Bytes and Borders:
Digital Trade-Related Provisions in Regional Trade Agreements

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ABSTRACT

This study looks into the developments in regional trade agreements (RTAs) with digital trade-related provisions (DTPs) with a focus on Asia. The analysis reveals that RTAs tend to incorporate more DTPs when they are recently signed, bilaterally negotiated, and interregional; especially between Asia and non-Asia economies. Using a structural gravity model, Poisson Pseudo-Maximum Likelihood (PPML) estimation, and a constructed *digital depth* index; the analysis finds that RTAs with DTPs have the potential to enhance trade flows more than those without. Specifically, RTAs with the highest digital depth may increase imports into Asia by 15.4% and exports from Asia by 13.8%, compared to 10.4% and 13.7% for RTAs without DTPs, respectively. These findings underscore the benefits of incorporating DTPs in plurilateral agreements and emphasize the value for policymakers to negotiate deeper agreements bilaterally. However, for these agreements to be most effective, economies must be digitally capable, have the digital infrastructure, and adopt and implement enabling domestic policies.

JEL Classification: F1, F18, O33
Key Words: digital trade, digital trade-related provisions, digital depth, regional trade agreements, structural gravity, Asia

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1. Introduction

Economies have long recognized regional trade agreements (RTAs)[2] as a valuable tool to facilitate trade and investments and to strengthen international cooperation. With the rapid pace of innovation and increasing digitalization, the landscape of RTAs and dynamics of global trade have undergone significant transformations. The rise of digital technologies has revolutionized the way goods and services are produced, distributed, and consumed. As a result, RTAs have increasingly incorporated provisions related to digital trade, statistically defined as "all international trade transactions that are digitally ordered and/or digitally delivered" (International Monetary Fund; Organization for Economic Cooperation and Development; UN Trade and Development; World Trade Organization, 2023).

These digital trade-related provisions (DTPs) embed digitalization in traditional objectives of facilitating and promoting businesses through paperless trading, digital services trade, and electronic payments, authentication, and signatures; as well as connectivity through telecommunications cable systems and internet interconnection charge sharing. Further, new objectives have been pursued such as data free flow and protection, digital inclusion, and online consumer protection.

This paper examines these developments in the context of attaining arguably the most prominent objective of RTAs – facilitating trade. With a focus on Asia, it explores the increasing prevalence of DTPs through content analysis, focusing on the trends in its inclusion in RTAs. It also examines the trade implications associated with the extent of DTP integration through the estimation of a structural gravity model.

The rest of the paper is organized as follows: Section 2 presents the trends and stylized facts on RTAs and DTPs and introduces the concept of *digital depth*; Section 3 details the empirical strategy to examine the trade flow effects of DTPs; Section 4 discusses the results; and Section 5 concludes.

2. Trends and Stylized Facts

Rising Complexities: Deep Trade Agreements

The World Trade Organization (WTO) serves as the primary global platform for member nations to participate in discussions and negotiations. However, with 164 members, the multilateral trading system is met with challenges in effecting binding measures, reaching a consensus, and updating trade rules. This has given rise to trade agreements being pursued at the regional and bilateral level.

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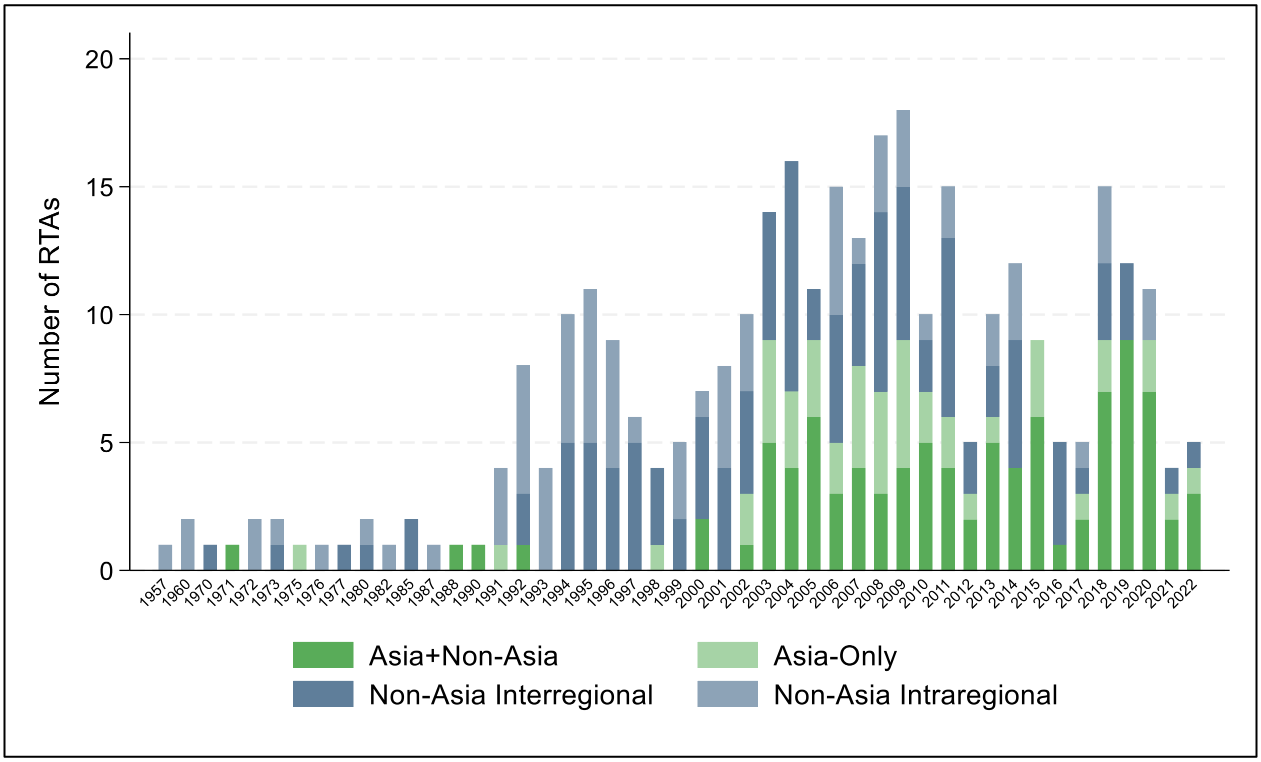
[2] In the literature these are sometimes referred to as preferential trade agreements (PTAs) recognizing that some trade agreements do not necessarily involve countries within the same region. The WTO (n.d.) formally defines RTAs as "reciprocal trade agreements between two or more partners to liberalize tariffs and services. They include free trade areas and customs unions and economic integration agreements on services" and PTAs "for trade preferences, such as lower or zero tariffs, which a member may offer to a trade partner unilaterally." For the purpose of this paper, the term "RTA" is used to refer to all types of agreements.

