The Impacts of Intellectual Property-Related Trade Agreements on Bilateral Patent Applications

Jacob Howard, MITRE Corporation[a]

Keith Maskus, University of Colorado Boulder

William Ridley, University of Illinois Urbana-Champaign

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Introduciton

Intellecutal Property Rights (IPRs) are inherently trade-related

- ▶ Protection of knowledge assets governs cost and benefits faced by rights holders in international commerce.
- ▶ Beyond trade, other forms of technology transfer are related to the protection of intellectual property in different countries.
  - ▶ Including FDI, licensing, and patenting.

The introduction of stronger standards in developing and emerging countries for protecting IPRs has been a policy objective of:

- ▶ The United States.
- ▶ Later the European Union (EU), and European Free Trade Association (EFTA).
- ▶ Increasingly by others, particularly Japan and the Republic of Korea.

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This Paper

A primary channel for such upgrades is the increasingly comprehensive treatment of IPRs in preferential trade agreements (PTAs).

- ▶ We consider the impacts on bilateral patenting flows of deeply IP-Related PTAs, which we call IPAs.
- ▶ We distinguish between flows among IPA member countries versus applications coming into member countries from non-members.
  - ▶ We call out the beneftis to Low-Income countries (LI) of signing an IPA.
- ▶ Estimated for total patent applications and those in high-IP industry clusters.

Increasing focus over time on IPRs in PTAs; moving to TRIPS-Plus IPAs

- US-Israel (1985): Single paragraph mentioning national treatment and MFN;
- NAFTA (1994): the precursor to TRIPS;
- US-Jordan (2001): Elevated patent standards, pharmaceutical test data protection, copyrights for digital goods;
- US-Chile (2004): Regularized test-data protection periods, required plant variety patentability.
- US-Australia (2005): Further pharmaceutical protections, linkage rules, limits on copyright exceptions.
- US-Korea (2012): further limits on copyright exceptions, patents for new uses, extensive enforcement.
- Original TPP: biologics test-data protection, trade-secrets obligations, criminal enforcement requirements, much of it retained in CPTPP.
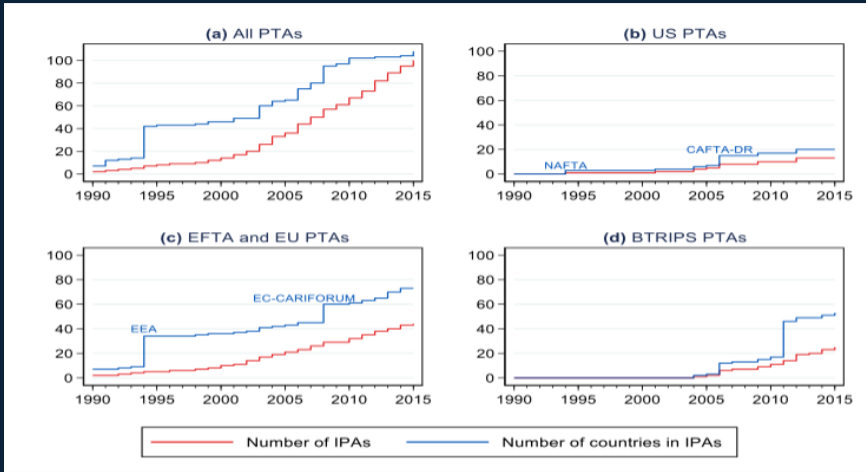- EU agreements: increasing emphasis on IP issues, including TRIPS-Plus.

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Figure: The Number of Legally Enforceable IP-Related Trade Agreements and Number of Countries with Membership in at least One such Agreement by Year, 1990 to 2015

Panel A: all IPR provisions as of 2015	US LE IPAs (13)			EU/EFTA LE IPAs (45)			Other LE IPAs (42)		
	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
Accession/Ratification (n = 15)	11.5	2	14	3.3	0	13	2.0	0	13
National Treatment (n = 2)	2.0	2	2	0.9	0	2	0.6	0	2
Trademarks (n = 15)	9.4	4	15	1.6	0	7	1.5	0	11
Geographical Indications (n = 7)	2.6	0	4	2.0	0	7	0.7	0	3
Patents (n = 14)	4.8	1	13	1.0	0	3	0.7	0	10
Data Protection (n = 5)	2.8	0	5	0.9	0	2	0.1	0	5
Copyrights (n = 14)	10.5	4	14	2.0	0	12	1.9	0	12
Enforcement (n = 23)	17.2	4	20	7.6	0	17	4.8	0	17

