ISSN No. 2454 - 1427

CDE
January 2024

Do Deep Trade Agreements with Intellectual Property Provisions Actually Increase International Trade?

Ridwan Ah Sheikh
Email: ridwan@econdse.org
Department of Economics,
Delhi School of Economic
University of Delhi

Sunil Kanwar
Email: sunil_kanwar@econdse.org
Department of Economics,
Delhi School of Economic
University of Delhi

Working Paper No. 344

Centre for Development Economics
Delhi School of Economics
Delhi- 110007

Do Deep Trade Agreements with Intellectual Property Provisions Actually Increase International Trade?

Ridwan Ah Sheikh[†] *and* Sunil Kanwar[‡]

Abstract

This paper utilizes a comprehensive dataset on deep trade agreements between 1988-2017 in a panel of 210 countries to examine the impact of preferential trade agreements (PTAs) on trade while specifically focusing on the provisions related to intellectual property. The present paper employs a standard structural gravity model using Poisson Pseudo-Maximum Likelihood (PPML) estimation that simultaneously accounts for heteroskedasticity and preponderance of zeros in trade flows. We include rich set of fixed effects to account for multilateral resistance factors and endogeneity in binary trade agreements indicators. Moreover, we incorporate treatment leads and lags to estimate the anticipatory and phased-in impacts of our key trade policy instruments. The results indicate that both PTAs and IPR-related provisions (IPAs) contribute significantly in enhancing trade among member countries. Within the broad category of IPAs, those related to accession/ratification, national treatment, trademark, patents, industrial design, and enforcement aspects reveal a significant positive impact on trade. Additionally, the results demonstrate that IPAs positively influence bilateral trade flows in both high-IP-intensive and low-IP-intensive products, with a stronger impact observed in the high-IP-intensive group. Similarly, among the high-IP intensive group, provisions related to patents have a stronger positive impact on concurrent trade flow in patent-intensive industries, with these effects persisting up to two years after agreements' inception. The provisions related to trademark and copyrights resulted in a significant reduction in trade flows within trademark-intensive and copyright-intensive industries, respectively, with any positive impact observed only after a lag. These results highlight the potential impact of deep trade agreements with intellectual property provisions, both at the extensive margin (i.e., number of IP-related provisions) as well as the intensive margin (i.e., specific provisions such as those related to copyrights, patents, enforcement, etc.) across different industries with varying degree of IPR-intensity, an aspect that has been inadequately explored in previous studies.

JEL Classification: F100, F130, F140, O340
Key words: Preferential trade agreements, Deep trade agreements, Intellectual property rights, International trade

[†]Corresponding author: Department of Economics, Delhi School of Economics, University of Delhi-110007. E-mail address: ridwan@econdse.org

[‡]Department of Economics, Delhi School of Economics, University of Delhi-110007. E-mail address: sunil_kanwar@econdse.org

1 Introduction

The content and design of preferential trade agreements (PTAs) has considerably expanded in recent decades. While traditionally, these focused on tariff reduction or services liberalization, more recent PTAs address critical policy areas such as investment provisions, intellectual property protection, and environment laws, amongst others. Evidently, these recent agreements go beyond trade, and aim to achieve deep(er) integration, earning the moniker of 'deep trade agreements' (DTAs).

Recent decades have witnessed a proliferation of preferential trade agreements that include a variety of provisions related to intellectual property rights (IPRs). In the period since the Trade Related Aspects of Intellectual Property Rights (TRIPS) agreement, enacted within the aegis of the World Trade Organization (WTO) in 1994, (some) technologically advanced countries have pushed for 'TRIPS-plus' provisions via preferential trade agreements with developing countries. While only about 25% preferential trade agreement included IP-related provisions between 1990-1995, this rose to almost 62% during 2011-2015, Wu (2020). Multiple reasons underlie this phenomenon, such as apparent dis-satisfaction of the developed countries with TRIPS agreement, increasing participation of developing countries in global value chains, and the increasing advent of digital technologies which are difficult to protect given national exhaustion of intellectual property rights.

Rather few studies have investigated the trade impact of deep trade agreements. Maskus and Ridley (2016) found that PTAs with IP-related provisions where one partner is the United States or the European Union or the European Free Trade Association, have significant impact on members' aggregate trade. On the contrary, Campi and Dueñas (2019) find that the trade impact of PTAs *without* IP-related provisions is in fact *stronger* than those with IP provisions. Their results, however, may be biased on account of the absence of controls for multilateral resistance.

A large literature obtains, however, on the trade impact of agreements that do not incorporate the impact of IP-related provisions per se. Baier et al. (2014) and Baier et al. (2018) find that economic integration agreements significantly increase trade flows, both in volume and products. Baier et al. (2019) find that countries with prior trade agreements tend to have a weaker partial impact on trade flows from subsequent agreements, and the same holds for countries that are geographically distant, as they find it difficult to comply with deeper provisions. On the other hand, Dhingra et al. (2018) examine the relative importance of individual provisions of these agreements, and find that provisions related to services, investment and competition have a positive significant impact on the exports of both goods and services, with the latter being larger. Lefebvre et al. (2023) analyze the effects of provisions related to regulating state-owned enterprises in regional trade agreements, and find that agreements between countries that trade with China lead to greater participation of Chinese state-owned enterprises as well as exports to these markets, relative to the performance of Chinese private firms. Breinlich et al. (2022) find that provisions related to technical barriers to trade, antidumping, trade facilitation, subsidies, and competition policy have significant positive impact on trade flows. Larch and Yotov (2022) did not find any significant impact of PTAs on trade. The impact of deep trade agreements (DTAs) in their sample, however, led to a significant increase of some 16% in bilateral trade, and more than 34% in foreign direct investment. Martínez-Zarzoso and Chelala (2021) find that regional trade agreements (RTAs) that contain technology provisions generate a significantly higher volume of trade than RTAs that do not.

The empirical analysis is conducted using a panel dataset on manufacturing trade flows spanning 210 countries for the period 1988-2017. Our data set incorporates information on trade flows, trade agreements and joint membership in the World Trade Organization (WTO), General Agreement on Tariffs and Trade (GATT) and European Union (EU). An important aspect of our dataset is that we leverage the extensive content information from the World Bank's database on deep trade agreements as detailed in Wu (2020) and Mattoo et al. (2020). This dataset allows us to differentiate between various indicators and continuous variables related to PTAs, by including a standard dummy variable for PTAs, an indicator for deep trade agreements (DTAs), an indicator for DTAs that include intellectual property related provisions, and two continuous variables for the overall depth of DTAs and for depth of DTAs with IPR-related provisions.

Our study contributes to the existing literature in several ways. First, in estimating the overall impact of deep trade agreements, we focus on the relative importance of intellectual property-related provisions, which is an improvement over Maskus and Ridley (2016) and Campi and Dueñas (2019). Second, we analyze the potential impact of deep trade agreements with intellectual property provisions, both at the *extensive margin* (i.e., number of IP-related provisions) as well as the *intensive margin* (i.e., specific provisions such as those related to copyrights, patents, enforcement, etc.). Third, we attempt to estimate both 'anticipatory' and 'phased-in' effects of deep trade agreements, by using a specification that allows for appropriate leads and lagged terms. Fourth, our study provides the first comprehensive analysis of PTAs and DTAs with IP-related provisions both at aggregate and detailed sectoral level. The impact is further broken down by examining the effect of specific provisions within IPRs on trade in industries exhibiting varying degree of IPR-intensity, an aspect that has been inadequately explored in previous studies.

Further, we improve upon earlier analyses in a number of estimation aspects. Thus, we capitalize on recent developments in trade modelling to simultaneously account for heteroskedasticity and the information contained in zero trade flows (Head and Mayer 2014, Yotov et al. 2016, Silva and Tenreyro 2006). We employ a rich set of *exporter-time* and *importer-time* fixed effects to control for time-varying multilateral resistance factors (Anderson and Van Wincoop 2003), and *country-pair* fixed effects that address the endogeneity concerns with respect to our key policy variables, namely the indicators for PTAs and IP-provisions (Baier and Bergstrand 2007). Following Bergstrand et al. (2015), we include a set of time varying border dummy variables ($Border_{ij,t}$) to account for common effects of globalization, that is., average declining international *relative* to intranational bilateral trade costs [1] . Finally, since we are dealing with a three-way fixed effects gravity model, we adjust for asymptotic bias in coefficient estimates as well as their standard errors (Weidner and Zylkin 2021), and show that the uncorrected estimates, as in the received studies, would lead to erroneous conclusions about the magnitude of the treatment effects of PTAs or IPR-related provisions.

The empirical analysis from our study reveals seven important findings. First, $PTA_{ij,t}$ contribute significantly in enhancing trade among member countries. Second, by distinguishing between the heterogenous impact of deep *versus* shallow agreements, our estimates suggest that $DTA_{ij,t}$ have a significant positive impact on trade. Third, our estimates reveal that two continuous variables for the overall depth of DTAs ($DEPTH_{ij,t}$) and for the depth of the DTAs with IPR-related provisions ($DEPTH_{ij,t}^{IPR}$) though positive are economically small and statistically insignificant, suggesting

[1] To obtain these dummy variables, we incorporate theory-motivated intra-national (domestic) trade flows in addition to international trade flows (Yotov 2022). The $Border_{ijt}$ is then calculated by interacting the binary indicator for each year t (D_t) with the time-invariant dummy variable ($INTER_{ij}$), which takes value of 1 for international trade flows ($i \neq j$) and value the of 0 for domestic trade ($i = j$)

that depth of DTAs per se do not promote trade, possibly because of difficulties in honoring complex agreement provisions. Fourth, on average, the deep agreements with IPR-related provisions ($IPR_{ij,t}$) in our sample have positive, sizable, and statistically significant effect on trade between their members. Fifth, Within the broad category of IPR-related provisions, those concerning to accession/ratification, national treatment, trademark, patents, industrial design, and enforcement show a significant positive effect on trade. Sixth, both PTAs and IPAs have a dynamic impact on aggregate trade flows. Specifically, the estimates of the PTA anticipation effect one year prior to the agreement's inception are negative and significant, with the full trade-facilitation effects phasing-in three years after the agreement. Similarly, we obtain a negative and significant estimate for $IPR_{ij,t+1}$, indicating that IPAs reduce trade flows between their members one year before their entry into force, with these effects persisting into the contemporaneous year as well, possibly because firms delay trade temporarily in anticipation of impending agreements (Baier and Bergstrand 2007). The positive effects of IPAs are realized three years after the agreements' inception. We also find some positive effects of IPAs indicator up to two and four years prior to their implementation. Hence, DTAs that include intellectual property provisions lead to increase in trade between partners even before their entry into force (Egger et al. 2022).