As of 2022, there are 328 active RTAs, with a predominance of agreements between non-Asia countries in the earlier years, particularly among European nations *(Figure 1)*. Although some agreements involving countries in Asia were present, their proliferation only became more noticeable in the 2000s, with a significant trend towards agreements with counterparts from regions outside of Asia. Out of the active RTAs, 46 are between countries in Asia and 93 are between Asia and non-Asia countries – together comprising 42.4% of the total. Of the remaining RTAs that involve other regions, 76 are intraregional and 113 are interregional.

Figure 1. Number of signed and active RTAs, by Regional Composition, 1957-2022



Note. Missing years indicate that RTAs signed in those years are classified as inactive agreements.
Asia-only includes agreements within and between subregions of Asia (e.g., within East Asia, between Southeast Asia and West Asia)
Source: Mapping results generated using the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) Trade Agreement Text Analysis Tool based on the Author's matching matrix

Beyond the increasing number of trade agreements, their complexity has also grown to address issues extending beyond trade. Horn, Mavroidis, and Sapir (2010) in analyzing EU and US trade agreements, categorized these provisions as *WTO+* or those that are still under the purview of the WTO but where bilateral commitments go beyond the multilateral level and *WTO-X* or those that deal with issues outside the current scope of the WTO *(see Appendix A)*.

These types of trade agreements, referred to as deep trade agreements (DTAs) has been the subject of recent literature. The work of Breinlich *et al.* (2021) using machine learning techniques found that provisions of DTAs related to technical barriers to trade, anti-dumping, trade facilitation, subsidies, and competition policy positively enhances the trade effects of RTAs; while the study of Fontagné, Rocha, Ruta, and Santoni (2021) using general equilibrium anaylsis revealed that deepening existing agreements could boost world trade and gross domestic product (GDP) by 3.9% and 0.9%, respectively.

While the effects of trade agreements have been generally estimated using a dummy variable to represent the involvement of country pairs to an RTA, studies on DTAs use constructed measures of depth to account for the differential effects on trade. The depth indices commonly use the database by Hofmann, Osnago, and Ruta (2017), which maps out the policy areas covered in each agreement and whether these are legally enforceable or not. These use either the 52 areas identified under the WTO+ and WTO-X or the 18 core provisions identified to be most often included in trade agreements. The analysis by Mattoo, Mulabdic, and Ruta (2017) using the depth index determined that deep agreements lead to more trade creation and less trade diversion compared to more shallow agreements.

Accelerating Digitalization: Digital Trade-Related Provisions

In breaking down the concept of digital trade, the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), UN Trade and Development (UNCTAD), and United Nations Industrial Development Organization (UNIDO) (2023) defines digital trade as either digitally ordered, digitally delivered, or a combination of both. Digitally ordered trade focuses on the medium through which the order is made and is closely associated with international e-commerce, covering both goods and services. On the other hand, only services can be digitally delivered, specifically those provided remotely through computer networks. The definition entails that digital trade is a subset of existing international trade statistics based on the nature of the transaction, however, statistics specifically on digital trade remains partial (Organisation for Economic Co-operation and Development, n.d.)

The digital era has accelerated the need to update trade rules, amplifying the slow pace of the multilateral trading system. As economies endeavor to cope with and take advantage of the opportunities digital trade offers, RTAs have grown more complex with the rise of digital trade agreements (DiTAs), digital partnership agreements (DPAs), or digital economy agreements (DEAs) that “establish[es] digital trade rules and digital economy collaborations between two or more economies” (Callebaut, 2022). Currently, there are four bilateral DiTAs/DPAs/DEAs (i.e., Australia-Singapore, US-Japan, Korea-Singapore, and UK-Singapore) and the Digital Economic Partnership (DEPA) between Singapore, Chile, and New Zealand. As the ESCAP, UNCTAD, and UNIDO (2023) notes, the scope of DTPs has significantly expanded from those that “affect trade by electronic means” to those that “affect trade in the digital economy.”

Moreover, DTPs have increasingly been incorporated in RTAs. Based on the literature (Wu, 2017; Organisation for Economic Co-operation and Development, 2019; Ciuriak, 2022); Du, Duval, Semenova, and Sutthivana (2023) map out these DTPs into the key areas of: (i) market access, (ii) enabling and facilitating digitalized trade, (iii) protecting users of e-commerce, (iv) inclusive digital trade, (v) e-commerce-related intellectual property (IP) issues, (vi) cooperation in e-commerce, (vii) dispute resolution in e-commerce, and (viii) other aspects of the digital economy. These other aspects include data-driven innovation, open government data, and other cutting-edge issues (e.g., artificial intelligence, *fintech*, *regtech*, internet interconnection charge sharing, submarine telecommunications cable systems).

A total of 56 provisions are identified under these key areas *(see Table B1 in Appendix B)*. It can be observed that some of the DTPs coincide with the areas under the WTO+ and WTO-X, such as in IP; innovation; small, and medium enterprises (SMEs); and taxation with the caveat that DTPs tackle these issues specifically within the context of digital trade.

Following developed measures of depth in the analysis of DTAs, this paper constructs a measure of *digital depth* of RTAs. The measure is computed as:

$$DD_{RTA_t^{ij}} = \sum_{k=1}^{N} DTP_{k,t}^{ij} \quad (01)$$

Simply, the digital depth of an RTA between countries *i* and *j* at year *t* is measured as the sum of DTPs that are covered by the RTA. We follow Mattoo, Mulabdic, and Ruta (2017) to normalize the values to be between 0 and 1 through the normalization formula below:

