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Bilateral Firm-level Analysis

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Bilateral Firm-level Analysis

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Abstract

We analyse the heterogeneous effects of technical regulations and safety standards embodied in non-tariff measures on foreign direct investment using global firm-level panel data of bilateral cross-border ownership relationships over the period 2008-2018. To this end, we develop a novel measure of time-varying bilateral ad valorem equivalents of sectoral non-tariff measures, which reveals that technical barriers to trade (TBTs) played a much greater role as a trade-inhibiting factor in comparison with import tariffs and sanitary and phytosanitary (SPS) measures over the period 1996-2018, with their relative importance increasing in the post-Great Recession period. Estimations using the Poisson pseudo-maximum likelihood framework reveal the importance of non-tariff measures as a driver of foreign direct investment, with heterogeneous effects observed for the measures imposed by the host and the home country, as well as across sectors and types of non-tariff measures. Among other results, we find that an increase in the stringency of technical barriers to trade imposed by the host country is associated with higher investment in the foreign subsidiaries operating in this country, pointing to the regulatory barrier-jumping motive of foreign direct investment. The effect is much stronger for the multinational corporations operating in the information and communications technology sector.

Keywords: FDI; non-tariff measures; ad-valorem equivalent of NTMs, TBT; SPS measures; ICT

JEL classification: F13, F14

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1. Introduction

Foreign direct investment (FDI) has been critically important for organising cross-border production activities by multinational enterprises (MNEs). Currently, most sectors are dominated by a relatively small number of large MNEs that establish global networks of subsidiaries via which trade, investment and production activities are distributed. The literature on the drivers of FDI typically distinguishes two major categories: (i) horizontal FDI, motivated by market-seeking objectives of MNEs, i.e. better access to the final goods market of the host economy or markets in its proximity (Markusen, 1984); (ii) vertical FDI, motivated by the efficiency-seeking motives of MNEs, i.e. the desire to improve the efficiency of the production process by taking advantage of location advantages (access to skilled labour, lower labour costs, relevant capital and infrastructure, natural resources and other sources of competitive advantage (Helpman, 1984). Although to some extent overlapping with these major motives, some scholars also distinguish additional modes of FDI, including (iii) 'export-platform' FDI that MNEs use to supply goods to third markets rather than the home or the host economies (see Ekholm et al., 2007); (iv) 'tariff-jumping' FDI that is used by MNEs to gain access to the host market as an alternative to more costly exports when import tariff protection is high, i.e. to 'jump over' the tariff barrier (Blonigen et al., 2004); and (v) 'resource-seeking' FDI that seeks to gain access to locally sourced inputs at a lower cost, while output is exported to other countries (see also Dunning, 1993 and 1998, distinguishing among these inputs physical resources, labour, technological capacity and intangible capital). Along these lines, from a firm-level perspective, such firm-specific competitive advantages of subsidiaries as intangible assets, utilisation of unique technologies, patents, branding, organisational capital, established marketing and promotion infrastructure in the host economy, are seen as drivers of FDI (Carr et al., 2001; Dunning, 1993).

Among the factors that serve as barriers to FDI, besides regulatory restrictions on foreign ownership and economic activities of foreign-owned firms (Mistura and Roulet, 2019), are also political resistance associated with the fears of increased competition that MNEs generate for domestic firms, and the acquisition of promising national companies ('national champions') or those of strategic importance (e.g. those dealing with sensitive technologies and infrastructure) by foreign-owned companies (World Economic Forum, 2013). The role of business taxation, public research and development expenditure, information and communications technology (ICT) infrastructure and labour costs as locational factors of FDI are examined in Bellak et al. (2010). The importance of productivity and taxation for FDI flows has been studied in Razin and Sadka (2007).

Conceptually, our analysis is closely related to the literature on the trade-investment choice by heterogeneous firms, as in Melitz (2003). In this theoretical framework, the decisions by MNEs as to FDI and trade in goods are interdependent and linked to the industrial structure, productivity heterogeneity and the relative costs of engaging in FDI rather than exports of goods. In our case, besides other relevant factors, the de facto intensity of non-tariff measures (NTMs) – country- and sector-specific – can be viewed as the additional relative cost variable altering the choice by global ultimate owners (GUOs) of investment versus trade. The impacts of trade costs on FDI were also addressed in Brenton and Di Mauro (1999), Egger and Pfaffermayr (2004), Frenkel et al. (2004), Head and Ries (2008).

In this respect, important factors that determine the locational choice and the intensity of investment in a particular subsidiary by a parent company are associated with the regulatory environment of both the host country and the home country, and are also sector-specific. The differences in the technical standards or technical barriers to trade (TBTs) and sanitary and phytosanitary (SPS) measures – jointly referred to as NTMs – potentially have non-trivial implications for the economic activities of MNEs. For instance, Ghodsi (2020) finds that trade-restrictive TBTs imposed by the host economy, on which a specific trade concern was raised by the home economy induce an increase in inward FDI stocks in the host economy. However, regular TBTs imposed by the host economy do not seem to have any impact on the stock of FDI, while regular TBTs imposed by the home economy may reduce the stock of FDI in the host economy.

Cross-country differences in technical standards inhibit exports of products that are not aligned with the standards of the importing country.[1] Furthermore, NTM regulations constitute an additional cost faced by producers, which is transferred to the cost of the final product directly or via intermediate supply-use linkages along global value chains. Meanwhile, implementation of technical standards enforces the quality of products and their compliance with environmental standards, which is a generally positive effect and may stimulate demand for the product. Given the important role that NTMs play in production, one may conjecture that the intensity of NTMs is among the factors that impact the decisions of MNEs as to in which country and sector to allocate certain tasks along its value-added chain. This, in turn, is associated with investment decisions as to whether to establish a subsidiary as a greenfield investment or via an acquisition of an existing company.

As NTMs constitute various regulations that are not directly comparable with one another, the literature has struggled to properly measure them. The earlier approach of using the count of NTMs adopted in the earlier empirical literature understandably was overly simplistic and only roughly conveyed their intensity, but the more recent literature has developed techniques to arrive at a continuous measure of NTMs by computing their import tariff equivalents – ad valorem equivalents (AVEs). Among the first works on this matter, Kee et al. (2009) developed a framework for estimating AVEs of NTMs using cross-sectional trade data at the detailed sectoral level – the six-digit level of the Harmonised System (HS). The approach was further extended in Beghin et al. (2015), Bratt (2017) and Niu et al. (2018), which incorporated also the notion of negative AVEs, implying that NTMs can have a positive effect on trade. However, these techniques did not allow for the heterogeneity of the NTMs' effects and thus their AVEs simultaneously across sectoral, time and bilateral trading partner dimensions, as well as distinguishing the type of NTMs, most importantly TBTs and SPS measures.

In this paper, we fill this gap and contribute to the literature along several dimensions. First, we estimate bilateral time-varying AVEs of NTMs at the six-digit level of the HS of product classification. The bilateral (country-sector pairs) approach allows for the proper accounting of heterogeneous effects of NTMs across trading partners of a given importer, while the computation of AVEs allows for a more precise and straightforward interpretation of the impact of NTMs for each country and sector, in contrast to an NTM count variable, thereby improving upon the previous literature. Second, as an empirical application of the devised measure, we quantify the impact of NTMs on FDI at the firm level. In this respect, thematically the paper bridges the two distinct strands of literature discussed above – the body of research that focuses on the estimation of the AVEs of NTMs and the literature on the drivers of FDI. Our empirical strategy takes

1 More generally, the product-specific impact of NTMs on trade has been studied in Beghin et al., 2015; Bratt, 2017; Cadot and Gourdon, 2016; Ghodsi, 2016; Niu et al., 2018.

advantage of bilateral firm-level data tracing the ultimate ownership relationships between parent MNEs and their subsidiaries, thereby addressing also the aggregation bias, which could be especially relevant in this context, given that the world economy nowadays is dominated by a relatively small number of large MNEs in each sector. Third, in addition to the assessment of manufacturing firms in general, as an additional empirical exercise we focus specifically on MNEs in the ICT sector. This sector has become a critical driver of the world economy and relies heavily on cross-border production sharing, with an extensive use of FDI to gain efficiency at a global scale. Therefore, identification of the drivers that foster FDI in the ICT sector has become an important topic of economic research. Finally, our analysis takes a global scope as regards country coverage (data permitting), and spans the recent post-Great Recession period (2008-2018), which may shed light on the drivers of cross-border ownership in the manufacturing sector in general and, more specifically, in the ICT sector in the 'new normal'.

The estimation of AVEs of NTMs reveals that over the period 1996-2018, and taking into account all countries and all HS six-digit level products, TBTs played a much greater role as a trade-inhibiting factor in comparison with import tariffs and SPS measures, with the relative importance increasing in the post-Great Recession period. On a trade-weighted average basis, AVEs of TBTs over this period tend to fall into a range of 6-16%, while AVEs of SPS measures fluctuate in a 0-6% range and import tariffs gradually decline from 7% to 3%.

We then use the Orbis database to construct a firm-level bilateral panel dataset of foreign ownership relationships between the holding companies – GUOs – and their subsidiaries, and the firm-level characteristics, including the value of capital, firm size and productivity. The country and the reported primary sector of activity of both firms in each pair linked by the ownership relationship is also used as the basis for relating the country-sector bilateral trade flows and thus the associated NTMs for both the host and the home countries and the sector. As mentioned above, we estimate bilateral time-varying AVEs of NTMs and analyse whether the stringency of NTMs imposed by the home country and the host country affect the capital of a foreign subsidiary of MNEs, which is used as a proxy for FDI intensity.[2] First, we analyse the drivers of FDI for the full sample that includes all manufacturing firms using Poisson pseudo-maximum likelihood (PPML) estimations. Then, we focus on the sample of ICT firms (more precisely, the ICT GUO firms, as MNEs in the ICT sector have subsidiaries in many sectors other than ICT).

The estimates confirm the belief that NTMs constitute an important driver of FDI, as well as pointing to rather heterogeneous effects observed for the measures imposed by the host and the home country, across sectors and the types of non-tariff measures (AVEs of TBTs and SPS measures). Notably, we find that an increase in the stringency of TBTs, as measured by their AVEs, imposed by the *host* country is associated with higher investment in the subsidiaries operating in this country, pointing to the regulatory barrier-jumping motive of FDI in line with the literature. The effect is much stronger for MNEs operating in the ICT sector. The magnitudes of the effect are also non-trivial: the estimates imply that a 1% increase in the import tariff equivalent of TBTs imposed by the host country against the imports from the home country is associated with an increase in the total assets of a foreign subsidiary by up to 0.33% in the case of the full manufacturing sample and by up to 0.76% in the case of the ICT sector – more than twice as much as for the manufacturing sector. The results thus show a much higher relevance of the regulatory barrier-jumping motive for the ICT sector associated with the horizontal FDI.

2 As a robustness check, alternative specifications use total fixed assets as the dependent variable instead of total assets.

In addition, in contrast to the full manufacturing sample, the results suggest a greater relevance of safety standards for FDI in the ICT sector, as captured by the AVEs of SPS measures.

Although not the main focus of the study, the results also indicate the important differences in the role of firm size and productivity in shaping FDI in the ICT sector, with the effect contingent upon the degree of ownership (we distinguish between majority ownership and full ownership): for instance – in contrast to the all-manufacturing sample – in the case of full ownership by ICT, the size and the productivity of the *subsidiary* have a positive and a statistically significant effect on its capital.

The rest of the paper is structured as follows. Section 2 introduces the bilateral AVEs of NTMs measure, and discusses the methodology behind and the key properties of the data. Section 3 discusses the sample and the data, incorporating the newly developed measure of NTMs. Section 4 reports the results of the econometric analysis focusing on bilateral firm-level FDI drivers. Section 5 presents our conclusions.

