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TRADE FACILITATION AND GLOBAL VALUE CHAINS IN A POST-PANDEMIC WORLD

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Abstract

The objective of this paper is twofold. First, it examines the effects of the implementation of trade facilitation (TF) measures on international trade flows and on participation in global value chains (GVCs). Second, it provides policy recommendations for developing Asia and the Pacific derived from model estimations. The main focus is to disentangle the effectiveness of a wide range of TF actions taken at a country level and see whether these have paved the way toward more sustainable trade flows. The data used are from the UN Global Surveys on Digital and Sustainable Trade Facilitation, covering 144 countries worldwide for the years 2015, 2017, 2019, and 2021. The empirical estimations obtained from a gravity model of trade indicate that TF measures related to transparency, institutions, and formalities are of utmost importance, whereas sustainable TF actions are still in their infancy, and more data are needed for a proper evaluation of their effectiveness. Moreover, the implementation of TF is related to reductions in the time and cost to export and import as well as to improvements in logistic performance. There are several policy recommendations and implications for developing Asia and the Pacific concerning TF, trade, and GVCs: first, transparency policies will increase trade in manufactured goods more than proportionally, especially in low-income countries in Asia (such as Afghanistan, Bangladesh, Bhutan, Cambodia, Lao PDR, Myanmar, Nepal, and Timor-Leste); second, improving the quality of TF-related institutions will foster participation in global value chains; and finally, for small islands in the Pacific (Kiribati, Solomon Islands, Tuvalu, and Vanuatu), public investments directed at improving their logistics performance would be of special relevance.

Keywords: trade facilitation agreement, paperless trade, transparency, customs, exports, gravity model, GVCs

JEL Classification: F13, F14, F60, O53

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1. INTRODUCTION

In the 2000s, the world economy experienced a sharp increase in international trade flows, as well as an increasing diversification of traded goods and services. Substantial improvements in information technology and sustained economic growth have been important factors contributing to this increase in trade (Xing, Gentile, and Dollar 2021). In particular, part of this new trade has been in intermediate products with the development of global value chains (GVCs). However, this trend was interrupted by the outbreak of the economic crisis of 2008–2009 and more so by that of the COVID-19 pandemic in 2020. One consequence of the latter crisis was the disruptions in GVCs driven by the lockdowns and the subsequent wish to relocate production to nearby countries. On the one hand, these disruptions were related to the pandemic outbreaks happening in different countries simultaneously and the lack of workers in important industries related to GVCs, such as logistics and transport. On the other hand, these phenomena could have accelerated the ongoing transformation in the logistics branch with reinforced support for paperless trade, electronic documents, and the automation of customs procedures. In relation to this, the ratification of the Trade Facilitation Agreement in 2017[1] should have started to pave the road that countries have to follow to adopt the required measures for implementation.

The main contribution of this paper is in quantifying the advantages derived from improving trade facilitation measures that help reduce trade barriers among countries, including time delays and administrative burdens for the products and services exchanged. This quantification should help to disentangle the effect of different components of trade facilitation in increasing gross trade and trade in value added after COVID-19, particularly in Asia and the Pacific countries. The main question to be answered is whether a number of trade facilitation measures implemented by countries have contributed to increasing bilateral and aggregated trade, as well as to the participation of countries in GVCs, and if so, to what extent.

There is scant empirical research covering the periods before and after the Trade Facilitation Agreement that includes value-added exports in the analysis. For instance, while some authors focused on the effects of transport infrastructure on trade (Limao and Venables 2001; Márquez-Ramos et al. 2011) and on trade facilitation issues (Wilson, Mann, and Otsuki 2003; Engman 2005; Persson 2007; Martínez-Zarzoso and Márquez-Ramos 2008; Hendy and Zachi 2021; Shepherd 2022; Kareem, Martínez-Zarzoso, and Bruemer 2022), only a few of them focused on value-added exports in developing countries (Xu, Sun, and Jiang 2022; Zhang and Martínez-Zarzoso 2022), and none of them covered recent years and aspects related to trade finance, support for small and medium-sized enterprises (SMEs), agriculture, and women. We will be able to include these factors in the analysis by making use of a new data set based on the UN Global Surveys on Digital and Sustainable Trade Facilitation, covering 144 countries worldwide for the years 2015, 2017, 2019, and 2021.

This paper aims to narrow this gap in the literature by investigating the relationship between trade facilitation and exports (gross exports and GVC participation) for a global sample of countries and a recent period of time (2015–2021) that covers the COVID-19 pandemic. The empirical methodology consists in applying a gravity model of bilateral trade estimated using panel data methods that control for unobserved

[1] WTO members ended their negotiations at the 2013 Bali Ministerial Conference with the landmark Trade Facilitation Agreement (TFA). The agreement entered into force on 22 February 2017, after its ratification by two thirds of the WTO members. See https://www.wto.org/english/tratop_e/tradfa_e/tradfa_e.htm for more details.

heterogeneity using multidimensional fixed effects and panel data models with country-fixed effects for aggregated trade flows and GVC participation and position.

The main results show that most of the trade facilitation indicators considered, namely those related to transparency, paperless trade, institutions, and formalities, have a direct influence on trade flows and some of them on participation in GVCs. However, there are insufficient data to assess the importance of sustainable trade facilitation, given that the data collection for such indicators started in 2020 and there is no information for many countries. Moreover, transparency policies will increase trade in manufactured goods more than proportionally, especially in low-income countries in the Asia and the Pacific region. Second, improving the quality of TF-related institutions will foster participation in global value chains in the region. Finally, public investments directed towards improving their logistics performance would be of special relevance for small islands.

The rest of the paper is organized into five sections. Section 2 presents a review of the literature on trade facilitation. Section 3 describes the data and variables used and some stylized facts. Section 4 describes the empirical strategy and the econometric estimation techniques used. Section 5 presents and discusses the main results from estimating a gravity model of bilateral trade and panel data models for aggregated trade and GVC indicators. Finally, Section 6 concludes and presents some policy implications.

2. LITERATURE REVIEW

The international trade literature has focused widely on trade facilitation issues since the early 2000s. Seminal contributions by Wilson, Mann, and Otsuki (2003, 2005) used a wide definition of trade facilitation and claimed that trade in the Asia and the Pacific region could increase by 21% if low performers improved their scores halfway to the average. Instead, Engman (2005) used the World Trade Organization (WTO) definition of trade facilitation, simplifying and harmonizing international trade procedures involving activities at the border, while also finding positive impacts on trade. A number of authors[2] investigated the effects of specific measures, including administrative barriers (Hummels and Schaur 2013; Djankov, Freund, and Pham 2010; Hendy and Zaki 2021), information technology (Márquez-Ramos et al. 2007; Rodriguez-Crespo and Martínez-Zarzoso 2021), port efficiency (Limao and Venables 2001; Martínez-Zarzoso and Hofmann 2007; Wilmsmeier, Martínez-Zarzoso, and Fiess 2011), maritime networks (Márquez-Ramos et al. 2011), and the quality of institutions (Gylfason, Martínez-Zarzoso, and Wijkman 2015; Martínez-Zarzoso and Márquez-Ramos 2019). The main takeaway from the existing literature is that advances in trade facilitation actions foster international trade to some extent, with the key issue being quantifying the effects to ascertain what measures are more effective. More recently, some authors have focused on the effects of TF on GVC participation. In this respect, Kumar and Shepherd (2019) find that the full implementation of the TF agreement will increase trade by about 3.5% with respect to 2015 and could lead to changes in the composition of trade, promoting trade in intermediates and hence the development of value chain trade mostly in middle-income economies. Moreover, Shepherd (2022) investigates the effect of changes in trade facilitation performance on changes in GVC trade. He uses the TF indicators computed by the OECD for the period 2015–2019

[2] See Wilson, Mann, and Otsuki (2005) for a comprehensive review of previous research on specific trade facilitation measures.

and finds that in some sectors, the estimated elasticity of TF on trade is higher for intermediates than for total trade, with the quantitative differences being small.

In addition, several works have jointly estimated the effect of trade facilitation variables and policy trade barriers (Márquez-Ramos, Martínez-Zarzoso, and Suárez-Burguet 2012 Hendy and Zachi 2021, among others), showing that the former are in general more important than the latter for trade. Finally, some recent papers have specifically focused on Asia or Asian subregions. More specifically, Central Asia was the focus of Kim, Mariano, and Abesamis (2022) and Cheong and Turakulov (2022), whereas Ismail (2021) investigated digital trade facilitation in selected Asian countries and Ramasamy and Yeung (2019) analyzed the impact of trade facilitation in relation to the People's Republic of China's (PRC) One Belt, One Road initiative. Also, Halaszovich and Kinra (2020) present some insights into trade facilitation in Asia, indicating that the elements of national transportation systems positively influence both trade and foreign direct investment.

With regard to the empirical methodologies, two main modeling strategies have been used. First, a number of authors relied on estimating a gravity model of trade, which includes trade facilitation factors in the specification as proxies for trade easiness (Wilson, Mann, and Otsuki 2003, 2005; Djankov, Freund, and Pham 2010; Nordas, Pinali, and Grosso 2006; Soloaga, Wilson, and Mejía 2006; Persson 2007; Martínez-Zarzoso and Márquez-Ramos 2008; Kumar and Shepherd 2019; Kim, Mariano, and Abesamis 2022; Shepherd 2022). Second, several works (Decreux and Fontagne 2006; Dennis 2006; Cheong and Turakulov 2022, among others) used computable general equilibrium models to estimate the effect of trade facilitation indices on trade flows. Overall, independently of the approach used, the results of the studies show positive and statistically significant effects derived from improved trade facilitation on international trade.

The present paper departs from existing literature in two respects. First, it focuses on both bilateral and aggregated trade and on GVCs; and second, it analyzes the effect of newly collected TF measures in the most recent years and after the TF agreement with a special focus on developing countries in the Asia and the Pacific region. It also provides policy recommendations for developing Asia and the Pacific derived from the model estimations, disentangling the effectiveness of a wide range of TF actions, taken at a country level.

3. DATA, VARIABLES, AND STYLIZED FACTS

This section first presents the data, variables, and sources (3.1) and next the stylized facts (3.2).

3.1 Data and Variables

Export and import data at the bilateral level are from UNCTAD, and data on aggregated exports and imports of goods and services, as well as GDP and GDP per capita at constant prices, are from the World Development Indicators data set. Other gravity variables, namely geographical distance, and whether countries share a common language, common border, and have or have had a colonial relationship, are extracted from the Centre d'Études Prospectives et d'Informations Internationales (CEPII). The Doing Business data set from the World Bank is the source for the number of documents needed to trade, time to trade, and cost to trade across countries, with data available using the new methodology from 2014 to 2019. Data for regional trade

agreements (RTAs) are from De Sousa (2012), updated by Martínez-Zarzoso and Chelala (2021), using information from the WTO. Trade facilitation data are from the United Nations Global Surveys on Digital and Sustainable Trade Facilitation.[3] They cover 144 countries worldwide for the years 2015, 2017, 2019, and 2021. The 2021 survey includes 58 questions[4] that are listed in the Appendix (Table A.1). The implementation stage and rate of implementation for each measure are provided for selected groups of trade facilitation factors. The grouped TF measures are transparency, formalities, institutions, paperless, cross-border, transit, TF for SMEs, agriculture, and women. Each of them varies from zero to 100, indicating the rate of implementation (zero = no implementation),[5] and is composed of a number of subcomponents as indicated in Table A.1. For instance, the transparency measure includes questions Q2–Q5 and Q9. The first four indicate the advance publication of trade-related regulations on the Internet and stakeholders' consultation, and the fifth whether there is an independent appeal mechanism. The original measures are coded with values from 0 to 3, indicating whether the measure: has been not implemented, is in the pilot stage of implementation, has been partially implemented, or has been fully implemented, respectively.

The survey was led and coordinated by ESCAP and jointly conducted in 2021 by five United Nations Regional Commissions: ECA, ECE, ECLAC, ESCAP, and ESCWA. Data for 2021 are duplicated for countries that participated in the 2019 Global Survey but did not answer in 2021 (Antigua and Barbuda, Belize, Brazil, El Salvador, Guyana, Saint Vincent and the Grenadines, Trinidad and Tobago, Tanzania, and Tunisia).

Proxies for GVCs are constructed using information from the UNCTAD-Eora GVC database that covers the period from 1990 to 2018, which is the last year available, to decompose gross exports (see Koopman, Wang, and Wei 2014; Wang et al. 2017; Borin and Mancini 2019). The gross exports' components are value-added exports (VA), foreign value added (FVA), domestic value added (DVA), and domestic value added in exports (DVX), available for 189 countries.[6]

A country's GVC participation (GVCP) is measured as a share of its gross exports (UNCTAD 2013). For country and year, the GVC participation index is given by:

$$GVCP_{it} = \left(\frac{FVA_{it}+DVX_{it}}{Gross\ Exports_{it}}\right) * 100 \quad (1)$$

where FVA_{it} denotes foreign value added in country *i* at time *t*. DVX_{it} denotes domestic value added in exports in country *i* at time *t*.