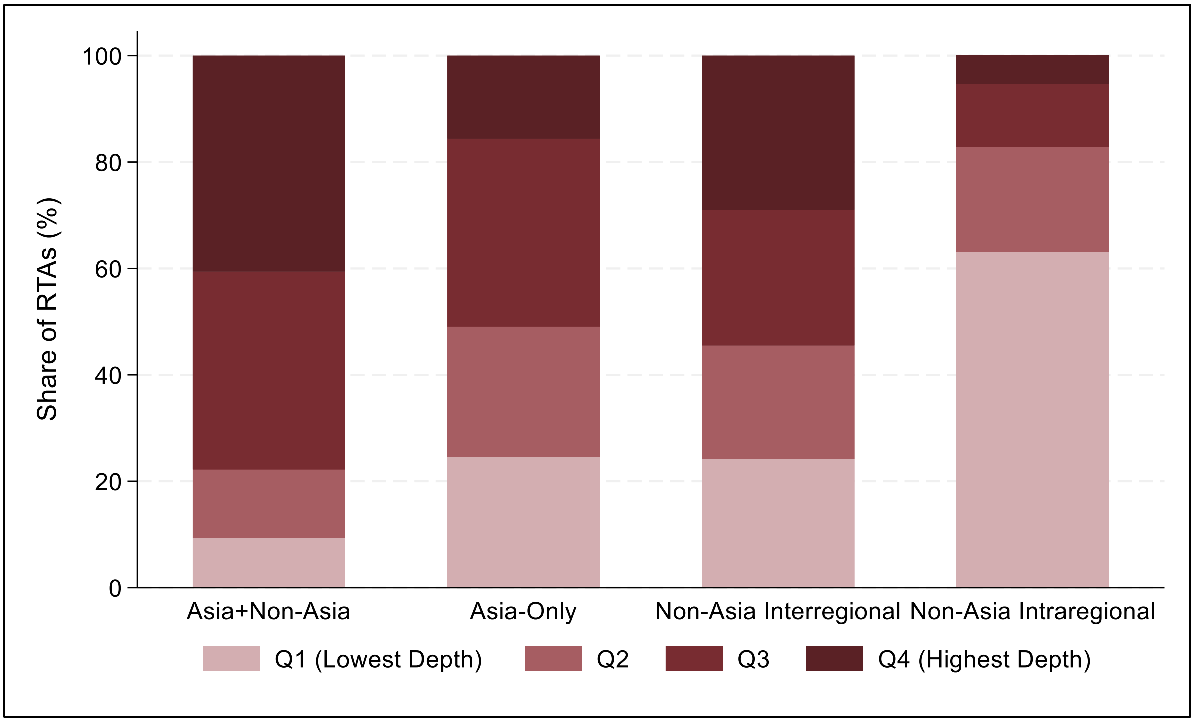
$$(DD_{RTA_t^{ij}})' = \frac{DD_{RTA_t^{ij}} - min\left(DD_{RTA_t^{ij}}\right)}{\max\left(DD_{RTA_t^{ij}}\right) - min\left(DD_{RTA_t^{ij}}\right)} \quad (02)$$

The index could be constructed to account for the more disaggregated 56 provisions or the broader 8 key areas. The ESCAP Trade Agreement Text Analysis Tool developed by Semenova, Kravchenko, and Duval (2023) is utilized to conduct the content analysis and ascertain the presence of the DTPs at the more disaggregated level.

Shifting Focus: Trends in DTPs

Interregional RTAs, particularly those between Asia and non-Asia countries, are more concentrated in the upper third and fourth quartiles of digital depth, indicating that they incorporate a higher number of DTPs *(Figure 2)*. Specifically, 44.1% of RTAs between Asia and non-Asia countries and 23.0% of interregional agreements between non-Asia countries are in the highest quartile. Among intraregional RTAs, 15.2% within Asia fall into the highest quartile, while just 5.3% of RTAs within other regions achieve this level of digital depth. This trend may be influenced by the generally more recent signing of the former agreements: Asia and non-Asia RTA were signed on average, in 2011; Asia-only RTAs in 2008; non-Asia interregional RTAs in 2004; and non-Asia intraregional RTAs as early as 1998.

Figure 2. Share of RTAs, by Digital Depth Quartile and Regional Composition



Note. Used the disaggregated level of 56 DTPs.

Source: Mapping results generated using the ESCAP Trade Agreement Text Analysis Tool, based on the Author's matching matrix

The RTAs with the highest digital depth are the UK –New Zealand Free Trade Agreement (FTA) (1.00 with 49 DTPs), UK – Australia FTA (0.92), and United States–Mexico–Canada Agreement (USMCA/CUSMA/T-MEC) (0.84). Following closely, the Korea–Singapore DPA, Australia–Singapore DEA, and the DEPA each have a digital depth of 0.82 *(Table 1)*. On average, RTAs between Asia and non-Asia countries exhibit the highest digital depth at 0.23, followed by non-Asia interregional RTAs at 0.12. These are closely followed by agreements between economies in Asia at 0.11. Non-Asia intraregional RTAs exhibit the lowest average digital depth at 0.05.

Digital depth is notably higher in RTAs involving key economies. Within Asia, agreements that include Singapore, Korea, Japan, and China tend to have significantly greater digital depth. Excluding these economies from the analysis sharply reduces the average digital depth of intra-Asia RTAs to just 0.02, and RTAs between Asia and non-Asia to 0.17. A similar trend is observed outside Asia, where RTAs involving Australia, New Zealand, the UK, the US, and EU member states exhibit higher digital depth. Removing these economies drops the average digital depth of non-Asia intraregional RTAs to a mere 0.03, while non-Asia interregional RTAs fall to 0.08. This highlights the substantial influence these advanced digital economies exert on the overall inclusion of DTPs in RTAs.

Table 1. RTAs and Digital Depth, Top 10, by Regional Composition

RTA	Agreement Type	Year Signed	DTPs	Digital Depth
Asia Only				
Korea – Singapore DPA	Bilateral	2022	40	0.82
Sri Lanka – Singapore FTA	Bilateral	2018	21	0.43
Japan – Mongolia for EPA	Bilateral	2015	16	0.33
China – Korea FTA	Bilateral	2015	16	0.33
Korea – Viet Nam FTA	Bilateral	2015	16	0.33
Korea – Singapore FTA	Bilateral	2005	12	0.24
Singapore – Chinese Taipei EPA	Bilateral	2013	12	0.24
Cambodia – China FTA	Bilateral	2020	11	0.22
China – Macao, China CEPA	Bilateral	2003	10	0.20
Japan – Indonesia EPA	Bilateral	2007	8	0.16
Asia + Non-Asia				
Australia – Singapore DEA	Bilateral	2020	40	0.82
DEPA	Plurilateral	2020	40	0.82
UK – Singapore DEA	Bilateral	2022	35	0.71
CPTPP	Plurilateral	2018	35	0.71
UK – Japan CEPA	Bilateral	2020	33	0.67
India – UAE CEPA	Bilateral	2022	30	0.61
Singapore – Australia FTA	Bilateral	2003	29	0.59
RCEP	Plurilateral	2020	28	0.57
New Zealand – Singapore CEP	Bilateral	2000	26	0.53
Hong Kong, China – Australia FTA	Bilateral	2019	24	0.49
Non-Asia Interregional				
UK – New Zealand FTA	Bilateral	2022	49	1.00
UK – Australia FTA	Bilateral	2021	45	0.92
Peru – Australia FTA	Bilateral	2018	30	0.61
CAFTA – DR	Plurilateral	2004	23	0.47
US – Panama TPA	Bilateral	2007	22	0.45
US – Colombia TPA	Bilateral	2006	21	0.43
US – Peru FTA	Bilateral	2006	21	0.43
Pacific Alliance	Plurilateral	2014	20	0.41
Australia – Chile FTA	Bilateral	2008	19	0.39
Mexico – Panama FTA	Bilateral	2014	19	0.39
Non-Asia Intraregional				
USMCA/CUSMA/T-MEC	Plurilateral	2018	41	0.84
UK – EU TCA	Bilateral	2020	22	0.45
EU – Ukraine DCFTA	Bilateral	2014	15	0.31
UK – Turkey FTA	Bilateral	2020	12	0.24
Chile – Colombia FTA	Bilateral	2006	11	0.22
EFTA – Turkey FTA	Bilateral	2018	10	0.20
Turkey – Serbia FTA	Bilateral	2009	9	0.18
EAEU	Plurilateral	2014	9	0.18
African Continental FTA	Plurilateral	2018	6	0.12
Panama – El Salvador FTA	Bilateral	2002	5	0.10

Note. Used the disaggregated level of 56 DTPs.