2. Estimation of bilateral sectoral time-varying ad valorem equivalents of NTMs

As discussed above, the first stage of the methodology deals with the estimation of bilateral annual AVEs of NTMs for all goods at the six-digit level of the HS classification traded bilaterally across the globe during the period 1996-2018. The methodology is based on the seminal approach by Kee et al. (2008, 2009), which estimated the unilateral AVEs of NTMs for a cross-section of unilateral import data. Our approach, however, extends the framework to allow the estimation of time-varying bilateral AVEs of NTMs. In the first step of our three-step framework, bilateral import demand elasticities for each six-digit product are estimated. The difference from the approach taken by Kee et al. (2008) is that they estimated price-demand elasticity of a product imported from the *world*, while in this methodology, price-demand elasticity of a product imported from a *single exporter* is estimated. In the second step, the impact of two types of NTMs – TBTs and SPS measures – on the quantity of trade is estimated for each six-digit product in each year. Then, in the third step, using the bilateral import demand elasticities estimated in the first step and the estimated impact of NTMs for each product in each year from the second step, we can calculate the annual bilateral AVEs of each type of NTM. Using a Heckman (1979) procedure that was theoretically developed in Helpman et al. (2008) for international trade, and econometrically implemented in Semykina and Wooldridge (2010), zero trade flows and the endogeneity bias are controlled for in both steps – elaborated in more detail in the subsections below.

2.1. DATA

The data cover global bilateral traded goods at the HS six-digit level during the period 1996-2018. Trade data are obtained from the UN COMTRADE provided by the World Integrated Trade Solution (WITS). The data on the stocks of NTMs are collected from the WTO I-TIP notifications database and improved by finding missing HS codes for some of the notifications following the methodology by Ghodsi et al. (2017). The data on import tariffs are from TRAINS and the WTO IDB provided by WITS. Country-level variables such as GDP and GDP deflator are obtained from the World Development Indicators of the World Bank. The data on human capital are from the Penn World Table (PWT, 10.0) provided by Feenstra et al. (2015).

2.2. BILATERAL IMPORT DEMAND ELASTICITIES

Calculating tariff equivalents or AVEs of NTMs in the third step of the outlined framework requires an estimate of import demand elasticities, measuring how much (in percentage terms) the quantity of imports changes when the import price changes by 1%. Such import demand elasticity was estimated by Kee et al. (2008), applying a semi-flexible function of GDP (Diewert and Wales, 1988) and using unilateral import data for the period 1988-2002. Applying a similar methodology and using bilateral import data, this paper updates the estimated import demand elasticities for the period 1996-2018, as well as adding a bilateral dimension. Following the theoretical framework provided by Kee et al. (2008), the equilibrium share of product h in the GDP of country i that is imported from country j in year t is a function of factor endowments in both countries, and the ratio of price of the imported product relative to the price of all other products in the GDP of the importing country. In this paper, country-level variables such as factor endowments are controlled for using country-time fixed effects. The following equation is estimated:

$$s_{ijht}(p_{ijht}, p_{ijh't}) = \alpha_{0h} + a_j \alpha_{h0} \ln \frac{p_{ijht}}{p_{ijh't}} + \alpha_{0ijh} + \alpha_{0iht} + \alpha_{0jht} + u_{0ijht}$$
$$\forall h = 1, \ldots H, \forall i = 1, \ldots, I, \forall j = 1, \ldots, J, \quad s_{ijht}(p_{ijht}, p_{ijh't}) = \frac{v_{ijht}}{Y_{it}} \qquad (1)$$

where $s_{ijht}(p_{ijht}, p_{ijh't})$ is the share of imported product h in the GDP of importing country i that is imported from country j in year t; p_{ijht} is the price of the imported product; $p_{ijh't}$ is the Törnqvist price index (Caves et al., 1982) of all other goods constructed using the GDP deflator p_{it} of country i at time t, calculated as $\ln p_{ijh\prime t} = {(\ln p_{it} - \bar{s}_{ijht} \ln p_{ijht})}/{(1 - \bar{s}_{ijht})}$ where $\bar{s}_{ijht} = {(s_{ijht} + s_{ijh,t-1})}/{2}$; a_j is a dummy variable for exporting country j that is interacted with the price index to give differentiated effects of price on the share of imports to GDP by exporters. The intuition behind this comes from the fact that Kee et al. (2008) estimated this equation using the unilateral import data, and hence a single coefficient was estimated for total world imports. However, in our case the estimation considers multiple exporting countries instead of the world total. Therefore, equation (1) can be estimated for each exporting country separately. However, to achieve robust results with a reasonable degree of freedom and using all the available information in one estimation, the exporting dummies are interacted with the price index. Therefore, following the gravity literature (Anderson and van Wincoop, 2003; Head and Mayer, 2014), importer-product-time α_{0iht}, exporter-product-time α_{0jht}, and bilateral product fixed effect α_{0ijh} are included to control for multilateral resistance and possible endogeneity due to the omitted variable bias. As estimation of the full matrix of all HS six-digit products traded bilaterally is not feasible, equation (1) is estimated for each product separately. Therefore, these fixed effects also control for factor endowments at the country level, and all other time-invariant relations between the two trading partners.

2.3. CONTROLLING FOR THE ENDOGENEITY BIAS AND ZERO TRADE FLOWS

However, estimating demand on price gives biased results, owing to reverse causality and measurement errors. As supply is an upward sloping function of price with respect to quantity, an increase in imported quantity might be reflected in a higher price. Therefore, to control for the endogeneity bias, an instrumental variable (IV) approach is used, following Semykina and Wooldridge (2010) and Kee et al. (2008). In fact, three exogenous instruments are used to estimate the price index $\ln \frac{p_{ijht}}{p_{ijh't}}$. And then, the fitted value of this index is used to estimate $a_j \alpha_h$. Simple and distance-weighted averages of the world price index are two of the three instruments that are borrowed from Kee et al. (2008). Furthermore, as the third instrument, the world average price of imports of all HS six-digit products within the four-digit sector (other than the price of the imported product for which the estimation is performed) is used. The calculation of these three instruments is presented in Appendix B.

As widely discussed in the literature, the omission of zero trade flows from the estimation leads to biased results (Santos Silva and Tenreyro, 2006; Head and Mayer, 2014). PPML or negative binomial distribution maximum likelihood (NBDML) estimators are usually used to control for zero trade flows in the dependent variable. However, each incidence of a zero trade flow is also associated with the 'zero' price for that product, thereby further complicating technically our estimation relying on import price variables. Therefore, to control for zero trade flows, and following Kee et al. (2008), the two-stage Heckman (1979) procedure is used. More specifically, along these lines, the probability of positive exports $Pr(v_{ijht} > 0)$ of good h imported in country i from country j in year t, or the extensive margin of trade, is estimated using a probit model following Helpman et al. (2008). Furthermore, following Semykina and Wooldridge (2010), the multilateral resistance and the fixed effects terms in equation (1) should be modelled in the probit regressions as a linear function of exogenous instruments that are averaged by country-product-year, and bilateral-product combinations. However, using the averages of all exogenous instruments in one regression invokes multicollinearity issues, and thus only one of the exogenous instruments is averaged by importer-product-year, exporter-product-year, and bilateral product and other exogenous instruments are included without taking their averages. The probit model is estimated as follows:

$$\begin{aligned}\rho_{ijht} &= Pr(v_{ijht} > 0) \\ &= \alpha_{1h} + \alpha_{1hG} X_{ij}^{G} + \alpha_{1h1}\bar{z}_{ijht} + \alpha_{1h2}\bar{\tilde{z}}_{ijht} + \alpha_{1h3}\bar{p}_{ijh_4t} + \alpha_{1h4}\bar{\bar{p}}_{jht} + \alpha_{1h5}\bar{\bar{p}}_{iht} \\ &+ \alpha_{1h7}\bar{\bar{p}}_{ijh} + u_{1ijht}\,, \\ &\forall h = 1, \ldots H, \forall i = 1, \ldots, I, \forall j = 1, \ldots, J\end{aligned} \tag{2}$$

where ρ_{ijht} is the probability of exporting product h from country j to country i in year t; X_{ij}^{G} includes a set of time-invariant gravity variables such as logarithm of distance between the two trading partners, colonial history, common language, contiguity and having been the same country historically; $\bar{z}_{ijht}$ is the simple average world price index as defined in equation (A1) in Appendix B; $\bar{\tilde{z}}_{ijht}$ is the distance-weighted average world price index as defined in equation (A2); $\bar{p}_{ijh_4t}$ is the world average price of imports of all HS six-digit level goods h within the four-digit sector H_4 other than the imported price under question as defined in equation (A3); $\bar{\bar{p}}_{jht}$, $\bar{\bar{p}}_{iht}$, and $\bar{\bar{p}}_{ijh}$ are respectively the importer-year, exporter-year, and bilateral averages of $\bar{p}_{ijh_4t}$ as defined in equation (A4); u_{1ijht} is the error term. After estimating equation (2) for each product separately, the inverse Mills ratio (IMR) is calculated as the ratio of the probability density function to the cumulative distribution function: $\hat{\tilde{\eta}}_{ijht}^{*} = \varphi(\hat{z}_{ijht}^{*})/\Phi(\hat{z}_{ijht}^{*})$, where $\hat{z}_{ijht}^{*} = \Phi^{-1}(\hat{\rho}_{ijht}^{*})$ is the probability of exports. Then, the IMR is used in the estimation of the price index, using the exogenous instruments as follows:

$$\begin{aligned}\ln\frac{p_{ijht}}{p_{ijh't}} &= \alpha_{2h} + \alpha_{2h1}\bar{z}_{ijht} + \alpha_{2h2}\bar{\tilde{z}}_{ijht} + \alpha_{2h3}\bar{p}_{ijh_4t} + \alpha_{2h4}\hat{\tilde{\eta}}_{ijht}^{*} + \alpha_{2ijh} + \alpha_{2iht} + \alpha_{2jht} + u_{2ijht}\,, \\ &\forall h = 1, \ldots H, \forall i = 1, \ldots, I, \forall j = 1, \ldots, J\end{aligned} \tag{3}$$

while owing to the reverse causality of the price index $\ln\frac{p_{ijht}}{p_{ijh't}}$ and import share s_{ijht} in equation (1), price index was correlated with the error term $E\left(\ln\frac{p_{ijht}}{p_{ijh't}}\, u_{0ijht}\right) \neq 0$, and the exogenous instruments in equation (3) are no longer caused by the import share. Therefore, the fitted value of the price index $\ln\frac{\widehat{p_{ijht}}}{p_{ijh't}}$ and the IMR retrieved from equation (2) could be used in the estimation of import share as follows:

$$s_{ijht}(p_{ijht}, p_{ijh't}) = \alpha_{3h} + a_j \alpha_{3h} \ln \frac{\widehat{p_{ijht}}}{p_{ijh't}} + \alpha_{3h1}\hat{\hat{\eta}}^*_{ijht} + \alpha_{3ijh} + \alpha_{3iht} + \alpha_{3jht} + u_{3ijht} \tag{4}$$

$$\forall h = 1, \dots H, \forall i = 1, \dots, I, \forall j = 1, \dots, J$$

According to the Sargan test statistics, $E\left(\ln \frac{\widehat{p_{ijht}}}{p_{ijh't}} u_{3ijht}\right) = 0$; and equation (4) and (3) could be simultaneously estimated using the generalised method of moments (GMM). However, as the fitted value of the price index is interacted with the exporter dummies to give exporter-specific import demand elasticities, running the simultaneous GMM is not feasible. Therefore, these stages are estimated separately, and the standard errors are clustered by bilateral pairs to give robust results.[3]

Following Kee et al. (2008), after maximising the demand in the semiflexible GDP function, one can calculate the bilateral import demand elasticity ε_{ijh} as follows:

$$\varepsilon_{ijh} \equiv \frac{\partial q_{ijht}(p_{tijh})}{\partial p_{ijht}} \frac{p_{ijht}}{q_{ijht}} = \frac{a_j a_{3h}}{\bar{s}_{ijW}} + \overline{s_{ijh}} - 1, \overline{s_{ijh}} < 0, \varepsilon_{ijh} \begin{cases} < -1 \ if \ a_j a_{3h} > 0 \\ = \bar{s}_{ijW} - 1 \ if \ a_j a_{3h} = 0, i \neq j \\ > -1 \ if \ a_j a_{3h} < 0 \end{cases} \tag{5}$$

where $\overline{s_{ijh}}$ is the period-averaged share of product h imports to country i from country j to the GDP of the importing country i. When the coefficient $a_j a_{3h}$ is not statistically significant at 10% level, it is replaced with zero, and the bilateral import demand elasticity becomes $\overline{s_{ijh}}$-1, which is slightly smaller than -1, as the imports share is negative in the construction of GDP.