A second variable constructed is the GVC position index, which indicates the relative "upstreamness" of a country in a GVC (Koopman, Wang, and Wei 2014). Examples of upstream activities are branding, design, and research and development, with all of them being capital-intensive pre-production activities that require high-skilled labor. Otherwise, downstream activities are associated with post-production services of high value added, such as sales and marketing. The GVC position of a country in a given year is given by:

[3] https://www.untfsurvey.org/.

[4] The question numbers correspond to those in the UNTF Survey questionnaire, available at https://www.untfsurvey.org/files/documents/2021-Survey-Questionnaire-English.pdf.

[5] The overall implementation rate of each subgroup is defined as: $IR_k = \Sigma(Q_n/3m_k)$, where Q_n is the score of question number n, and m_k is the number of measures included in group m. The methodology used is described here: https://www.untfsurvey.org/files/documents/2021-Survey-Methodology.pdf.

[6] For the years from 2016 to 2018, the components are obtained using an imputation technique based on the macroeconomic estimates of the IMF World Economic Outlook (WEO) (Casella et al. 2019).

$$GVCPosition_{it} = \left[\left(ln\frac{1+DVX_{it}}{Gross\ Exports_{it}}\right) - \left(ln\frac{1+FVA_{it}}{Gross\ Exports_{it}}\right)\right] * 100 \quad (2)$$

where FVA_{it} denotes foreign value added in country *i* at time *t*. DVX_{it} denotes domestic value added in exports in country *i* at time *t*.

Table 1 shows the summary statistics of the variables used in the empirical application of the gravity model of trade. The table indicates the number of observations (obs), mean values (mean), standard deviations (Std. dev.), and minimum and maximum values of the dependent (ln exports) and independent (income, distances, gravity variables, and TF indicators) variables used in the gravity model application. TF indicators are explained in the next section, focusing specifically on the Asia and the Pacific region. The TF average values shown in Table 1 mainly indicate that there is room for improvement for many countries, since they are around 30%–65% out of 100%.

Table 1: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ln exports of manufactures	6,206	5.562	4.080	–6.908	16.574
ln GDP exporter	6,206	24.290	1.645	20.721	28.235
ln GDP importer	6,206	24.298	1.776	20.520	28.235
Ln distance	6,206	8.330	0.900	4.558	9.775
Common language	6,206	0.395	0.489	0	1
Common colony	6,206	0.160	0.366	0	1
Contiguity	6,206	0.074	0.262	0	1
Regional trade agreement (RTA)	6,206	0.260	0.439	0	1
WTO exporter	6,206	0.968	0.177	0	1
WTO importer	6,206	0.971	0.167	0	1
Trade Facilitation Indicators:					
TFI exporter	6,206	0.544	0.186	0.097	0.91
TFI importer	6,206	0.549	0.190	0.097	0.91
Transparency importer	6,206	0.640	0.274	0	1
Transparency exporter	6,206	0.635	0.274	0	1
Formalities importer	6,206	0.659	0.206	0.125	1
Formalities exporter	6,206	0.654	0.206	0.125	1
Institutions importer	6,206	0.525	0.207	0	1
Institutions exporter	6,206	0.523	0.208	0	1
Paperless importer	6,206	0.583	0.240	0.074	1
Paperless exporter	6,206	0.579	0.234	0.074	1
Transit importer	5,509	0.642	0.236	0	1
Transit exporter	5,631	0.639	0.235	0	1
Smes importer	4,658	0.339	0.203	0	0.867
Smes exporter	4,649	0.339	0.206	0	0.867
Agriculture importer	4,427	0.422	0.303	0	1
Agriculture exporter	4,382	0.428	0.298	0	1
Women importer	4,546	0.191	0.244	0	1
Women exporter	4,496	0.195	0.244	0	1

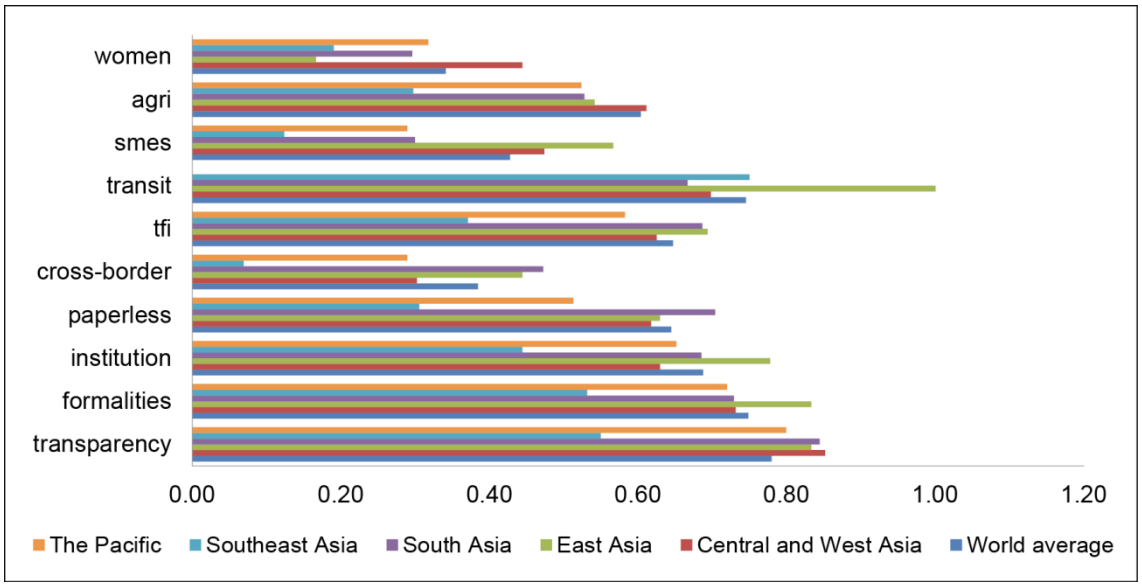
Note: See Table A.1 for a description of the variables. TFI denotes the trade facilitation index.

Source: Author's elaboration. WTO denotes World Trade Organization.

3.2 Stylized Facts

In this section, we present some figures that show the implementation stage of TF measures in 2021. Figures 1 and 2 show the rate of implementation in 2021 of the TF aggregated indicators in the Asia and the Pacific region by subregions and in the world economy compared with the Asia and the Pacific region, respectively. Figure 1 indicates that East Asia is the best performer in terms of transparency, transit, and formalities, with TF measures reaching more than 80% of the full implementation target (scale between 0 and 1), but the same subregion is the worst performer in terms of sustainable TF measures (related to women, sustainable agriculture, and SMEs). Central and West Asia are also doing well in regard to transparency, but not so concerning cross-border TF, as they have the lowest degree of implementation (below 30%). As regards Southeast Asia, sustainable TF is also poorly implemented, whereas transparency and formality TF measures show a better achievement. The Pacific does best in transparency TF and worst in cross-border TF measures, whereas South Asia shows 80% implementation in transparency, and around 70% in formality, institutions, and paperless TF-adopted measures.

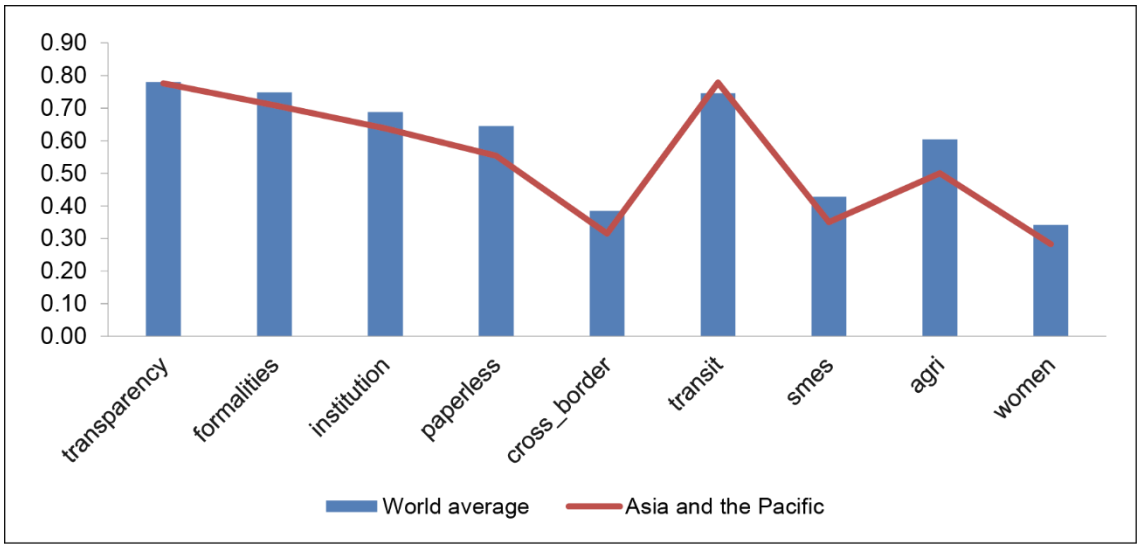
Figure 1: Trade Facilitation in Asia and the Pacific in 2021



Source: https://www.untfsurvey.org/region?id=ESCAP and author's elaboration. See list of countries in each subregion in Table A.2 in the Appendix.

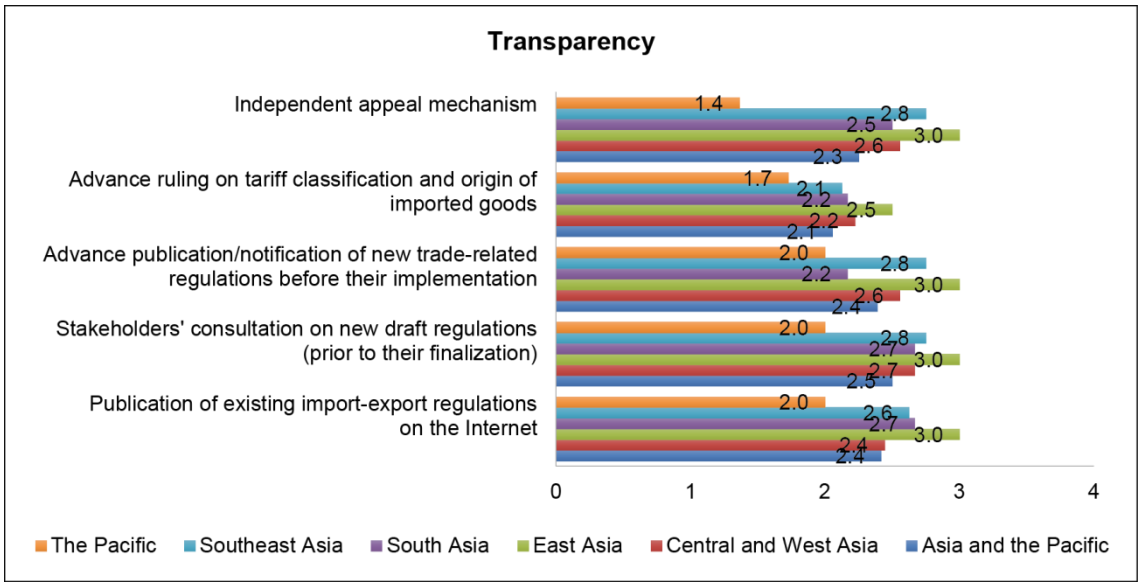
Figure 2 indicates that countries in Asia and the Pacific generally perform around the global average in some categories, such as transit and transparency, and slightly below concerning border formalities. Otherwise, Asia and the Pacific have a worse performance than the world average in the case of paperless trade and institutions, meaning there is room for improvement.

Figure 2: Trade Facilitation in the World in 2021



Source: https://www.untfsurvey.org/region?id=ESCAP and author's elaboration.