Source: Mapping results generated using the ESCAP Trade Agreement Text Analysis Tool, based on the Author's matching matrix

It can also be observed that the top RTAs have been signed in the 2000s, with most occurring within the last decade. These also include recent mega-regional trade agreements such as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) and the Regional Comprehensive Economic Partnership (RCEP), both of which incorporate major DTPs. Based on the type of agreement, RTAs tend to display more depth when they are bilateral.

The trend on the type of agreement and year of signing become particularly evident when examining specific agreements involving the Association of Southeast Asian Nations (ASEAN). The digital depth of agreements that the ASEAN has collectively negotiated with partners such as Japan (0.00), Korea (0.06), and Australia and New Zealand (0.33) are generally lower compared to bilateral agreements concluded by individual ASEAN member states *(Table 2)*. This pattern is especially pronounced in bilateral agreements signed *after* the plurilateral agreements, such as the Vietnam-Korea FTA (0.33), Singapore-Australia DEA (0.82), and Indonesia-Australia CEPA (0.41). However, some bilateral agreements that were signed earlier than the plurilateral agreements also had higher digital depths like the Singapore-Japan EPA (0.06), Thailand-Australia FTA (0.20), Malaysia-New Zealand FTA (0.10), and Thailand-New Zealand CEPA (0.18). Notably, both the CPTPP and RCEP – despite their plurilateral nature – demonstrate higher digital depth, bucking the overall trend.

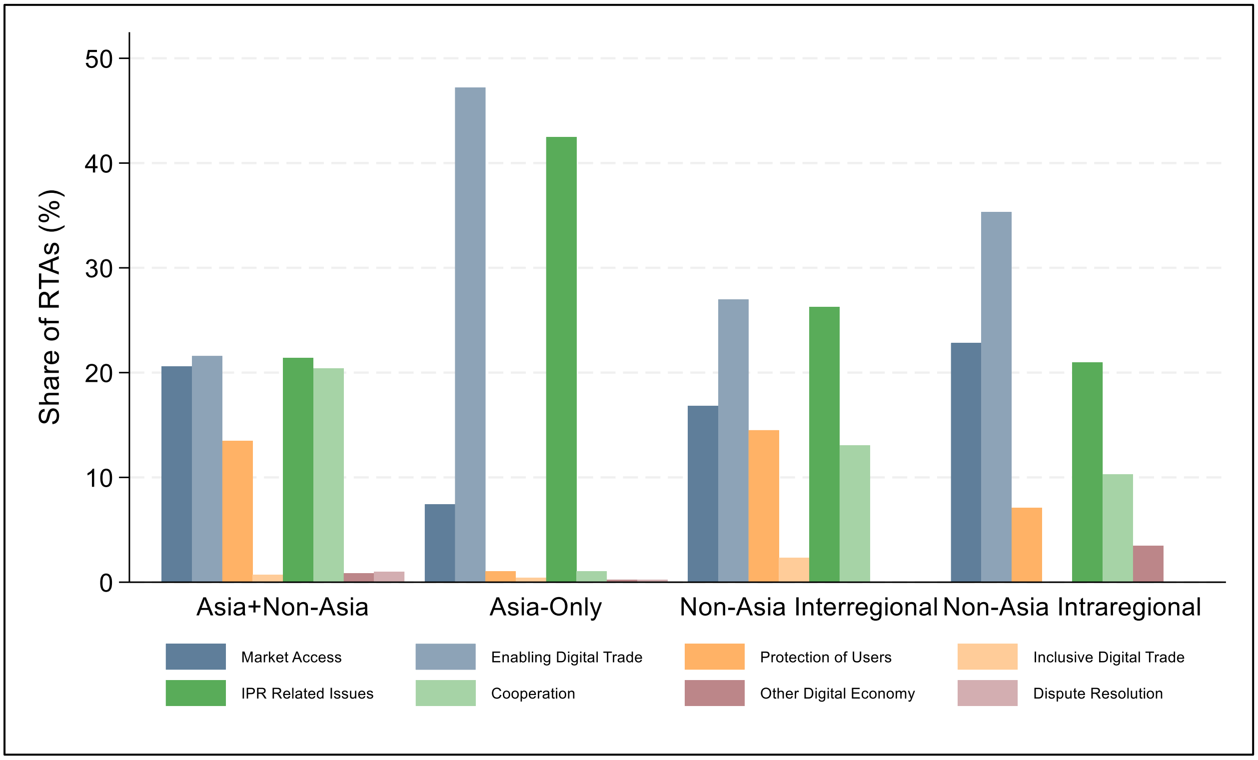
Table 2. Digital Depth, Selected ASEAN RTAs

RTA	Agreement Type	Year Signed	DTPs	Digital Depth
With Japan				
ASEAN	Plurilateral	2008	0	0.00
Indonesia	Bilateral	2007	8	0.16
Malaysia	Bilateral	2005	6	0.12
Philippines	Bilateral	2006	7	0.14
Singapore	Bilateral	2002	3	0.06
Thailand	Bilateral	2007	8	0.16
With Korea				
ASEAN	Plurilateral	2008	3	0.06
Singapore	Bilateral	2005	12	0.24
Vietnam	Bilateral	2015	16	0.33
With Australia				
ASEAN (+ New Zealand)	Plurilateral	2009	16	0.33
Indonesia	Bilateral	2019	20	0.41
Malaysia	Bilateral	2012	17	0.35
Singapore	Bilateral	2020	40	0.82
Thailand	Bilateral	2004	10	0.20
With New Zealand				
ASEAN (+ Australia)	Plurilateral	2009	16	0.33
Malaysia	Bilateral	2009	5	0.10
Singapore	Bilateral	2000	26	0.53
Thailand	Bilateral	2005	9	0.18

Note. Used the disaggregated level of 56 DTPs.
Source: Mapping results generated using the ESCAP Trade Agreement Text Analysis Tool, based on the Author's matching matrix

Looking into the key areas, it is evident that RTAs across all regional compositions primarily cover DTPs that enable and facilitate digital trade and those related to IP rights *(Figure 3)*. The most common trade facilitation DTPs involve e-signatures and e-authentication, paperless trade, and the electronic exchange of trade-related documents. In terms of IP rights, DTPs frequently pertain to participation in or affirmation of commitments to the World Intellectual Property Organization (WIPO) and other multilateral IP treaties.[3] These are followed by provisions on market access including customs duties on digital products and electronic technologies in procurement; and cooperation.