2.4. AVES FOR NTMS

To calculate the annual bilateral AVEs for the two types of regulative NTMs, namely TBTs and SPS measures, the impact of NTMs on the bilateral imported quantity for each year t and each product h at the six-digit level of the HS is estimated using the gravity model of trade framework. This approach is based on the seminal approach by Kee et al. (2009), that was developed further to include both negative and positive impact of NTMs by Beghin et al. (2015), Ghodsi et al. (2016), Bratt (2017) and Niu et al. (2018). Then, using the bilateral import demand elasticity that varies across bilateral products ijh, a single coefficient obtained from the gravity framework estimated for each year t and each product h can be used to derive the bilateral annual AVE. The gravity equation to be estimated for each year t and each product h separately is as follows:

$$q_{ijht} = exp^{[\beta_{0ht} + \beta_{0ht1} \ln(1+T_{ijht}) + \sum_n \beta_{n,0ht2} NTM_{n,ijht} + \beta_{0ht3} X_{it} + \beta_{0ht4} X_{jt} + \beta_{0ht5} G_{ij} + \beta_{0ht6} W_{ijt}]} \mu_{oijt}, \tag{6}$$
$$\forall h \in HS, \forall t \in \{1, \dots, T\}, \forall i, j \in \{1, \dots i, \dots j, \dots, I\}, n \in \{TBT, SPS\}$$

where q_{ijht} is the quantity of product h imported from country j to country i in year t; $\ln(1 + T_{ijht})$ is the log of tariffs in percentages, and they are added to one because they may equal zero for some bilateral trade flows; $NTM_{n,ijht}$ is the stock number of NTMs of type n which is either TBTs or SPS measures imposed by the importing country i in force in year t on the import of product h from the exporting

[3] It is important to note that best practice would be to bootstrap the standard errors in the second stage of estimating equation (4). However, it is not feasible to use bootstrapped standard errors when multiple fixed effects are included in the regression.

country j; X_{it} includes the nominal GDP as an indicator of the size of the economy and real GDP per capita as an indicator of the level of development of the importing country; X_{jt} includes GDP and GDP per capita of the exporting country; G_{ij} includes the traditional time-invariant gravity variables that comprise geographical distance between the two trading partners, colonial history, common language, contiguity and having been the same country historically, W_{ijt} includes a dummy variable indicating whether the two trading partners are both members of the World Trade Organisation (WTO) in that year, respectively; ϑ_{ijt} is the error term.

Following the strand of the literature on gravity frameworks (Santos Silva and Tenreyro, 2006; Head and Mayer, 2014), dropping zero trade flows after taking the log of the dependent variable leads to the estimation bias. In particular, when an NTM becomes sufficiently restrictive that it impedes the bilateral trade flow completely, the zero trade flow should be taken into account in the estimation to give an unbiased result. Therefore, the PPML estimation approach developed by Santos Silva and Tenreyro (2006) and Correia et al. (2019a, b) is used to estimate the gravity model, which addresses the zero trade flow issue, as well as controls for the heteroscedasticity of the error term.

The main variable of interest is $NTM_{n,ijht}$, and the main coefficient of interest for the AVE of each NTM type n is $\beta_{n,0ht2}$. The estimation of traded quantity against NTMs may suffer from the endogeneity bias due to reverse causality, and the measurement error.[4] To control for the endogeneity bias, the IV approach is used in the literature (Kee et al., 2009; Bratt, 2017; Niu et al., 2018; Ghodsi, 2019). Log of exports $\ln q_{jiht}$ [5] of product h from country i to country j in year t, and the past growth of imported quantity in the previous period $\Delta \ln q_{ijht-1} = \ln q_{ijht} - \ln q_{ijht-1}$ are the two exogenous variables that would control for the reverse causality bias. For the measurement bias, the literature (Kee et al., 2009; Kee and Nicita, 2016; Bratt, 2017; Niu et al., 2018) is usually using an indicator of NTMs imposed by the three or the five closest countries, which is usually weighted by the GDP of those countries. However, imposition of NTMs could be also affected by distant countries. For instance, Chinese TBTs may be very much affected by the NTMs imposed by the advanced countries situated very far from China. One major reason is that advanced countries have heavily invested in China and their value chains require similar standard and regulative settings between them and China. Therefore, similar to Ghodsi (2019), average NTMs imposed globally on that product by all countries other than the importer i is used as the third exogenous variable. As price (unit value) of the imported product could indicate the quality and the cost impact of the regulative NTM, unit value is used as a weight to construct this IV $\overline{NTM}_{iwht}^{p}$, as shown in equation A5 in Appendix B.

Using these three exogenous instruments and other explanatory variables in equation (6), the first-stage equation is run by PPML for each of the NTM type n as follows:

$$NTM_{n,ijht} = exp^{\left[\beta_{1ht}+\beta_{1ht1}\ln(1+T_{ijht}) + \beta_{n',1ht2}NTM_{n',ijht}+\beta_{1ht3}X_{it}+\beta_{1ht4}X_{jt}+\beta_{1ht5}G_{ij}+\beta_{1ht6}W_{ijt}+\beta_{1ht7}\ln q_{jiht}+\beta_{1ht8}\Delta\ln q_{ijht-1}+\beta_{1ht9}\overline{NTM}_{iwht}^{p}\right]}\mu_{1i}$$

$$\forall h \in HS, \forall t \in \{1, \dots, T\}, \forall i, j \in \{1, \dots i, \dots j, \dots, I\};\ n, n' \in \{TBT, SPS\}, n \neq n' \quad (7)$$

4 For further discussion on the sources of endogeneity, see Ghodsi (2019).

5 As there are zero trade values in exports and imports quantities, hyperbolic sine transformation of these traded values is used instead of the natural logarithm, which yields asymptotic marginal effects as in natural logarithm (Bellemare and Wichman, 2020).

In each case, when estimating NTM of type n as the dependent variable in equation (7), the other NTM type n' is used as a control variable. The fitted values $\widehat{NTM_{n,ijht}}$ are obtained from these estimations and used in the gravity equation below:

$$q_{ijht} = exp^{[\beta_{2ht}+\beta_{2ht1}\ln(1+T_{ijht}) + \sum_n \beta_{n,2ht2}\widehat{NTM_{n,ijht}}+\beta_{2ht3}X_{it}+\beta_{2ht4}X_{jt}+\beta_{2ht5}G_{ij}+\beta_{2ht6}W_{ijt}]}\mu_{2ijt}, \quad (8)$$
$$\forall h \in HS, \forall t \in \{1, \dots, T\}, \forall i,j \in \{1, \dots i, \dots j, \dots, I\}, n \in \{TBT, SPS\}$$

According to the Sargan test statistics, $E(\widehat{NTM_{n,ijht}}\ \mu_{2ijt}) = 0$. The augmented Durbin-Wu-Hausman test proposed by Davidson and MacKinnon (1993) is used to test the inconsistency of estimating equation (6) without the IV PPML approach. Furthermore, the exogeneity of instruments is additionally tested using the Anderson-Rubin test (Anderson and Rubin, 1949). These test results are available upon request.

The estimations are based on all bilateral traded goods in the global economy during the period 1996-2018. On account of mutual recognition and harmonisation of standards and regulations within the EU single market, intra-EU trade is excluded from these gravity regressions, and the AVEs of NTMs for intra-EU trade are considered to be zero.

2.5. ANNUAL BILATERAL AVES

After estimating the bilateral traded quantity in equation (8) by each product h for each year t separately, the marginal effect of each NTM type n on traded quantity, $\frac{\partial \ln(q_{ijht})}{\partial NTM_{n,ijht}}$, is converted to the ad valorem equivalent (price-based) $AVE_{n,ijht}$ of NTM type n applying the bilateral import demand elasticities ε_{ijh}. The marginal effect is simply the derivative of the traded quantity with respect to the NTM type n when the coefficient $\beta_{n,2ht2}$ is statistically significant at the 10% level (otherwise, it is considered to be zero). Then, the annual bilateral AVE of NTM type n is calculated as follows:

$$AVE_{n,ijht} = \frac{1}{\varepsilon_{ijh}}\frac{\partial \ln(q_{ijht})}{\partial NTM_{n,ijht}} = \frac{e^{\beta_{n,2ht2}} - 1}{\varepsilon_{ijh}} \times 100, n \in \{TBT, SPS\}, i \neq j, \quad (9)$$
$$\forall h \in HS, \forall t \in \{1, \dots, T\}, \forall i,j \in \{1, \dots i, \dots j, \dots, I\}, n \in \{TBT, SPS\}$$

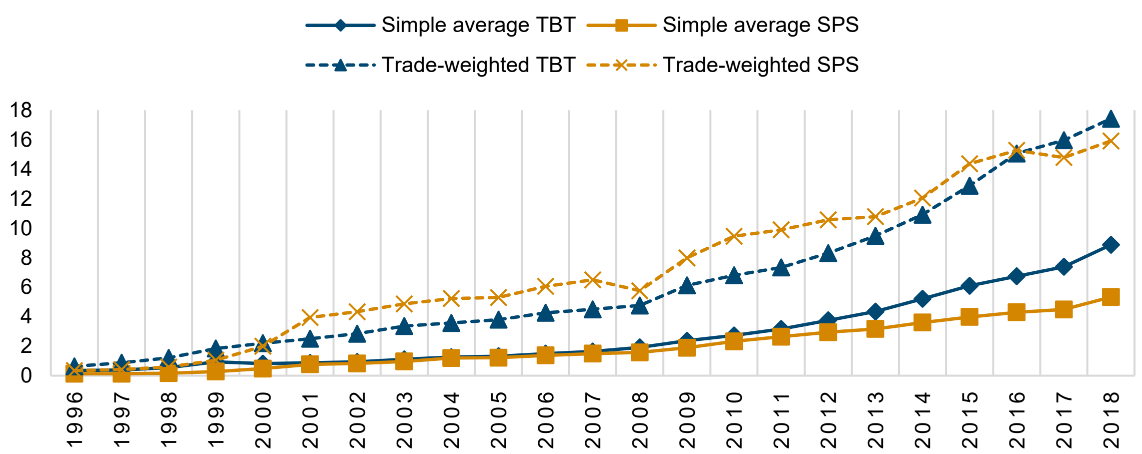
We truncate the resulting AVEs at the extreme values of the distribution (values below -100 at the low end and above 10,000 at the top end of the distribution). This has only a marginal impact on the data as the truncated observations amount to less than 1% of all estimated AVEs.[6] The bottom -100 is chosen as a trade-promoting NTM that acts as a subsidy instead of a tariff can reduce the price of the imported good by only 100%. The 10,000+ value is chosen in order to have a comparable number of observations truncated from each side.