Figure 3: Degree of Implementation of Transparency TF Measures in Asia and the Pacific



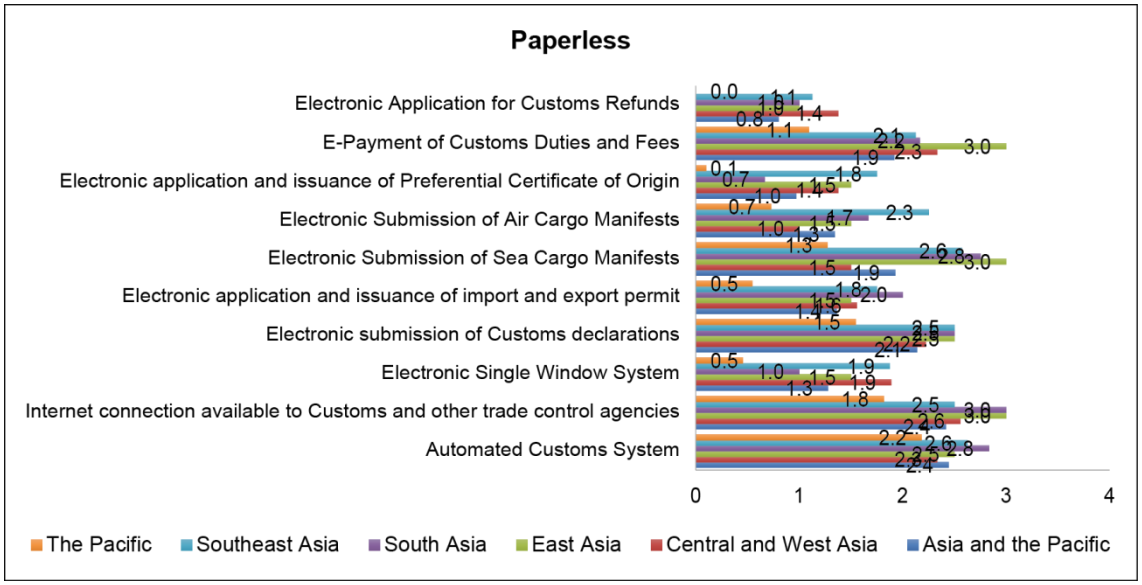
Note: Average scores are calculated only using economies where measure implementation information is available (i.e., not implemented = 0, planning stage = 1, partially implemented = 2, or fully implemented = 3).

Source: https://www.untfsurvey.org.

Figures 3–5 show specific TF scores (notice that the variations go from 0 to 3) for different subregions in Asia and the Pacific and specific TF indicators. Those are related to transparency (Figure 3), paperless trade (Figure 4), and formalities (Figure 5). Figure 3 indicates that the best score in transparency items is for countries in East Asia, whereas the worst refers to countries in the Pacific subregion. This means that while the transparency TF measures have been fully implemented in the former, they are still in the planning stage or have been partially implemented in the latter region. In regard to paperless TF measures, Figure 4 shows that there is room for improvement in most subregions concerning the implementation of electronic

single windows and several electronic application processes, which are still not fully implemented in any of the considered subregions. Similarly, Figure 5 shows that formalities for TF are, at best, partially implemented, indicating that risk management in South Asia is either in the planning stage or partially implemented, as is the case for post-clearance audits in the Pacific.

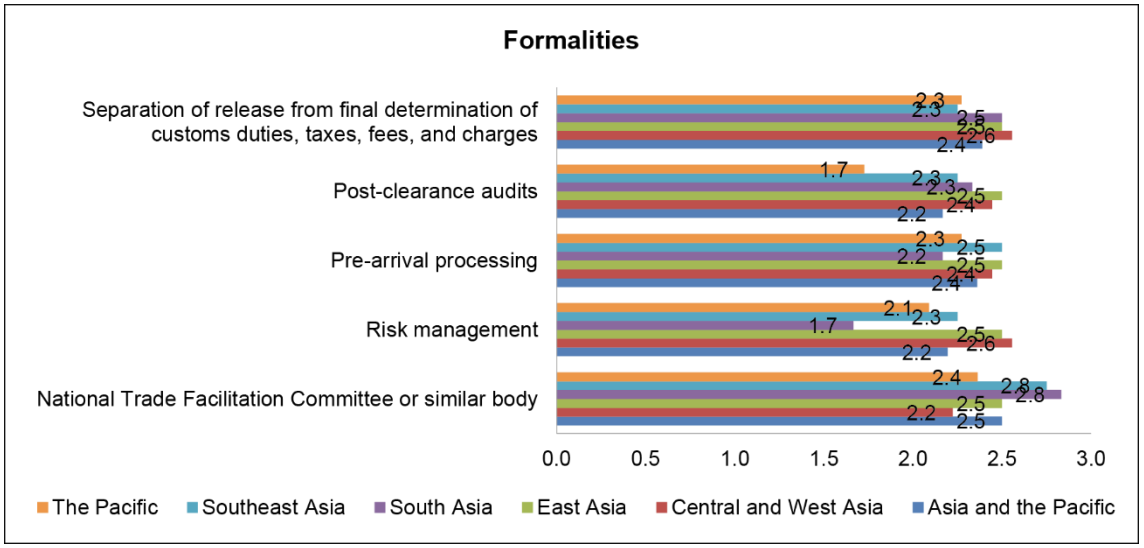
Figure 4: Degree of Implementation of Paperless TF in Asia and the Pacific



Note: Average scores are calculated only using economies where measure implementation information is available (i.e., not implemented = 0, planning stage = 1, partially implemented = 2, or fully implemented = 3).

Source: https://www.untfsurvey.org.

Figure 5: Degree of Implementation of Formalities TF in Asia and the Pacific



Note: Average scores are calculated only using economies where measure implementation information is available (i.e., not implemented = 0, planning stage = 1, partially implemented = 2, or fully implemented = 3).

Source: https://www.untfsurvey.org.

4. EMPIRICAL STRATEGY

To evaluate the effects of TF measures across countries, in light of the TF agreement, the main strategy consists in: first, estimating a gravity model of bilateral trade for the years 2016 to 2021 for a global sample of countries and for exports of primary and manufactured products separately; second, estimating correlations between total exports of goods and services and GVC proxies for a global sample of countries and for specific geographical areas, with a special focus on the Asia and the Pacific region; third, considering the doing business time to exports and cost to export and import as dependent variables.

4.1 The Gravity Model of Trade

The gravity model of trade has been extensively used to estimate the factors that explain bilateral trade flows among countries (Feenstra 2004). In the last four decades, being a structural model with firm theoretical foundations, it has been considered the workhorse for international trade analysis, as documented by Eaton and Kortum (2002), Anderson and Van Wincoop (2003), Allen, Arkolakis, and Takahashi (2014), Head and Mayer (2014), and Anderson, Larch, and Yotov (2018), among others. Therefore, it is suitable for evaluating the effects of trade facilitation factors.

The international trade theories in relation to the gravity model were reformulated and modernized by Anderson and Van Wincoop (2003). The model's underlying assumptions are that the elasticity of substitution between goods is constant and products are differentiated by country of origin. Moreover, bilateral trade costs are assumed to be symmetric, so prices differ among countries. According to the gravity model, bilateral exports between two countries are directly proportional to the product of their economic mass and inversely proportional to the costs of trade between them. The multiplicative form of the model is given by:

$$\mathrm{X_{ijt}} = \frac{\mathrm{Y_{it}Y_{jt}}}{\mathrm{Y_t^W}}\left(\frac{\mathrm{t_{ijt}}}{\mathrm{P_{it}P_{jt}}}\right)^{1\text{-}\sigma} \quad (3)$$

where X_{ijt} is the bilateral exports from country i to country j in year t, and Y_{it} (Y_{jt}) and Y^W are the GDP of the exporting (importing) country and the world in year t, respectively. t_{ijt} is the trade costs between the pair of trading countries in year t, and P_{it} and P_{jt} are price indices that reflect the multilateral resistance terms (MRTs). σ is the elasticity of substitution between goods.

The model specification in its log-linear form is given by:

$$ln\, X_{ijt} = ln\, Y_{it} + ln\, Y_{jt} - \ln\, Y_t^W + (1-\sigma)\ln\, t_{ijt} - (1-\sigma) ln\, P_{it} - (1-\sigma)\ln P_{jt} \quad (4)$$

The presence of trade costs and MRTs in Equation (4) implies that some estimation issues must be considered. For instance, the trade cost function $t_{ijt,}$ is generally assumed to be a function of several trade barriers. These include the geographical distance between countries, the lack of a common border, a common colonial past and common language (all time-invariant), and a number of policy variables, including membership in multilateral agreements such as: regional trade agreements (RTAs), World Trade Organization (WTO), and trade facilitation variables (all time-varying). The trade cost function is given by:

$$T_{ijt} = d_{ij}^{\alpha_3} TF_{it}^{\alpha_4} TF_{jt}^{\alpha_5} \exp(\alpha_6 Contig_{ij} + \alpha_7 Comlang_{ij} + \alpha_8 Comcol_{ij} + \alpha_9 RTA_{ijt} + \alpha_{10} WTO_{ijt}) \quad (5)$$

Substituting Equation (5) into Equation (4) and extending the model with year dummy variables and an error term gives the next model specification:

$$Ln\, X_{ijt} = \pi_i + \delta_j + \alpha_1 \ln Y_{it} + \alpha_2 \ln Y_{jt} + \alpha_3 \ln D_{ij} + \alpha_4 TF_{it} + \alpha_5 TF_{jt} + \alpha_6 Contig_{ij} + \alpha_7 Comlang_{ij} + \alpha_8 Comcol_{ij} + \alpha_9 RTA_{ijt} + \alpha_{10} WTO_{ijt} + \theta_t + u_{ijt} \quad (6)$$

where X_{ijkt} denotes exports of shipped from country *i* to country j in year *t*, $\ln D_{ij}$ denotes the natural logarithm of the distance between country *i* and country *j*, and TF_{it} (TF_{ij}) denotes trade facilitation measures taken by country *i* (*j*) at time *t*. $Contig_{ij}$ takes the value of 1 for a pair of countries sharing a border, and 0 otherwise. $Comlang_{ij}$ and $Comcol_{ij}$ take the value of 1 when a pair of countries share an official language or have ever had a colonial relationship, respectively, and 0 otherwise; RTA_{ijt} takes the value of 1 when the trading countries are members of a regional trade agreement, and 0 otherwise; WTO_{ijt} takes the value of 1 if country *i* or country *j* is a WTO member and 2 if both are members. ϕ_t denotes a set of year dummies that proxy for business cycle and other time-variant common factors (globalization) that affect all trade flows in the same manner.

The MRTs are modeled using time-invariant country-specific dummies (π_i, λ_j), given the short time span of our sample and the year-time variation of our TF variables. In the final specification, the time-invariant gravity variables that account for trade cost factors are substituted by country-pair fixed effects γ_{ij} to control for all bilateral unobserved characteristics. The model is specified as:

$$ln\, X_{ijt} = \gamma_{ij} + \beta_1 ln\, Y_{it} + \beta_2 ln\, Y_{jt} + \beta_3 ln\, TF_{it} + \beta_4 ln\, TF_{jt} + \beta_5 RTA_{it} + \alpha_6 WTO_{jt} + \theta_t + u_{ijt} \quad (7)$$

In this regard, we follow Baier and Bergstrand (2007) and Head and Mayer (2014), who suggested the use of pair fixed effects and time dummy variables to control for bilateral unobserved heterogeneity and common time trends, respectively. For completeness, we also include estimates of the traditional gravity model (6) that include economic and bilateral variables and with common time effects in the Appendix (Table A.3 for manufactures and Table A.4 for primary products).

According to Head and Mayer (2014), fixed effects that vary by exporter-time (*it*) and importer-time (*jt*) could be included as a proxy for MRTs. In this case, variables such as GDP and TF cannot be identified directly.[7] As a way to identify the effect of variables that vary by country and over time, such as TF, a two-stage approach is used (also following Martínez-Zarzoso and Chelala 2020). In the first stage, the country-time fixed effects are estimated from the following gravitational model:

$$lnX_{ijt} = \delta_{ij} + \tau_{it} + \varphi_{jt} + \alpha_1 TP_{ijt} + \varepsilon_{ijt} \quad (8)$$

Exporter-time (τ_{it}) and importer-time (φ_{it}) fixed effects represent trade barriers that are country-specific and vary over time, that is, third-party countries' barriers to trade that affect the costs of trade.

[7] The direct effect on exports of variables that change by country and over time is subsumed in the exporter-time and importer-time fixed effects.

The exporter-time and importer-time fixed effects, extracted from Model (8), are used as dependent variables in the second stage:

$$\hat{\tau}_{it} = \gamma_i + \beta_1 \ln Y_{it} + \beta_2 TF_{it} + \beta_3 X_{it} + \eta_{it} \quad (9)$$

To account for factors such as institutions, infrastructure, and cultural factors that vary slowly, the estimation includes unobservable country effects, γ_i. Y_{it} indicates the exporter's GDP. *TF* takes the value of 1 when the exporting country has applied a given TF improvement in period *t*. X denotes additional control variables that have country-time variation.