Figure 3. Share of RTAs, by Key Area and Regional Composition



Note. Used the broader level of 8 key areas, such that an RTA is considered to have the key area incorporated if at least one of the provisions under it is present.
Source: Mapping results generated using the ESCAP Trade Agreement Text Analysis Tool, based on the Author's matching matrix

Provisions for protection of users of e-commerce are more generally incorporated in interregional RTAs, such as those on online consumer protection and the regulation of unsolicited commercial messages. The key areas of inclusive digital trade, dispute resolution, and other aspects of the digital economy are largely absent in most RTAs. Inclusive digital trade provisions, especially for SMEs, is slightly more noticeable for non-Asia interregional RTAs, dispute resolution provision in Asia and non-Asia RTAs, while other aspects of the digital economy (e.g., data-driven innovation and open government data) in non-Asia intraregional RTAs.

[3]These include the Berne Convention, Budapest Treaty, Patent Cooperation Treaty, Patent Law Treaty, Paris Convention, Phonograms Convention, Singapore Treaty, and Rome Convention, among others.

It is also noteworthy that the inclusion of DTPs appears to follow a sequential pattern, with certain key areas often serving as a foundation for others. Specifically, DTPs related to enabling and facilitating digital trade often precede the incorporation of DTPs in areas such as protection of users, inclusive digital trade, cooperation, and dispute resolution. This pattern is evident as RTAs that lack DTPs in enabling digital trade also omit DTPs in these subsequent key areas. Moreover, RTAs are less likely to include DTPs in these latter categories unless they have first addressed DTPs related to market access and IP rights.

3. Empirical Strategy

3.1 Estimation Model and Variables

To examine the trade implications of DTPs in RTAs, this paper estimates a series of structural gravity models. The initial estimation establishes the general effects of RTAs on trade flows using the following model:

$$X_{t,goods}^{ij} = \exp\left[\beta_1\left(RTA_t^{ij}\right) + \beta_2 ln\left(1 + TTRI_t^{ij}\right) + \pi_t^i + \chi_t^j + \mu^{ij}\right] \times \varepsilon_t^{ij}, \quad (03)$$

where $X_{t,goods}^{ij}$ is the value of goods imports of country *j* from country *i* expressed in US$ billions. This variable depends on the following parameters:

(a) RTA_t^{ij} is the presence of a trade agreement between the country pair;
(b) $TTRI_t^{ij}$ is the tariff trade restrictiveness index between the country pair; and
(c) π_t^i, χ_t^j, and μ^{ij} are the importer-time, exporter-time, and country-pair fixed effects.

The variable $TTRI_t^{ij}$ is included to isolate the effects of changes in tariffs between countries from the impact of having a trade agreement, which encompasses factors beyond tariffs.

The second estimation involves the estimation of the RTAs with and without DTPs, regardless of depth. This model is specified as:

$$X_{t,goods}^{ij} = \exp\left[\beta_1\left(RTA\_WD_t^{ij}\right) + \beta_2\left(RTA\_ND_t^{ij}\right) + \beta_3 ln\left(1 + TTRI_t^{ij}\right) + \pi_t^i + \chi_t^j + \mu^{ij}\right] \times \varepsilon_t^{ij}, \quad (04)$$

where the previous RTA_t^{ij} variable is split into:

(a) $RTA\_WD_t^{ij}$ for RTAs with at least one DTP incorporated; and
(b) $RTA\_ND_t^{ij}$ for RTAs without any DTP.

Finally, the differential effects of digital depth on trade flows are analyzed using the model:

$$X_{t,goods}^{ij} = \exp\left[\beta_1\left(DD_{RTA_t^{ij}}\right)' + \beta_2\left(RTA\_ND_t^{ij}\right) + \beta_3 ln\left(1 + TTRI_t^{ij}\right) + \pi_t^i + \chi_t^j + \mu^{ij}\right] \times \varepsilon_t^{ij}, \quad (05)$$

where $\left(DD_{RTA_t^{ij}}\right)'$ represents the normalized digital depth index of the RTA computed as in Equation (02) using the broad index based on the key areas. Since RTAs with digital depth are already captured by this variable, the model controls only for $RTA\_ND_t^{ij}$ to account for trade agreements without DTPs.

The TTRI is s computed following Fugazza and Nicita (2013) as:

$$TTRI_t^{ij} = \frac{\sum_l X_{(95-97),l}^{ij} \delta_l^j \tau_{t,l}^{ij}}{\sum_l X_{(95-97),l}^{ij} \delta_l^j}, \quad (06)$$

where $X_{(95-97),l}^{ij}$ is the average product level imports of country *j* from country *i* between 1995 and 1997; $\tau_{t,l}^{ij}$ is the applied tariff rate on product l, which is at the 6-digit HS code level; and δ_l^j is the import elasticity of country *j* for product *l*. The trade flow weights will use the period prior to the sample data to address the endogeneity of trade to tariff changes.

Following standard practice in the literature, the model includes exporter- and importer-time fixed effects to control for the unobservable multilateral resistances and for other factors that vary for each country (Anderson & van WIncoop, 2003). The issue of endogeneity of trade policies is also addressed through the inclusion of country-pair fixed effects, which accounts for unobservable time-invariant covariates (Baier & Bergstrand, 2004).

Focusing on Asia, this paper conducts estimations for RTAs involving Asian countries, classified as Asia-only and Asia+Non-Asia agreements. Trade flows from Asia (i.e., exports) and trade flows to Asia (i.e., imports) are analyzed jointly and then separately. The estimation period covers the years 2002 to 2022, reflecting the availability and quality of tariff data for this timeframe.

3.2 Estimation Method

The Poisson Pseudo-Maximum Likelihood (PPML) estimator is used to estimate the models, which has been found to be a robust approach in the presence of heteroskedasticity and the existence of zero trade flows (Santos Silva & Tenreyro, 2006). To account for the critique that trade flows do not instantaneously adjust to trade policy changes, panel data with intervals is utilized in the estimation (Trefler, 2004; Cheng & Wall, 2005). Anderson and Yotov (2016) used 3- and 5-year intervals, Olivero and Yotov (2012) employed 4-year intervals, while Egger, Larch, and Yotov (2022) utilized consecutive years to improve efficiency. The estimations will be conducted for all time intervals, but the discussion of results will focus on those that used 4-year intervals.

3.3 Data Sources and Descriptive Statistics

Data for $X_{t,goods}^{ij}$ is taken from the United Nations Trade and Development (UNCTAD) Comtrade accessed through the Trade Analysis Information System (TRAINS). The variables RTA_t^{ij}, $RTA\_WD_t^{ij}$, and $RTA\_ND_t^{ij}$ are derived from the trade agreement data compiled by the *Centre d'Etudes Prospectives et d'Informations Internationales* (CEPII) constructed by Conte, Cotterlaz, and Mayer (2022). The $(DD_{RTA_t^{ij}})'$ is calculated based on the mapping results of the ESCAP Trade Agreement Text Analysis Tool, developed by Semenova, Kravchenko, and Duval (2023). The $TTRI_t^{ij}$ is computed using tariff data $\tau_{t,l}^{ij}$ from the UN Comtrade and elasticity values δ_l^{ij} from Fontagné, Guimbard, and Orefice (2022).