Consistent with our findings on aggregate manufacturing trade flows, the estimates of DTA effects on trade across detailed product categories—particularly those more sensitive to intellectual property—are similarly heterogeneous. The PPML estimates demonstrate that IPAs positively affect bilateral trade flows for both high-IP-intensive and low-IP-intensive industries, with the effect being significantly stronger in the high-IP-intensive category. Similarly, within the high-IP intensive group, provisions related to patents have a stronger positive impact on concurrent trade flow in patent-intensive industries, with these effects persisting up to two years after the agreements' inception. The provisions related to trademark and copyrights led to significant reduction in trade flows within trademark-intensive and copyright-intensive industries, respectively, with any positive impact emerging only after a lag.

The remainder of the paper is organized as follows: Section 2 takes us from the underlying theory to the empirical specification. Section 3 briefly discusses the dataset employed. Section 4 presents a detailed discussion of the estimation results. The robustness of baseline model is discussed in Section 5. Finally, Section 6 provides the conclusions emanating therefrom.

2 From theory to empirics

In the standard structural gravity framework of international trade (Anderson and Van Wincoop 2003), nominal trade flows[2] from country i to country j in year t ($Trade_{ij,t}$) are expressed as a function of their incomes (Y_{it} and Y_{jt}) relative to world income (Y_t^w), the vector of bilateral trade costs associated with goods shipped from origin i to destination j ($\mathbb{T}_{ij,t}$), and outward and inward multilateral resistance terms (Π_{it} and P_{jt}, respectively)[3], as follows:

$$Trade_{ijt} = \frac{Y_{it}\, Y_{jt}}{Y_t^w} \left[\frac{\mathbb{T}_{ij,t}}{\Pi_{it}\, P_{jt}} \right]^{1-\sigma} \quad \forall \quad i, j \tag{1}$$

$$\Pi_{it} = \sum_{j=1}^{N} \left[\left(\frac{\theta_{jt}}{\mathbb{T}_{ij,t}^{\sigma-1}} \right) P_{jt}^{\sigma-1} \right]^{\frac{1}{1-\sigma}} \quad \forall \quad i \tag{2}$$

$$P_{jt} = \sum_{i=1}^{N} \left[\left(\frac{\theta_{it}}{\mathbb{T}_{ij,t}^{\sigma-1}} \right) \Pi_{it}^{\sigma-1} \right]^{\frac{1}{1-\sigma}} \quad \forall \quad j \tag{3}$$

Here, $Trade_{ij,t}$ denotes nominal trade flows from i to j at time t. Consistent with theory, $Trade_{ij,t}$ includes both international and domestic trade flows (Yotov 2022), σ is the elasticity of substitution between goods, $\theta_{it} = \frac{Y_{it}}{Y_t^w}$ and $\theta_{jt} = \frac{Y_{jt}}{Y_t^w}$ are the income shares of i and j, respectively. The multilateral resistance terms (MRTs) consistently aggregate the bilateral trade costs of each country across their trading partners. Thus, controlling for size, equation (1) states that bilateral trade between i and j

[2] Baldwin and Taglioni (2006) argue that inappropriate deflation of nominal trade values by the U.S. aggregate price index may introduce systematic biases in the parameter estimates, which they call 'Bronze-medal mistake', and caution against using real trade flows in empirical gravity estimation. In addition, deflation may be redundant, because the price-bias is effectively accounted for by the two multilateral resistance terms, which are essentially unobserved price indices. In our preferred specification, the time-varying country-specific directional fixed effects (FEs) also eliminate any problems arising from incorrect deflation of trade flows. Besides, the FEs would absorb any deflator indexes, exchange rates, etc. Thus, real (and nominal) trade estimates should be identical (Anderson and Yotov 2016)

[3] The structural interpretation of multilateral resistance terms is that they consistently aggregate bilateral trade costs ($\mathbb{T}_{ij,t}$) faced by each country across all their trading partners.

depends upon bilateral trade barriers ($\mathbb{T}_{ij,t}$) relative to the product of their multilateral resistance factors ($\Pi_{it}\ P_{jt}$)

Our estimation approach closely follows Anderson and Yotov (2016) to infer the effects of deep trade agreements (DTAs). It treats DTAs as a part of unobservable trade costs $\mathbb{T}_{ij,t}$, therefore the power transformation of trade costs as a function of observable variables in structural gravity is modeled as:

$$\begin{aligned}\mathbb{T}_{ij,t}^{1-\sigma} = \exp\{DTAS_{ijt}\beta + GRAVITY_{ijt}\alpha + \rho_1 ln(Dist_{ij}) + \rho_2 Cont_{ij}\} \\ \times \exp\{\rho_3 Comlang_{ij} + \rho_4 Col_{ij} + \rho_5 Comcol_{ij}\}\end{aligned} \tag{4}$$

where $DTAS_{ij,t}$ is a vector that includes an indicator $PTA_{ij,t} = 1$ if i and j are members of preferential trade agreements (PTAs) in year t, and $= 0$ otherwise; and an indicator $DTA_{ij,t} = 1$ if i and j are members of deep trade agreements (DTAs), and $= 0$ otherwise. By construction, the observations that take value 1 in $DTA_{ij,t}$ are a subset of the observations that equal 1 for the $PTA_{ij,t}$ indicator. In other words, there must first be a trade agreement between country pairs at time t, and only then can that agreement be deep or shallow. To capture the impact of IPAs (Wu 2020), $DTAS_{ij,t}$ also includes an indicator $IPR_{ij,t} = 1$ if the agreement includes at least one IPR provision, and $= 0$ otherwise. By construction, the observations for which $IPR_{ij,t} = 1$ are a subset of the observations for which $DTA_{ij,t} = 1$. Finally, vector $DTAS_{ij,t}$ includes two continuous measures of trade agreement depth, namely, variable $DEPTH_{ij,t}$ which is a count measure of the total number of provisions in $PTA_{ij,t}$, and $DEPTH_{ij,t}^{IPR}$ which is a count measure of the total number of IPR-related provisions in an agreement.

The vector $GRAVITY_{ij,t} = [GATT_{ij,t},\ WTO_{ij,t},\ EU_{ij,t}]$ includes the controls for deep economic integration via membership to the World Trade Organization (WTO), its predecessor the General Agreement on Tariffs and Trade (GATT), and European Union (EU). Specifically, $WTO_{ij,t} = 1$ if i and j are members of the WTO and equals 0 otherwise, $GATT_{ij,t} = 1$ if the trading countries i and j are members of GATT in year t and equals 0 otherwise, and $EU_{ij,t} = 1$ if i and j are members of the EU and equals 0 otherwise. We allow for the differential impact of GATT and WTO to identify those (few) cases in which countries are part of GATT but not WTO (Conte et al.

2022). Finally, $ln(Dist_{ij})$ denote the logarithm of bilateral distance between i and j, while $Cont_{ij}$, $Comlang_{ij}$, Col_{ij}, and $Comcol_{ij}$ captures presence of contiguous borders, common language and historical colonial ties respectively.

The econometric specification of gravity is completed by substituting equation (4) for the power transformation of $\mathbb{T}_{ijt}$ into equation (1) and then expanding the gravity equation with an error term to identify the impact of DTAs on trade flows. Therefore, our final estimation equation becomes:

$$Trade_{ijt} = exp\left\{DTAS_{ij,t}\,\beta + GRAVITY_{ij,t}\,\alpha + \sum_{t}\gamma_t\,Border_{ij,t} + \psi_{it} + \phi_{jt} + \mu_{ij}\right\} \times \epsilon_{ij,t} \quad \forall \quad i,j \tag{5}$$

We include *exporter-time* fixed effects ψ_{it} and *importer-time* fixed effects ϕ_{jt} to proxy the unobservable multilateral resistance terms [4]. In addition to controlling for network dependencies, these fixed effects control for the observable (GDP, human capital, trade openness, etc.) and unobservable country-specific time-varying determinants of bilateral trade. Finally, *country-pair* fixed effects μ_{ij} mitigate the endogeneity concerns with respect to our key policy variables $PTA_{ij,t}$ and $IPR_{ij,t}$ in panel data (Baier and Bergstrand 2007). The pair-FE's (additionally) control for time-invariant bilateral determinants of trade, such as: $ln(Dist_{ij})$, $Cont_{ij}$, $Comlang_{ij}$, Col_{ij} and $Comcol_{ij}$. Finally, following Bergstrand et al. (2015), we include a set of time-varying border dummies ($Border_{ijt}$) to account for the common effects of globalization defined as $Border_{ij,t} = D_t \times INTER_{ij}$, where D_t is a year dummmy and $INTER_{ij}$ is time-invariant binary variable which assumes the value of 1 if the source and destination countries, i and j, respectively, are different ($i \neq j$) and value of 0 if i and j are same countries ($i = j$). We estimate equation (5) using Poisson Pseudo-Maximum Likelihood (PPML) estimator, which provides unbiased estimates in the presence of heteroskedasticity and takes advantage of the information contained in zero trade flows (Silva and Tenreyro 2006). Further, to correct for asymptotic bias on account of the incidental parameter problem, we use the Weidner and Zylkin (2021) adjustment of the coefficient estimates and their standard errors that is available in `Stata`.

[4] On log-linearization of equation (1), the structural interpretation of these multilateral resistance terms (MRTs) is obtained as, $\psi_{it} = -(1-\sigma)\; ln\;(\Pi_{it})$ and $\phi_{jt} = -(1-\sigma)\; ln\;(P_{jt})$.

