS	0.455
	(0.299)		(0.407)
Low-inc. × PT × IPA	-1.349***	Low-inc. × PT × TRIPS	0.441
	(0.354)		(0.370)
Observations			20,253
R^2			0.891
Income group-sector-year FE			Yes
Country time trends			Yes

Notes: Robust standard errors clustered by country are reported in parentheses. The omitted IPA and TRIPS dummies are High-inc.×IPA and High-inc.×TRIPS.. Reported coefficiencts are estimated from a single regression of aggregate exports on the set of controls in equation (4). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4 Conclusion

IPRs provisions in preferential trade agreements have proliferated since their inception in the 1990s. The extent to which these provisions have influenced member countries' trade has gone unstudied before this paper. Our results point out that ignoring the role of IP-related PTAs in the international intellectual property system fails to consider a critical channel through which countries effect changes in their policy regimes. Our empirical analysis reveals that IP-related trade agreements have significant effects on countries' aggregate sectoral trade. While these effects are most often found in middle-income developing countries, they characterize particular sectors in high-income and low-income countries as well. In brief, IP-related PTAs are also "trade-related" in significant ways. Moreover, these effects often dominate those coming simply from adherence to TRIPS, the multilateral framework for protecting intellectual property rights.

The analysis here could be extended in several potentially rewarding ways. The aggregate nature of the trade data surely masks important and interesting phenomena that could be found in sectoral and bilateral trade. For example, to what extent do the estimated effects represent increased trade of final goods versus intermediates as global supply chains respond to changes in relative institutional environments? It would also be useful to study the effects on bilateral trade, both within and outside the treatment PTAs, to see if IPRs provisions exert a separate effect on trade creation or trade diversion. The most important extension would be to investigate the channels through which IPRs chapters may affect measured trade. It is possible that IP-related PTAs have similar impacts on within-region FDI, which could supplement our findings. More fundamentally, it may be that IPRs provisions interact with investment rules, services liberalization, or other regulatory issues implicated by PTAs. Indeed, there may be complementary effects between tariff cuts and IPRs standards in driving high-technology trade. Ultimately, the new breed of regulation-intensive PTAs seems to be an important determinant of international policy environments, opening up wide vistas for further research.

References

Bagwell, K. and R. Staiger (1997). Multilateral tariff cooperation during the formation of free trade areas. *International Economic Review 38*(2), 291–319.

Baier, S. and J. Bergstrand (2007). Do free trade agreements actually increase members' international trade? *Journal of International Economics 71*(1), 72–95.

Branstetter, L., R. Fisman, C. F. Foley, and K. Saggi (2011). Does intellectual property rights reform spur industrial development? *Journal of International Economics 83*(1), 27–36.

Branstetter, L. and K. Saggi (2011). Intellectual property rights, foreign direct investment and industrial development. *The Economic Journal 121*(555), 1161–1191.

Chaudhuri, S., P. Goldberg, and P. Gia (2006). Estimating the effects of global patent protection in pharmaceuticals: A case study of quinolones in India. *The American Economic Review 96*(5), 1477–1514.

Chen, Y. and T. Puttitanum (2005). Intellectual property rights and innovation in developing countries. *Journal of Development Economics 78*(2), 474–493.

Co, C. (2004). Do patent rights regimes matter. *Review of International Economics 12*(3), 359–373.

Deere, C. (2009). *The Implementation Game: The TRIPS Agreement and the Global Politics of Intellectual Property Reform in Developing Countries*. Oxford: Oxford University Press.

Delgado, M., M. Kyle, and A. McGahan (2013). Intellectual property protection and the geography of trade. *The Journal of Industrial Economics LXI*(3), 733–762.

Dür, A., L. Baccini, and M. Elsig (2014). The design of international trade agreements: Introducing a new dataset. *The Review of International Organizations 9*(3), 353–375.

Duggan, M., C. Garthwaite, and A. Goyal (2016). The market impacts of pharmaceutical product patents in developing countries: Evidence from India. *The American Economic Review 106*(1), 99–135.

Ginarte, J. and W. Park (1997). Determinants of patent rights: A cross-national study. *Research Policy 26*(3), 283–301.