The summary statistics of the dataset reveals the presence of zero trade flows, with a maximum value of US$0.56 billion *(Table 3)*. The digital depth variable exhibits a mean value of 0.086, largely attributable to the limited incorporation of DTPs in existing trade agreements and the prevalence of country pairs without any RTAs, resulting in a digital depth of zero. The lower mean value observed for RTAs with no depth compared to RTAs with any level of depth indicates that more country pairs engage in RTAs that have at least a DTP incorporated. The TTRI ranges from 0.00 to 2.96, with an average value of 0.06, reflecting the variability in trade tariff restrictiveness across country pairs.

Table 3. Model Variables and Parameters for Regression, 2002-2022

Variable	Mean	S.D.	Min.	Max.
$X_{t,goods}^{ij}$	0.001	0 .005	0.000	0 .563
RTA_t^{ij}	0.029	0.168	0	1
$RTA\_WD_t^{ij}$	0.017	0.128	0	1
$RTA\_ND_t^{ij}$	0.012	0.111	0	1
$(DD_{RTA_t^{ij}})'$	0.086	.064	0.000	1.000
$TTRI_t^{ij}$	0.062	.090	0.000	2.961

Author's calculation

4. Results and Discussion

4.1 Estimation Results

The base estimation results in specification (01) align with the extensive literature highlighting the generally positive impact of trade agreements on trade flows *(see* Larch and Yotov, 2024), though the effects were not found to be statistically significant *(Table 4)*. Tariffs have a significant negative effect on the imports and exports of Asia countries when estimated separately. Specifically, a 1.0% increase in the $ln(1 + TTRI_t^{ij})$ is expected to reduce trade flows *to* Asia countries by 0.8% and trade flows *from* Asia countries by 0.7%.

Table 4. PPML Regression Results with 4-Year Intervals, 2002-2022

Variable	All Trade Flows involving Asia Countries			Trade Flows with Asia Countries as Importers			Trade Flows with Asia Countries as Exporters		
	(01)	(02)	(03)	(01)	(02)	(03)	(01)	(02)	(03)
RTA_t^{ij}	0.037	-	-	0.032	-	-	0.012	-	-
	(0.032)			(0.032)			(0.038)		
$RTA\_WD_t^{ij}$	-	0.035	-	-	0.025	-	-	-0.002	-
		(0.033)			(0.034)			(0.039)	
$RTA\_ND_t^{ij}$	-	0.044	0.055	-	0.070	0.099^{+}	-	0.091	0.128*
		(0.040)	(0.036)		(0.056)	(0.053)		(0.059)	(0.055)
$(DD_{RTA_t^{ij}})'$	-	-	0.116**	-	-	0.143**	-	-	0.129**
			(0.032)			(0.041)			(0.045)
$ln(1+TTRI_t^{ij})$	-0.237	-0.236	-0.258	-0.845*	-0.865*	-0.861*	-0.670^{+}	-0.716*	-0.651
	(0.165)	(0.165)	(0.170)	(0.394)	(0.395)	(0.392)	(0.401)	(0.127)	(0.396)
Obs.	46,571	46,571	46,368	25,178	25,178	25,095	25,532	25,532	25,451
R-squared	0.995	0.995	0.995	0.994	0.994	0.994	0.994	0.994	0.994

Note. The values without parentheses are the coefficients, while those in parentheses are the robust standard errors. The symbols +, *, and ** denote statistical significance at the 10, 5, and 1 percent level, respectively.
Source: Author's calculation

In the estimation that differentiates between RTAs with and without depth as in specification (02), it is observed that RTAs without depth tend to have a marginally higher coefficient. However, the variables for RTAs remain statistically insignificant. Tariffs again exhibit a significant negative effect on both imports and exports of Asian countries, with a more pronounced impact on imports compared to exports (0.9% vs. 0.7%).

The final estimation with specification (03) reveals that RTAs lacking DTPs have a strong statistically significant effect on both imports and exports of Asia. Specifically, an RTA between country pairs without DTPs is expected, on average, to boost imports into Asia by 10.4% and exports from Asia by 13.7% *(Table 4)*.[4] Conversely, the analysis of the digital depth index, which offers a more detailed examination of RTAs with DTPs, indicates that RTAs with the highest depth (i.e., covering 8 key areas) are anticipated to increase imports into Asia by 15.4% and exports from Asia by 13.8%.[5] Moreover, total trade flows involving Asia are projected to rise by 12.3% with RTAs of the highest depth, compared to a 5.6% increase with RTAs lacking depth, although this latter effect is not statistically significant. The tariff index continues to exhibit a negative relationship with trade flows, with statistical significance observed solely for imports into Asia.

[4] The trade volume effects for indicator variables is given by Yotov, Piermartini, Monte, and Larch (2017) as: $\left[e^{\beta_2} - 1\right] \times 100$

[5] Since the index is normalized to be between 0 and 1, the effects of signing an RTA with the highest digital depth is also given by: $\left[e^{\beta_2} - 1\right] \times 100$

These results and the goodness-of-fit of the regression model remain relatively consistent even while using different time intervals, with the R-squared exceeding 99.0% *(See Tables C1-3 in Appendix C)*. The signs of the coefficients were also generally maintained, especially for the tariff index, which emerged to be significant in majority of the estimations. The coefficient of the digital depth index was also found to be higher compared to RTAs without DTPs in all but two estimations (i.e., exports from Asia using 3-year intervals and consecutive years).

4.2 Discussion and Recommendations

The general findings of this study align with existing research on the positive impact of DTPs on digitally ordered and digitally deliverable trade (APEC, 2023) and services (Ma, Yuting, & Fang, 2023). Additionally, López González, Sorescu, and Kaynak (2023) found that digital trade chapters have the potential to double the effect of trade agreements. This is an encouraging prospect as the ESCAP, UNCTAD, and UNIDO (2023) estimated that 10 additional DTPs in RTAs are associated with a 0.08 percentage point increase in the growth rate of an economy's real GDP per capita.

When interpreting the estimation results of specification (02), which found RTAs without DTPs to have a slightly higher effect than those with DTPs, the work of Herman and Oliver (2021) could potentially offers some insights. Their study found an insignificant effect of DTPs, specifically data flow provisions, on total trade. They argue that this may reflect the nature of the agreements incorporating these provisions rather than the provisions' effectiveness themselves. Since DTPs and data flow provisions are relatively new in RTAs, the limited sample size may have constrained their impact. Additionally, RTAs with DTPs are predominantly between Asia and non-Asia countries, which may highlight challenges faced by developing countries in fully leveraging digital trade facilitation.

Nevertheless, when the heterogeneity of digital depth is considered, as in specification (03), the results suggest that RTAs with DTPs can potentially enhance trade flows in Asia more effectively than those without. These results, when taken together, underscore the importance of considering the specific DTPs included in these agreements. While the digital depth index generally indicates a positive effect, suggesting that deeper integration of DTPs facilitate increased trade, the effect of DTPs on trade flows varies depending on their scope and implementation.