3 Dataset

To perform the empirical analysis, we use annual data relating to manufacturing trade flows across 210 countries, for the period 1988-2017. Estimation with annual data is sometimes criticized on grounds that variables cannot fully adjust annually (Cheng and Wall 2005). To address this criticism, Cheng and Wall (2005) and Baier and Bergstrand (2007) use 5-year interval data instead of one based on consecutive years, whereas Anderson and Yotov (2016) use data on 4-year intervals, Olivero and Yotov (2012) experiment with 3-year and 5-year time intervals, respectively. However, as highlighted by Egger et al. (2022), the common practice of estimating gravity model with interval data may lead to systematic biases in treatment effects. Instead, they recommend to use annual data for efficiency and identification reasons. First, the time-interval data on trade and PTAs may lead to biased estimates of both short-run and long-run effects during the pre-defined intervals due to unequal spacing of PTAs and other trade policy indicators. Second, the unnecessarily discarding of data causes parameters and their standard errors to be less precisely estimated. An alternative approach is to employ time-averaged data. While this may smoothen out yearly fluctuations, it is subject to the same caveats as noted above for interval data. Therefore, we estimate equation (5) using annual data – but pay attention to dynamic adjustment responses by using a specification that allows for appropriate leads and lagged terms.

The dataset on trade flows is based on the new *International Trade and Production Database for Estimation* (ITPD-E), that contains consistent data on international and domestic trade flows across four broad sectors, Agriculture, Mining and Energy, Manufacturing, and Services, Borchert et al. (2021). In this paper, we utilize release-2 of ITPD-E database, our focus will be on 'Manufacturing' sector. The dataset covers information on both intranational and international trade flows across 118 manufacturing industries spanning the years 1988-2017, Borchert et al. (2022).

Our analysis requires the definition of product categories that vary in the relevance of intellectual property. In our setting, the database on manufacturing trade flows is based on ITPD-E classification. In defining the IPR-intensive group of traded products, we follow Delgado et al. (2013), who classify product categories in SITC rev.3 according to IPR-intensity. For this purpose, we build on the concordance presented by Borchert et al. (2021) between the ITPD-E manufacturing classification and ISIC rev.4. To define the industry groups at varying degree of IPR-intensity, we match ITPD-E industries to the SITC rev.3. However, there is no direct mapping between ITPD-E and SITC rev.3 product codes. Instead, we develop an indirect concordance from ITPD-E to ISIC rev.4, and then to SITC rev.3. Using detailed industry definitions from both ITPD-E and SITC rev.3, we established a final match, resulting in the classification of ITPD-E industries into two groups: high-IP intensive and low-IP intensive industries. Within the broad category of high-IP group, the classification further subdivides product categories into high-patent, high-trademark, and high-copyright intensive sub-groups. The detailed concordance between ITPD-E and SITC rev.3 is presented in Table A1.

The dataset on preferential trade agreements is based on World Bank's database on deep trade agreements (Mattoo et al. 2020). The rich dataset provides information on preferential trade agreements and alternative provisions contained in PTAs, as well as depth measures such as the number of provisions contained in each agreement. Data on the intellectual property-related provisions of deep trade agreements are taken from Wu (2020). The dataset on deep trade agreements contains information on 120 IP-related provisions, which we classify into 13 IP-related policy areas by defining an indicator variable and the corresponding depth for each of the 13 types of alternative trade policy instruments related to IPRs. This enables us to estimate which provisions within IPRs matter more for trade flows and how. For example., *patent* is an indicator that highlights the presence (or absence) of provisions related to patents and *depth* gives the number of provisions related to patents. Similarly, for other trade policy instruments within IPRs. To control for confounders, we include information on membership of GATT, WTO and EU from CEPII's *Gravity* database (Conte et al. 2022).

4 Empirical results

We begin by providing estimates of DTAs effects on trade using a three-way gravity model that adopts the current best practices from specialized literature, including the use of PPML estimator, the inclusion of exporter-time, importer-time, and directional country-pair fixed effects, respectively. The results are obtained using aggregate international and intranational manufacturing trade flows.

In addition, all specifications use time-varying border dummy variables to control for the presence of common globalization trends. Since we are dealing with a three-way fixed effects gravity model, we adjust for asymptotic incidental parameter bias in coefficient estimates as well as their standard errors in all our specifications, (Weidner and Zylkin 2021).[5]

4.1 The base model findings

Table 1 reports the estimates of deep trade agreements on aggregate manufacturing trade flows based on equation (5). The estimates in column (1) of Table 1 includes an overall indicator $PTA_{ij,t}$, that reflects the presence (or absence) of preferential trade agreements (deep or shallow) between i and j in year t. The average treatment effect (ATE) of PTAs indicates a positive, economically meaningful, and statistically significant impact on bilateral trade flows between member countries.

Moreover, we find that without the asymptotic bias correction of Weidner and Zylkin (2021), the estimated coefficient of $PTA_{ij,t}$ is downward biased. The bias-corrected PPML estimate of $PTA_{ij,t}$ is about 1.24% larger than the uncorrected estimate, and the bias-corrected standard error is almost 8% larger than uncorrected one.

In column (2) we differentiate between deep vs shallow agreements by including an indicator $DTA_{ij,t}$ that takes a value of one for deep trade agreements, and it is equal to zero otherwise. Specifically, we obtain a positive and statistically significant estimate for $DTA_{ij,t}$, indicating that, on average, the deep trade agreements in our sample have led to a 20% $[(e^{0.182} - 1) \times 100]$ increase in bilateral trade among member countries. This result aligns with and supports the general conclusion of Fernandes et al. (2021) that DTAs contribute significantly in enhancing manufacturing trade flows among member countries. In column (3), we additionally include the continuous measure of the number of provisions contained in the agreement, $DEPTH_{ij,t}$. Although the estimates are economically small, they do not indicate a significant impact of increased depth (number of provisions) on manufacturing trade flows. In column (4), we isolate the impact of deep agreements that include the complex chapters on intellectual property. The estimated treatment effect for $IPR_{ij,t}$

[5] We use STATA's `ppml_fe_bias` command to implement analytical bias correction for the PPML estimator in a gravity model with three-way fixed effects (equation 5). Following the replication file by Weidner and Zylkin (2021), we begin by orthogonalizing the treatment variable $DTAS_{ij,t}$ and other covariates with respect to globalization dummies ($Border_{ij,t}$) and fixed effects, to address any partial correlation with $Border_{ij,t}$.

reveal a positive, sizable, and statistically significant impact, which suggests that, on average, PTAs with IPR provisions in our sample have led to a 13.75% increase in trade between their members, confirming the earlier findings in Maskus and Ridley (2016). Finally, the column (5) results of the number of IP-related provisions $DEPTH^{IPR}_{ij,t}$ do not reveal a significantly effect on the trade flows. One plausible reason could be that more complex IPR-related chapters in the corresponding DTA make the agreements more difficult to comply (Larch and Yotov 2022).

Of the time-varying dyadic controls, we find that membership to EU has a significant positive impact on trade, consistent with Nagengast et al. (2024). Importantly, to solve the *"puzzle of missing WTO effects"*, we incorporate domestic trade flows in lieu of international flows to estimate the gravity equations (Yotov 2022). Therefore, our estimates of the impact of WTO are positive, large and statistically significant, indicating that WTO membership does promote trade. This result is at odd with Rose (2004) and Esteve-Pérez et al. (2020), but confirm the findings in Felbermayr et al. (2024) and Larch and Yotov (2022).

4.2 Impact of alternative IPR-related provisions on trade

While studying the overall impact of preferential trade agreements is useful, the impact of the provisions that they contain might be more helpful in gauging their worth. To do so vis-à-vis the intellectual property rights related provisions $IPR_{ij,t}$, we sequentially replace the indicator for $IPR_{ij,t}$ and $DEPTH^{IPR}_{ij,t}$ in columns (4) and (5) of Table 1 by the corresponding IP indicator and depth for each of the twelve types of intellectual property related provisions. The estimation equation may then be written as:

$$Trade_{ijt} = exp\left\{DTAS_{ij,t}\beta + IPRP^{s}_{ij,t}\delta + GRAVITY_{ij,t}\alpha + \sum_{t}\gamma_t Border_{ij,t} + \psi_{it} + \phi_{jt} + \mu_{ij}\right\}\times\epsilon_{ij,t} \tag{6}$$

The variable $IPRP^{s}_{ij,t}$ is a 1×2 vector that includes an indicator for each IPR-related provision of type s and its corresponding depth (number of provisions in indicator type s). For example, the indicator for *patents* assumes the value of 1 if the trade agreement with IPR-related provisions contains at least one provision related to *patents*, and 0 otherwise (which applies to the subset of observations where $IPR_{ij,t} = 1$). The measure $DEPTH^{s}_{ij,t}$ is calculated as the total number of chapters in the provision s (in this case, *patents*). The same approach applies to all other provisions of type s.

Table 2 shows the distribution of policy areas within the broad category of provisions related to IPRs. The enforcement mechanism has the highest number of provisions (23) followed by ratification of international IP agreements (18), whereas national treatment, exhaustion, biodiversity, and traditional knowledge have the lowest number of provisions (02 in each).

Table 3 reports the estimates from equation (6) using the PPML estimator. Panel (A) reports the estimates of each indicator s by sequentially replacing the dummy for DTAs with IPR provision ($IPR_{ij,t}$) with corresponding indicator variables for each of twelve policy areas of IPR-related provisions (similar to column (4) of Table 1). Panel (B) reports average treatment effects (ATEs) by additionally including the measure of depth of each indicator s (akin to column (5) in Table 1). All the estimates are derived using a three-way fixed effects gravity model, which includes the controls for GATT, WTO, EU, and time-varying border dummies, but their results are omitted for brevity. Our estimates in panel (A) indicate that within the broad category of IPAs, provisions related to accession/ratification, national treatment, trademarks, patents, industrial design, and enforcement exhibit a significant positive impact on trade. Specifically, DTAs with national treatment related obligations increase bilateral manufacturing trade flows by 25% and those with patent, industrial design, and enforcement related obligations increase by 23.12%, 22.5% and 20.32%, respectively. The provisions related to trademarks and the accession/ratification of international treaties and conventions covering intellectual property demonstrate effect sizes of 18.6% and 17.7%, respectively, at 10% significance level. However, trade agreements with exhaustion related obligations reduce members international trade by 23.73% $[(e^{-0.271} - 1) \times 100]$. The impact of other policy areas within $IPR_{ij,t}$, though positive, are statistically insignificant.