6 This is a common practice in the literature. In our case, the threshold level is less restrictive in comparison with the literature. For instance, Bratt (2017) removes about 2% of the estimated AVEs: 1% from the top and 1% from the bottom of the distribution.

2.6. REVIEW OF THE BILATERAL AVE ESTIMATES AND THEIR KEY PROPERTIES

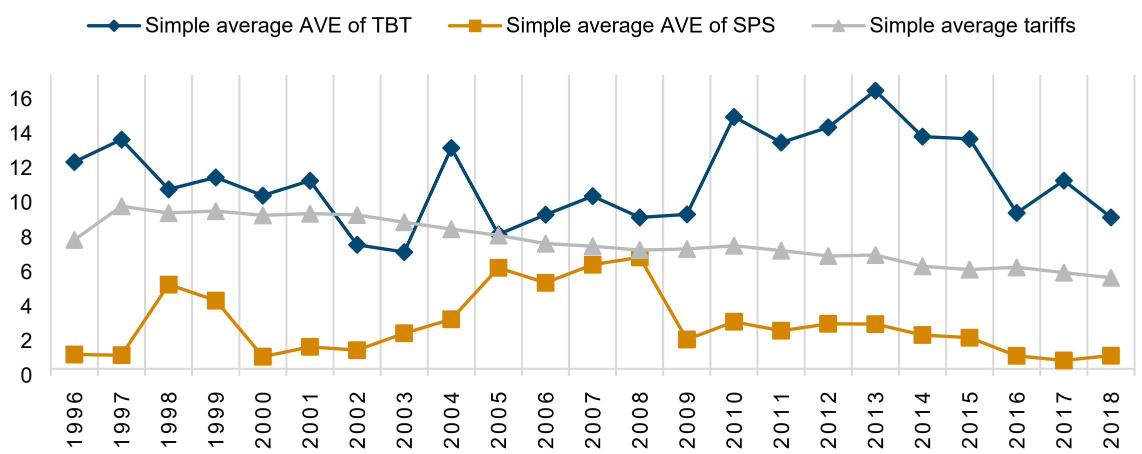
Figure 1 shows the dynamics of the *number* of NTMs of both types (TBTs and SPS measures) imposed on HS six-digit products globally during the period 1996-2018. As can be seen, the simple average number of TBTs imposed on traded products increased notably from 0.35 in 1996 to 8.9 in 2018. Moreover, the trade-weighted average number of TBTs over the same period increased from 0.6 to 17.4. The difference between the weighted and unweighted averages indicates that the products with higher values of trade have been targeted by more TBTs than the products with lower trade values. One can find a similar pattern for SPS measures: the trade-weighted average number of SPS measures is about three times higher than the simple average over the same period.

Figure 1 / Average number of TBTs and SPS measures imposed on HS six-digit products during 1996-2018



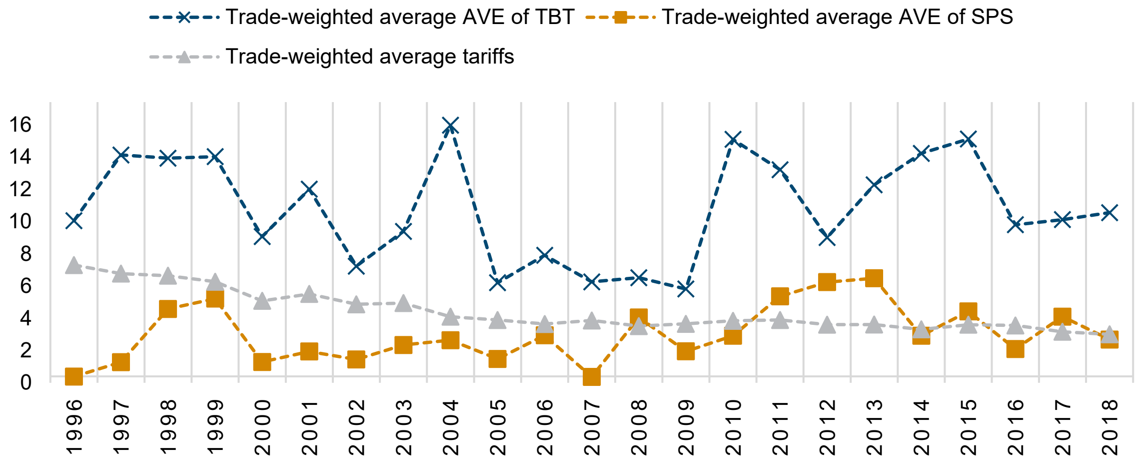
Sources: WTO I-TIP; authors' collection.

Figure 2 / Simple average of tariffs, AVEs of TBT and SPS measures imposed on HS six-digit products during 1996-2018



Sources: WTO I-TIP TRAINS and the WTO IDB provided by WITS; authors' collection and estimations.

Figure 3 / Trade-weighted average of tariffs, AVEs of TBT and SPS measures imposed on HS six-digit products during 1996-2018



Sources: WTO I-TIP, TRAINS and the WTO IDB provided by WITS; and authors' collection and estimations.

Figure 2 shows the global simple average of import tariffs and AVEs of TBT and SPS measures estimated following the methodology discussed above in 1996-2018. While import tariffs have been gradually decreasing during this period owing to WTO commitments and preferential trade agreements, the impact of NTMs as measured by AVEs (and thus comparable to the import tariff dynamics) exhibits a more volatile dynamic. Notably, throughout the entire period the revealed trade restrictiveness of TBTs is much larger than that of import tariffs and SPS measures, and continues to dominate after the Great Recession. Trade-weighted averages of tariffs and AVEs of TBTs and SPS measures, depicted in Figure 3, show similar dynamics. Over the entire sample period, AVEs of TBTs fall within a range of 6-16%, while AVEs of SPS measures fluctuate within a 0-6% range and import tariffs gradually decline from 7% to 3%.

The trade-weighted average of tariffs is smaller than the simple average of tariffs, which again indicates that the products with lower tariffs have been traded in larger gross values. A similar pattern is observed for the traded products affected by TBTs. During the entire period, the simple average of AVEs of TBTs is about 10.9, which is slightly higher than its trade-weighted counterpart (about 10.4). In other words, products that are less hampered by TBT measures have been traded in higher values. However, in contrast to tariffs and TBTs, since 2009 the simple average of AVEs of SPS measures has been almost half of the weighted average of AVEs of SPS measures, suggesting that trade has been more prevalent in the product lines that were covered by the corresponding SPS measures. As SPS measures certify that the traded goods meet the safety and health requirements of the importing countries, this may be associated with a growing greater preference for safer but more expensive products.

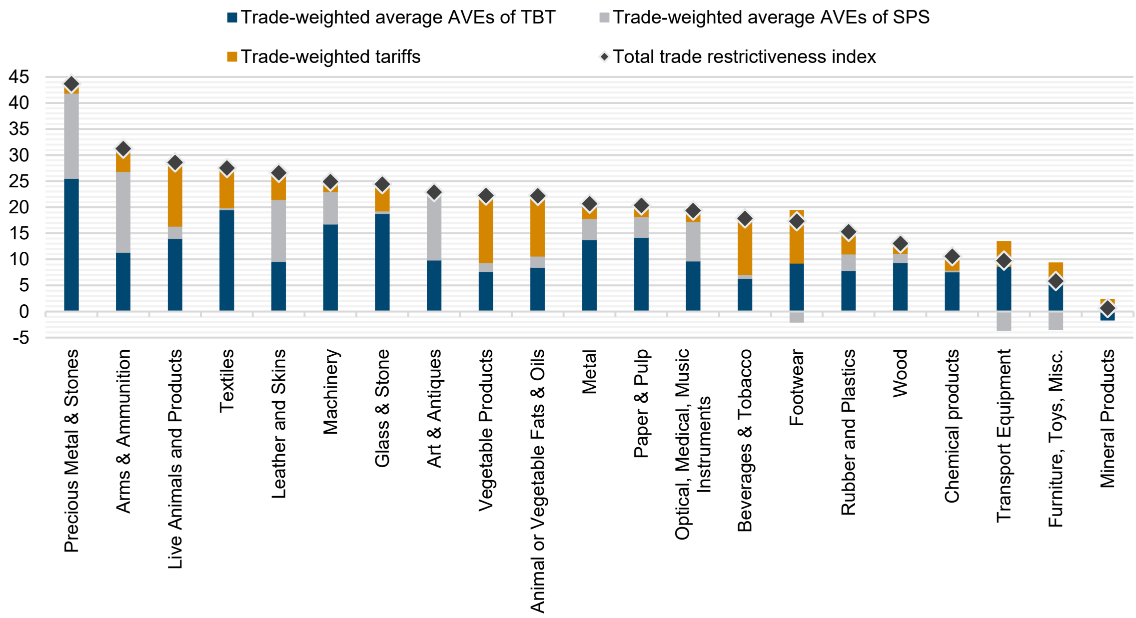
Table A5 in Appendix A shows the simple average of tariffs and estimated AVEs of NTMs imposed by each country against exporting country groups, classified by their development level and GDP per capita following the UNIDO classification (Upadhyaya, 2013): Advanced Industrial Economies (AIE), Emerging Industrialised Economies (EIE), Other Developing Economies (ODE) and Least Developed Countries

(LDC).[7] As can be seen, the revealed effects of import tariffs and NTMs are highly asymmetric across the country groups. In particular, import tariffs imposed by the AIE group are the lowest, especially those imposed on the imports from the LDC group. However, this is not the case for NTMs: SPS measures imposed by the AIEs are usually very trade-restrictive for emerging and developing economies, as indicated by high NTM AVE levels. In turn, TBTs imposed by developing countries are more trade-restrictive in comparison with other country groups.

Taking advantage of the newly computed data, one can also calculate the overall level of trade restrictiveness for each bilaterally traded product by calculating the trade restrictiveness index as the sum of import tariffs and AVEs of TBTs and SPS measures. Figure 4 illustrates the trade-weighted tariffs and AVEs of NTMs, along with the total trade restrictiveness index for all products averaged over HS sections. As can be seen, the precious metal and stones section has the largest trade restrictiveness index value, equivalent to an import tariff rate of 43.7%. Although the trade-weighted average import tariff levied on the products in this section is below 2%, the trade-weighted AVE of TBTs is more than 25%, which is the highest level among all sections. The average AVE of SPS measures for this section is above 16%, which is also the highest among all sections.

Consumption goods have the highest level of import tariffs. The largest tariffs are imposed on agri-food product sections: vegetable products (13%), live animals and products (12.2%), animal or vegetable fats and oils (11.6%), and beverages and tobacco (10.9%) are the sectors with the highest import tariff protection. At the same time, import protection via NTMs has a lower importance: the AVE of SPS measures for these products is about 2% and the AVE of TBTs about 9%.

Figure 4 / Trade-weighted tariffs and AVEs of TBTs and SPS measures imposed globally during the period 1996-2018 by HS sections



Sources: WTO I-TIP, TRAINS and the WTO IDB provided by WITS; and authors' collection and estimations.

[7] Detailed annual data on estimated AVEs of TBTs and SPS measures at the bilateral product level are available upon request.

3. Application of the AVE estimates to the analysis of FDI in the ICT sector

As discussed in the introduction, the decisions of MNEs to alter their investment in subsidiaries abroad are expected to be influenced by trade patterns, among other factors. Therefore, as an empirical application using the AVEs of NTMs estimated in the previous section, we further analyse their impacts on the capital of foreign affiliates of MNEs, focusing on the ICT sector, for which the role of heterogeneous technical standards across countries is likely to manifest itself more strongly, as well as taking into account the rising role of ICT and digitalisation in the world economy.