This variability could be attributed to the complexity of DTPs, with some imposing more stringent rules on digital trade, such as those requiring compliance with international frameworks and enabling domestic policies to be in place. While these DTPs may offer long-term benefits, they may initially introduce complexities and challenges for countries with less developed digital infrastructures and institutions. As Jaller, Gaillard, and Molinuevo (2020) argue, domestic regulations play a crucial role in shaping digital trade. Regulations that foster digital trade include policies on electronic documentation, e-signature, e-payments, consumer protection, IP, and cybersecurity. Conversely, regulations such as domain name restrictions, ban of online sales, and data localization may hinder digital trade. Regulations concerning privacy and data protection, in particular, can either promote or impede digital trade depending on their design.

While this paper's findings underscore the potential of RTAs with higher digital depth to enhance trade flows, further research is needed to pinpoint which specific components of DTPs most significantly drive these benefits and to assess their long-term effects. For instance, the computable general equilibrium analysis of van der Marel, Bauer, Lee-Makiyama, and Verschelde (2016) found that data regulation such as requirements for digital localization may have a more adverse impact on trade flows, investments, and welfare than traditional barriers. Further, the WTO Moratorium on Electronic Transmissions was found to prevent an economic loss of US$10.6 billion in GDP annually for developing countries, highlighting the negative effects of levying custom duties on electronic transmissions (Makiyama & Badri, 2019). The analysis of López González, Sorescu, and Kaynak (2023) shows that growing digital connectivity increases both domestic and international trade. Further, they found a 0.1-point reduction in the OECD Digital Services Trade Restrictiveness Index results in a 145.0% increase in overall trade. The ESCAP, UNCTAD, and UNIDO (2023) demonstrated that the full implementation of digital cross-border trade facilitation under the Framework Agreement on Facilitation of Cross-border Paperless Trade in Asia and the Pacific could boost the Asia-Pacific regional GDP of almost 1.0%.

The analysis also espouses the idea that negotiations between fewer countries tend to result in agreements with more DTPs. Thus, economies seeking to deepen the digital depth of their agreements may leverage plurilateral negotiations to establish foundational provisions on enabling and facilitating digital trade, however, more comprehensive agreements on other key areas may be more effectively negotiated bilaterally. This observation is supported by the findings of Elsig and Klotz (2021), noting that countries' participating in the multilateral system, specifically in the discussions of the WTO Work Programme on Electronic Commerce and in the WTO-based plurilateral Information Technology Agreement are more likely to negotiate ambitious commitments in their RTAs and commit to deeper cooperation in digital trade.

The results of this paper, complemented by other studies, support the pursuit of more comprehensive DTPs in RTAs. However, policymakers must carefully consider the diverse requirements of each DTP, including necessary digital capacities, infrastructure, and enabling policies. As digital trade and DTPs evolve, it is essential for policymakers to ensure flexibility in these provisions to adapt to shifting global trade dynamics, especially in cutting-edge issues such as artificial intelligence, internet interconnection charge sharing, and submarine telecommunications cables systems. Moreover, it may be of great interest to policymakers to incorporate certain DTPs in RTAs that may aid in addressing the key structural challenges highlighted by the ESCAP, UNCTAD, and UNIDO (2023) to reap the benefits of digital trade in achieving the sustainable development goals. These include DTPs that address inequities in specific sectors, such as inclusive digital trade designed to enhance access for SMEs, women, and developing economies. Additionally, certain provisions explicitly aim to narrow the digital divide and address unjustified barriers to digital trade.

Finally, enhanced data collection on digital trade and detailed analyses of how countries implement and comply with DTPs will be crucial for fully understanding their impact on regional and global trade. Such insights will inform more effective and tailored trade policies, ultimately fostering more inclusive and robust digital trade environments.

5. Conclusion

This study investigates the role of DTPs in RTAs and their impact on trade flows in Asia. The findings highlight that RTAs incorporating DTPs are more prevalent when these agreements are recently signed, bilaterally negotiated, and interregional—particularly between Asia and non-Asia economies. The use of structural gravity models, PPML estimation, and a digital depth index demonstrates that RTAs with higher digital depth can significantly enhance trade flows, with potential increases in imports into Asia by 15.4% and exports from Asia by 13.8%, compared to the 10.4% and 13.7% increases from RTAs without DTPs.

The analysis reveals that while RTAs with DTPs generally promote greater trade flows, their impact varies depending on the digital depth. These findings provide support for the potential benefits of integrating DTPs into RTAs, both in plurilateral agreements and through more in-depth bilateral negotiations. However, to fully leverage these benefits, it is crucial that participating economies are digitally capable, have the digital infrastructure, and adopt and implement enabling domestic policies.

For future research, it will be important to identify the specific elements of DTPs that contribute most to trade enhancement and to explore their long-term effects. Enhanced data collection on digital trade and a thorough examination of how different countries implement and comply with DTPs will provide deeper insights into their overall impact on global trade dynamics. Such efforts will support more effective and tailored trade policies, fostering a more inclusive and robust digital trade environment.

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Appendix A

WTO+ Areas

1. Tariff liberalization and elimination of non-tariff measures on industrial goods
2. Tariff liberalization and elimination of non-tariff measures on agricultural goods
3. Customs
4. Export taxes
5. Sanitary and phytosanitary measures
6. Technical barriers to trade
7. State trading enterprise
8. Anti-dumping
9. Countervailing measures
10. State aid
11. Public procurement
12. Agreement on Trade-Related Investment Measures (TRIMS)
13. General Agreement on Trade in Services (GATS)
14. Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS)

WTO-X Areas

1. Anti-corruption
2. Competition policy
3. Environmental laws
4. Intellectual property rights not referenced in TRIPS
5. Investments not referenced in TRIMS
6. Labor market regulations
7. Movement of capital
8. Consumer protection
9. Data protection
10. Agriculture (i.e., technical assistance to conduct modernization projects)
11. Approximation of legislation
12. Audio visual
13. Civil protection
14. Innovation policies
15. Cultural cooperation
16. Economic policy dialogue
17. Education and training
18. Energy
19. Financial assistance
20. Health
21. Human rights
22. Illegal immigration
23. Illicit drugs
24. Industrial cooperation
25. Information society
26. Mining
27. Money laundering
28. Nuclear safety
29. Political dialogue
30. Public administration
31. Regional cooperation
32. Research and technology
33. Small and medium enterprises
34. Social matters
35. Statistics
36. Taxation
37. Tourism
38. Visa and asylum

Source: WTO (2011)*; as cited in Mattoo, Mulabdic, and Ruta* (2017)