Panel B: BTRIPS provisions as of 2015	US LE IPAs (13)			EU/EFTA LE IPAs (45)			Other LE IPAs (42)		
	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
Trademarks (n = 4)	2.3	2	4	0.2	0	2	0.4	0	4
Geographical Indications (n = 3)	0.9	0	1	0.8	0	3	0.3	0	2
Patents (n = 5)	1.2	0	4	0.4	0	1	0.2	0	3
Data Protection (n = 5)	2.8	0	5	0.9	0	2	0.1	0	5
Copyrights (n = 6)	5.6	1	6	1.0	0	6	0.8	0	6
Enforcement (n = 10)	7.1	1	9	3.1	0	7	2.0	0	7

Data Sources

Patent applications
- Universe of bilateral patent filings from source countries to destination (patent office) countries, taken from PATSTAT database (187 identified sources, 82 identified destinations).
    - Sample period 1995-2015.
    - All patent destinations in a family are counted as applications.
    - Those listed in PCT and EPO filings are counted only in ultimate destinations.
    - Domestic (within-country) filings are included to support accuracy of the gravity estimates.

Trade Agreement Data
- World Bank's Deep Trade Agreements Database
- Provides detailed information on 18 policy areas most frequently covered in a set of 283 agreements currently notified to the WTO between 1958 and 2017.

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Defining IPAs

Candidate choices of "strong" IPAs:

► Those with IPR norms that are considered enforceable in the World Bank database (WTO-X IPR LE IPAs);

► Those with primary demandeur countries, the US and EU/EFTA (US/EU/EFTA IPAs);

► Those with at least 3 of the core TRIPS Plus provisions (Three or More Core TRIPS Plus Provisions IPAs).

   ► We call these BTRIPS for Beyond TRIPS

`Provisions`

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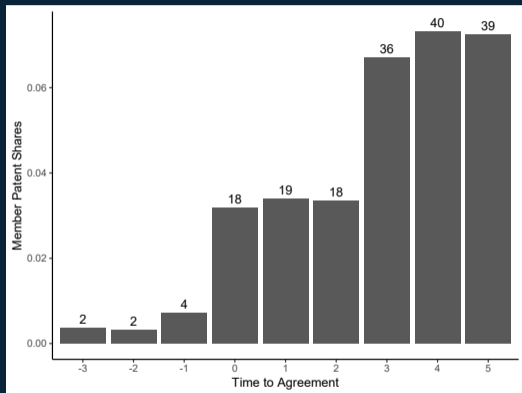
IPAs with ≥ 3 BTRIPS provisions
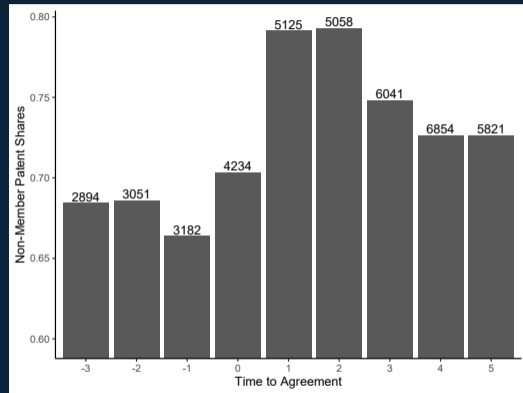

Figure: Member to member (1000s)

Figure: Non-Member to Low-Income Members (count)

Econometric Framework

In a gravity framework, estimate the impacts of the formation of strong IPAs on bilateral patent applications:

- ▶ Bilaterally between member countries (both i and j are in the same IPA(s));
- ▶ Bilaterally from non-member sources to within-IPA destinations;
- ▶ Include domestic applications to avoid biasing international coefficients.

Identify directional effects of third-party patenting for low-income (LI) countries:

- ▶ For example, effect of joining an IPA on patents filed in LI country by parties in non-member countries.
- ▶ Use the 1995 World Bank income classifications.
- ▶ Group middle-income and low-income together, refer to as low income for convenience.