3.1. DATA AND SAMPLE

The sample covers the period 2008-2018 and includes 10,621 manufacturing firms across the globe that are owned by 2,739 MNEs. As intra-EU trade was excluded from the estimation of AVEs as explained above, the subsidiaries in the EU that are owned by MNEs of other EU countries are also not included in the sample[8] [9]. The sample covers all manufacturing firms in the world that are owned by foreign GUOs. We use a threshold of 50.01%, i.e. majority ownership, as the ownership share criterion for inclusion in the sample.

The main firm-level variables are obtained from the Orbis database provided by Bureau Van Dijk Electronic Publishing GmbH. We use total assets and total fixed assets as the two indicators measuring the stock of FDI in each subsidiary. The ultimate ownership linkages between GUOs and their subsidiaries thus identify the host and home countries of FDI. Furthermore, the primary sector of activity reported by the owner and the subsidiary firms is used as a reference to identify the associated sectors of investment and trade activity for the host and home economies of FDI.

Table A2 in Appendix A provides the summary statistics of the variables used in this analysis. The sample of estimation has 54,443 observations and the table presents every variable in levels. The average size of firms in terms of total assets that are owned by foreign MNEs is about USD 8bn, while their average size in terms of total fixed assets is about USD 4.4bn. The average size of subsidiaries in terms of employment is about 606, while the average employment size of the GUOs in the sample is about 27,600. However, labour productivity in subsidiaries is much higher than in GUOs. On average, each employee in subsidiaries is associated with about USD 122m in operating revenue, while in the GUO the figure is about USD 2m.

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8 This estimation sample includes firms that have at least two non-zero values for their total assets during the period of analysis; otherwise, the sample of data for all manufacturing firms owned by foreign MNEs comprises about 90,393 firms owned by 13,226 GUOs abroad.

9 Furthermore, tax haven countries are not included in the sample either, as the related FDI is associated with profit shifting and holding activities of MNEs, and this ‘phantom’ FDI severely distorts the data. To this end, we use the list of tax haven countries developed in Hines (2010). However, we also do robustness estimations with the sample including these countries, which are available upon request.

3.2. METHODOLOGY

We estimate the following specification that explains the stock of capital of subsidiary f in year t operating in a two-digit NACE sector ξ in country i and owned by a GUO g in sector ϱ in country j as a function of the trade policy and other relevant variables:

$$K_{fgij\xi\varrho t} = EXP\,[\gamma + \gamma_1 l_{gt} + \gamma_2 l_{gt} + \gamma_3 prod_{gt} + \gamma_4 prod_{gt} + \gamma_{n,5}\sum_n \operatorname{arc} AVE_{n,ji\xi t} + + \gamma_{n,6}\sum_n \operatorname{arc} AVE_{n,ij\xi t} + \gamma_7 \operatorname{arc} T_{ji\xi t} + \gamma_8 \operatorname{arc} T_{ij\xi t} + \gamma_f + \gamma_g + \gamma_{i\xi t} + \gamma_{j\xi t} + \gamma_{ij\xi} + \gamma_{\varrho t}] \times \nu_{fgij\xi t}\,, \quad (10)$$

$$\forall h \in HS, \forall t \in \{1, \dots, T\}, \forall i,j \in \{1, \dots i, \dots j, \dots, I\}, n \in \{TBT, SPS\}$$

where $K_{fgij\xi\varrho t}$ is the value of total assets of the subsidiary f operating in sector ξ in country i in year t that is owned by GUO g in sector ϱ in country j (as a robustness test, we also use the value of total *fixed* assets); l_{ft} and l_{gt} are the number of employees in the subsidiary and the GUO, respectively, to control for the size of firms, in logarithmic form; $prod_{ft}$ and $prod_{gt}$ are the labour productivity of the subsidiary and the GUO, respectively, in terms of the operating revenue as a share of employee (in logarithmic form).

$\operatorname{arc} AVE_{n,ij\xi t}$ is the hyperbolic sine transformation of the average AVE of NTM type n on all six-digit products in the two-digit NACE sector ξ that is imposed by country i against imports from country j in year t; $\operatorname{arc} AVE_{n,ji\xi t}$ is the hyperbolic sine transformation of the average AVE of NTM type n on all six-digit products in the two-digit NACE sector ξ that is imposed by country j against imports from country i in year t; $\operatorname{arc} T_{ij\xi t}$ is the hyperbolic sine transformation of average tariffs imposed by country i against the imports of six-digit products from country j in year t; $\operatorname{arc} T_{ji\xi t}$ is the hyperbolic sine transformation of average tariffs imposed by country j against the imports of six-digit products from country i in year t.

A priori, the tariff-jumping motive (or, in the context of NTMs, the regulatory barrier-jumping motive) is one of the main determinants of horizontal FDI. This motive suggests that when the cost of bilateral trade from the home country to the destination country increases, MNEs intend to invest more in the destination country as a host of their investment. One should also note that market seeking is one of the major reasons behind horizontal FDI. However, when stages of production are integrated across borders owing to efficiency seeking in vertical FDI in order to make production cheaper, trade costs have to be sufficiently low that the production could be fragmented between several countries. Following these two motives behind the FDI, one can assume that a higher AVE of NTMs in the host country can increase horizontal FDI. However, a negative impact of AVE of NTMs imposed by either home or host country on the FDI could indicate the vertical integration of production.

γ_f and γ_g are, respectively, firm fixed effects for the subsidiary and the GUO; $\gamma_{i\xi t}$, $\gamma_{j\xi t}$ and $\gamma_{ij\xi}$ are, respectively, host-sector-time, home-sector-time, and bilateral sector fixed effects that control for multilateral resistance, following the gravity model of trade literature; $\gamma_{\varrho t}$ is the sector-time fixed effects variable that controls for the global characteristics in the GUO sector; $\nu_{fgij\xi t}$ is the error term that is clustered by bilateral sector.

In addition to the full manufacturing firms sample, we then focus specifically on the sample of ICT GUO firms and their manufacturing subsidiaries. The definition of ICT manufacturing and services sectors is provided in the technical report of the Joint Research Centre (JRC) of the European Commission on the

2018 PREDICT database (Benages et al., 2018). The list of the ICT sectors is presented in Table A1 in the Appendix.

As innovation plays an important role in the ICT sector, securing intellectual property rights through patents is an important strategy by ICT firms to gain market share. Therefore, as an additional control variable, we include the number of patents registered by the subsidiary and the GUO that are successfully granted by the patent offices. As different NTMs and their AVEs may be mutually correlated, as an additional robustness check we include AVEs sequentially in separate specifications.

3.3. ESTIMATION RESULTS

We estimate the model specified in the methodology subsection using PPML. We first estimate the model with all manufacturing firms in the global sample, followed by the estimation for the sample of ICT GUO firms.

3.3.1. FDI in manufacturing sectors by global firms

The results for the full manufacturing sample are shown in Table 1. The benchmark specification (column 1), is based on all firms that are reported in Orbis as being in the majority ownership relationship, implying that the GUO owns at least 50.01% of the subsidiary's shares. However, in some cases information on the exact ownership share is not reported, although Orbis still classifies the owner as the majority owner of the subsidiary. Therefore, as a robustness check, we also perform estimations with two additional sub-samples: a sample of firms for which the information on the majority (i.e., above 50.01%) ownership is also reported by Orbis (column 2), and a sample of firms with the 100% ownership (column 3).

Although AVEs of SPS variables pertaining to both the host and the home economies are statistically insignificant across all specifications, as can be seen, AVEs of TBTs reveal a strong impact on FDI dynamics as measured by the total assets of subsidiaries. Notably, AVEs of TBTs imposed by the *home* country ($\text{arc}\, AVE_{TBT,ji\xi t}$) have a highly statistically significant negative coefficient across all specifications. This implies that when TBTs imposed by a country become more trade-restrictive, its MNEs that are investing abroad are more inclined to reduce their investments. This may be associated with the higher costs of exports from the host country (the country in which the subsidiary operates) to their home country induced by the TBTs, leading to a disincentive for the MNEs to develop cross-border production sharing and thus engage in vertical FDI. However, the AVEs of TBTs imposed by the *host* economy against the imports from the home country ($\text{arc}\, AVE_{TBT,ij\xi t}$) have a positive coefficient statistically significant at the 5% level for the specifications with the 50% ownership share threshold (columns 1 and 2) and at the 1% level for the specification with the 100% ownership share threshold (column 3). This suggests that when the TBTs imposed by a country in which an MNE has established its subsidiaries become more trade-restrictive, the MNE may tend to increase its investment in that country. This could be interpreted as a means to mitigate the trade obstacles induced by the higher level of TBTs via FDI, similar to the tariff-jumping motive of FDI.

Table 1 / Estimation results for the sample of all manufacturing firms

Dependent variable:	1 $K_{fgij\xi t}^{TA,all}$	2 $K_{fgij\xi t}^{TA,50\%}$	3 $K_{fgij\xi t}^{TA,100\%}$
l_{gt}	0.048***	0.054***	0.023**
	(0.011)	(0.013)	(0.011)
l_{ft}	0.14***	0.16***	0.21***
	(0.034)	(0.043)	(0.043)
$prod_{gt}$	0.0063	0.0057	0.026**
	(0.0095)	(0.011)	(0.012)
$prod_{ft}$	0.11***	0.14***	0.20***
	(0.035)	(0.045)	(0.040)
$\text{arc}\,AVE_{TBT,ji\xi t}$	-0.32**	-0.37***	-0.28***
	(0.14)	(0.11)	(0.077)
$\text{arc}\,AVE_{TBT,ij\xi t}$	0.19**	0.31**	0.20*
	(0.090)	(0.13)	(0.11)
$\text{arc}\,AVE_{SPS,ji\xi t}$	-0.15	-0.0013	0.0061
	(0.19)	(0.19)	(0.14)
$\text{arc}\,AVE_{SPS,ij\xi t}$	-0.11	0.0036	-0.13
	(0.076)	(0.093)	(0.088)
$\text{arc}\,T_{ji\xi t}$	0.15	0.14	2.46**
	(0.25)	(0.24)	(1.02)
$\text{arc}\,T_{ij\xi t}$	2.27***	2.30***	2.03***
	(0.61)	(0.85)	(0.72)
Observations	54,443	40,266	22,082
Pseudo R-squared	1.000	1.000	1.000
Subsidiary FE, γ_f	Yes	Yes	Yes
GUO FE, γ_g	Yes	Yes	Yes
Destination-sector-year FE, $\gamma_{i\xi t}$	Yes	Yes	Yes
Origin-sector-year FE, $\gamma_{j\xi t}$	Yes	Yes	Yes
Owner-sector-year FE, $\gamma_{\varrho t}$	Yes	Yes	Yes

Standard errors in parentheses, *** p<0.01, ** p<0.05, *** p<0.01

Indeed, the estimation results also point to the tariff-jumping motive behind FDI, as indicated by the positive statistically significant coefficient associated with the import tariffs imposed by the host economy. The import tariff imposed by the home economy has a less profound effect and is statistically significant only when the GUO fully owns the subsidiary – positive and statistically significant at the 5% level.

The results also indicate that, in line with expectations, the firm size of both the subsidiary and the GUO is positively associated with the capital of the subsidiary. Furthermore, labour productivity of the subsidiary is also highly conducive to its capital. However, labour productivity of the GUO is statistically significant only for the specification in column 3, suggesting that higher productivity of the GUO is associated with capital-boosting effects in its subsidiaries only when it has 100% ownership.