In addition to the log-linearized models proposed, and based on the ongoing development of new techniques for estimating the gravity model based on theoretical advances (Head and Mayer 2014; Yotov, Piermartini, and Larch 2016; Egger, Larch and Yotov 2022), we also estimate the model in its multiplicative form using a Poisson pseudo maximum likelihood (PPML) estimator:

$$X_{ijt} = \exp\left(\vartheta_{ij} + \tau_{it} + \varphi_{jt} + \delta_1 TP_{ijt}\right) \varepsilon_{ijt} \quad (10)$$

where the dyadic fixed effects associated with trade, u_{ij}, represent the time-invariant characteristics of the trade relationship between *i* and *j*, as above. TP_{ijt} represents time-variable bilateral factors, such as being a member of the WTO or of an RTA. Finally, ε_{ijt} is the error term and is assumed to be identically or independently distributed. As before, we extract the country-time fixed effects from Model (10) and use them in a second step, similarly to Equation (9).

4.2 Effect of Trade Facilitation on Exports and GVCs

In this section, we estimate a panel data model using country-level variables related to trade and GVCs and link them with TF factors. Estimating the models in first differences will also allow us to infer the effect of the pandemic on fostering the use of electronic documents and procedures to decrease trade costs. This, however, will only be possible with trade variables, given that trade-in value added and the related variables are only available until 2018.

As dependent variables, we alternatively consider total trade, trade in goods, and trade in services. Moreover, we also use the participation of countries in GVCs, using the two proxies described in the data and variables section, that is, the GVC participation index and the GVC position of a country. The empirical strategy to infer the effect of trade facilitation improvements on trade and GVC variables consists in estimating a panel data model that controls for country and time unobserved heterogeneity and estimated with the variables in first differences. This method is also known as a "random trend model" (Wooldridge 2010), which is an extension of the standard unobserved effects models for panel data. The model allows each country to have its own time trend. The country-specific trend is an additional source of heterogeneity. The estimated model is given by:

$$\ln y_{it} = \theta_i + g_i t + \delta_1 TF_{it} + \delta_3 T_{it} + \omega_{it} \quad (11)$$

where y_{it} is the natural log of the trade and GVC variables and g_i is (roughly) the average growth rate over a period (holding the explanatory variables fixed). Since we would like to allow θ_i and g_i to be arbitrarily correlated with the other explanatory

variables, our analysis is within a fixed-effects framework. Our approach to estimating Model (11) is to difference away θ_i and estimate the model given by:

$$\Delta \ln y_{it} = g_i + \delta_1 \Delta TF_{it} + \delta_3 \Delta T_{it} + \Delta \omega_{it} \quad (12)$$

where we have used the fact that $g_it - g_i(t-1) = g_i$ and Equation (12) becomes the standard fixed-effects model. In differencing the equation to eliminate θ_i we lose one time period, so that Equation (12) applies to T-1 time periods. We are able to apply fixed-effects methods to Equation (12) since our trade facilitation indicators have at least four distinct waves, and the minimum requirement to estimate this model is T = 3. According to Wooldridge (2010), it is reasonable to assume that the first difference of the residuals is serially uncorrelated, in which case the FE method applied to Equation (12) is attractive.

4.3 Cost of Trading Across Countries

The third set of estimations takes the variables from the World Bank Doing Business data set as dependent variables, one by one. These will serve us to answer the question of whether the implementation of the trade facilitation agreement has indeed reduced the cost to export, cost to import, and the number of documents used for export and import, respectively. A similar model to that in the previous subsection will be used, but without exploiting the panel dimension of the data, given that the time variation is almost not there. Another limitation is that these variables are only available until 2019. Therefore, we will be able to show correlations but not causality in this case. A similar exercise is done using the different components of the Logistics Performance Index (LPI), which is also available from the World Bank, but only for the years 2016 and 2018.

5. MAIN RESULTS

Table 2 shows the main results from estimating the gravity model of trade given by Equation (7) for trade in manufactured goods.[8] The results, including gravity variables instead of dyadic fixed effects, as in Equation (6), are shown in the Appendix (Tables A.3 and A.4). Model (7) includes bilateral and time fixed effects, and hence it controls for bilateral unobserved heterogeneity and common time effects. Column (1) reports the result for the trade facilitation index (TFI). The reported coefficient indicates that a one percentage point increase in the index for exporters increases trade by around 1.34%. The overall TF index includes the above-mentioned components (transparency, formalities, paperless, institutions, and cross-border). First, Columns (2) to (6) present the estimates for each component of the specific TF scores. The highest effect in magnitude is obtained for the transparency rating score (1.97), followed by formalities and institutions, whereas paperless TF and transit TF measures are not statistically significant. Second, Columns (7) to (9) present the coefficients for each component of the sustainable TF scores. Only the agricultural component is statistically significant, whereas the TF for SMEs and for women is not. Interestingly, only the TF indicators for the exporter are statistically significant, whereas those for the importer are not. Similarly, only the GDP of the exporter is statistically significant and shows a more than proportional effect on exports, whereas the GDP for the importer is not. With regard to the RTA dummy variable, it shows a weakly significant effect, indicating that

[8] The model was also estimated for exports of primary products and none of the TF variables was found to be statistically significant. Results are available on request.

exports are around 44% higher when countries belong to the same RTA according to Column (1): [exp(0.368)-1]*100)].

Table 2: Results for the Gravity Model of Trade

Dep. Var: ln Exports in Manufactured Goods									
	TFI Subcomponents								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables:	TFI	Transp	Formal	Paperless	Instit	Transit	Smes	Agri	Women
TFI exporter	1.348**	1.973***	0.844**	0.0447	0.807***	0.239	0.151	0.885***	-0.218
	(0.542)	(0.458)	(0.358)	(0.434)	(0.301)	(0.313)	(0.396)	(0.297)	(0.280)
TFI importer	-0.125	-0.253	-0.382	0.507	0.215	0.250	0.189	0.0483	-0.280
	(0.529)	(0.391)	(0.338)	(0.396)	(0.275)	(0.287)	(0.436)	(0.234)	(0.282)
ln GDP exporter	2.027***	2.048***	2.004***	1.866***	1.983***	2.411***	2.545***	2.435***	2.464***
	(0.414)	(0.405)	(0.414)	(0.416)	(0.410)	(0.447)	(0.397)	(0.408)	(0.395)
ln GDP importer	0.152	0.159	0.0900	0.186	0.189	-0.0723	0.374	0.271	0.368
	(0.390)	(0.384)	(0.387)	(0.388)	(0.383)	(0.427)	(0.407)	(0.400)	(0.386)
RTA	0.368*	0.481**	0.369*	0.370*	0.365*	0.423*	0.457*	0.0970	0.331
	(0.191)	(0.194)	(0.192)	(0.191)	(0.190)	(0.226)	(0.276)	(0.316)	(0.265)
2017 dummy	0.117	0.104	0.187**	0.168*	0.0571	0.215**			
	(0.107)	(0.0917)	(0.0921)	(0.0979)	(0.104)	(0.0955)			
2018 dummy	0.0812	0.0608	0.154*	0.135	0.0208	0.129	-0.0895	-0.0259	-0.0369
	(0.107)	(0.0911)	(0.0923)	(0.0967)	(0.104)	(0.0939)	(0.0716)	(0.0953)	(0.0771)
2019 dummy	-0.191	-0.239**	-0.0787	-0.0837	-0.249*	-0.153	-0.283***	-0.723***	-0.165*
	(0.145)	(0.113)	(0.115)	(0.114)	(0.132)	(0.109)	(0.0861)	(0.250)	(0.0845)
2020 dummy	-0.269*	-0.315***	-0.160	-0.166	-0.327***	-0.199*	-0.307***	-0.727***	-0.165*
	(0.140)	(0.108)	(0.109)	(0.107)	(0.125)	(0.106)	(0.0862)	(0.246)	(0.0863)
2021 dummy	-0.204	-0.246*	-0.0508	-0.0630	-0.249	-0.0392	-0.259**	-0.646**	-0.0853
	(0.185)	(0.137)	(0.142)	(0.144)	(0.152)	(0.122)	(0.119)	(0.272)	(0.112)
Observations	6,206	6,206	6,206	6,206	6,206	4,994	4,471	3,901	4,220
R-squared	0.25	0.26	0.24	0.26	0.25	0.22	0.28	0.27	0.28
Number of id	2,405	2,405	2,405	2,405	2,405	2,027	1,752	1,546	1,688

Note: Robust standard errors in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1. All columns include country-pair and time fixed effects. Trade facilitation variables are described in Appendix A.1. TFI denotes the trade facilitation index of the exporter/importer country. Id denotes the number of bilateral trade relations. GDP denotes the gross domestic product per capita of the exporter/importer in constant USD of 2017. RTA denotes regional trade agreements and takes the value of one when the trading countries belong to the same regional trade agreement and zero otherwise.

Source: Author's elaboration.

Next, Table 3 presents the results obtained by estimating Equations (8) and (10). Columns (1) and (2) report the results for the specification with exports in natural logarithms and Columns (3) and (4) in levels for exports of manufactured goods and primary products, respectively. The results for the RTA variable for manufactured goods are consistent with the analysis in Table 2 (compare 0.368 with 0.231 in the first columns of Tables 2 and 3, respectively). From these models, the country-time fixed effects (CTFEs) are extracted and used in a second-step estimation, the results of which are shown in Table 4, which presents the outcomes obtained using Column (1) in Table 3 as a first step. The correlation between these CTFEs and the TF index (TFI) is shown in Figure 6, which shows a clear positive correlation.

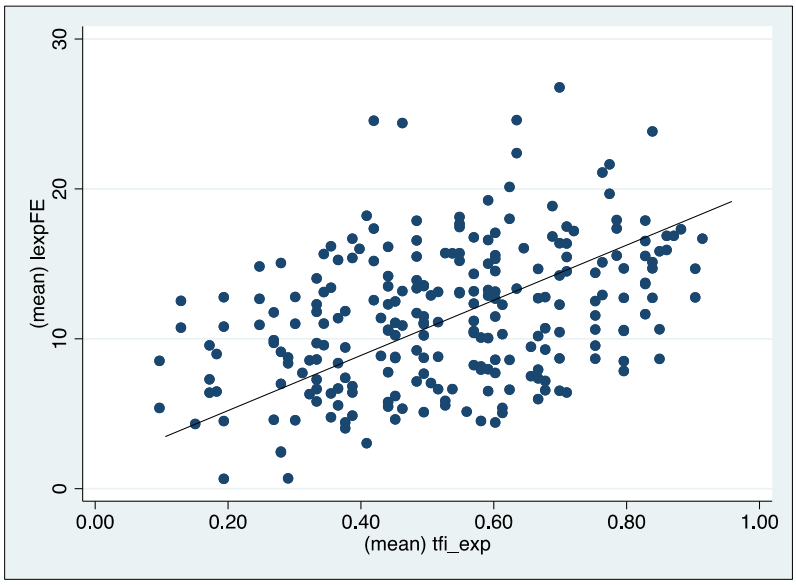
Table 3: Gravity Model Estimates with Multidimensional Fixed Effects

	(1)	(2)	(3)	(4)
Dep. Variables	**Ln Exp_ma**	**Ln Exp_pri**	**Exp_ma**	**Exp_pri**
RTA	0.261**	-0.187*	0.231***	0.179**
	(0.126)	(0.110)	(0.0599)	(0.0866)
it, jt, ij Fixed effects	Yes	Yes	Yes	Yes
Observations	18,939	15,427	19,495	15,969
R-squared	0.900	0.911	0.999	0.995

Note: Robust standard errors in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1. Exp_ma and Exp_pri denote total exports in manufactured and primary products, respectively. RTA denotes regional trade agreements and takes the value of 1 when the trading countries belong to the same regional trade agreement and 0 otherwise. The results in Columns (1) and (2) are obtained with the Stata command *reghdfe* and in (3) and (4) with *ppml_panel_sg*.

Source: Author's elaboration. It, jt, and ij denote exporter-time, importer-time, and bilateral fixed effects.

Figure 6: Scatterplot of Country-Time FE from the Gravity Model and Trade Facilitation Scores



Source: Author's elaboration. Using the ln of the exporter-time FE (lnexpFE on y-axes) from Model (3) in Table 3; tfi_exp denotes the trade facilitation index of the exporter countries.

It is worth noting that the estimates obtained in Table 4 for the TF indicators are similar in general to those in Table 2, but slightly smaller in magnitude. In particular, it is confirmed that transparency measures, formalities, and institutions supporting TF are the most effective, whereas paperless TF is only weakly significant, and transit TF does not show a clear effect. In this case, agriculture-related TF shows a significant positive effect concerning sustainable TF indicators. However, the effect of TF measures related to SMEs, in this case, is negative and significant, perhaps reflecting the small cost firms have to incur to adopt the measures in the short term. Likewise, TF for women does not show a significant effect on trade.