The estimates in Panel (B) of Table 3 indicate that the continuous measure of depth is negative but largely insignificant across most of the policy areas related to IPRs, while significantly negative for provisions related to geographic indicators and copyrights. These findings suggest that, in terms of their extensive margin and compositional requirements, these individual agreements are inherently complex and difficult to comply with, which may reduce the aggregate manufacturing trade flows (Larch and Yotov 2022). However, due to perfect or near-perfect collinearity, which makes the variance-covariance matrix nonsymmetric or nearly singular, we were unable to obtain reliable estimates and standard errors for transparency and national treatment obligations with an indicator-variable approach.

4.3 The anticipatory and phased-in effects of trade policy instruments

In this section we introduce the treatment leads and lags of our key policy variables $PTA_{ij,t}$ and IPR_{ijt} to estimate their effects at different lengths of event horizon. The rationale for including lagged terms is that the treatment effects might take time to manifest, so that the response cannot be captured in the contemporaneous year itself (Baier and Bergstrand 2007). Similarly, it is plausible that firms may adjust their trade flows in anticipation of an impending agreement, so that the trade response to an agreement may become visible even before the agreement is finalized.

Following Wooldridge (2010) and Baier and Bergstrand (2007), we add a *future* level of both PTA and IPR in our regression model. The inclusion of first PTA lead enables us to test for the 'strict exogeneity' of these agreements. In the panel data context, if PTA changes are strictly exogenous to trade flow changes, then $PTA_{ij,t+1}$ should be uncorrelated with concurrent trade flows. The same logic applies to IPR-related provisions.

4.3.1 Anticipatory and lagged response of the PTA-indicator

We will first estimate the anticipatory and lagged response of the PTAs indicator on aggregate manufacturing trade flows. Our estimation equation takes the form:

$$\begin{aligned} Trade_{ij,t} = \exp\left\{\alpha PTA_{ij,t} + \sum_s \beta_s PTA_{ij,(t+s)} + \sum_k \delta_k PTA_{ij,(t-k)}\right\} \\ \times \exp\left\{GRAVITY_{ij,t}\,\zeta + \sum_t \gamma_t\, Border_{ij,t} + \psi_{it} + \phi_{jt} + \mu_{ij}\right\} \times \epsilon_{ijt} \quad \forall \quad i,j \end{aligned} \tag{7}$$

$Trade_{ij,t}$ denotes theory-consistent intranational and international trade flows. Here, parameter α gives the direct contemporaneous effect of PTAs on trade. We include $s = 5$ treatment leads (future levels of PTA) in our model to estimate the anticipatory response on country-pairs' aggregate trade flows to the inception of the PTA. Therefore, the parameter β_s gives the average treatment effect s-periods before the agreement is signed. However, since the treatment effects may phase-in with delay, we also include $k = 10$ lagged levels of $PTA_{ij,t}$. Parameter δ_k measures the post-treatment dynamic effects [6]. The estimates are obtained using the PPML estimator, with asymptotic bias correction à la Weidner and Zylkin (2021). As in previous estimation, we include time-varying border dummies, three sets of fixed effects, and controls for joint membership in GATT, WTO and EU.

Table 4 presents the main findings from equation (7). We note that the estimates of PTA anticipation effects for 1 year prior to the inception of an agreement ($PTA_{ij,(t+1)}$) are significantly negative. This can be attributed to firms' response to delay trade flows temporarily in anticipation of future benefits of the PTA. The full trade-facilitation effect phase-in three years after the agreement's inception. Specifically, the agreement led to almost 15.6% increase in manufacturing trade flows, three years after their entry into force. One plausible explanation for this result could be that firms may respond slowly to the terms-of-trade changes and gradually adjust to the new trade rules (Bergstrand et al. 2015, Anderson and Yotov 2016, Egger et al. 2022). The cumulative ATE of PTAs that appear in the bottom of Table 4 (obtained as the sum of all PTA leads and lags) is positive and significant implying - if anything - all else equal, the average treatment effect of PTAs that enter into force during the period of investigation have led to an average increase of manufacturing trade flows by 40.7% between agreement signatories relative to non-signatories. These results confirm earlier findings in Baier and Bergstrand (2007) and Egger et al. (2022), which report a similarly large effect size of FTAs on trade.

4.3.2 Anticipatory and lagged response of the IPR-indicator

To estimate the anticipatory and delayed (lagged) response of trade agreements with IPR-related provisions, we employ the specification:

[6] For example., if $k = 2$, then δ_k is the average treatment effect two periods after the PTA was signed between i and j.

$$
\begin{aligned}
Trade_{ij,t} = \exp\left\{\lambda IPR_{ij,t} + \sum_{s}\lambda_s IPR_{ij,(t+s)} + \sum_{k}\tau_k IPR_{ij,(t-k)}\right\} \\
\times \exp\left\{GRAVITY_{ij,t}\,\zeta + \sum_{t}\tau_t\, Border_{ij,t} + \psi_{it} + \phi_{jt} + \mu_{ij}\right\} \times \epsilon_{ijt} \quad \forall \quad i, j
\end{aligned} \tag{8}
$$

As before, the parameters λ, λ_s and τ_k are of particular interest here, as they measure direct contemporaneous, leading (anticipation) and delayed (phasing-in) responses of DTAs with IPR-related provisions on trade.

Table 5 presents the estimates of the anticipatory and lagged responses of DTAs with IPR provisions. As before, all estimates are obtained using the PPML estimator with three-way fixed effects. We implement analytic bias correction described in Weidner and Zylkin (2021), and additionally include the controls for the presence of common globalization trends and joint membership in GATT, WTO, EU. Similar to our findings regarding PTAs, we also observe a negative and significant estimate for $IPR_{ij,t+1}$, suggesting that IPAs reduce trade flows between their members in the year preceding their entry into force, with these effects continuing into the year of implementation. The negative and significant estimate of the contemporaneous effect of $IPR_{ij,t}$ suggests that IPAs lead to 10.68% reduction in trade flows between their members (relatively) immediately. Notably, three-years after the agreements take effect, IPAs result in an increase of nearly 36.34% in manufacturing trade flows among signatory countries, suggesting that these agreements need time to expand their full potential on trade flows. Moreover, ten years from their entry into force, IPAs lead to significant reduction in trade flows by 6.48%. This finding can be attributed to the fact that IPAs have reached the 'matuarity phase' around 6-7 years from their implementation, after which the trade response of corresponding agreement is actually negative. The total (partial) effect of IPR-related provisions is positive and significant, indicating that ATE of IPAs leads to an increase of nearly 33.10% $[(e^{0.286} - 1) \times 100]$ in manufacturing trade flows between members.

5 Robustness checks

5.1 Aggregate impact on high-IP *versus* low-IP intensive products

The analysis in the previous sections was based on aggregate trade flows. However, it is likely that the trade response to preferential trade agreements could be quite heterogenous at the sectoral level. Furthermore, since intellectual property protection matters more for technologically advanced sectors for rent appropriation, the IPRs-related provisions are likely to have a differential impact on trade in high-IP intensive versus low-IP intensive products. To allow for a varying impact of DTAs on the composition of trade across industries of different IPR-intensity, we estimate:

$$\begin{aligned} Trade^{s}_{ij,t} = \exp\left\{DTAS_{ij,t}\beta + \sum_{k}\delta_k PTA_{ij,(t-k)} + \sum_{k}\lambda_k IPR_{ij,(t-k)}\right\} \\ \times \exp\left\{GRAVITY_{ij,t}\,\zeta + \sum_{t}\tau_t\, Border_{ij,t} + \psi_{it} + \phi_{jt} + \mu_{ij}\right\} \times \epsilon_{ijt} \quad \forall \quad i,j \end{aligned} \tag{9}$$

The dependent variable is nominal trade flows in sector s, high-IP intensive or low-IP intensive products, all other variables are as defined above, and estimation proceeds as before.

Table 6 presents the estimation results from equation (9), columns (1) to (7) pertain to high-IP intensive products, and columns (8) to (14) pertain to low-IP intensive products. First, we did not find any significant effect of PTAs on high-IP intensive trade flows (column 1), while the agreement resulted in an increase of nearly 16.53% in trade for low-IP intensive products (column 8). A possible explanation for these results could be that specific provisions within PTAs, such as those related to intellectual property, may be more crucial to trade in high-IP sectors, we will show that this is indeed the case in column (5). Therefore, by imposing a common effect to all trade agreements, irrespective of their specific type and depth, may not be useful in gauging their impact on trade at detailed industry levels with varying IPR-intensity. Second, DTAs lead to significant increase in trade flows both in high-IP (column 2) and low-IP intensive products (column 9), with the impact being more pronounced for high-IP products. Specifically, $DTA_{ij,t}$ enhance trade by 23% in high-IP intensive categories and 12% in low-IP intensive categories. Third, depending upon the number of provisions included in the agreement, we did not find any significant impact of increased depth on trade flows in either high-IP intensive (column 3) and low-IP intensive (column 10) products. As discussed in the previous section, this may be because more provisions can make an agreement difficult to comply with. Fourth, The IPR-related provisions have noticeably stronger effects on trade in high-IP intensive products relative to low-IP intensive products. The coefficient estimates of 0.209 and 0.104 for $IPR_{ij,t}$ in column (4) and column (11), respectively, implies that IPAs lead to increase in international trade by 23.24% in high-IP products and by 11% in low-IP products. Fifth, the depth of IPAs (in terms of number of IPR-related provisions included in the agreement) does not result in any significant increase in trade flows for high-IP products (column 5), while it led to decline of international trade by 0.49% in low-IP category. One possible explanation could be that additional provisions and increased complexity may render IPAs less effective in promoting trade in high-IP products, where the de facto compliance with those provisions is most crucial. Sixth, the phasing-in effects of PTAs on high-IP and low-IP trade flows are allowed for in the results reported in column (6) and (13), respectively. The estimates in column (6) indicates that PTAs does not have any instantaneous effects on trade in high-IP products, any discernible effects become manifest over time. Particularly, the PTA estimates though positive and significant are economically small in the third and fourth year after entry into force, which, as previously discussed, can be attribute to the gradual elimination of trade barriers and frictions, as well as the delayed adaptation of firms to new trade rules following the inception of PTA (Egger et al. (2022). Moreover, the full trade-facilitation effect of PTAs is realized five years after the agreement's inception, with an effect size of 11%. Similarly, the significantly positive estimates of $PTA_{ij,t-1}$ in column (13), suggest that PTAs lead to increase in low-IP trade flows between their members by 15.71% one years after the agreement's entry into force, with no significant lagged response observed thereafter. Seventh, in columns (7) and (14), we introduce lagged effects of IPR-related provisions on trade. The IPAs enhance trade flows by 3.35% in high-IP products two years after their entry into force, but lead to a 17% reduction in trade three years after the agreement's inception (column 7). However, we do not observe any significant lagged response of IPAs on trade in low-IP products (column 14).