As discussed, for robustness, Table A3 in the Appendix presents the PPML estimation results for the full manufacturing firms sample with the total fixed assets, rather than total assets, as the dependent variable. Fixed assets reflect long-term assets of a company that cannot be easily liquidated in the short run, e.g. the value of equipment, land and buildings. The estimates for the control variables are similar to the ones for the baseline estimation results. As regards the effects of NTMs, however, in this case AVEs of TBTs imposed by the home country become statistically insignificant, indicating that the effects observed in the baseline model results are associated with assets other than those falling into the fixed assets category of the subsidiary firm. AVEs of TBTs imposed by the host country still indicate a technical barrier-jumping motive behind the FDI. In contrast to the baseline results with total assets, AVEs of SPS measures imposed by the host economy have a statistically significant negative coefficient. SPS measures constitute standards and regulations that protect human health, safety and plant life, and therefore the results imply that a loosening of sanitary and safety regulations in the host country may facilitate investment.

3.3.2. FDI in manufacturing sectors by global ICT firms

Next, we focus our attention on the results for the ICT sector – more precisely, the FDI originating from the ICT GUO firms, which is directed not only to subsidiaries in the ICT sector, but also other sectors. Table 2 presents the PPML estimation results for the sample of manufacturing foreign subsidiaries owned by global ICT firms. The results for TBTs remain similar to those for the sample with all manufacturing GUO firms presented in Table 1. However, the impact of AVEs of TBTs imposed by the home country is less statistically significant, while the impact of AVEs of TBTs imposed by the host country is more statistically significant relative to the all-manufacturing sample. Taking into account the hyperbolic transformation used for AVEs, the estimates imply that a 1% increase in the tariff equivalent of TBTs imposed by the host country against the imports from the home country is associated with an increase in the total assets of a foreign subsidiary owned by an ICT firm of up to 0.76% (and of 0.78% for the subsidiaries fully owned by an ICT GUO). This is more than twice the size of the TBT effect for the full manufacturing sample. Such a large elasticity may indicate a higher regulatory barrier-jumping motive for the ICT sector and associated with the horizontal FDI. Moreover, in contrast to the full manufacturing sample, AVEs of SPS measures imposed by the host country on the subsidiary's sector of activity are now statistically significant at the 1% level, negative across all specifications, which implies a greater relevance of safety standards for FDI by the ICT MNEs in all manufacturing sectors. In contrast to the all-manufacturing sample, neither the size nor the productivity of the ICT GUO matter in the case of fully owned subsidiaries, while for the majority ownership sample both productivity and GUO firm size are still significant. Meanwhile, again differently from the all-manufacturing sample, the size and the productivity of the *subsidiary* are positive and statistically significant in the case of full ownership by ICT GUOs. Contrary to expectations, granted patents do not reveal any statistically significant effects.

As a robustness check, Table A4 in the Appendix presents the PPML estimation results based on total fixed assets of manufacturing foreign subsidiaries owned by global ICT firms. Results of the estimation on the control variables remain similar to the results on total assets presented in Table 2. However, the results on AVEs of NTMs change in some specifications. For instance, the AVES of TBTs imposed by the home country become statistically insignificant, while the AVEs of TBTs imposed by the host country remain statistically significant and positive. Furthermore, the AVEs of SPS measures imposed by the host country remain negative and statistically significant similar to the results on the estimated total assets presented in Table 2. However, the impact of AVEs of SPS measures imposed by the home country on the total fixed assets of the subsidiaries now become negative and statistically significant. This suggests that when the standards and regulations embedded within SPS measures imposed by the home country that protect human health, safety and plant life become very trade-restrictive, the amount of fixed assets invested by the ICT MNE in the host country decreases. This is due to the increased cost of supply of products from the host country to the home country. Moreover, tariffs imposed by the home country have now a statistically significant and negative impact on the total fixed assets of the foreign subsidiary. This is interpreted as an impediment on vertical integration of the production process of the MNE that is expanded in other countries. In addition, the results indicate that tariffs imposed by the host country have a statistically significant impact on the fixed assets of a subsidiary that is fully owned by the ICT MNE, which again suggests that vertical FDI can be significantly hampered by larger trade costs induced by these traditional trade policy measures.

Table 2 / Estimation results for the sample of on total assets of manufacturing foreign subsidiaries owned by global ICT firms

	1	2	3
Dependent variable:	$K_{fgij\xi t}^{TA,all}$	$K_{fgij\xi t}^{TA,50\%}$	$K_{fgij\xi t}^{TA,100\%}$
l_{gt}	0.15***	0.19**	0.056
	(0.044)	(0.077)	(0.042)
l_{ft}	0.18	0.15	0.50***
	(0.18)	(0.13)	(0.086)
$prod_{gt}$	0.16**	0.20**	0.12
	(0.074)	(0.088)	(0.076)
$prod_{ft}$	0.14	0.12	0.48***
	(0.19)	(0.14)	(0.089)
$\text{arc}\,AVE_{TBT,ji\xi t}$	-0.16	-0.20*	-0.26**
	(0.10)	(0.11)	(0.12)
$\text{arc}\,AVE_{TBT,ij\xi t}$	0.54***	0.76***	0.78***
	(0.20)	(0.22)	(0.26)
$\text{arc}\,AVE_{SPS,ji\xi t}$	-0.30	-0.42	-0.35
	(0.27)	(0.26)	(0.26)
$\text{arc}\,AVE_{SPS,ij\xi t}$	-0.31***	-0.32***	-0.55***
	(0.098)	(0.11)	(0.13)
$\text{arc}\,T_{ji\xi t}$	-2.82**	-2.22	-0.20
	(1.29)	(1.49)	(2.13)
$\text{arc}\,T_{ij\xi t}$	0.86	1.31	0.64
	(0.85)	(0.87)	(0.98)
$patent_{gt}$	0.029	0.023	0.044
	(0.032)	(0.039)	(0.055)
$patent_{ft}$	0.013	0.013	0.027
	(0.013)	(0.022)	(0.021)
Observations	4532	3539	1973
Pseudo R-squared	0.980	0.980	0.987
Subsidiary FE, γ_f	Yes	Yes	Yes
GUO FE, γ_g	Yes	Yes	Yes
Destination-sector-year FE, $\gamma_{i\xi t}$	Yes	Yes	Yes
Origin-sector-year FE, $\gamma_{j\xi t}$	Yes	Yes	Yes
Owner-sector-year FE, $\gamma_{\varrho t}$	Yes	Yes	Yes

Standard errors in parentheses, *** p<0.01, ** p<0.05, *** p<0.01

4. Conclusion

The paper estimates bilateral time-varying AVEs of NTMs at the detailed HS six-digit sectoral level. We show the significant heterogeneity of the NTMs and the extent of their stringency that varies over time. In particular, the new estimates point to an increasing role of TBTs and SPS measures in the post-Great Recession period, which contrasts with a gradually declining role of import tariffs as a trade-inhibiting policy measure. In order to further demonstrate the implications of NTMs, we analyse their implications for foreign direct investment in a firm-level bilateral setting, i.e. focusing on individual MNEs and the global network of their subsidiaries. The results suggest that, controlling for other relevant characteristics such as firm size and productivity (of both the GUO firm and the subsidiary), NTMs are of significance to the MNE's decisions to invest abroad. Given the rising importance of the ICT sector, we further focus on the implications of NTMs for foreign direct investment by MNEs in the ICT sector.

From the policy perspective, the results reveal the importance of TBT and SPS regulations, their intensity and their cross-country differences not only for foreign trade, which has been well studied in the literature, but also for cross-border investment – a topic that has remained hitherto largely unexplored. While harmonisation of technical and safety regulations between trading partners naturally boosts trade between them, we show that this alters the bilateral direct investment flows. The ultimate net effect on the host and the recipient economies are thus less clear-cut when one takes into account these spillover effects rather than focusing on the trade aspects only. This constitutes an interesting topic for further research, as well as policy analysis. Related to this, the database on the bilateral time-varying NTMs opens possibilities for further research at the detailed sectoral or aggregate country levels, focusing on trade and investment, as well as permitting a more nuanced understanding of the impacts of deeper integration agreements, allowing measurement of the depth of the agreements, when the bilateral AVE NTM data developed in this paper are combined with bilateral import tariff data.

References

Anderson, T. W., & Rubin, H. (1949). Estimation of the parameters of a single equation in a complete system of stochastic equations. The Annals of Mathematical Statistics, 20(1), 46-63.

Anderson, J.E. and E. van Wincoop (2003), 'Gravity with Gravitas: a solution to the border puzzle', *American Economic Review*, Vol. 93(1), pp. 170-192.

Beghin, J.C., A.-C. Disdier and S. Marette (2015), 'Trade Restrictiveness Indices in the Presence of Externalities: an application to non-tariff measures', *The Canadian Journal of Economics/Revue canadienne d'économique*, Vol. 48(4), pp. 1513-1536.

Bellak, C., M. Leibrecht and R. Stehrer (2010), 'The Role of Public Policy in Closing Foreign Direct Investment Gaps: an empirical analysis', Empirica, Vol. 37(1), pp. 19-46.

Bellemare, M.F. and C.J. Wichman (2020), 'Elasticities and the Inverse Hyperbolic Sine Transformation', *Oxford Bulletin of Economics and Statistics*, Vol. 82(1), pp. 50-61.

Benages, E., Hernández, L., Mínguez, C., Pérez, J., Robledo, J., Salamanca, J., Solaz, M., Cardona, M., López-Cobo, M., Righi, R., Samoili, S., 2018. The 2018 PREDICT dataset methodology. Tech. rep., Joint Research Centre, European Commission, https://ec.europa.eu/jrc/sites/jrcsh/files/jrc111922.pdf.

Blanchard, O. and J. Acalin (2016), 'What Does Measured FDI Actually Measure?', PIIE Policy Brief 16-17, Peterson Institute for International Economics.

Blonigen, B.A, K. Tomlin, and W.W. Wilson (2004), 'Tariff-Jumping FDI and Domestic Firms' Profits'. *The Canadian Journal of Economics/Revue canadienne d'économique*, Vol. 37(3), pp. 656-677.

Bratt, M. (2017), 'Estimating the Bilateral Impact of Nontariff Measures on Trade', *Review of International Economics*, Vol. 25(5), pp. 1105-1129.

Brenton, P. and F. Di Mauro (1999), 'The Potential Magnitude and Impact of FDI flows to CEECs', *Journal of Economic Integration*, Center for Economic Integration, Sejong University, Vol. 14, pp. 59-74.

Cadot, O. and J. Gourdon (2016), 'Non-Tariff Measures, Preferential Trade Agreements, and Prices: new evidence', *Review of World Economics*, Vol. 152(2), pp. 227-249.

Carr, D.L., J.R. Markusen and K.E. Maskus (2001), 'Estimating the Knowledge-Capital Model of the Multinational Enterprise', *American Economic Review*, Vol. 91(3), pp. 693-708.

Caves, D.W., L.R. Christensen and W.E. Diewert (1982), 'Multilateral Comparisons of Output, Input, and Productivity Using Superlative Index Numbers', *Economic Journal*, Vol. 92(365), pp. 73-86.

Correia, S., Guimara~es, P., Zylkin, T., 2019a. Ppmlhdfe: Fast Poisson Estimation with High-Dimensional Fixed Effects (arXiv. org).

Correia, S., Guimar~aes, P., Zylkin, T., 2019b. Verifying the Existence of Maximum Likelihood Estimates for Generalized Linear Models arXiv preprint arXiv:1903.01633.

Davidson, R. and J.G. MacKinnon (1993), *Estimation and Inference in Econometrics*, Oxford University Press, Oxford.

Diewert, W.E. and T.J. Wales (1988), 'A Normalized Quadratic Semiflexible Functional Form', *Journal of Econometrics*, Vol. 37(3), pp. 327-342.