Table 4: Multilateral Resistance and Trade Facilitation – Second-Step Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. Var: FE GM	**TFI**	**Tranps**	**Formal**	**Paperless**	**Insti**	**Transit**	**SMES**	**Agri**	**Women**
TFI exporter	0.998***	1.165***	0.485***	0.123*	0.739***	0.0193	–0.731***	0.570***	–0.0911
	(0.0823)	(0.0528)	(0.0455)	(0.0661)	–0.0421	(0.0484)	(0.0594)	(0.0375)	(0.0595)
ln GDP exporter	1.975***	1.953***	1.935***	1.855***	1.955***	2.146***	2.448***	2.331***	2.446***
	(0.0759)	(0.0660)	(0.0749)	(0.0751)	–0.0707	(0.0760)	(0.0801)	(0.0709)	(0.0820)
Obs	10,961	10,961	10,961	10,961	10,961	9,966	8,469	7,960	8,194
R-squared	0.231	0.265	0.225	0.217	0.248	0.251	0.290	0.284	0.252
Number of id	3,139	3,139	3,139	3,139	3,139	2,941	2,682	2,475	2,615

Note: Robust standard errors in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1. TFI denotes the overall trade facilitation index (TFI) as defined in Table A1. GDP exporter denotes the gross domestic product per capita of the exporter in constant USD of 2017. All columns include country and time fixed effects. The number of id refers to the pair of countries included in the sample.

Source: Author's elaboration.

Since the effects could differ by income level, Table 5 presents estimates for high-income countries (HICs), low-income countries (LICs), upper-middle-income countries (UMCs), and low-middle-income countries (LMCs). It seems that all income groups benefit from the implementation of transparency TF, formalities TF, and institution TF. In contrast, paperless TF mainly benefits UMCs and LMCs, and transit TF only LICs. As regards the sustainable TF measures, agriculture TF is beneficial for all, but not so SMEs and women TF measures.

Table 5: Multilateral Resistance and Trade Facilitation – Second-Step Results (by Income Group)

Country Group:	**Transp**	**Formal**	**Insti**	**Paperless**	**Transit**	**SMES**	**Agri**	**Women**
HIC	1.068***	0.409***	1.390***	–1.011***	–0.148***	–0.803***	0.389***	–0.399***
	(0.109)	(0.0865)	(0.113)	(0.220)	(0.0467)	(0.166)	(0.0469)	(0.0336)
LIC	1.582***	0.477***	0.321***	–0.106	0.931***	–0.989***	0.226*	0.113
	(0.0793)	(0.0716)	(0.0416)	(0.103)	(0.0477)	(0.117)	(0.136)	(0.135)
UMC	1.009***	0.450***	1.081***	0.178*	–0.714***	–1.102***	0.281***	–1.098***
	(0.0824)	(0.124)	(0.113)	(0.0915)	(0.0498)	(0.0417)	(0.0621)	(0.118)
LMC	0.940***	0.578***	0.856***	0.691***	0.0525	–0.122	0.551***	0.0759
	(0.0625)	(0.0555)	(0.0477)	(0.0868)	(0.0374)	(0.0786)	(0.0390)	(0.0864)

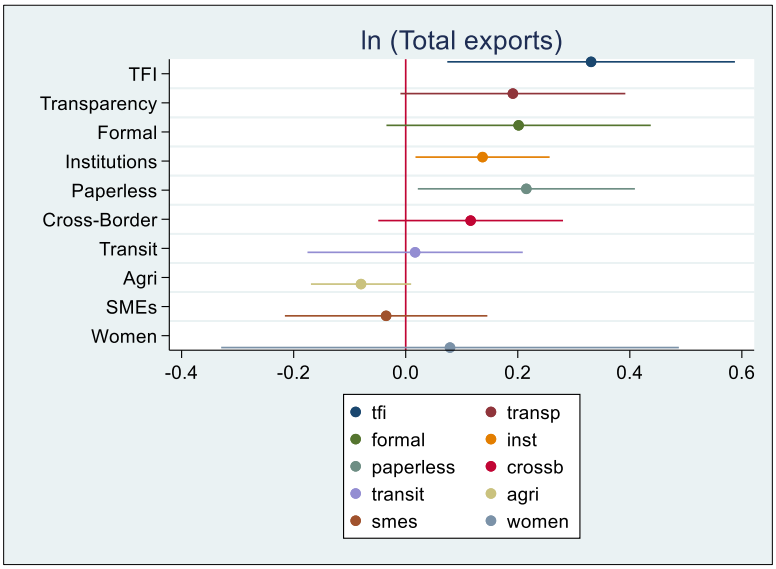
Note: Robust standard errors in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1. See Table A1 for the definition of the TF variables in the first row. High-income countries (HICs), low-income countries (LICs), upper-middle-income countries (UMCs), and low-middle-income countries (LMCs).

Source: Author's elaboration.

5.1 Results from Country-Level Regressions: Trade, GVC, Cost, and Time to Trade

This section presents the results from estimating Equation (12) for trade and GVC variables. The estimated coefficients and the corresponding confidence bands at the 5% significance level are shown in Figures 7–11 for total trade, trade in goods, trade in services, GVC participation, and the GVC position index.

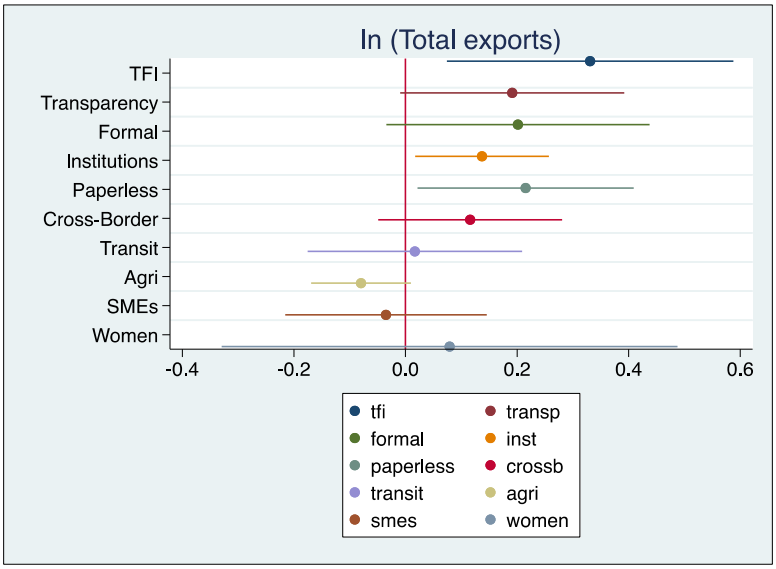
Figure 7: Dependent Variable Trade in Goods and Services – Global Sample



Source: Author's elaboration using the results from estimating Equation (12) for trade and GVC variables. The lines indicate confidence bands at the 5% significance level and the dots indicate estimated coefficients for each of the components of the trade facilitation indicator.

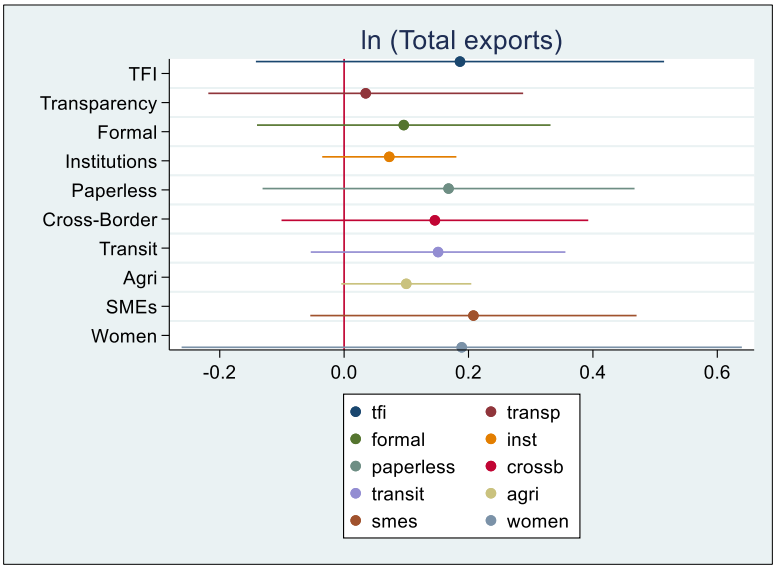
The coefficients shown in Figure 7 indicate that TF related to transparency, formalities, institutions, and paperless trade explains total exports of goods and services at the aggregated level. However, cross-border procedures and transit at the border TF do not show any clear effect, as is also the case for sustainable TF indicators (SMEs, agriculture, women). When distinguishing between trade in goods (Figure 8) and trade in services (Figure 9), we see that most of the effects are due to trade in goods, whereas only the institutions component is weakly significant for trade in services.

Figure 8: Dependent Variable Trade in Goods – Global Sample



Source: Author's elaboration using the results shown in Table A.5 in the Appendix. The lines indicate confidence bands at the 5% significance level, and the dots indicate estimated coefficients for each of the components of the trade facilitation indicator.

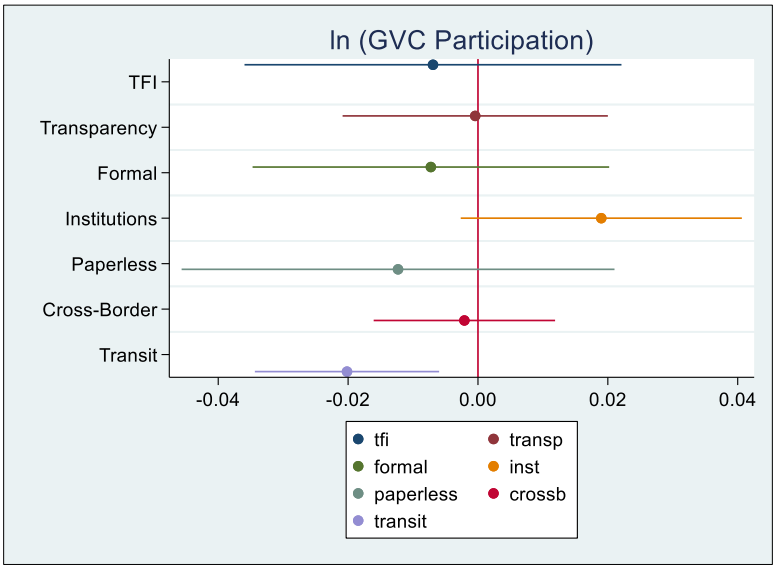
Figure 9: Dependent Variable Trade in Services – Global Sample (Trade in Technology-Intensive Goods)



Source: Author's elaboration. The lines indicate confidence bands at the 5% significance level and the dots indicate estimated coefficients for each of the components of the trade facilitation indicator.

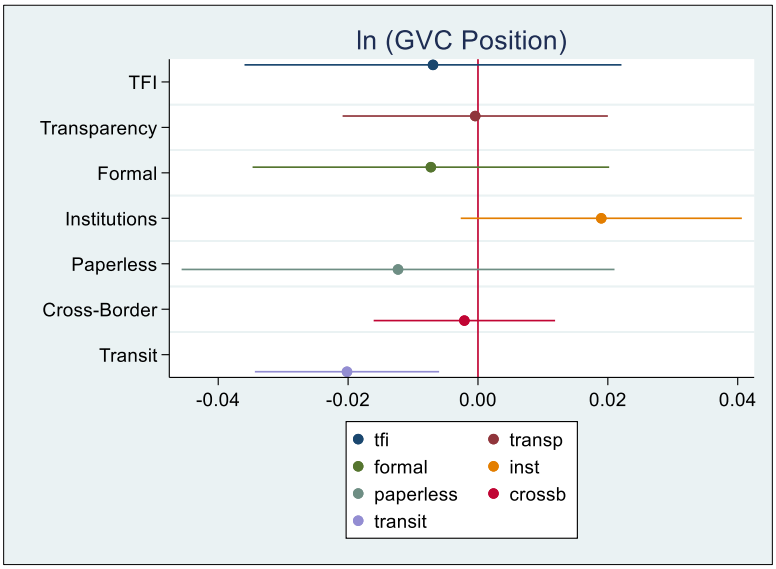
Next, Figures (10) and (11) show the results for the GVC participation and the GVC position index described in the data section. According to the results shown in Figure 10, only the subcomponent referring to institutions for TF seems to have a clear effect on GVC participation, whereas the component cross-border TF is significant at the 10% level. When the GVC position is examined as shown in Figure 11, however, almost none of the TF components show a significant effect at conventional levels, with only institutions for TF showing a 10% significance.

Figure 10: Dependent Variable GVC Participation – Global Sample



Source: Author's elaboration. The lines indicate confidence bands at the 5% significance level and the dots indicate estimated coefficients for each of the components of the trade facilitation indicator. Point estimates are from Table A.5 in the Appendix.