Finally, the membership to WTO and EU result in larger trade gains in high-IP products, while joint WTO membership causes aggregate trade flow to decline in the low-IP intensive group.

However, we do not observe any significant effect of GATT and EU membership on trade in low-IP products.

5.2 Impact of deep trade agreements by type of IPR-intensiveness

In this section, we narrow our focus to examine the heterogeneous sectoral impacts within the high-IP intensive group, based on the degree of intellectual property rights intensity. In particular, we analyze the impact of provisions relating to patents, copyrights and trademarks on trade flows within patent-intensive, copyright-intensive, and trademark-intensive industries. To identify such effects, we augment equation (6) to estimate:

$$\begin{aligned} Trade^{r}_{ij,t} = \exp\left\{ DTAS_{ij,t}\beta + IPRP^{s}_{ij,t}\gamma + \sum_{k} \delta_k IPRP^{s}_{ij,(t-k)} \right\} \\ \times \exp\left\{ GRAVITY_{ij,t}\,\zeta + \sum_{t} \tau_t\, Border_{ij,t} + \psi_{it} + \phi_{jt} + \mu_{ij} \right\} \times \epsilon_{ijt} \quad \forall \quad i,j \end{aligned} \tag{10}$$

The dependent variable is nominal trade flows in industry type r (patent-intensive or trademark-intensive or copyright-intensive), $IPRP^{s}_{ij,t}$ is a vector of IPR-related provisions of type s (patent-related or trademark-related or copyright-related), and the lagged provisions of type s allow for dynamic adjustment. All other variables are as defined in previous analysis, and the estimation follows the same procedure as before.

Table 7 presents the estimation results. Column (1) to (4) corresponds to patent-intensive industries, column (5) to (8) reports the coefficient estimates for trademark-intensive industries, and column (9) to (12) show the findings for copyright-intensive industries. First, our results from this exercise demonstrate that PTAs lead to an average reduction of 15.54% in trade flows within patent-intensive industries. However, we obtain a positive and statistically significant estimate on $DTA_{ij,t}$ in panel (A) and panel (B) of Table 2, which suggests that, on average, the deep trade agreements in our sample have led to a 19.24% and 30% increase in bilateral trade among member countries in patent-intensive and trademark-intensive industries, respectively. As already noted, due to perfect or near-perfect collinearity - leading to nonsymmetric or nearly singular variance-covariance matrix - we were unable to obtain bias-corrected standard errors for $PTA_{ij,t}$ in trademark-intensive and copyright-intensive industries. The deep trade agreements containing IPR provisions result in average increase in trade flow by 19% in patent-intensive industries and 64.04% in copyright-intensive industries. We do not find any significant impact of IPAs on trade in trademark-intensive industries. Second, consistent with our previous findings, the continuous measure for overall depth and depth of IPAs, though positive and economically small, have statistically insignificant effect on trade across all three industry types. Third, we include an indicator for an alternative IPR-related provision, indexed by s, in each industry where it matters the most [7]. Our results suggest that patent-related provisions in the corresponding IPAs lead to 27.37% increase patent-intensive trade flows between their members (relatively) immediately. There is significant evidence of phasing-in and persistence of these effects over time. Specifically, one year after entry into force, IPAs with patent obligations enhance patent-intensive trade flows by 65.69% as the reduction in policy barriers gains bite. However, three years after their implementation, the trade impact of patent-related provisions turns negative. Additionally, IPAs with copyright obligations exhibit trade-reducing effects in copyright intensive industries during the contemporaneous year, with positive estimates observed after a lag. We did not find any significant contemporaneous effects of trademark-related provisions on trade flows in trademark-intensive industries; any discernible effects emerge two years after the agreement's inception. Interestingly, the joint membership in WTO and EU lead to significant positive impact on trade in patent-intensive industries, we do not observe similar gains in trademark-intensive or copyright-intensive industries.

6 Conclusion

This paper studies the links between deep trade agreements (DTAs) and trade both at the aggregate and detailed product levels, using data for a panel of 210 countries over the period 1988-2017. The comprehensive dataset allows us to identify the impact of preferential trade agreements, as

[7] That is, in column (3), we include the indicator $Patent_{ij,t}$, which takes the value of 1, if $IPR_{ij,t}$ contains at least one provision related to patents, and 0 otherwise. The objective is to assess the impact of patent-related provisions on trade within patent-intensive industries. Likewise, we define the indicator for trademark-related ($Trademark_{ij,t}$) and copyright related ($Copyright_{ij,t}$) provisions to evaluate their impacts on trade in trademark-intensive and copyright-intensive industries in column (7) and column (11), respectively

well as depth measures (relating to the number of IP-provisions in each agreement) on bilateral manufacturing trade flows. We categorize these provisions into 13 policy areas associated with IPRs, with each area defined by an indicator variable and its corresponding depth. Through this categorization, we can assess the significance of individual IPR provisions in influencing trade flows. Since the response of trade policy instruments, such as an indicator for PTAs ($PTA_{ij,t}$) or DTAs with IP-related provisions ($IPR_{ij,t}$), typically phases-in with delay, the entire treatment effect may not be fully captured in the concurrent year. Therefore, by employing a specification with lead and lag terms for our key trade policy instruments, we can estimate their treatment effects at different lengths of event horizon. Finally, we examine the impact of specific provisions within the broad category of IPAs on trade in industries demonstrating heightened sensitivity to intellectual property - an aspect that has been largely overlooked in previous studies.

To perform the empirical analysis, we leverage recent advances in structural gravity estimation. The use of panel estimation techniques with rich set of *exporter-time* and *importer-time* fixed effects enables us to effectively control for multilateral resistance and other general equilibrium effects. Additionally, we include *country-pair* fixed effects to address the potential endogeneity concerns with respect to key trade policy instruments - indicators for PTAs and IPR-related provisions. Our dataset on trade flows comes from the new *International Trade and Production Database for Estimation* (ITPD-E), which contains information on both intranational and international trade flows. This enables us to include international border dummies to effectively account for the common effects of globalization. As we are dealing with a three-way fixed effects gravity model, we adjust for the asymptotic bias in estimated coefficient and their standard errors, and show that uncorrected estimates may lead to erroneous conclusions about treatment effects. Finally, we use the Poisson Pseudo-Maximum Likelihood (PPML) estimation framework to simultaneously account for heteroskedasticity and information contained in zero trade flows.

Our estimations results reveal that both PTAs and DTAs with IPR-related provisions have significant positive effects on member's international trade. The continuous measure of overall depth and depth of IPAs reveal no significant impact on bilateral manufacturing trade flows. Moreover, within the broad category of IPAs, those concerning with national treatment, patents, industrial designs, trademarks, accession or ratification of international treaties and conventions, and enforcement related aspects demonstrate positive and sizable impact on bilateral trade. Additionally, our estimation results highlight the dynamic adjustment of trade flows in response to trade policy, such as the inception of trade agreements, and provide significant evidence of phasing-in and persistence of these effects over time. The indicator for deep trade agreements ($DTA_{ij,t}$) and DTAs with IPR-related provisions ($IPR_{ij,t}$) have noticeably stronger effects on trade in high-IP intensive products relative to low-IP intensive products. Finally, our empirical analysis shows that patent-related, copyright-related and trademark-related provisions have both immediate and lagged impact on trade flows in the patent-intensive, copyright-intensive and trademark-intensive industries, respectively. These finding suggest that the dynamic, non-linear response of trade policy instruments within the broader category of IPRs appear to be more consequential in industries where the respective provision hold the significance.

The results of this paper enable us to capture the dynamic adjustment of trade policy changes over an event window. In particular, we provide empirical evidence of IPR-related provisions both at extensive and intensive margins and disentangle their impact across different industries with varying degree of IPR sensitivity. Furthermore, our findings on the differential impacts of trade agreements across industries could inform theoretical models purporting to study these issues. Such theorizing could serve as the basis for richer quantitative dynamic models that take both trade agreements and industry heterogeneity into consideration.

References

Anderson, J. E. and E. Van Wincoop (2003). Gravity with gravitas: A solution to the border puzzle. *American Economic Review 93*(1), 170–192.

Anderson, J. E. and Y. V. Yotov (2016). Terms of trade and global efficiency effects of free trade agreements, 1990–2002. *Journal of International Economics 99*, 279–298.

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

Baier, S. L., J. H. Bergstrand, and M. W. Clance (2018). Heterogeneous effects of economic integration agreements. *Journal of Development Economics 135*, 587–608.

Baier, S. L., J. H. Bergstrand, and M. Feng (2014). Economic integration agreements and the margins of international trade. *Journal of International Economics 93*(2), 339–350.

Baier, S. L., Y. V. Yotov, and T. Zylkin (2019). On the widely differing effects of free trade agreements: Lessons from twenty years of trade integration. *Journal of International Economics 116*, 206–226.

Baldwin, R. and D. Taglioni (2006). Gravity for dummies and dummies for gravity equations. Working Paper No. 12516, National Bureau of Economic Research.

Bergstrand, J. H., M. Larch, and Y. V. Yotov (2015). Economic integration agreements, border effects, and distance elasticities in the gravity equation. *European Economic Review 78*, 307–327.

Borchert, I., M. Larch, S. Shikher, and Y. V. Yotov (2021). The international trade and production database for estimation (itpd-e). *International Economics 166*, 140–166.

Borchert, I., M. Larch, S. Shikher, and Y. V. Yotov (2022). The international trade and production database for estimation - release 2 (itpd-e-r02). USITC Working Paper 2022–07–A.