Hamdan-Livramento, I. (2009). How compliant are developing countries with their TRIPS obligations? CEMI Working Paper 2009-001, College of Management of Technology, Ecole Polytechnique Fédérale de Lausanne.

He, Y. and K. E. Maskus (2012). Southern innovation and reverse knowlknow spillovers: a dynamic FDI model. *International Economic Review 53*(1), 281–304.

Ivus, O. (2010). Do stronger patent rights raise high-tech exports to the developing world? *Journal of International Economics 81*(1).

Maskus, K. E. (2012). *Private Rights and Public Problems: The Global Economics of Intellectual Property in the 21st Century*. Washington: Peterson Institute for International Economics.

Maskus, K. E. and M. Penubarti (1995). How trade-related are intellectual property rights? *Journal of International Economics 39*(3-4), 227–248.

Maskus, K. E. and L. Yang (2016). The impacts of post-TRIPS patent reforms on the structure of exports. University of Colorado at Boulder, working paper.

Nicholson, M. (2007). The impact of industry characteristics and IPR policy on foreign direct investment. *Review of World Economy 143*(1), 27–54.

Park, W. (2008). International patent protection. *Research Policy 37*(4), 761–766.

Porter, M. (2003). The economic performance of regions. *Regional Studies 37*(6-7), 549–578.

Qian, Y. (2007). Do national patent laws stimulate domestic innovation in a global patenting environment? *Review of Economics and Statistics 89*(3), 436–453.

Romalis, J. (2007). NAFTA's and CUSFTA's impact on international trade. *Review of Economics and Statistics 89*(3), 416–435.

Rose, A. (2004). Do we really know that the WTO increases trade? *The American Economic Review 94*(1), 98–114.

Smith, P. (2001). How do foreign patent rights affect U.S. exports, affiliate sales, and licenses? *Journal of International Economics 55*(2), 411–439.

UN Comtrade (2016). Comtrade Database. Available at http://comtrade.un.org/.

U.S. Department of Commerce (2012). Intellectual property and the U.S. economy: Industries in focus. Available at http://uspto.gov/sites/default/files/news/publications/IP_Report_March_2012.pdf, Department of Commerce, Washington, D.C.

Vishwasrao, S. (1994). Intellectual property rights and the mode of technology transfer. *Journal of Development Economics 44*(2), 381–402.

World Bank (2016). World Bank online database. Available at http://data.worldbank.org/.

Appendix

Table A1: Data sources and description

Variable	Description	Data Source
Trade	Aggregate trade flows in current USD by SITC Rev. 3 code, 1993-2013	UN Comtrade (2016)
Ginarte and Park index	Measure of national patent regime strength	Ginarte and Park (1997); Park (2008)
GDP	GDP in current USD by country	World Bank (2016)
GDP per capita	GDP per capita in current USD by country	World Bank (2016)
Income groups	Yearly income group classifications by GDP per capita	World Bank (2016)
IPA	Accession to IP-related free trade agreements by country and year of accession	Dür et al. (2014)
TRIPS	TRIPS compliance dates by country	Ginarte and Park (1997); Park (2008); Hamdan-Livramento (2009)
High-IP	IP-intensive commodities by SITC Rev. 3 code	Delgado et al. (2013) based on U.S. Department of Commerce (2012)
Sector	Low-IP control and IP-intensive sectoral clusters by SITC Rev. 3 code	Delgado et al. (2013) based on Porter (2003); U.S. Department of Commerce (2012)
Type	Classification of high-IP commodities by type of IP in which good is intensive (patents vs. copyrights vs. trademarks)	Delgado et al. (2013); U.S. Department of Commerce (2012)

Table A2: US, EU, and EFTA IP-related preferential trade agreements and entry-into-force years