Econometric Approach: Structural Gravity

$$Patents_{ijt} = \exp\big[\beta_1 Intra_{ijt} + \beta_2 Extra_{ijt}\mathcal{I}(Income_i = Income_j = HI)$$
$$+ \beta_3^{i \to j} Extra_{ijt}\mathcal{I}(Income_i = LI) + \beta_4^{j \to i} Extra_{ijt}\mathcal{I}(Income_j = LI)$$
$$+ \gamma_1 Invest_{ijt} + \gamma_2 Other\ IPR_{ijt} + \theta_{ij} + \delta_{it} + \nu_{jt} + \varepsilon_{ijt}\big]$$

▶ $Patents_{ijt}$: Annual flows of patent applications from i to j.

▶ $Intra_{ijt} = 1$ if i and j are both in a particular type of IPA.

▶ $Extra_{ijt} = 1$ if either i or j is in a particular type of IPA.

▶ $Invest_{ijt} = 1$ if i and j are members of a BIT or IIA.

▶ $Other\ IPR_{ijt} = 1$ if i and j are members of another type of IPA.

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Econometric Approach: Structural Gravity

$$
\begin{aligned}
Patents_{ijt} = \exp\big[& \beta_1 Intra_{ijt} + \beta_2 Extra_{ijt}\mathcal{I}(Income_i = Income_j = HI) \\
& + \beta_3^{i \to j} Extra_{ijt}\mathcal{I}(Income_i = LI) + \beta_4^{j \to i} Extra_{ijt}\mathcal{I}(Income_j = LI) \\
& + \gamma_1 Invest_{ijt} + \gamma_2 Other\ IPR_{ijt} + \theta_{ij} + \delta_{it} + \nu_{jt} + \varepsilon_{ijt}\big]
\end{aligned}
$$

- ▶ β_1: Average effect of joint membership on within-agreement patents.
- ▶ β_2: Average effect on external patenting in the IPA, for high-income countries.
- ▶ $\beta_3^{i \to j}$ and $\beta_4^{j \to i}$ measure average directional effect on external patenting for low-income countries.
- ▶ Gravity fixed effects control for multilateral resistance and mitigate concerns over endogenous selection into IPAs.

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Results Total Applications

Member to Member Flows

▶ The WTO LE and US/EU/EFTA IPAs have insignificant impacts on within-IPA applications.

▶ In contrast, BTRIPS $\geq$ 3 IPAs considierably increase within-IPA applications.

Member and Non-member flows

▶ All three agreement types have positive estimates of flows from non-members into LI members (Significant for WTO LE2 and US/EU/EFTA).

▶ Little effect on flows from LI members to non-members (does not appear to be driving innovation in LI countries in aggregate).

▶ Flows between members and non-members when both parties are HI are increasing for US/EU/EFTA and BTRIPS.

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Impact of IPAs on Bilateral Patent Applications

	WTO LE2	US/EU/ EFTA	BTRIPS ≥ 3
$Intra_{ijt}$: (member to member)	-0.244	-0.014	0.238***
	(0.187)	(0.130)	(0.074)
$Extra_{ijt}\mathcal{I}(Income_i = Income_j = HI)$: (HI member to HI non-member)	0.116**	0.137*	0.071
	(0.052)	(0.074)	(0.098)
$Extra_{ijt}\mathcal{I}(Income_j = LI)$: (LI destination in IPA from all non-member sources)	0.145	0.235**	0.346***
	(0.147)	(0.104)	(0.115)
$Extra_{ijt}\mathcal{I}(Income_i = LI)$: (LI source in IPA to all non-member destinations)	0.180	-0.252	-0.290
	(0.294)	(0.340)	(0.194)
Any IPR provision not meeting WTO LE2	0.004	0.187*	0.319**
	(0.060)	(0.103)	(0.156)
Any bilateral investment agreement (BIT or other IIA)	0.523***	0.228**	0.051
	(0.171)	(0.091)	(0.053)

Standard errors are clustered at the country-pair level. All specifications have 104,081 observations and include origin-year, destination-year, and country-pair fixed effects with a pseudo R^2 of 0.997.

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

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What might be underlying these results?