Breinlich, H., V. Corradi, N. Rocha, M. Ruta, J. Santos Silva, and T. Zylkin (2022). Machine learning in international trade research-Evaluating the impact of trade agreements. Policy Research Working Paper No. 9629, World Bank Group.

Campi, M. and M. Dueñas (2019). Intellectual property rights, trade agreements, and international trade. *Research Policy 48*(3), 531–545.

Cheng, I.-H. and H. J. Wall (2005). Controlling for heterogeneity in gravity models of trade and integration. *Federal Reserve Bank of St. Louis Review 87*(1), 49–63.

Conte, M., P. Cotterlaz, and T. Mayer (2022). The CEPII gravity database. CEPII Working Paper No. 2022-05.

Delgado, M., M. Kyle, and A. M. McGahan (2013). Intellectual property protection and the geography of trade. *The Journal of Industrial Economics 61*(3), 733–762.

Dhingra, S., R. Freeman, and E. Mavroeidi (2018). Beyond tariff reductions: What extra boost from trade agreement provisions? Discussion Paper No. 1532, LSE, Centre for Economic Performance.

Egger, P. H., M. Larch, and Y. V. Yotov (2022). Gravity estimations with interval data: Revisiting the impact of free trade agreements. *Economica 89*(353), 44–61.

Esteve-Pérez, S., S. Gil-Pareja, and R. Llorca-Vivero (2020). Does the GATT/WTO promote trade? After all, Rose was right. *Review of World Economics 156*, 377–405.

Felbermayr, G., M. Larch, E. Yalcin, and Y. V. Yotov (2024). On the heterogeneous trade and welfare effects of gatt/wto membership. *Review of World Economics*, 1–26.

Fernandes, A. M., N. Rocha, and M. Ruta (Eds.) (2021). *The Economics of Deep Trade Agreements.* ISBN: 978-1-912179-46-6, Washington, DC: World Bank. eBook, https://www.worldbank.org/en/research/brief/the-economics-of-deep-trade-agreementsebook#2.

Head, K. and T. Mayer (2014). Gravity equations: Workhorse, toolkit, and cookbook. In G. Gopinath, E. Helpman, and K. Rogoff (Eds.), *Handbook of International Economics*, Volume 4, Chapter 3, pp. 131–195.

Larch, M. and Y. V. Yotov (2022). Deep trade agreements and FDI in partial and general equilibrium: A structural estimation framework. CESifo Working Paper No. 9985.

Lefebvre, K., N. Rocha, and M. Ruta (2023). Containing Chinese state-owned enterprises? The role of deep trade agreements. *Review of World Economics 159*(4), 887–920.

Martínez-Zarzoso, I. and S. Chelala (2021). Trade agreements and international technology transfer. *Review of World Economics 157*(3), 631–665.

Maskus, K. E. and W. Ridley (2016). Intellectual property-related preferential trade agreements and the composition of trade. EUI Working Paper RSCAS 2016/35, Robert Schuman Centre for Advanced Studies.

Mattoo, A., N. Rocha, and M. Ruta (2020). *Handbook of Deep Trade Agreements*. World Bank Publications.

Nagengast, A., F. Rios-Avila, and Y. V. Yotov (2024). The European single market and intra-EU trade: An assessment with heterogeneity-robust difference-in-differences methods. School of Economics, LeBow College of Business, Drexel University, WP 2024-05.

Olivero, M. P. and Y. V. Yotov (2012). Dynamic gravity: Endogenous country size and asset accumulation. *Canadian Journal of Economics/Revue canadienne d'économique 45*(1), 64–92.

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

Silva, J. S. and S. Tenreyro (2006). The log of gravity. *The Review of Economics and Statistics 88*(4), 641–658.

U.S. Department of Commerce (2012). *Intellectual Property and the U.S. Economy: Industries in Focus*. Department of Commerce, Washington, D.C., U.S.A.

Weidner, M. and T. Zylkin (2021). Bias and consistency in three-way gravity models. *Journal of International Economics 132*, 103513.

Wooldridge, J. M. (2010). *Econometric Analysis of Cross Section and Panel Data*. MIT press.

Wu, M. (2020). Intellectual property rights. In A. Matto, N. Rocha, and M. Ruta (Eds.), *Handbook of Deep Trade Agreements*, Chapter 7, pp. 201–222.

Yotov, Y. V. (2022). On the role of domestic trade flows for estimating the gravity model of trade. *Contemporary Economic Policy 40*(3), 526–540.

Yotov, Y. V., R. Piermartini, M. Larch, et al. (2016). *An Advanced Guide to Trade Policy Analysis: The Structural Gravity Model*. Geneva: UNCTAD and WTO.

Table 1 Estimates of the effects of deep trade agreements on trade

	(1)	(2)	(3)	(4)	(5)
$PTA_{ij,t}$	0.163	0.0003	-0.018	-0.003	-0.004
	(0.054)***	(0.065)	(0.067)	(0.056)	(0.057)
$DTA_{ij,t}$		0.182	0.137	0.140	0.154
		(0.052)***	(0.090)	(0.087)	(0.092)*
$DEPTH_{ij,t}$			0.0002	0.0000	-0.000
			(0.0004)	(0.0003)	(0.0004)
$IPR_{ij,t}$				0.129	0.124
				(0.048)***	(0.047)***
$DEPTH_{ij,t}^{IPR}$					0.0006
					(0.001)
$GATT_{ij,t}$	-0.356	-0.312	-0.314	-0.320	-0.319
	(0.150)**	(0.148)**	(0.148)**	(0.149)**	(0.149)**
$WTO_{ij,t}$	0.283	0.285	0.284	0.287	0.286
	(0.149)*	(0.149)*	(0.149)*	(0.150)*	(0.150)*
$EU_{ij,t}$	0.139	0.070	0.075	0.083	0.083
	(0.033)***	(0.029)***	(0.029)**	(0.031)***	(0.031)***
$FE(\psi_{it},\ \phi_{jt},\ \mu_{ij})$	Yes	Yes	Yes	Yes	Yes
$Border_{ij,t}$	Yes	Yes	Yes	Yes	Yes
N	241,065	241,065	241,065	241,065	241,065

Notes: The table reports the estimates of DTAs on international trade in manufacturing sector. The dependent variables is nominal trade flows in levels, and all estimates obtained from equation (5) using PPML estimator with a local de-biasing adjustment to account for estimation noise in the estimated coefficients and their standard errors (Weidner and Zylkin 2021). The results are obtained using a three-way gravity specification with *exporter-time*, *importer-time* , *country-pair* fixed effects, and time-varying border dummies. The estimates of these fixed effects are omitted for brevity. Standard errors clustered by country-pair reported in parentheses. Column (1) reports the estimates of overall PTA effect across all agreements; column (2) adds the effects of DTAs; column (3) introduces a continuous variable for the depth of DTA; column (4) isolates the impact of DTAs with IPR-related provisions and finally column (5) adds the continuous measure of depth for IPR-related provisions. *, **, *** denotes $p < 0.10$, $p < 0.05$, $p < 0.01$, respectively.

Table 2 Distribution of policy areas of type s within the broad category of IPR-related provision

Policy areas within IPR − related provision	*Number of provisions*
Ratification of International IP Agreements	18
National Treatment	02
Exhaustion	02
Transparency	08
Trademarks	15
Geographic Indicators	07
Patents	15
Data Protection/Undisclosed Information	05
Industrial Design	04
Copyrights and Related Rights	14
Biodiversity and Traditional Knowledge	02
Enforcement	23
Others	04
Total	119

Notes: Classification of provisions in respective policy areas is based on Wu (2020). The one provision related to domain name/country name is excluded in this distribution.

Table 3 Estimates of the effects of alternative IPR-related provisions on trade

	(A)	(B)	
Provision	$IPRP^s_{ijt}$	$IPRP^s_{ijt}$	$DEPTH^s_{ijt}$
(1)	(2)	(3)	(4)
Accession/Ratification	0.163	0.246	-0.017
	(0.084)*	(0.124)**	(0.015)
National treatment	0.227	0.201	0.015
	(0.099)**	(-)	(0.080)
Exhaustion	-0.271	-	-
	(0.123)**	(-)	(-)
Transparency	0.118	-0.022	0.044
	(0.117)	(0.206)	(0.033)
Trademark	0.171	0.126	0.011
	(0.092)*	(0.090)	(0.011)
Geographic indicators	0.063	0.202	-0.100
	(0.050)	(0.059)***	(0.024)***
Patents	0.208	0.220	-0.003
	(0.104)**	(0.147)	(0.022)
Data protection	-0.052	-0.445	0.122
	(0.144)	(0.220)**	(0.065)*
Industrial design	0.203	0.281	-0.042
	(0.098)**	(0.181)	(0.074)
Copyrights	0.120	0.360	-0.042
	(0.120)	(0.185)*	(0.017)**
Biodiversity	0.009	0.310	-0.167
	(0.163)	(0.337)	(0.211)
Enforcement	0.185	0.229	-0.004
	(0.094)**	(0.126)*	(0.010)
Others	0.114	0.040	0.046
	(0.079)	(0.117)	(0.081)
$Controls(GATT_{ij,t}, WTO_{ij,t}, EU_{ij,t})$	Yes		Yes
$FE(\psi_{it},\ \phi_{jt},\ \mu_{ij})$	Yes		Yes
$Border_{ij,t}$	Yes		Yes
N	241,065		241,065

Notes: The table reports the estimates of alternative IPR provisions on trade in manufacturing sector. Panel (A) reports the estimates of average treatment effect (ATE) for each indicator of type s. Panel (B) reports ATEs by additionally including a continuous measure of depth for each indicator s. The dependent variables is nominal trade flows in levels, and all estimates obtained from equation (6) using PPML estimator with a local de-biasing adjustment to account for estimation noise in the estimated coefficients and their standard errors (Weidner and Zylkin 2021). The results are obtained using a three-way gravity specification with *exporter-time*, *importer-time* , *country-pair* fixed effects, and time-varying border dummies. The estimates of these fixed effects are omitted for brevity. We also include controls for joint membership in GATT, WTO and EU. Standard errors clustered by country-pair reported in parentheses. *, **, *** denotes $p < 0.10$, $p < 0.05$, $p < 0.01$, respectively.