Agreement	**Entry-into-force year**
Australia-USA	2005
Bahrain-USA	2006
Bulgaria-EFTA	1993
CARIFORUM-EU	2008
Central American Free Trade Agreement	2006
Chile-USA	2004
Colombia-EFTA	2011
Colombia-USA	2012
EU-Macedonia	2001
EU-Turkey	1996
EFTA-Estonia	1996
EFTA-Latvia	2006
EFTA-Mexico	2001
EFTA-Slovenia	1995
European Free Trade Association (Services)	2001
European Union	Varies by member
Jordan-USA	2001
Morocco-USA	2006
North American Free Trade Agreement	1994
Oman-USA	2009
Panama-USA	2012
Peru-USA	2009
Singapore-USA	2004
South Korea-USA	2012

Table A3: Sectoral definitions and associated SITC Rev. 3 codes and code descriptions

High-IP sectors by mode of IP-intensiveness	
High-patent	
Crude fertilizers: 277, 278	Metalworking machinery: 73
Organic and inorganic chemicals: 51, 52	General machinery: 7413-9, 7421-3, 7427, 743-9
Dyeing materials: 53	Office machines: 75
Medicinal and pharmaceutical products: 54	Telecommunications: 76
Essential oils and perfume materials: 55	Electrical machinery: 77
Chemical materials and products: 59	Professional apparatus: 87
Rubber manufactures: 6214, 625, 6291-2	Photographic apparatus: 881-2, 884, 8853-4
Power-generating machinery: 71	Miscellaneous manufacturing: 8931, 893332, 8939,
Industrial machinery: 721-3, 7243, 7248, 725-8	8941-3, 8947, 8952, 89591, 897-9, 8991-6
High-trademark	
Dairy products and beverages: 022-4, 111, 1123	Manufactures of metal: 66494, 69561-2, 69564,
Crude rubber: 231-2	6966, 6973
Pulp and waste paper: 251	Road vehicles: 784, 78531, 78536
Plastics: 57, 5813-7, 582-3	Furniture: 82
Paper and related articles: 64	Footwear: 85
High-copyright	
Cinematographic film: 883	Printed matter & recorded media: 892, 8986-7
High-IP sectors	
Analytical Instruments (AI)	***Medical Devices (MED)***
Laboratory instruments: 87325, 8742-3	Diagnostic substances: 54192-3, 59867-9
Optical instruments: 8714, 8744	Medical equipment and supplies: 59895, 6291, 774
Process instruments: 8745-6, 8749	872, 8841
Biopharmaceuticals (BIO)	***Production Technology (PT)***
Medicinal and pharmaceutical products: 5411-6,	Materials and tools: 2772, 2782, 69561-2, 69564
54199, 542	Process and metalworking machinery: 711, 7248,
Chemicals (CHEM)	726, 7284-5, 73
Chemically-based ingredients: 5513, 5922, 5972, 59899	General industrial machinery:
Dyeing and package chemicals: 531-2, 55421, 5977	7413, 7417-9, 7427, 7431, 74359, 74361-2,
Organic chemicals: 5124, 5137, 5139, 5145-6, 5148, 5156	74367-9, 7438-9, 7441, 7444-7, 74481, 7449
Information and Communications Technology (ICT)	7452-3, 74562-3, 74565-8, 74591, 74595-7,
Communications equipment: 7641, 76425, 7643, 76481,	746-7, 7482-3, 7486, 7492-9
7649, 77882-4	
Computers and peripherals: 752, 75997	
Office machines: 7511-2, 7519, 75991-5	
Electrical and electronic components: 5985, 7722-3,	
7731, 7763-8, 77882-4	
Low-IP sectors	
Animal and vegetable oils, fats, and waxes: 41-3	Manufactures of leather, cork and wood, minerals, or
Food and live animals: 01, 03, 041-5, 05, 061, 071-2,	metal: 61, 63, 6511-4, 652, 654-9, 661-2, 6633, 6639
074-5, 08	6641-5, 6648-9, 67, 6821-6, 68271, 683, 6841, 68421-6,
Inedible crude materials (except fuels): 21, 22, 244,	685-9, 6911-2, 69243-4, 6932-5, 694, 6975, 699
261-5, 289-9, 273, 28, 292-7, 29292-3, 29297-9	Miscellaneous: Prefabricated buildings (811-2), travel
Lubricants, mineral fuels, and related materials: 32-4	goods (83), and apparel and accessories (84)

Notes: From Delgado et al. (2013), based on U.S. Department of Commerce (2012).