Additional work is needed to try to track down the sources of these impacts. Considering the data, the following is a potential explanation:

► The BTRIPS IPAs include most agreements involving the US, not many of the EU/EFTA, and a few others.
  ► The US has been the strongest demandeur nation in pushing TRIPS-Plus provisions.
  ► The BTRIPS provisions often are regulations focused on specific industries, including those in our IP clusters.
  ► US led agreements seem to be more focused on bilateral protections rather than inviting
► When low income countries, in theory the places where IPRs are lowest, join BTRIPS+ IPAs they see more foreign patent applicatons because:
  ► the strong increase in IP rights induced by the BTRIPS IPA.
  ► OR it could be a sign to third parties of a commitment to enforce IPRs in the LI country.

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Cluster Results

Additional Work

- Understanding what is special about BTRIPS+ agreements:
  - We have tried to use a PPML LASSO to understand what provisions seem to be most important
  - Understanding if these are new innovations or technology transfers seem relevant

- How do these IPAs impact trade?
  - IP owners file patents abroad to protect exports from imitators OR...
  - to protect manufacturing secrets (for offshoring production or horizontal FDI)

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Thank you

Jacob Howard
jbhoward@mitre.org

TRIPS Plus Provisions in the World Bank Database

59 Stipulates the scope of protection for a GI

66 Requires patent be made available for new uses of a known product

67 Requires patent be made available for new methods of a known product

68 Requires patent be made available for new processes of a known product

75 Requires patent term adjustment be given for unreasonable delays by granting authority

77 Includes rules governing patent linkage

80 Provides minimum term of protection for undisclosed test or other data for a new agricultural chemical

81 Provides minimum term of protection for undisclosed test or other data for a new pharmaceutical product

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81 Provides minimum term of protection for undisclosed test or other data for a new pharmaceutical product

83 Provides minimum term of protection for undisclosed test or other data for a pharmaceutical product containing a chemical entity not previously approved by either party

84 Provides minimum term of protection for undisclosed test or other data for a new pharmaceutical product that is or contains a biologic

101 Requires protection against persons seeking to circumvent technological protection measures

102 Requires protection against persons altering rights management information

103 Requires protection against persons who distribute, import, make available product with altered rights management information

112 Stipulates that judicial authorities shall have authority to order injunctive relief

124 Requires parties to provide for criminal procedures & penalties for willful TM counterfeiting on a commercial scale

125 Requires parties to provide for criminal procedures & penalties for willful copyright or related rights piracy on a commercial scale

126 Requires parties to provide for criminal procedures & penalties for unauthorized disclosure/misappropriation of a trade secret

127 Requires parties to make it a criminal offense to unlawfully decode an encrypted program-carrying satellite signal

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Howard, Maskus, and Ridley-Impact of IPA's on Bilateral Patent Applications

IP-intensive industry clusters

Clusters are defined analogously to Delgado, et al (2013)

- ▶ Originally used for analyzing trade effects.
- ▶ We adjusted to NAICS industries designated by US Department of Commerce (2012) as above-mean patenting sectors.

Clusters include:

1. Analytical instruments (AI)
2. Biopharmaceuticals (BIO)
3. Chemicals (CHEM)
4. Information and communication technologies (ICT)

5. Medical devices (MED)
6. Production technology (PT)
7. A group of other patent-sensitive sectors (OTHER)

IP-Cluster Specification

- ► TRIPS-Plus Provisions are often focused on certain sectors, such as BIO, MED, and ICT.
- ► Estimate a structural gravity model across all sectors with IP-cluster specific coefficients.

$$
\begin{aligned}
\textit{Patents}_{ijst} = \exp \Big\{ \sum_s \Big[& \beta_1^s \textit{Sector}_s \times \textit{Intra}_{ijt} \\
& + \beta_2^s \textit{Sector}_s \times \textit{Sector}_s \times \textit{Extra}_{ijt} \mathcal{I}(\textit{Income}_i = \textit{Income}_j = HI) \\
& + \beta_{3,s}^{i \to j} \textit{Sector}_s \times \textit{Extra}_{ijt} \mathcal{I}(\textit{Income}_i = LI) \\
& + \beta_{4,s}^{j \to i} \textit{Sector}_s \times \textit{Extra}_{ijt} \mathcal{I}(\textit{Income}_j = LI) \\
& + \gamma_1^s \textit{Sector}_s \times \textit{Invest}_{ijt} + \gamma_2^s \textit{Sector}_s \times \textit{Other IPR}_{ijt} \\
& + \theta_{ijs} + \delta_{ist} + \nu_{jst} \Big] + \varepsilon_{ijst} \Big\}
\end{aligned}
$$

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IP-Cluster Specification

▶ Sector us a dummy for a particular cluster (includes additional grouping of low-IP inudstries).