Disdier, A.-C., L. Fontagné and M. Mimouni (2008), 'The Impact of Regulations on Agricultural Trade: evidence from the SPS and TBT agreements', *American Journal of Agricultural Economics*, Vol. 90(2), pp. 336-350.

Dunning, J.H. (1993), *Multinational Enterprises and the Global Economy*, Addison-Wesley Publishing Company, Harlow, Essex.

Dunning, J.H. (1998), 'Location and the Multinational Enterprise: a neglected factor?' *Journal of International Business Studies*, Vol. 29(1), pp. 45-66.

Egger P. and M. Pfaffermayr (2004), 'Foreign Direct Investment and European Integration in the 1990s', *The World Economy*, Vol. 27(1), pp. 99-110.

Ekholm, K., R. Forslid and J.R. Markusen (2007), 'Export-Platform Foreign Direct Investment', *Journal of the European Economic Association*, Vol. 5(4), pp. 776-795.

Feenstra, R.C., R. Inklaar and M.P. Timmer (2015), 'The Next Generation of the Penn World Table', *American Economic Review*, Vol. 105(10), pp. 3150-3182.

Frenkel, M., K. Funke and G. Stadtmann (2004), 'A Panel Analysis of Bilateral FDI Flows to Emerging Economies', *Economic Systems*, Vol. 28(3), pp. 281-300.

Ghodsi, M. (2016), 'Determinants of Specific Trade Concerns Raised on Technical Barriers to Trade EU versus Non-EU', *Empirica*, Vol. 45(1), pp. 83-128.

Ghodsi, M. (2020), 'How Do Technical Barriers to Trade Affect Foreign Direct Investment? Tariff jumping versus regulation haven hypotheses', *Structural Change and Economic Dynamics*, Vol. 52, pp. 269-278.

Ghodsi, M., J. Grübler, O. Reiter and R. Stehrer (2017), 'The Evolution of Non-Tariff Measures and Their Diverse Effects on Trade', wiiw Research Report No. 419, The Vienna Institute for International Economic Studies (wiiw), Vienna, May.

Ghodsi, M., J. Gruebler and R. Stehrer (2016), 'Estimating Importer-Specific Ad Valorem Equivalents of Non-Tariff Measures', wiiw Working Paper No. 129, The Vienna Institute for International Economic Studies (wiiw), Vienna, September.

Head, K. and T. Mayer (2014), 'Gravity Equations: workhorse, toolkit, and cookbook', in: G. Gopinath, E. Helpman and K. Rogoff (eds), *Handbook of International Economics, Vol. 4*, Elsevier, Amsterdam, pp. 131-195.

Head, K. and J. Ries (2008), 'FDI as an Outcome of the Market for Corporate Control: theory and evidence', *Journal of International Economics*, Vol. 74(1), pp. 2-20.

Heckman, J.J. (1979), 'Sample Selection Bias as a Specification Error', *Econometrica*, Vol. 47(1), pp. 153-161.

Helpman, E. (1984), 'A Simple Theory of International Trade with Multinational Corporations', *Journal of Political Economy*, Vol. 92(3), pp. 451-471.

Helpman, E., M. Melitz and Y. Rubinstein (2008), 'Estimating Trade Flows: trading partners and trading volumes', *The Quarterly Journal of Economics*, Vol. 123(2), pp. 441-487.

Hines Jr, J.R.. (2010), 'Treasure Islands', *Journal of Economic Perspectives*, Vol. 24(4), pp. 103-126.

Kee, H. L., & Nicita, A. (2016, November). Trade frauds, trade elasticities and non-tariff measures. In 5th IMF-World Bank-WTO Trade Research Workshop, Washington, DC, November (Vol. 30).

Kee, H.L., A. Nicita and M. Olarreaga (2008), 'Import Demand Elasticities and Trade Distortions', *Review of Economics and Statistics*, Vol. 90(4), pp. 666-682.

Kee, H.L., A. Nicita and M. Olarreaga (2009), 'Estimating Trade Restrictiveness Indices', *The Economic Journal*, Vol. 119(534), pp. 172-199.

Markusen, J.R. (1984), 'Multinationals, Multi-Plant Economies, and the Gains from Trade', *Journal of International Economics*, Vol. 16(3-4), pp. 205-226.

Melitz, M.J. (2003), 'The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity', *Econometrica*, Vol. 71(6), pp. 1695-1725.

Mistura, F. and C. Roulet (2019), 'The Determinants of Foreign Direct Investment: Do statutory restrictions matter?', OECD Working Papers on International Investment, No. 2019/01.

Niu, Z., C. Liu, S. Gunessee and C. Milner (2018), 'Non-Tariff and Overall Protection: evidence across countries and over time', *Review of World Economics*, Vol. 154(4), pp. 675-703.

Razin, A. and E. Sadka (2007), 'Productivity and Taxes as Drivers of FDI', NBER Working Papers 13094, National Bureau of Economic Research.

Santos Silva, J. and S. Tenreyro (2006), 'The Log of Gravity', *Review of Economics and Statistics*, Vol. 88(4), pp. 641-658.

Semykina, A. and J.M. Wooldridge (2010), 'Estimating Panel Data Models in the Presence of Endogeneity and Selection', *Journal of Econometrics*, Vol. 157(2), pp. 375-380.

Upadhyaya, S. (2013), 'Country Grouping in UNIDO Statistics', Development policy, statistics and research branch Working Paper, 1/2013.

World Economic Forum (2013), 'Foreign Direct Investment as a Key Driver for Trade, Growth and Prosperity: the case for a multilateral agreement on investment'.

Appendix

Table A1 / List of ICT sectors included in the analysis

NACE Rev. 2	Description	
26.1	Manufacture of electronic components and boards	ICT manufacturing
26.2	Manufacture of computers and peripheral equipment	
26.3	Manufacture of communication equipment	
26.4	Manufacture of consumer electronics	
58.2	Software publishing	ICT services
61	Telecommunications	
62	Computer programming, consultancy and related activities	
63.1	Data processing, hosting and related activities; web portals	
95.1	Repair of computers and communication equipment	

APPENDIX A. ADDITIONAL PPML ESTIMATION RESULTS

Table A2 / Summary statistics of firm-level variables used in the analysis

Variable	Mean	Standard deviation	Min.	Max.
$K^{TA,all}_{fgij\xi t}$	8.51E+10	8.01E+12	0	1.03E+15
$K^{FA,all}_{fgij\xi t}$	4.72E+10	4.43E+12	0	4.86E+14
L_{gt}	27,634.06	51,925.53	1	434,246
L_{ft}	606.51	3,657.55	1	343,000
$Prod_{gt}$	2,058,824	3.20E+07	0	4.17E+09
$Prod_{ft}$	1.22E+08	6.40E+09	0	6.04E+11
$AVE_{TBT,ji\xi t}$	10.90	9.94	-47.93	400.90
$AVE_{TBT,ij\xi t}$	12.10	10.65	-40	177.94
$AVE_{SPS,ji\xi t}$	0.89	4.36	-50	278.23
$AVE_{SPS,ij\xi t}$	2.60	8.12	-20.41	298.21
$T_{ji\xi t}$	3.16	14.15	0	1,544.07
$T_{ij\xi t}$	6.51	6.36	0	75.67

Note: number of observations is 54,443, which is the sample size of estimation on Table 1, column 1. All variables are in levels.

Table A3 / Estimation results based on total fixed assets, all-manufacturing sample

Dependent variable:	$K^{FA,all}_{fgij\xi t}$	$K^{FA,50\%}_{fgij\xi t}$	$K^{FA,100\%}_{fgij\xi t}$
l_{gt}	0.021**	0.026**	0.029*
	(0.011)	(0.011)	(0.015)
l_{ft}	0.070***	0.075***	0.15***
	(0.020)	(0.022)	(0.033)
$prod_{gt}$	0.0076	0.0061	0.033**
	(0.013)	(0.015)	(0.017)
$prod_{ft}$	0.053***	0.060***	0.14***
	(0.018)	(0.021)	(0.031)
arc $AVE_{TBT,ji\xi t}$	0.060	-0.0018	-0.053
	(0.16)	(0.20)	(0.19)
arc $AVE_{TBT,ij\xi t}$	0.21**	0.35*	0.27
	(0.10)	(0.18)	(0.20)
arc $AVE_{SPS,ji\xi t}$	-0.38	-0.34	-0.34*
	(0.24)	(0.25)	(0.18)
arc $AVE_{SPS,ij\xi t}$	-0.36***	-0.39***	-0.17*
	(0.10)	(0.12)	(0.100)
arc $T_{ji\xi t}$	1.19**	1.50***	2.11
	(0.57)	(0.55)	(1.34)
arc $T_{ij\xi t}$	1.20**	1.35	0.55
	(0.57)	(0.90)	(0.55)
Observations	53,896	39,871	21,842
Pseudo R-squared	1.000	1.000	1.000
Subsidiary FE, γ_f	Yes	Yes	Yes
GUO FE, γ_g	Yes	Yes	Yes
Destination-sector-year FE, $\gamma_{i\xi t}$	Yes	Yes	Yes
Origin-sector-year FE, $\gamma_{j\xi t}$	Yes	Yes	Yes
Owner-sector-year FE, $\gamma_{\varrho t}$	Yes	Yes	Yes

Standard errors in parentheses, *** p<0.01, ** p<0.05, *** p<0.01

Table A4 / Estimation results based on total fixed assets of manufacturing foreign subsidiaries owned by global ICT firms

Dependent variable:	$K^{FA,all}_{fgij\xi t}$	$K^{FA,50\%}_{fgij\xi t}$	$K^{FA,100\%}_{fgij\xi t}$
l_{gt}	0.21***	0.20**	0.058
	(0.066)	(0.085)	(0.067)
l_{ft}	0.12***	0.13***	0.46***
	(0.042)	(0.037)	(0.15)
$prod_{gt}$	0.21***	0.23***	0.20**
	(0.082)	(0.067)	(0.079)
$prod_{ft}$	0.067	0.063	0.44***
	(0.049)	(0.042)	(0.16)
$\text{arc}\,AVE_{TBT,ji\xi t}$	0.067	0.12	0.072
	(0.26)	(0.32)	(0.29)
$\text{arc}\,AVE_{TBT,ij\xi t}$	1.20***	1.34***	1.36**
	(0.39)	(0.49)	(0.57)
$\text{arc}\,AVE_{SPS,ji\xi t}$	-0.95***	-0.94***	-0.65**
	(0.34)	(0.33)	(0.28)
$\text{arc}\,AVE_{SPS,ij\xi t}$	-0.50***	-0.70***	-0.42**
	(0.12)	(0.13)	(0.19)
$\text{arc}\,T_{ji\xi t}$	-6.33**	-5.08*	-8.90*
	(2.51)	(2.86)	(5.12)
$\text{arc}\,T_{ij\xi t}$	1.22	1.63	-3.86***
	(0.97)	(1.12)	(1.46)
$patent_{gt}$	-0.0072	-0.0068	0.064
	(0.035)	(0.033)	(0.058)
$patent_{ft}$	0.015	0.039	0.030
	(0.027)	(0.035)	(0.045)
Observations	4,482	3,491	1,954
Pseudo R-squared	0.970	0.971	0.978
Subsidiary FE, γ_f	Yes	Yes	Yes
GUO FE, γ_g	Yes	Yes	Yes
Destination-sector-year FE, $\gamma_{i\xi t}$	Yes	Yes	Yes
Origin-sector-year FE, $\gamma_{j\xi t}$	Yes	Yes	Yes
Owner-sector-year FE, $\gamma_{\varrho t}$	Yes	Yes	Yes