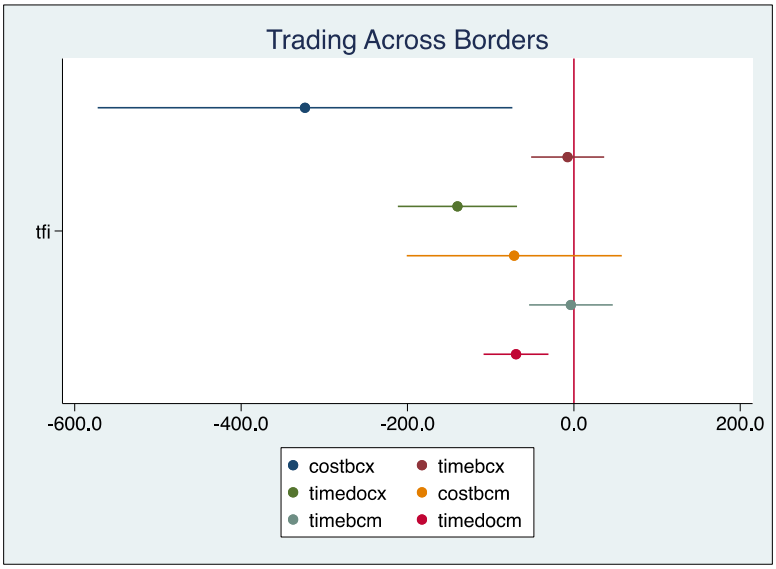
Figure 11: Dependent Variable GVC Position – Global Sample



Source: Author's elaboration. The lines indicate confidence bands at the 5% significance level and the dots indicate estimated coefficients for each of the components of the trade facilitation indicator.

Finally, in order to see whether the implementation of TF measures is helping to reduce the time and cost to trade across borders, we show a graphical representation of the results obtained from simple regressions that do not exploit the panel data structure, and hence show correlations rather than causality.

Figure 12: Dependent Variables: Cost and Time to Trade Across Borders – Global Sample



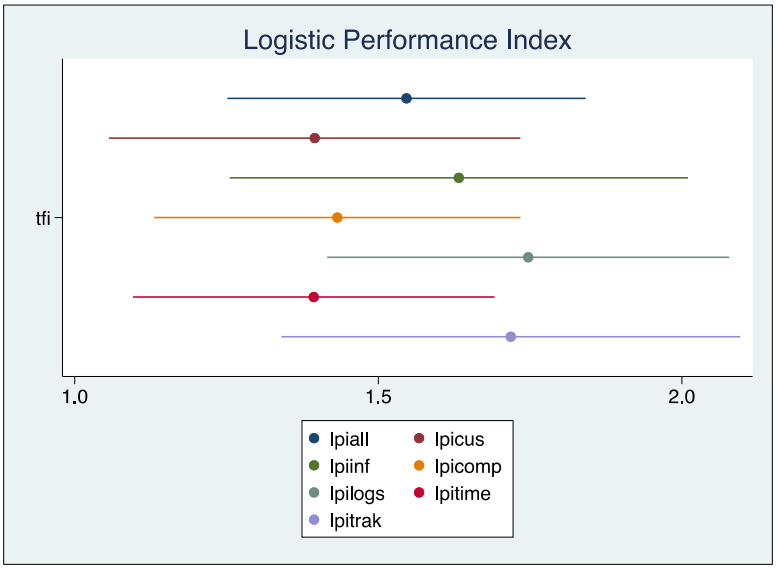
Note: costbcx(m) = cost to export(import), border compliance (US$); timebcx(m) = time to export(import), border compliance (hours); timedocx(m) = time to export(import), documentary compliance (hours).

Source: Author's elaboration with data from World Bank Doing Business Indicators (2016–2019). See Table A.6 for the full regression results. The lines indicate confidence bands at the 5% significance level and the dots indicate estimated coefficients for each of the components of the trade facilitation indicator.

Figure 12 shows the results of using three sets of variables for exporters and importers related to trading across borders, namely the cost and time to export and import, and the number of hours needed to fill the documents required to export and import. All these variables are negatively correlated with the TF index (*tfi*), as indicated in Figure 12. For instance, an increase in the *tfi* of one percentage point is related to a decrease in the cost involved in border compliance (costbcx) of $323, which doubles the mean value in the sample. Similarly, the same increase in *tfi* is related to a reduction in the hours needed for documentary compliance for exporting 139 (timedocx), with a sample average of 51.

We also consider, as shown in Figure 13, whether the TF index is correlated with the LPI and its components, that is: quality of trade and transport-related infrastructure; competence and quality of logistics services (*lpilogs*); ability to track and trace consignments(*lpitrak*); efficiency of the customs clearance process (*lpicus*); ease of arranging competitively priced shipments (*lpicomp*); and frequency with which shipments reach consignees within the time scheduled (*lpitime*). It can be seen that all the LPI components are positively correlated with the TF index, and these correlations are all statistically significant. This result indicates that improvements in logistics performance are clearly correlated with better trade facilitation performance and will surely improve trade across borders and reduce trade costs.

Figure 13: Dependent Variables: Logistic Performance Index and its Components – Global Sample



Note: lpiall = logistics performance index(lpi): Overall (1 = low to 5 = high); lpiinf = quality of trade and transport-related infrastructure; lpilogs = competence and quality of logistic services; lpitrak = ability to track and trace consignments; lpicus = efficiency of the customs clearance process; lpicomp = ease of arranging competitively priced shipments; lpitime = frequency with which shipments reach consignee within time scheduled.

Source: Author's elaboration. The lines indicate confidence bands at the 5% significance level and the dots indicate estimated coefficients for each of the components of the trade facilitation indicator.

6. CONCLUSIONS

The combined interlink between economies and the undisputed importance of trading across countries makes the issue of trade facilitation very relevant in the 21st century – more so in a world subject to increasing risks and uncertainties related to pandemics and climatic disasters. This paper evaluates the degree of implementation of trade facilitation measures in the world economy and its correlation with some measures of globalization, namely exports of goods and services and participation in GVCs. The main methodology relies on the gravity equation of trade and econometric techniques for panel data sets. With the help of newly collected data covering the pre- and post-pandemic periods, this paper evaluates the relative importance of several developments all directed towards implementing a number of trade facilitation actions that are expected to reduce the cost of trading across borders and to increase trade in goods and services.

The main results from the gravity model indicate that TF measures related to transparency, institutions, and formalities are of utmost importance, whereas sustainable TF actions are still in their infancy, and more data are needed for a proper evaluation of their effectiveness. The TF implementation is related to a reduction in the time and cost to export and import as well as to improvements in logistics performance, which indicates the importance of reducing the time needed to trade, that is, to export and import, with the implementation of targeted policy measures directed towards reducing these times. Moreover, the implementation of TF measures has a significant effect on exports of manufactured goods overall, which is visible for all TFI sub-components.

The implications of the results for developing countries located in the Asia and the Pacific region are manyfold. For instance, the region comprises 12 least-developed countries, of which five are small islands and four are landlocked. For all of them, policies that invest in trade facilitation will contribute more than proportionally to increasing exports of manufactured goods. In particular, measures directed at improving institutional arrangements for border agencies, creating authorized operators, and publishing average release times (transparency) have a more-than-proportional effect on exports. The results from our models indicate that increasing transparency measures will foster exports of manufactured goods more than proportionally for low-income countries. Those include, for example, advanced publication of new trade regulations on the Internet and stakeholders' consultation of new draft regulations. Moreover, policies directed towards improving the quality of institutions will favor the development and deepening of global value chains. Some examples of actions could be the creation of a National Trade Facilitation Committee or similar body or the existence of a clear national institutional arrangement for border agency cooperation.

The main limitation is related to the lack of data in the last two waves of the survey for sustainable trade facilitation measures, which does not allow us to draw conclusions in this respect. Further work should focus on country-specific analysis in the Asia and the Pacific region using firm-level data. This will enable us to disentangle whether the effects of the trade facilitation measures affect differently large and small firms in the region.

REFERENCES

Allen, T., C. Arkolakis, and Y. Takahashi. 2014. Universal Gravity. NBER Working Paper No. 20787. Cambridge: National Bureau of Economic Research.

Anderson, J., M. Larch, Y. V. Yotov. 2018. GEPPML: General Equilibrium Analysis with PPML" *The World Economy* 41(10): 2750–2782.

Anderson, J., and E. Van Wincoop, 2003. Gravity with Gravitas: A Solution to the Border Puzzle. *American Economic Review* 93(1): 170–192.

Baier, S., and J. Bergstrand. 2007. Do Free Trade Agreements Actually Increase Members International Trade? *Journal of International Economics* 71(1): 72–95.

Borin, A., and M. Mancini. 2019. Measuring What Matters in Global Value Chains and Value-Added Trade. Policy Research Working Paper. No. 8804. Washington, DC: World Bank.

Casella, B., R. Bolwijn, D. Moran, and K. Kanemoto. 2019. Improving the Analysis of Global Value Chains: The UNCTAD-Eora Database.

Cheong, I., and V. Turakulov. 2022. How Central Asia to Escape from Trade Isolation?: Policy Targeted Scenarios by CGE Modelling. *The World Economy* 45(8): 2622–2648.

Decreux, I., and Fontagne, L. 2006. A Quantitative Assessment of the Outcome of the Doha Development Agenda, CEPII Working Paper No. 2006-10.

Dennis, A. 2006. The Impact of Regional Trade Agreements and Trade Facilitation in the Middle East and North Africa Region. Policy Research Working Paper Series 3837, The World Bank.

De Sousa, J. 2012. The Currency Union Effect on Trade is not Decreasing over Time. Economics Letters 117(3): 917–920.

Djankov, S., C. Freund, and C. S. Pham. 2010. Trading on time. *The Review of Economics and Statistics 92*(1): 166–173.

Eaton, J., and S. Kortum. 2002. Technology, Geography, and Trade. *Econometrica* 70(5): 1741–1779.

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.

Engman, M. 2005. The Economic Impact of Trade Facilitation. OECD Trade Policy Working Papers 21, OECD Trade Directorate.

Feenstra, R. 2004. *Advanced International Trade: Theory and Evidence.* Princeton: Princeton University Press.

Gylfason T., I. Martínez-Zarzoso, and P. M. Wijkman, 2015. Free Trade Agreements, Institutions and the Exports of Eastern Partnership Countries. *Journal of Common Market Studies* 53(6): 1214–1229.

Halaszovich, T. F. and A. Kinra. 2020. The Impact of Distance, National Transportation Systems and Logistics Performance on FDI and International Trade Patterns: Results from Asian Global Value Chains. *Transport Policy* 98: 35–47

Head, K., and T. Mayer. 2014. Gravity Equations: Workhorse, Toolkit, and Cookbook. In *Handbook of International Economics*, Vol. 4. Edited by G. Gopinath, E. Helpman, and K. Rogoff. Amsterdam: Elsevier.

Hendy, R. and C. Zaki. 2021. Trade facilitation and firms exports: Evidence from customs data. *International Review of Economics & Finance 75*: 197–209.

Hummels, D. L. and G. Schaur, 2013. Time as a Trade Barrier. *American Economic Review* 103(7): 2935–2959.

Ismail, N. W. 2021. Digital Trade Facilitation and Bilateral Trade in selected Asian Countries. *Studies in Economics and Finance* 38(2): 257–271.

Kareem, F., I. Martínez-Zarzoso, and B. Bruemer. 2022. What Drives Africa's Inability to Comply with EU Standards? Insights from Africa's Institution and Trade Facilitation Measures. *European Journal of Development Research*, forthcoming.

Kim, K., P. Mariano, and J. Abesamis. 2022. Trade Impact of Reducing Time and Costs at Borders in the Central Asia Regional Economic Cooperation Region. *Emerging Markets Finance and Trade* 58(9): 2602–2619.

Koopman, R., Z. Wang, and S. Wei. 2014. Tracing Value-Added and Double Counting in Gross Exports. *American Economic Review* 104(2): 459–494.

Kumar, U. and B. Shepherd. 2019. Implementing the Trade Facilitation Agreement: From Global Impacts to Value Chains. Asian Development Bank Working Paper Series 67. Manila, Philippines: Asian Development Bank.

Limao, N., and A. J. Venables. 2001. Infrastructure, Geographical Disadvantage and Transport Costs. *World Bank Economic Review* 15: 451–479.

Márquez-Ramos, L., I. Martínez-Zarzoso, and C. Suárez-Burguet. 2012. Trade Policy versus Trade Facilitation: An Application Using "Good Old" OLS. Economics. *The Open-Access, Open-Assessment E-Journal* 6(11): 1–38.

Márquez-Ramos, L., I. Martínez-Zarzoso, C. Suarez-Burguet, and E. Sanjuan-Lucas. 2007. Efecto de las TIC Sobre el Comercio y el Desarrollo Económico. Análisis Para el Caso de España. *Estudios de Economía Aplicada* 25(1): 313–340.