▶ Fixed effects expanded to incorporate IP-Cluster sectors.

$$
\begin{aligned}
Patents_{ijst} = \exp \Big\{ \sum_s \Big[& \beta_1^s Sector_s \times Intra_{ijt} \\
& + \beta_2^s Sector_s \times Sector_s \times Extra_{ijt} \mathcal{I}(Income_i = Income_j = HI) \\
& + \beta_{3,s}^{i \to j} Sector_s \times Extra_{ijt} \mathcal{I}(Income_i = LI) \\
& + \beta_{4,s}^{j \to i} Sector_s \times Extra_{ijt} \mathcal{I}(Income_j = LI) \\
& + \gamma_1^s Sector_s \times Invest_{ijt} + \gamma_2^s Sector_s \times Other\ IPR_{ijt} \\
& + \theta_{ijs} + \delta_{ist} + \nu_{jst} \Big] + \varepsilon_{ijst} \Big\}
\end{aligned}
$$

Results: IP-Cluster Applications

The same broad pattern exists across most IP-Clusters

- ▶ The first 2 IPA types have little impact on member-to-member patenting while BTRIPS IPAs lead to an increase in memeber-to-member patenting

- ▶ All three IPA types have some clusters with positive estimates of flows from non-members into LI members.
  - ▶ This result is strongest in BTRIPS IPAs

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WTO LE2 IPAs and Bilateral Patent Filings by Industry Cluster

	Low-IP	AI	BIO	CHEM	ICT	MED	PT	Other
$Intra_{ijt}$: (member to member)	-0.142	-0.475***	-0.141	-0.003	-0.095	-0.001	-0.316	-0.260
	(0.182)	(0.168)	(0.140)	(0.148)	(0.162)	(0.200)	(0.208)	(0.188)
$Extra_{ijt}\mathcal{I}(Income_i = Income_j = HI)$:	0.159**	0.005	0.100*	0.133**	0.223***	0.163***	0.044	0.047
(HI member to HI non-member)	(0.081)	(0.061)	(0.052)	(0.059)	(0.068)	(0.058)	(0.061)	(0.050)
$Extra_{ijt}\mathcal{I}(Income_j = LI)$: (LI destination in	0.097	-0.198	0.210**	0.191*	0.229	0.298**	-0.069	0.035
IPA from all non-member sources)	(0.123)	(0.212)	(0.096)	(0.113)	(0.174)	(0.133)	(0.195)	(0.137)
$Extra_{ijt}\mathcal{I}(Income_i = LI)$: (LI source in IPA	-0.117	0.532	0.006	-0.122	0.549*	0.013	0.112	0.108
to all non-member destinations)	(0.322)	(0.371)	(0.317)	(0.272)	(0.295)	(0.357)	(0.463)	(0.311)
Any IPR provision not meeting WTO LE2	0.024	-0.078	-0.060	-0.013	0.084	0.041	0.014	0.068
	(0.092)	(0.146)	(0.063)	(0.077)	(0.088)	(0.081)	(0.115)	(0.089)
Any bilateral investment agreement	0.412***	0.681***	0.339***	0.206	0.521***	0.416**	0.505***	0.491***
	(0.160)	(0.182)	(0.125)	(0.134)	(0.152)	(0.180)	(0.193)	(0.170)

Standard errors are clustered at the country-pair level. All specifications have 664,665 observations and include origin-sector-year, destination-sector-year, and country-pair-sector fixed effects with a pseudo R^2 of 0.994.