Table 4 The anticipatory and phased-in effects of PTAs on trade

$PTA_{ij,t+5}$	0.102
	(0.034)***
$PTA_{ij,t+4}$	0.011
	(0.054)
$PTA_{ij,t+3}$	0.010
	(0.025)
$PTA_{ij,t+2}$	-0.004
	(0.031)
$PTA_{ij,t+1}$	-0.077
	(0.043)*
$PTA_{ij,t}$	-0.017
	(0.034)
$PTA_{ij,t-1}$	0.027
	(0.027)
$PTA_{ij,t-2}$	0.039
	(0.032)
$PTA_{ij,t-3}$	0.145
	(0.059)**
$PTA_{ij,t-4}$	0.091
	(0.057)
$PTA_{ij,t-5}$	0.071
	(0.048)
$PTA_{ij,t-6}$	0.013
	(0.064)
$PTA_{ij,t-7}$	-0.028
	(0.034)
$PTA_{ij,t-8}$	-0.017
	(0.042)
$PTA_{ij,t-9}$	-0.065
	(0.086)
$PTA_{ij,t-10}$	0.041
	(0.035)
ATE^a	0.342
	(0.098)***
$Controls\ (GATT_{ij,t}, WTO_{ij,t}, EU_{ij,t})$	Yes
$Border_{ij,t}$	Yes
$FE(\psi_{it},\ \phi_{jt},\ \mu_{ij})$	Yes
N	111,275

Notes: The table reports the phasing-in and anticipatory effects of PTAs. The dependent variables is nominal trade flows in levels, and all estimates obtained from equation (7) using PPML estimator with a local de-biasing adjustment to account for estimation noise in the estimated coefficients and their standard errors (Weidner and Zylkin 2021). The results are obtained using a three-way gravity specification with *exporter-time*, *importer-time* , *country-pair* fixed effects, and time-varying border dummies. The estimates of these fixed effects are omitted for brevity. We also include controls for joint membership in GATT, WTO and EU. Standard errors clustered by country-pair reported in parentheses. *, **, *** denotes $p < 0.10$, $p < 0.05$, $p < 0.01$, respectively.
[a] The average treatment effect (ATE) is obtained as the sum of all treatment leads and lags parameters.

Table 5 The anticipatory and phased-in effects of IPR-related provisions on trade

$IPR_{ij,t+5}$	-0.115
	(0.044)***
$IPR_{ij,t+4}$	0.211
	(0.083)**
$IPR_{ij,t+3}$	-0.012
	(0.027)
$IPR_{ij,t+2}$	0.108
	(0.060)*
$IPR_{ij,t+1}$	-0.053
	(0.020)***
$IPR_{ij,t}$	-0.113
	(0.054)**
$IPR_{ij,t-1}$	-0.071
	(0.053)
$IPR_{ij,t-2}$	0.040
	(0.030)
$IPR_{ij,t-3}$	0.310
	(0.095)***
$IPR_{ij,t-4}$	0.111
	(0.084)
$IPR_{ij,t-5}$	0.013
	(0.059)
$IPR_{ij,t-6}$	-0.019
	(0.055)
$IPR_{ij,t-7}$	-0.025
	(0.047)
$IPR_{ij,t-8}$	-0.025
	(0.026)
$IPR_{ij,t-9}$	-0.003
	(0.053)
$IPR_{ij,t-10}$	-0.067
	(0.034)**
ATE^a	0.286
	(0.138)**
$Controls\ (GATT_{ij,t}, WTO_{ij,t}, EU_{ij,t})$	Yes
$Border_{ij,t}$	Yes
$FE(\psi_{it},\ \phi_{jt},\ \mu_{ij})$	Yes
N	111,275

Notes: The table reports the phasing-in and anticipatory effects of DTAs with IPR-related provisions. The dependent variables is nominal trade flows in levels, and all estimates obtained from equation (8) with PPML estimator using asymptotic bias-correction in (Weidner and Zylkin 2021). The results are obtained using a three-way gravity specification with *exporter-time*, *importer-time* , *country-pair* fixed effects, and time-varying border dummies. The estimates of these fixed effects are omitted for brevity. We also include controls for joint membership in GATT, WTO and EU. Standard errors clustered by country-pair reported in parentheses. *, **, *** denotes $p < 0.10$, $p < 0.05$, $p < 0.01$, respectively.

[a] The average treatment effect (ATE) is obtained as the sum of all treatment leads and lags parameters.

Table 6 Estimates of deep trade agreements on trade in high-IP and low-IP intensive products.

	A. High-IP intensive products							B. Low-IP intensive products						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
PTA_{ijt}	0.072	-0.114	-0.126	-0.102	-0.103	-0.131	-0.011	0.153	0.050	0.061	0.074	0.081	0.159	0.283
	(0.064)	(0.076)	(0.078)	(0.064)	(0.065)	(0.101)	(0.094)	(0.064)**	(0.078)	(0.073)	(0.074)	(0.075)	(0.071)**	(0.077)***
DTA_{ijt}		0.206	0.175	0.193	0.204	0.122	0.129		0.115	0.140	0.139	0.046	-0.076	-0.074
		(0.059)***	(0.098)*	(0.093)**	(0.098)**	(0.122)	(0.121)		(0.049)**	(0.100)	(0.101)	(0.099)	(0.088)	(0.090)
$DEPTH_{ijt}$			0.0001	-0.0002	-0.0002	-0.0003	-0.0003			-0.0001	-0.0003	0.0002	-0.000	-0.000
			(0.0004)	(0.0003)	(0.0004)	(0.0004)	(0.0004)			(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
IPR_{ijt}				0.209	0.205	0.182	0.102				0.104	0.136	0.145	0.166
				(0.054)***	(0.052)***	(0.052)***	(0.055)*				(0.048)**	(0.052)**	(0.046)***	(0.056)***
$DEPTH_{ijt}^{IPR}$					0.0004	0.0008	0.001					-0.005	-0.004	-0.004
					(0.002)	(0.002)	(0.002)					(0.002)**	(0.002)*	(0.002)*
PTA_{ijt-1}						0.036							0.146	
						(0.031)							(0.075)*	
PTA_{ijt-2}						0.049							-0.026	
						(0.026)*							(0.034)	
PTA_{ijt-3}						0.077							0.005	
						(0.046)*							(0.034)	
PTA_{ijt-4}						-0.032							0.041	
						(0.052)							(0.034)	
PTA_{ijt-5}						0.104							0.016	
						(0.028)***							(0.046)	
IPR_{ijt-1}							0.141							-0.030
							(0.096)							(0.032)
IPR_{ijt-2}							0.033							-0.029
							(0.018)*							(0.026)
IPR_{ijt-3}							-0.185							0.029
							(0.105)*							(0.028)
IPR_{ijt-4}							-0.012							0.015
							(0.034)							(0.023)
IPR_{ijt-5}							0.163							-0.039
							(0.062)***							(0.046)
$GATT_{ijt}$	-0.398	-0.351	-0.353	-0.361	-0.360	-0.052	-0.062	0.015	0.043	0.044	0.037	0.033	0.024	0.024
	(0.151)***	(0.149)**	(0.150)**	(0.151)**	(0.151)**	(0.045)	(0.044)	(0.043)	(0.041)	(0.041)	(0.040)	(0.040)	(0.046)	(0.046)
WTO_{ijt}	0.308	0.311	0.311	0.315	0.314	0.013	0.011	-0.078	-0.078	-0.077	-0.074	-0.069	-0.025	-0.028
	(0.149)**	(0.149)**	(0.149)**	(0.150)**	(0.150)**	(0.040)	(0.039)	(0.037)**	(0.037)**	(0.038)**	(0.036)**	(0.036)*	(0.036)	(0.036)
EU_{ijt}	0.162	0.088	0.091	0.102	0.102	0.058	0.064	0.071	0.026	0.023	0.033	0.029	-0.019	-0.016
	(0.038)***	(0.030)***	(0.031)***	(0.032)***	(0.032)***	(0.025)**	(0.026)**	(0.035)**	(0.032)	(0.033)	(0.034)	(0.034)	(0.037)	(0.037)
$Border_{ij,t}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$FE(\psi_{it}, \phi_{jt}, \mu_{ij})$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	238,831	238,831	238,831	238,831	238,831	197,461	197,461	236,133	236,133	236,133	236,133	236,133	195,273	195,273

Notes: The table reports the estimates of DTAs on trade in high-IP and low-IP intensive products. The results in columns 1-7 pertains to high-IP intensive products, whereas those in columns 8-14 pertain to low-IP intensive products. The dependent variables is nominal trade flows in levels, and all estimates obtained from equation (9) with PPML estimator using asymptotic bias-correction in (Weidner and Zylkin 2021). The results are obtained using a three-way gravity specification with *exporter-time*, *importer-time* , *country-pair* fixed effects, and time-varying border dummies. The estimates of these fixed effects are omitted for brevity. Standard errors clustered by country-pair reported in parentheses. *, **, *** denotes $p < 0.10$, $p < 0.05$, $p < 0.01$, respectively.

Table 7 Estimates of deep trade agreements on trade flows by type of IP-intensiveness.