Márquez-Ramos, L., I. Martínez-Zarzoso, E. Pérez-García, and G. Wilmsmeier. 2011. Maritime Networks, Services Structure and Maritime Trade. *Networks and Spatial Economics* 11(3): 555–576.

Martínez-Zarzoso, I. and J. Hofmann, 2007. Costes de Transporte y Conectividad en el Comercio Internacional entre la Unión Europea y Latinoamérica. *Información Comercial Española. Revista de Economía* 834: 45–60.

Martínez-Zarzoso, I. and L. Márquez-Ramos. 2008. The Effect of Trade Facilitation on Sectoral Trade. *B.E. Journal of Economic Analysis & Policy* 8(1) (Topics), Article 42.

Martínez-Zarzoso, I. and L. Márquez-Ramos. 2019. Exports and Governance: Is the Middle East and North Africa Region Different?. *The World Economy 42*(1): 143–174.

Martínez-Zarzoso, I. and S. Chelala. 2020. The Impact of Single Windows on Trade. *World Economy* 43 (10): 2549–2573.

Martínez-Zarzoso, I. and S. Chelala. 2021. Trade Agreements and International Technology Transfer. *Review of World Economics* 157: 631–665.

Nordas, E. P., E. Pinali, and N. G. Grosso. 2006. Logistics and Time as a Trade Barrier. OECD Trade Policy Working Papers 35, OECD Trade Directorate.

Persson, M. 2007. Trade Facilitation and the EU-ACP Economic Partnership Agreements: Who Has the Most to Gain? Working Papers 2007:8, Lund University, Department of Economics.

Ramasamy, B., and M. C. Yeung. 2019. China's One Belt One Road Initiative: The Impact of Trade Facilitation versus Physical Infrastructure on Exports. *The World Economy* 42(6): 1673–1694.

Rodriguez-Crespo, E., and I. Martínez-Zarzoso. 2019. The Effect of ITC on Trade: Does Product Complexity Matter? *Telematics and Informatics* 41: 182–196.

Shepherd, B. 2022. Modelling Global Value Chains: From Trade Costs to Policy Impacts. *The World Economy*, forthcoming.

Soloaga, I., J. Wilson, and A. Mejía. 2006. Moving Forward Faster: Trade Facilitation reform and Mexican Competitiveness. World Bank Policy Research Working Paper No. 3953, The World Bank.

UNCTAD. 2013. "Global Value Chains and Development: Investment and Value Added Trade in the Global Economy– a Preliminary Analysis." *Geneva: UNCTAD*.

Wang, Z., S. Wei, X. Yu, and K. Zhu. 2017. Measures of Participation in Global Value Chains and Global Business Cycles. NBER Working Paper. No. 23222. Cambridge, MA: National Bureau of Economic Research.

Wilson, J. S., C. L. Mann, and T. Otsuki, 2003. Trade Facilitation and Economic Development: A New Approach to Quantifying the Impact. *World Bank Economic Review* Oxford University Press 17(3): 367–389.

Wilmsmeier, G., I. Martínez-Zarzoso, and N. Fiess, 2011. Regional Hub Port Development: The Case of Montevideo, Uruguay. *International Journal of Shipping and Transport Logistics* 3(4): 475–493.

Wilson, J. S., C. L. Mann, and T. Otsuki. 2005. Assessing the Benefits of Trade Facilitation: A Global Perspective. *World Economy* 28(6): 841–871.

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

Xing, Y., E. Gentile, and D. Dollar. 2021. Global Value Chain Development Report 2021: Beyond Production: 1–247. Research Collection School of Economics.

Xu, J., C. Sun, and H. Jiang, 2022. Can China's Aid Promote the Value-added Exports of Recipient Countries? *Applied Economics* 1–19, forthcoming.

Yotov, Y. V., R. Piermartini, and M. Larch. 2016. *An advanced guide to trade policy analysis: The structural gravity model*. WTO iLibrary.

Zhang, Y., and I. Martínez-Zarzoso, 2022. Does New Donors' Aid Affect Gross Exports and GVC Participation Differently? *Journal of International Trade & Economic Development* 31(1): 2–22.

APPENDIX

Table A.1: Trade Facilitation Indicators

Variable	Description (short name)	Link to WTO TFA*	Group*	Subgroup*
Q1	National Trade Facilitation Committee or similar body	Section 3, Article 23: Institutional Arrangements	General	Institution
Q2	Publication of existing import-export regulations on the internet	Section 1, Article 1.2: Information Available Through Internet	General	Transparency
Q3	Stakeholders' consultation on new draft regulations (prior to their finalization)	Section 1, Article 2.2: Consultations	General	Transparency
Q4	Advance publication/notification of new trade-related regulations before their implementation	Section 1, Article 2.1: Opportunity to Comment and Information Before Entry into Force	General	Transparency
Q5	Advance ruling on tariff classification and origin of imported goods	Section 1, Article 3: Advance Rulings	General	Transparency
Q6	Risk management	Section 1, Article 7.4: Risk Management	General	Formalities
Q7	Pre-arrival processing	Section 1, Article 7.1: Pre-arrival Processing	General	Formalities
Q8	Post-clearance audits	Section 1, Article 7.5: Post-Clearance Audit	General	Formalities
Q9	Independent appeal mechanism	Section 1, Article 4: Procedures for Appeal and Review	General	Transparency
Q10	Separation of release from final determination of customs duties, taxes, fees, and charges	Section 1, Article 7.3: Separation of Release from Final Determination of Customs Duties, Taxes, Fees, and Charges	General	Formalities
Q11	Establishment and publication of average release times	Section 1, Article 7.6: Establishment and Publication of Average Release Times	General	Formalities
Q12	TF measures for authorized operators	Section 1, Article 7.7: Trade Facilitation Measures for Authorized Operators	General	Formalities
Q13	Expedited shipments	Section 1, Article 7.8: Expedited Shipments	General	Formalities
Q14	Acceptance of copies of original supporting documents required for import, export, or transit formalities	Section 1, Article 10.2: Acceptance of Copies (10.2.1)	General	Formalities
Q15	Automated Customs System	n/a	Digital	Paperless
Q16	Internet connection available to Customs and other trade control agencies	n/a	Digital	Paperless
Q17	Electronic Single Window System	Section 1, Article 10.4: Single Window	Digital	Paperless
Q18	Electronic submission of Customs declarations	n/a	Digital	Paperless
Q19	Electronic application and issuance of import and export permit	n/a	Digital	Paperless
Q20	Electronic Submission of Sea Cargo Manifests	n/a	Digital	Paperless
Q21	Electronic Submission of Air Cargo Manifests	n/a	Digital	Paperless

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Table A.1 *continued*

Variable	Description (short name)	Link to WTO TFA*	Group*	Subgroup*
Q22	Electronic application and issuance of Preferential Certificate of Origin	n/a	Digital	Paperless
Q23	E-Payment of Customs Duties and Fees	Section 1, Article 7.2: Electronic Payment	Digital	Paperless
Q24	Electronic Application for Customs Refunds	n/a	Digital	Paperless
Q25	Laws and regulations for electronic transactions	n/a	Digital	Cross-border
Q26	Recognized certification authority	n/a	Digital	Cross-border
Q27	Electronic exchange of Customs Declaration	n/a	Digital	Cross-border
Q28	Electronic exchange of Certificate of Origin	n/a	Digital	Cross-border
Q29	Electronic exchange of Sanitary and Phyto-Sanitary Certificate	n/a	Digital	Cross-border
Q30	Paperless collection of payment from a documentary letter of credit	n/a	Digital	Cross-border
Q31	National legislative framework and/or institutional arrangements for border agency cooperation	Section 1, Article 8: Border Agency Cooperation	General	Institution
Q32	Government agencies delegating border controls to Customs authorities	n/a	General	Institution
Q33	Alignment of working days and hours with neighboring countries at border crossings	Section 1, Article 8: Border Agency Cooperation (8.2(a))	General	Institution
Q34	Alignment of formalities and procedures with neighboring countries at border crossings	Section 1, Article 8: Border Agency Cooperation (8.2(b))	General	Institution
Q35	Transit facilitation agreement(s)	n/a	General	Transit
Q36	Limit the physical inspections of transit goods and use risk assessment	Section 1, Article 10.5: Pre-shipment Inspection	General	Transit
Q37	Supporting pre-arrival processing for transit facilitation	Section 1, Article 11: Freedom of Transit (11.9)	General	Transit
Q38	Cooperation among agencies of countries involved in transit	Section 1, Article 11: Freedom of Transit (11.16)	General	Transit
Q39	Trade-related information measures for SMEs	n/a	Sustainable	SMEs
Q40	SMEs in AEO scheme	n/a	Sustainable	SMEs
Q41	SMEs access Single Window	n/a	Sustainable	SMEs
Q42	SMEs in National Trade Facilitation Committee	n/a	Sustainable	SMEs
Q43	Other special measures for SMEs	n/a	Sustainable	SMEs
Q44	Testing and laboratory facilities available to meet SPS of main trading partners	n/a	Sustainable	Agriculture
Q45	National standards and accreditation bodies to facilitate compliance with SPS	n/a	Sustainable	Agriculture
Q46	Electronic application and issuance of SPS certificates	n/a	Sustainable	Agriculture
Q47	Special treatment for perishable goods	Section 1, Article 7.9: Perishable Goods	Sustainable	Agriculture
Q48	TF policy/strategy to increase women's participation in trade	n/a	Sustainable	Women
Q49	TF measures to benefit women involved in trade	n/a	Sustainable	Women

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Table A.1 *continued*

Variable	Description (short name)	Link to WTO TFA*	Group*	Subgroup*
Q50	Women membership in the National Trade Facilitation Committee or similar bodies	n/a	Sustainable	Women
Q51	Single window facilitates traders' access to finance	n/a	Others	Trade-finance
Q52	Authorities engaged in blockchain-based supply chain project covering trade finance	n/a	Others	Trade-finance
Q53	Variety of trade finance services available	n/a	Others	Trade-finance
Q54	Agency in place to manage TF in times of crises and emergencies	n/a	Others	Crisis
Q55	Online publication of emergency TF measures	n/a	Others	Crisis
Q56	Coordination among countries on emergency TF measures	n/a	Others	Crisis
Q57	Additional trade facilitation measures to facilitate trade in times of emergency	n/a	Others	Crisis
Q58	Plan in place to facilitate trade during future crises	n/a	Others	Crisis
transparency *(transp)*	Transparency (Q2–Q5, Q9) [unit: rate of implementation; 0% = no implementation, 100% = full implementation]			
Formalities (formal)	Formalities (Q6–Q8, Q10–Q14) [unit: rate of implementation; 0% = no implementation, 100% = full implementation]			
Institution (inst)	Institution (Q1, Q31 and Q32) [unit: rate of implementation; 0% = no implementation, 100% = full implementation]			
Paperless (paperless)	Paperless trade (Q15–Q19, Q21–Q24) [unit: rate of implementation; 0% = no implementation, 100% = full implementation]			
Crossborder (crossb)	Cross-border paperless trade (Q25–Q30) [unit: rate of implementation; 0% = no implementation, 100% = full implementation]			
Trade Facilitation Index (tfi)	Total trade facilitation implementation: transparency, formality, institution, paperless trade, and cross-border paperless trade [unit: rate of implementation; 0% = no implementation, 100% = full implementation]			
Transit TF (transit)	Transit (Q35–Q38) [unit: rate of implementation; 0% = no implementation, 100% = full implementation]			
TF for SMEs (smes)	Sustainable TF: Trade facilitation for SMEs (Q39–Q43) [unit: rate of implementation; 0% = no implementation, 100% = full implementation]			
Agricultural TF (agri) =	Sustainable TF: Agricultural trade facilitation (Q44–47) [unit: rate of implementation; 0% = no implementation, 100% = full implementation]			
TF for women (women)	Sustainable TF: Women in trade facilitation (Q48–Q50) [unit: rate of implementation; 0% = no implementation, 100% = full implementation]			

Note: For details, see questionnaire and methodology at https://www.untfsurvey.org/about. * (Only applicable for Q1–58.)

Source: Author's elaboration.

Table A.2: List of Countries in Subregions (Figures 1 to 5)

East Asia	South Asia	Southeast Asia	The Pacific	Central and West Asia
Mongolia	Bangladesh	Cambodia	Cook Islands	Afghanistan
People's Republic of China	Bhutan	Indonesia	Federated States of Micronesia	Armenia
	India	Lao People's Democratic Republic	Fiji	Azerbaijan
	Maldives	Myanmar	Kiribati	Georgia
	Nepal	Philippines	Marshall Islands	Kazakhstan
	Sri Lanka	Thailand	Nauru	Kyrgyz Republic
		Timor-Leste	Niue	Pakistan
		Viet Nam	Palau	Tajikistan
			Papua New Guinea	Turkmenistan
			Samoa	Uzbekistan
			Solomon Islands	
			Tonga	
			Tuvalu	
			Vanuatu	

Source: ADBI website and author's elaboration.