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

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Howard, Maskus, and Ridley-Impact of IPA's on Bilateral Patent Applications

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US/EU/EFTA IPAs and Bilateral Patent Filings by Industry Cluster

	Low-IP	AI	BIO	CHEM	ICT	MED	PT	Other
$Intra_{ijt}$: (member to member)	-0.087	-0.178	0.014	0.068	0.138	0.090	-0.055	-0.115
	(0.155)	(0.132)	(0.136)	(0.160)	(0.143)	(0.161)	(0.187)	(0.149)
$Extra_{ijt}\mathcal{I}(Income_j = Income_j = HI)$:	0.074	0.060	0.144**	0.139	0.339***	0.160**	0.046	0.046
(HI member to HI non-member)	(0.084)	(0.070)	(0.072)	(0.099)	(0.103)	(0.074)	(0.064)	(0.063)
$Extra_{ijt}\mathcal{I}(Income_j = LI)$: (LI destination in	0.118	-0.011	0.321***	0.211	0.363	0.340***	-0.042	0.087
IPA from all non-member sources)	(0.116)	(0.200)	(0.108)	(0.132)	(0.306)	(0.124)	(0.169)	(0.115)
$Extra_{ijt}\mathcal{I}(Income_i = LI)$: (LI source in IPA	-0.261	0.200	-0.275	-0.583**	0.260	-0.423*	-0.312	-0.303
to all non-member destinations)	(0.334)	(0.413)	(0.238)	(0.291)	(0.494)	(0.244)	(0.516)	(0.362)
Any IPR provision not meeting WTO LE2	0.147**	0.119	0.033	0.044	0.193	0.127	0.229*	0.193*
	(0.071)	(0.190)	(0.060)	(0.059)	(0.135)	(0.086)	(0.123)	(0.101)
Any bilateral investment agreement	0.237**	0.285***	0.180**	0.109	0.216***	0.289***	0.209*	0.274***
	(0.102)	(0.098)	(0.090)	(0.105)	(0.078)	(0.092)	(0.126)	(0.102)

Standard errors are clustered at the country-pair level. All specifications have 664,665 observations and include origin-sector-year, destination-sector-year, and country-pair-sector fixed effects with a pseudo R^2 of 0.994.
$*** p < 0.01, ** p < 0.05, * p < 0.1$

BTRIPS ≥ 3 IPAs and Bilateral Patent Filings by Industry Cluster

	Low-IP	AI	BIO	CHEM	ICT	MED	PT	Other
$Intra_{ijt}$: (member to member)	0.187***	0.254	0.315***	0.269***	0.438***	0.388***	0.095	0.262***
	(0.060)	(0.157)	(0.077)	(0.082)	(0.162)	(0.114)	(0.099)	(0.074)
$Extra_{ijt}\mathcal{I}(Income_i = Income_j = HI)$:	0.092	0.020	0.152	0.116	0.204**	0.120	-0.021	0.021
(HI member to HI non-member)	(0.116)	(0.086)	(0.095)	(0.081)	(0.087)	(0.127)	(0.119)	(0.096)
$Extra_{ijt}\mathcal{I}(Income_j = LI)$: (LI destination in	0.266**	0.259**	0.382***	0.322**	0.489***	0.545***	0.301*	0.420***
IPA from all non-member sources)	(0.122)	(0.124)	(0.125)	(0.145)	(0.121)	(0.148)	(0.175)	(0.140)
$Extra_{ijt}\mathcal{I}(Income_i = LI)$: (LI source in IPA	-0.305	-0.266	-0.402*	-0.427	-0.445	-0.852***	-0.399	-0.548*
to all non-member destinations)	(0.297)	(0.290)	(0.222)	(0.403)	(0.344)	(0.229)	(0.444)	(0.286)
Any IPR provision not meeting WTO LE2	0.275**	0.309	0.128	0.097	0.361**	0.192	0.313*	0.330**
	(0.136)	(0.198)	(0.096)	(0.098)	(0.170)	(0.148)	(0.162)	(0.161)
Any bilateral investment agreement	0.065	0.034	-0.042	-0.024	-0.003	0.052	0.098	0.032
	(0.058)	(0.119)	(0.052)	(0.063)	(0.118)	(0.062)	(0.072)	(0.055)

Standard errors are clustered at the country-pair level. All specifications have 664,665 observations and include origin-sector-year, destination-sector-year, and country-pair-sector fixed effects with a pseudo R^2 of 0.994.

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

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