Appendix B

Table B1. Digital Trade-Related Provisions

Key Area	Provision
Market access	Trade in digital products
	Customs duties on digital products
	Internal taxes on digital products
	Customs value of carrier medium
	Non-discriminatory treatment of digital products
	Treatment of financial instruments
	Digital products and intellectual property
	Other aspects of regulating trade in digital products
	Cryptography
	Trade in cryptographic goods
	Treatment of products that use cryptography
	Electronic technologies in procurement and e-procurement
Enabling digital trade and trade facilitation	Access to or use of internet for digital trade and net neutrality
	Electronic commerce and electronic technologies in trade
	Electronic transferable record
	Adherence to international frameworks
	Technological neutrality in e-commerce
	Interoperability and adherence to recognize standards in digital trade
	Electronic signature and electronic authentication
	Electronic signature and electronic authentication implementation principles
	Digital identities
	Electronic payment
	Electronic invoicing
	Cross-border data flows
	Computing facilities
	Competition policy in digital trade
	Private-sector self-regulation in e-commerce
	Paperless trade
	Single window
	Electronic exchange of trade-related documents
	Automation of customs procedures
	Automation of risk management systems
	Express shipments
	Interactive computer services
Protection of users of e-commerce and online security	Online consumer protection
	Personal information protection
	Unsolicited commercial messages

Key Area	Provision
	Recourse, redress, and remedy in protection of users of e-commerce Enhancing interoperability of standards in protection of users of e-commerce Cybersecurity and online safety
Inclusive digital trade	Inclusive digital trade for MSMEs Inclusive digital trade for developing economies Other inclusive digital trade
IPR-related issues relevant to e-commerce	Treatment of source code Domain name Participation in or affirmation of commitment to WIPO/Internet/"treaties" Participation in or affirmation of commitment to other multilateral IP treaties Rights management information Technological protection measures Intermediary liability Other IPR issues
Cooperation relevant to e-commerce	Cooperation in e-commerce and digital trade
Other aspects of the digital economy	Data-driven innovation Open government data Cutting-edge issues
Dispute resolution relevant to e-commerce	Dispute resolution in e-commerce and digital trade

Source: Du (2023)

Appendix C

Table C1. PPML Regression Results with 3-Year Intervals, 2002-2022

Variable	All Flows of Asia Countries			Trade Flows with Asia Countries as Importers			Trade Flows with Asia Countries as Exporters		
	(01)	(02)	(03)	(01)	(02)	(03)	(01)	(02)	(03)
RTA_t^{ij}	0.042 (0.031)	-	-	0.059* (0.035)	-	-	0.046 (0.036)	-	-
$RTA\_WD_t^{ij}$	-	0.041 (0.032)	-	-	0.060 (0.050)	-	-	0.045 (0.037)	-
$RTA\_ND_t^{ij}$	-	0.047 (0.040)	0.043 (0.035)	-	0.045 (0.050)	0.016 (0.047)	-	0.055 (0.049)	0.033 (0.045)
$(DD_{RTA_t^{ij}})'$	-	-	0.072* (0.035)	-	-	0.020 (0.046)	-	-	0.011 (0.048)
$\ln(1+TTRI_t^{ij})$	-0.306⁺ (0.184)	-0.307⁺ (0.180)	-0.334⁺ (0.190)	-0.320 (0.214)	-0.320 (0.213)	-0.373 (0.244)	-0.268 (0.190)	-0.268 (0.190)	-0.309 (0.213)
Obs.	55,377	55,145	53,238	37,271	37,271	37,129	37,625	37,625	37,485
R-squared	0.994	0.994	0.995	0.992	0.992	0.992	0.992	0.992	0.992

Note. The values without parentheses are the coefficients, while those in parentheses are the robust standard errors. The symbols +, *, and ** denote statistical significance at the 10, 5, and 1 percent level, respectively.

Source: Author's calculation

Table C2. PPML Regression Results with 5-Year Intervals, 2002-2022

Variable	All Flows of Asia Countries			Trade Flows with Asia Countries as Importers			Trade Flows with Asia Countries as Exporters		
	(01)	(02)	(03)	(01)	(02)	(03)	(01)	(02)	(03)
RTA_t^{ij}	0.037	-	-	0.028	-	-	-0.001	-	-
	(0.033)			(0.036)			(0.041)		
$RTA\_WD_t^{ij}$	-	0.038	-	-	0.016	-	-	-0.021	-
		(0.035)			(0.037)			(0.042)	
$RTA\_ND_t^{ij}$	-	0.032	0.043	-	0.082	0.119*	-	0.088	0.133*
		(0.041)	(0.035)		(0.056)	(0.055)		(0.055)	(0.054)
$(DD_{RTA_t^{ij}})'$	-	-	0.123**	-	-	0.171*	-		0.141*
			(0.036)			(0.070)			(0.073)
$\ln(1 + TTRI_t^{ij})$	-0.220	-0.221	-0.235	-0.447**	-0.449**	-0.401**	-0.404**	-0.409**	-0.348**
	(0.154)	(0.154)	(0.157)	(0.142)	(0.141)	(0.126)	(0.041)	(0.135)	(0.123)
Obs.	42,174	42,174	41,984	19,754	19,754	19,682	20,108	20,108	20,038
R-squared	0.995	0.995	0.995	0.994	0.994	0.992	0.994	0.994	0.994

Note. The values without parentheses are the coefficients, while those in parentheses are the robust standard errors. The symbols +, *, and ** denote statistical significance at the 10, 5, and 1 percent level, respectively.

Source: Author's calculation

Table C3. PPML Regression Results with No Intervals, 2002-2022

Variable	All Flows of Asia Countries			Trade Flows with Asia Countries as Importers			Trade Flows with Asia Countries as Exporters		
	(01)	(02)	(03)	(01)	(02)	(03)	(01)	(02)	(03)
RTA_t^{ij}	0.038	-	-	0.035	-	-	0.024	-	-
	(0.031)			(0.035)			(0.034)		
$RTA\_WD_t^{ij}$	-	0.038	-	-	0.038	-	-	0.020	-
		(0.031)			(0.036)			(0.036)	
$RTA\_ND_t^{ij}$	-	0.040	0.038	-	0.021	0.029	-	0.050	0.049
		(0.040)	(0.035)		(0.042)	(0.037)		(0.042)	(0.037)
$(DD_{RTA_t^{ij}})'$	-	-	0.074*	-	-	0.108**	-	-	0.043
			(0.035)			(0.039)			(0.044)
$\ln(1+TTRI_t^{ij})$	-0.306+	-0.305+	-0.325+	-0.180	-0.181	-0.207	-0.072+	-0.071	-0.079
	(0.184)	(0.184)	(0.190)	(0.147)	(0.147)	(0.156)	(0.109)	(0.110)	(0.115)
Obs.	53,420	53,420	53,238	26,830	26,830	26,672	35,172	35,172	35,029
R-squared	0.995	0.995	0.995	0.996	0.996	0.996	0.995	0.995	0.995

Note. The values without parentheses are the coefficients, while those in parentheses are the robust standard errors. The symbols +, *, and ** denote statistical significance at the 10, 5, and 1 percent level, respectively.

Source: Author's calculation