Table A.3: Gravity Model Estimations with Bilateral Variables for Manufactures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**TFI**	**Transp**	**Formal**	**Paperless**	**Inst**	**Transit**	**SMES**	**Agri**
tfi_exp	2.245***	1.790***	1.576***	0.979***	0.0563	0.450**	0.177	0.667***
	(0.313)	(0.202)	(0.242)	(0.231)	(0.204)	(0.195)	(0.250)	(0.239)
tfi_imp	0.237	0.253	0.487**	–0.260	0.104	0.155	–0.203	–0.0743
	(0.313)	(0.194)	(0.239)	(0.219)	(0.190)	(0.178)	(0.265)	(0.197)
lgdp_exp	0.968***	0.976***	0.980***	1.041***	1.087***	1.063***	1.109***	1.103***
	(0.0365)	(0.0353)	(0.0363)	(0.0352)	(0.0337)	(0.0377)	(0.0390)	(0.0426)
lgdp_imp	0.642***	0.641***	0.618***	0.660***	0.645***	0.624***	0.680***	0.665***
	(0.0343)	(0.0322)	(0.0346)	(0.0317)	(0.0304)	(0.0345)	(0.0357)	(0.0371)
ld	–2.033***	–2.044***	–2.029***	–2.003***	–1.990***	–1.933***	–1.912***	–1.983***
	(0.0791)	(0.0780)	(0.0792)	(0.0795)	(0.0798)	(0.0910)	(0.0964)	(0.107)
comlang_off	1.275***	1.233***	1.326***	1.374***	1.435***	1.586***	1.482***	1.353***
	(0.130)	(0.129)	(0.126)	(0.132)	(0.127)	(0.137)	(0.151)	(0.157)
comcol	–0.257	–0.202	–0.289*	–0.433**	–0.538***	–0.580***	–0.437**	0.0169
	(0.169)	(0.166)	(0.162)	(0.168)	(0.159)	(0.175)	(0.194)	(0.200)
contig	0.968***	0.950***	0.974***	0.972***	0.969***	1.029***	1.162***	1.017***
	(0.202)	(0.200)	(0.200)	(0.204)	(0.205)	(0.212)	(0.237)	(0.258)
rta	0.632***	0.637***	0.646***	0.676***	0.693***	0.760***	0.659***	0.556***
	(0.118)	(0.117)	(0.117)	(0.119)	(0.120)	(0.134)	(0.146)	(0.159)
wto_o	0.267	0.694***	0.125	0.614***	0.694***	1.090***	0.719***	0.711***
	(0.243)	(0.238)	(0.251)	(0.237)	(0.242)	(0.283)	(0.260)	(0.258)
wto_d	0.465	0.512	0.361	0.533	0.529	0.503	0.904**	0.805**
	(0.331)	(0.327)	(0.335)	(0.331)	(0.332)	(0.387)	(0.357)	(0.349)
2017.year dummy	0.0219	0.0855	0.0398	0.159**	0.180**	0.217***		
	(0.0830)	(0.0768)	(0.0789)	(0.0792)	(0.0858)	(0.0840)		
2018.year dummy	0.00268	0.0636	0.0188	0.136*	0.155*	0.139*	–0.0491	–0.0127
	(0.0772)	(0.0709)	(0.0727)	(0.0738)	(0.0803)	(0.0775)	(0.0692)	(0.0921)
2019.year dummy	–0.301***	–0.213***	–0.223***	–0.0718	–0.0153	–0.0907	–0.164**	–0.344*
	(0.0912)	(0.0753)	(0.0766)	(0.0816)	(0.0949)	(0.0833)	(0.0772)	(0.192)
2020.year dummy	–0.389***	–0.301***	–0.312***	–0.157*	–0.0988	–0.150*	–0.226***	–0.373*
	(0.0938)	(0.0784)	(0.0797)	(0.0835)	(0.0956)	(0.0858)	(0.0774)	(0.194)
2021.year dummy	–0.396***	–0.243***	–0.311***	–0.0797	0.00824	3.45e-07	–0.116	–0.154
	(0.109)	(0.0830)	(0.0878)	(0.0935)	(0.105)	(0.0878)	(0.0932)	(0.203)
Observations	6,206	6,206	6,206	6,206	6,206	4,994	4,471	3,901
Number of id	2,405	2,405	2,405	2,405	2,405	2,027	1,752	1,546

Note: Robust standard errors in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1. tfi_exp (tfi_imp) denotes trade facilitation measures of the exporter (importer) country; lgdp_exp (lgdp_imp) denotes the natural log of the gross domestic product of the exporter (importer) country; ld is the natural log of the distance between countries; *Contig* takes the value of 1 for a pair of countries sharing a border, and 0 otherwise. *Comlang_off* and *Comcol* take the value of 1 when a pair of countries share an official language or have ever had a colonial relationship, respectively, and 0 otherwise; rta takes the value of 1 when the trading countries are members of a regional trade agreement, and 0 otherwise; wto_o (_d) takes the value of 1 if country *i* (country *j)* is a WTO member.

Source: Author's elaboration.

Table A.4: Gravity Model Estimations with Bilateral Variables for Primary Products

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**TFI**	**Trans**	**Formal**	**Paperless**	**Instit**	**Transit**	**SMEs**	**Agri**
tfi_exp	2.241***	1.415***	0.636**	1.978***	0.0113	0.628***	–0.167	0.379
	(0.387)	(0.247)	(0.289)	(0.310)	(0.258)	(0.239)	(0.272)	(0.299)
tfi_imp	0.385	0.112	0.0525	0.481*	–0.599***	0.153	0.335	–0.112
	(0.362)	(0.230)	(0.271)	(0.282)	(0.232)	(0.209)	(0.259)	(0.272)
lgdp_exp	1.026***	1.055***	1.115***	1.017***	1.146***	1.133***	1.207***	1.167***
	(0.0486)	(0.0464)	(0.0468)	(0.0475)	(0.0436)	(0.0481)	(0.0495)	(0.0522)
lgdp_imp	0.591***	0.599***	0.601***	0.580***	0.600***	0.627***	0.636***	0.670***
	(0.0418)	(0.0399)	(0.0395)	(0.0417)	(0.0382)	(0.0438)	(0.0436)	(0.0454)
ld	–1.511***	–1.494***	–1.491***	–1.528***	–1.491***	–1.431***	–1.449***	–1.444***
	(0.0876)	(0.0874)	(0.0884)	(0.0873)	(0.0887)	(0.103)	(0.112)	(0.119)
comlang_off	0.743***	0.762***	0.851***	0.787***	0.930***	0.923***	0.971***	0.747***
	(0.173)	(0.174)	(0.175)	(0.167)	(0.168)	(0.182)	(0.201)	(0.209)
comcol	–0.250	–0.295	–0.459**	–0.252	–0.580***	–0.584**	–0.350	0.129
	(0.232)	(0.233)	(0.234)	(0.228)	(0.224)	(0.252)	(0.268)	(0.281)
contig	1.638***	1.636***	1.636***	1.626***	1.629***	1.765***	1.748***	1.576***
	(0.227)	(0.225)	(0.228)	(0.225)	(0.228)	(0.233)	(0.279)	(0.306)
rta	0.882***	0.910***	0.909***	0.902***	0.918***	0.914***	0.812***	0.824***
	(0.118)	(0.117)	(0.118)	(0.117)	(0.118)	(0.128)	(0.141)	(0.155)
wto_o	0.851**	1.318***	1.280***	0.494	1.328***	1.822***	1.427***	1.179***
	(0.400)	(0.395)	(0.397)	(0.409)	(0.396)	(0.462)	(0.429)	(0.421)
wto_d	0.808	0.881*	0.892*	0.723	1.001**	1.883***	0.932*	0.950*
	(0.502)	(0.499)	(0.505)	(0.498)	(0.504)	(0.689)	(0.559)	(0.539)
2017.year dummy	–0.208**	–0.0980	–0.0671	–0.202**	0.0564	–0.0222		
	(0.0838)	(0.0788)	(0.0791)	(0.0804)	(0.0819)	(0.0778)		
2018.year dummy	–0.255***	–0.148*	–0.119	–0.250***	0.00354	–0.146*	–0.0618	–0.0108
	(0.0868)	(0.0814)	(0.0837)	(0.0832)	(0.0864)	(0.0850)	(0.0706)	(0.0870)
2019.year dummy	–0.335***	–0.154*	–0.0851	–0.282***	0.127	–0.109	–0.0410	–0.0417
	(0.102)	(0.0870)	(0.0903)	(0.0874)	(0.107)	(0.0923)	(0.0871)	(0.290)
2020.year dummy	–0.331***	–0.148*	–0.0759	–0.278***	0.138	–0.0811	0.00478	0.0175
	(0.104)	(0.0870)	(0.0910)	(0.0898)	(0.108)	(0.0942)	(0.0879)	(0.289)
2021.year dummy	–0.402***	–0.133	–0.0521	–0.351***	0.235**	0.0244	0.0589	0.207
	(0.121)	(0.0933)	(0.105)	(0.103)	(0.119)	(0.0957)	(0.104)	(0.298)
Observations	5,242	5,242	5,242	5,242	5,242	4,255	3,768	3,342
Number of id	2,020	2,020	2,020	2,020	2,020	1,702	1,456	1,306

Note: Robust standard errors in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1. tfi_exp (tfi_imp) denotes trade facilitation measures of the exporter (importer) country; lgdp_exp (lgdp_imp) denotes the natural log of the gross domestic product of the exporter (importer) country; ld is the natural log of the distance between countries; *Contig* takes the value of 1 for a pair of countries sharing a border, and 0 otherwise. *Comlang_off* and *Comcol* take the value of 1 when a pair of countries share an official language or have ever had a colonial relationship, respectively, and 0 otherwise; rta takes the value of 1 when the trading countries are members of a regional trade agreement, and 0 otherwise; wto_o (_d) takes the value of 1 if country *i* (country *j)* is a WTO member.

Source: Author's elaboration.

Table A.5: Random Trend Model Estimations for GVC Participation

Dep. Var.: GVC participation	(1) TFI	(2) Transp	(3) Formal	(4) Inst	(5) Paperless	(6) Crossb	(7) Transit	(8) Agri	(9) SMES	(10) Women
Ind. Variables:										
FD.lgdppck	2.415***	2.446***	2.443***	2.787***	2.430***	2.463***	2.489***	2.734***	2.660***	2.711***
	(0.186)	(0.186)	(0.183)	(0.201)	(0.192)	(0.181)	(0.207)	(0.256)	(0.244)	(0.325)
FD.tfi	0.331**									
	(0.129)									
FD.transp		0.191*								
		(0.101)								
FD.formal			0.201*							
			(0.119)							
FD.inst				0.137**						
				(0.061)						
FD.paperless					0.215**					
					(0.097)					
FD.crossb						0.116				
						(0.083)				
FD.transit							0.017			
							(0.097)			
FD.agri								–0.080*		
								(0.045)		
FD.smes									–0.035	
									(0.091)	
FD.women										0.079
										(0.205)
Observations	364	364	364	629	364	364	317	198	210	183
R-squared	0.494	0.490	0.490	0.573	0.491	0.488	0.435	0.633	0.591	0.583
Number of iso3c	90	90	90	132	90	90	80	71	77	69

Notes: Robust standard errors in parentheses***, p < 0.01, ** p < 0.05, * p < 0.1. FD denotes variables in first differences. Country and time fixed effects included in all models; not shown to save space. Variables are described in Table A.1.

Source: Author's elaboration.

Table A.6: Cost and Time to Trade Across Borders and Trade Facilitation

Dep. Var:	(1) Costbx	(2) Timedocx	(3) Costbm	(4) Timebm	(5) Timedocm
Ind. Var:					
Ln GDP per head	0.816	–8.600	–82.839***	–40.531***	–24.065***
	(16.320)	(5.698)	(15.436)	(6.520)	(3.745)
TFI	–323.196**	–139.930***	–71.761	–3.626	–69.513***
	(126.721)	(36.424)	(65.718)	(25.567)	(19.838)
Constant	297.537***	209.366***	971.716***	453.603***	323.287***
	(85.839)	(38.125)	(131.219)	(52.902)	(32.384)
Sample Mean	120.779	58.291	51.122	158.448	73.010
Observations	359	359	359	359	359
R-squared	0.100	0.241	0.232	0.291	0.298

Note: Robust standard errors in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1. costbcx(m) = cost to export(import), border compliance (US$); timebcx(m) = time to export(import), border compliance (hours); timedocx(m) = time to export(import), documentary compliance (hours). TFI = Trade Facilitation Index.

Source: Author's elaboration.