	A. Patent intensive				B. Trademark intensive				C. Copyright intensive			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
PTA_{ijt}	-0.169	-0.154	-0.167	-0.054	-0.004	0.006	0.004	0.106	-0.364	-0.262	-0.232	-0.290
	(0.087)*	(0.086)*	(0.086)*	(0.101)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(0.067)***
DTA_{ijt}	0.176	0.236	0.221	0.115	0.261	0.294	0.292	0.055	0.127	0.353	0.357	0.327
	(0.065)***	(0.107)**	(0.110)**	(0.124)	(0.057)***	(0.087)***	(0.091)***	(0.092)	(-)	(-)	(-)	(0.080)***
IPR_{ijt}	0.173	0.174	0.164	0.117	0.123	0.125	0.124	0.112	0.495	0.554	0.551	0.495
	(0.058)***	(0.052)***	(0.051)***	(0.050)**	(0.089)	(0.099)	(0.105)	(-)	(0.169)***	(0.189)***	(0.188)***	(0.187***)
$DEPTH_{ijt}$		-0.0003	-0.0002	-0.0003		-0.0001	-0.0001	0.0001		-0.001	-0.001	-0.0005
		(0.0004)	(0.0004)	((0.0005)		(0.0003)	(0.0003)	(0.0003)		(0.0004)***	(0.0004)***	(0.0006)
$DEPTH^{IPR}_{ijt}$		0.001	-0.002	-0.0005		0.0003	-0.000	-0.0003		-0.004	0.0007	-0.001
		(0.002)	(0.002)	(0.002)		(0.002)	(0.002)	(0.001)		(0.005)	(0.004)	(0.004)
$Patent_{ijt}$			0.242	-0.115								
			(0.136)*	(0.093)								
$Trademark_{ijt}$							0.025	-0.200				
							(0.111)	(0.036)***				
$Copyright_{ijt}$											-0.313	-0.369
											(0.162)*	(0.181)**
$Patent_{ijt-1}$				0.505								
				(0.229)**								
$Patent_{ijt-2}$				0.076								
				(0.028)***								
$Patent_{ijt-3}$				-0.413								
				(0.148)***								
$Patent_{ijt-4}$				0.075								
				(0.104)								
$Patent_{ijt-5}$				0.155								
				(0.100)								
$Trademark_{ijt-1}$								0.242				
								(0.196)				
$Trademark_{ijt-2}$								0.088				
								(0.039)**				
$Trademark_{ijt-3}$								-0.100				
								(0.099)				
$Trademark_{ijt-4}$								0.132				
								(0.093)				
$Trademark_{ijt-5}$								0.107				
								(0.066)				
$Copyright_{ijt-1}$												-0.096
												(0.109)
$Copyright_{ijt-2}$												0.198
												(0.113)*
$Copyright_{ijt-3}$												0.387
												(0.149)***
$Copyright_{ijt-4}$												-0.464
												(0.171)***
$Copyright_{ijt-5}$												0.310
												(0.163)*
$GATT_{ijt}$	-0.332	-0.329	-0.335	-0.068	0.028	0.030	0.029	-0.035	-0.035	-0.005	-0.008	-0.012
	(0.135)**	(0.136)**	(0.136)**	(0.047)	(0.054)	(0.054)	(0.054)	(0.046)	(0.077)	(0.083)	(0.082)	(0.082)
WTO_{ijt}	0.279	0.278	0.281	0.009	-0.058	-0.058	-0.058	0.029	-0.064	-0.069	-0.069	-0.028
	(0.133)**	(0.134)**	(0.134)**	(0.039)	(0.045)	(0.045)	(0.046)	(0.046)	(0.066)	((0.068)	(0.068)	(0.073)
EU_{ijt}	0.107	0.104	0.107	0.077	0.062	0.059	0.061	0.017	0.181	0.150	0.154	0.099
	(0.035)***	(0.035)***	(0.036)***	(0.029)***	(0.039)	(0.038)	(0.039)	(0.027)	(-)	(0.042)***	(0.043)***	(0.053)*
$Border_{ij,t}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$FE(\psi_{it}, \phi_{jt}, \mu_{ij})$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	237,184	237,184	237,184	196,251	227,716	227,716	227,716	188,476	204,439	204,439	204,439	169,157

Notes: The table reports the estimates of DTAs on trade in patent-intensive products (columns 1-4), trademark-intensive products (columns 5-8), and copyright-intensive products (columns 9-12). The dependent variables is nominal trade flows in levels, and all estimates obtained from equation (10) with PPML estimator using asymptotic bias-correction in (Weidner and Zylkin 2021). The results are obtained using a three-way gravity specification with *exporter-time*, *importer-time* , *country-pair* fixed effects, and time-varying border dummies. The estimates of these fixed effects are omitted for brevity. Standard errors clustered by country-pair reported in parentheses. *, **, *** denotes $p < 0.10$, $p < 0.05$, $p < 0.01$, respectively.

Table A1 ITPD-E classification and concordance for industries in manufacturing sector

ITPD-E	ITPD-E description	ISIC4	SITC3
	A. High-IP intensive industries		
	1. Patent-intensive products		
82	Basic chemicals except fertilizers	2011	51-2
83	Fertilizers and nitrogenous compounds	2012	56
85	Pesticides and agro-chemical products	2021	27
86	Paints, varnishes, printing ink, and mastics	2022	53
87	Pharmaceuticals medicinal chemicals	2100	54
88	Soap cleaning and cosmetic preparation	2023	55
89	Other chemical products n.e.c	2029, 2680	59
91	Rubber tires and tubes	2211	6214, 625
92	Other rubber products	2219	6291-2
93	Plastic products	2220	893
106	Steam generators	2513	711
109	Engine and turbines (not for transport equipment)	2811	713-4, 718
110	Pumps, compressors, taps, and valves	2813	742
111	Bearing gears, gearing, and driving elements	2814	748
112	Ovens furnaces and furnace burners	2815	741
113	Lifting and handling equipment	2816	744
114	Other general purpose machinery	2819	74
115	Agricultural and forestry machinery	2821	721
116	Machine tools	2818, 2822	745
117	Machinery for metallurgy	2823	737
118	Machinery for mining and construction	2824	723
119	Food/beverages/tobacco processing machinery	2825	727
120	Machinery for textile apparel and leather	2826	724
121	Weapons and ammunition	2520, 3040	891
122	Other special purpose machinery	2829	725-6, 728
123	Domestic appliances n.e.c	2750	775
124	Office accounting and computing machinery	2620, 2817	75
125	Electric motors, generators, and transformers	2710	771
126	Electricity distribution and control apparatus	2733	772
127	Insulated wire and cable	2731, 2732	773
128	Accumulators, primary cells, and batteries	2720	778
129	Lighting equipment and electric lamps	2740	7782
130	Other electric equipment n.e.c	2790	7788
131	Electronic valves, tubes, etc.	2610	776
132	TV/radio transmitters, line communication apparatus	2630	764
133	TV and radio receivers and associated goods	2640	761-3
134	Medical, surgical & orthopedic equipment	2660, 2350	5419,59895,774,872
135	Measuring, testing, and navigating appliances and equipment	2651	874
136	Optical instrument and photographic equipment	2670	871, 881-2, 884
137	Watches and clocks	2652	8853-4
149	Jewellery and related articles	3211, 3212	897
150	Musical instruments	3220	898
151	Sports goods	3230	8947
152	Games and toys	3240	8941-3
153	Other manufacturing n.e.c	3290	8952, 89591, 899
	2. Trademark-intensive products		
40	Dairy products	1050	022-4
49	Distilling, rectifying and blending of sprits	1101	1124
50	Wines	1102	1121-2
51	Malt liquors and malt	1103	1123
52	Soft drinks and mineral waters	1104	1110
64	Footwear	1520	85
70	Pulp paper and paper boards	1701	251
71	Corrugated paper and paperboard	1702	641

Continued on next page

Table A1 (Continued)

ITPD-E	ITPD-E description	ISIC4	SITC3
	2. Trademark-intensive products		
72	Other articles of paper and paperboard	1709	642
84	Plastic in primary form; synthetic rubber	2013	231-2, 57
107	Cutlery, hand tools and general hardware	2593	695-6, 6991
140	Parts and accessories of automobiles	2930	784
146	Bicycles and invalid carriages	3092	78531, 78536
148	Furniture	3100	82
	3. Copyright-intensive products		
73	Publishing of books and other publications	5811	8921
74	Publishing of newspapers, journals etc.	5813	8922
75	Publishing of recorded media	5920	8986-7
76	Other publishing	5819	8924
77	Printing	1811	-
	B. Low-IP intensive industries		
36	Processing/preserving of meat	1010	01
37	Processing/preserving of fish	1020	03
38	Processing/preserving of fruits and vegetables	1030	05
39	Vegetable, animal oil and fats	1040	41-3
41	Grain mill products	1061	04
43	Prepared animal feeds	1080	08
44	Bakery products	1071	0484
45	Sugar	1072	061
46	Cocoa, chocolate and sugar confectionery	1073	062, 072, 073
47	Macaroni, noodles and similar products	1074	0483
48	Other food products, n.e.c	1075, 1079	098
54	Textile fibre preparations; textile weaving	1311, 1312	651-4, 657
55	Made-up textile articles except apparel	1392	658
56	Carpets and rugs	1393	659
57	Cordages, rope, twine, and netting	1394	6575
58	Other textiles n.e.c	1399	656
59	Knitted and crocheted fabrics and articles	1430, 1391	655
60	Wearing apparel except fur apparel	1410	84
61	Dressing and dyeing of fur; processing of fur	1420	613
62	Tanning and dressing of leather	1511	611
63	Luggage, handbags, etc., saddlery and harness	1522	612
65	Sawmilling and planing of wood	1610	6349
66	Veneer sheets, plywood, particle boards etc.	1621	634
67	Builders' carpentry and joinery	1622	6353
68	Wooden containers	1623	6351-2
69	Other wood products; articles of cork/straw	1629	6354, 6359
79	Coke oven products	1910	32
80	Refined petroleum products	1920	33, 3441
94	Glass and glass products	2310	664-5
95	Pottery, china, and earthware	2393	6661-2, 6639
96	Refractory ceramic products	2391	6623
97	Structural non-refractory clay; ceramic products	2392	6624
98	Cement, lime, and plaster	2394	6611-2
99	Articles of concrete cement and plaster	2395	6613, 6618
100	Cutting, shaping and finishing of stones	2396	-
101	Other non-metallic mineral products n.e.c	2399	6631, 6633, 6635
102	Basic iron and steel	2410	67
103	Basic precious and non-ferrous metals	2420	68
104	Structural metal products	2511	691
105	Tanks, reservoirs, and containers of metal	2512	692
108	Other fabricated metal products n.e.c	2599	693-4, 69933, 6994, 6996

Notes: This table presents the concordance that we created between ITPD-E manufacturing classification and SITC rev.3. We use Delgado et al. (2013) to classify ITPD-E product categories according to varying levels of IPR-intensity based on ESA-USPTO reports (U.S. Department of Commerce 2012). By utilizing the detailed industry definitions from both ITPD-E and SITC rev.3, we established a final match, resulting in the classification of ITPD-E industries into two groups: high-IP intensive and low-IP intensive industries. Within the broad category of high-IP group, the classification further subdivides product categories into high-patent, high-trademark, and high-copyright intensive sub-groups.