Standard errors in parentheses, *** p<0.01, ** p<0.05, *** p<0.01

Table A5 / Simple averages of tariffs and AVEs of TBT and SPS measures imposed by each importing country against exporting groups during the period 1996-2018

Group	Importer's Name	Simple average AVE of TBTs imposed against exporting group:				Simple average AVE of SPS measures imposed against exporting group:				Simple average levied tariffs against exporting group:			
		AIE	EIE	ODE	LDC	AIE	EIE	ODE	LDC	AIE	EIE	ODE	LDC
AIE	Australia	11.69	11.78	10.39	12.31	3.58	3.20	3.52	4.00	3.76	4.04	4.02	1.35
AIE	Austria	11.14	11.17	10.83	11.83	3.58	3.29	2.84	3.86	3.65	3.32	2.45	1.76
AIE	Bahrain	13.22	15.98	12.90	14.82	3.80	2.10	1.71	1.97	4.48	4.47	3.62	4.20
AIE	Belgium	11.53	12.52	10.54	11.58	3.24	3.09	1.99	2.49	3.46	2.97	2.00	0.81
AIE	Canada	11.28	11.31	10.39	10.92	1.40	1.19	0.12	0.68	4.28	4.21	5.40	1.27
AIE	Czechia	12.81	12.07	12.29	15.10	3.60	3.28	2.40	3.33	4.25	3.68	2.79	2.11
AIE	Denmark	10.74	11.56	10.68	13.15	4.42	3.17	2.55	0.47	3.50	3.51	2.61	0.49
AIE	Estonia	10.61	12.63	14.84	17.30	2.29	2.55	0.32	-0.38	1.69	2.49	2.14	1.13
AIE	Finland	11.24	11.34	13.71	19.27	3.82	3.35	2.68	0.00	3.46	3.41	2.69	1.28
AIE	France	10.65	10.88	10.71	10.98	3.23	3.06	2.44	2.75	3.79	3.18	2.28	1.37
AIE	Germany	10.81	11.00	9.92	10.81	4.13	3.71	3.56	9.66	3.73	3.20	2.48	1.30
AIE	Hong Kong	14.21	13.74	15.56	16.54	3.10	3.70	6.87	8.25	0.00	0.00	0.00	0.00
AIE	Hungary	13.04	11.96	11.54	9.34	3.44	3.59	2.69	3.54	4.49	4.09	3.99	2.11
AIE	Iceland	13.28	13.92	15.00	23.62	3.01	1.73	-0.19	-1.43	3.57	5.21	9.49	10.83
AIE	Ireland	11.34	12.39	12.89	14.64	4.08	3.41	0.85	1.91	3.84	3.64	2.92	1.29
AIE	Israel	12.52	11.77	9.46	12.97	1.82	1.34	0.83	-1.00	3.81	4.90	7.02	7.26
AIE	Italy	11.00	11.91	11.12	11.24	4.11	4.49	4.27	11.34	3.42	2.88	1.96	0.49
AIE	Japan	9.72	11.25	10.70	11.64	3.30	3.41	3.51	5.84	3.91	3.92	5.15	1.70
AIE	Kuwait	13.69	14.87	15.67	17.06	4.13	3.11	1.20	0.90	4.42	4.36	3.42	4.44
AIE	Lithuania	8.27	11.37	10.12	9.54	2.43	2.84	1.95	0.71	2.45	3.00	3.12	3.42
AIE	Luxembourg	12.23	15.18	13.91	18.54	4.18	3.66	1.17	0.95	3.13	3.38	2.54	1.29
AIE	Macau	12.57	14.09	13.63	16.00	2.61	2.09	2.33	-0.55	0.00	0.00	0.00	0.00
AIE	Malaysia	12.85	13.17	11.94	12.50	3.40	3.15	3.52	2.60	8.28	7.88	7.56	9.68
AIE	Malta	12.13	15.88	10.67	49.37	2.66	2.72	0.48	-0.88	4.73	3.91	2.82	2.57
AIE	Netherlands	10.97	10.83	9.62	12.60	2.71	3.03	2.21	3.70	3.66	3.20	2.00	0.54
AIE	New Zealand	13.06	12.53	10.05	11.30	2.96	2.61	1.25	1.93	3.56	3.92	4.68	0.90
AIE	Norway	13.14	12.13	10.87	13.57	3.70	3.00	1.12	1.37	4.50	3.71	5.16	2.67
AIE	Portugal	10.89	11.26	11.06	11.46	4.92	3.26	3.30	4.07	3.33	3.25	1.57	0.80
AIE	Qatar	13.82	14.01	12.56	19.49	5.54	3.75	3.12	1.95	4.32	4.27	3.19	4.09
AIE	Russia	4.00	5.19	4.25	6.34	0.45	0.42	0.13	0.55	9.94	8.49	8.29	9.77
AIE	Singapore	13.46	13.25	12.67	15.59	1.88	1.86	1.57	2.07	0.16	0.21	0.49	0.20
AIE	Slovakia	12.74	12.55	13.10	15.47	3.66	3.43	1.12	-0.14	4.14	3.43	2.65	1.88
AIE	Slovenia	12.66	14.43	13.36	16.37	3.46	3.50	1.86	0.06	5.53	4.47	4.04	3.67
AIE	South Korea	12.22	12.44	10.89	14.18	3.96	3.65	2.93	5.37	8.50	9.67	10.77	9.56
AIE	Spain	10.45	11.32	11.61	12.84	3.95	4.08	2.64	1.79	3.55	3.16	2.12	1.08
AIE	Sweden	11.74	10.61	9.39	12.04	3.89	4.15	1.10	2.01	3.45	3.23	2.60	0.61
AIE	Switzerland	12.78	10.72	9.83	11.09	4.20	3.00	3.84	4.41	4.20	4.16	6.22	1.49
AIE	Taiwan	10.36	11.21	11.68	12.77	4.40	3.82	4.31	8.10	5.57	6.24	7.15	8.09
AIE	United Arab Emirates	13.28	13.68	13.25	13.24	4.58	3.64	3.80	3.53	4.50	4.40	3.39	4.26
AIE	United Kingdom	10.87	11.12	9.46	11.41	4.62	3.83	3.10	5.20	3.70	3.08	2.18	0.74
AIE	United States	10.87	10.85	9.62	10.22	0.99	0.93	0.29	-0.22	3.68	3.33	3.75	5.08
EIE	Argentina	11.33	12.89	9.79	18.71	3.46	3.29	1.65	-0.31	13.71	10.87	12.81	23.02
EIE	Brazil	11.20	11.00	10.66	12.04	3.53	3.65	3.46	5.75	14.32	12.81	14.79	20.52
EIE	Brunei	13.76	13.97	12.21	11.99	0.94	0.65	-0.76	-1.27	2.13	1.39	1.08	0.99
EIE	Bulgaria	13.30	14.25	12.10	11.93	4.20	3.59	1.06	-0.91	7.47	6.68	7.39	6.83
EIE	Chile	12.05	12.23	12.69	17.09	2.21	1.92	1.22	1.65	4.55	4.53	5.01	4.02
EIE	China	9.86	9.97	10.31	11.40	2.81	2.28	4.05	5.99	10.38	9.42	8.76	6.56
EIE	Colombia	11.65	13.14	13.31	15.35	3.06	3.20	2.76	6.93	9.32	8.24	9.77	13.50
EIE	Costa Rica	12.71	13.69	12.57	16.78	3.19	2.44	2.66	-0.11	5.20	5.54	4.10	10.74
EIE	Croatia	11.59	13.24	13.60	20.45	3.67	2.95	2.29	-0.01	2.39	4.46	4.78	8.35
EIE	Cyprus	11.75	13.08	11.11	16.23	2.70	2.39	2.26	0.12	5.17	5.62	4.83	5.31
EIE	Greece	10.86	13.84	11.16	12.21	4.42	4.37	2.34	1.44	3.37	3.28	2.30	0.62
EIE	India	11.44	11.14	8.87	10.51	3.00	3.33	5.64	9.09	17.08	15.57	13.59	13.64
EIE	Indonesia	12.69	13.40	12.38	13.10	4.02	3.56	3.28	3.87	7.04	6.16	6.27	7.87

contd.

Table A5 / Contd.

Group	Importer's Name	Simple average AVE of TBTs imposed against exporting group:				Simple average AVE of SPS measures imposed against exporting group:				Simple average levied tariffs against exporting group:			
		AIE	EIE	ODE	LDC	AIE	EIE	ODE	LDC	AIE	EIE	ODE	LDC
EIE	Kazakhstan	2.57	3.12	2.96	4.89	0.26	0.10	0.08	-0.02	5.70	5.59	4.62	7.27
EIE	Latvia	10.62	12.19	11.21	28.30	2.76	2.79	5.44	0.46	2.89	3.14	2.99	1.67
EIE	Macedonia	11.31	12.72	9.59	17.24	2.06	1.87	1.83	1.09	4.84	6.22	9.72	15.58
EIE	Mauritius	11.96	13.94	11.99	14.14	1.61	2.11	0.42	1.07	8.82	8.56	7.57	4.88
EIE	Mexico	11.71	11.39	10.53	12.14	2.44	2.39	1.92	2.59	8.02	10.20	12.06	14.42
EIE	Oman	12.74	15.51	11.97	11.16	3.03	2.79	2.82	2.15	4.06	4.65	3.70	3.18
EIE	Poland	13.39	13.05	12.95	13.85	3.30	3.08	2.35	1.65	7.51	7.37	8.17	6.26
EIE	Romania	13.35	13.53	12.08	19.78	4.50	3.28	1.75	1.21	5.00	5.53	6.94	7.46
EIE	Saudi Arabia	10.51	12.72	9.96	9.57	3.54	2.78	1.76	4.92	6.16	6.11	5.73	5.61
EIE	South Africa	12.59	13.21	11.52	12.48	2.97	3.14	1.55	2.92	6.65	9.81	10.16	7.66
EIE	Thailand	12.12	12.29	12.40	12.26	2.85	3.05	4.10	6.61	12.06	12.17	13.16	12.24
EIE	Tunisia	14.54	16.42	15.31	15.78	4.08	3.03	3.30	2.28	16.91	19.66	21.62	25.61
EIE	Turkey	12.72	12.67	13.53	15.09	3.88	3.67	2.24	4.10	2.54	3.65	4.64	3.96
EIE	Ukraine	8.67	10.40	9.15	14.43	2.10	1.62	0.79	0.72	4.60	4.87	5.56	7.38
EIE	Uruguay	12.60	13.49	11.94	17.82	3.99	3.18	1.73	-0.48	12.75	7.82	12.84	18.37
EIE	Venezuela	13.49	12.33	11.23	9.93	5.32	3.83	3.90	2.84	13.37	11.31	12.94	16.10
ODE	Albania	12.91	13.72	11.70	22.94	3.21	2.06	1.56	-1.56	5.01	6.07	6.99	6.65
ODE	Antigua and Barbuda	12.53	13.98	12.26	15.41	1.76	0.66	0.17	-1.46	13.46	14.85	10.74	16.72
ODE	Armenia	12.01	14.81	12.83	27.36	2.38	0.87	1.26	2.37	4.22	4.64	4.80	7.32
ODE	Barbados	12.74	13.35	11.36	14.05	2.43	1.33	1.46	0.66	14.41	16.45	14.63	21.19
ODE	Belize	12.50	12.61	11.61	8.49	1.32	1.11	0.68	1.00	11.76	12.46	11.67	12.89
ODE	Bolivia	12.75	14.99	13.18	17.74	3.16	2.68	1.51	0.32	9.94	7.09	8.38	24.86
ODE	Botswana	12.50	16.08	12.55	12.70	3.59	3.88	0.39	0.66	9.63	5.21	9.00	6.04
ODE	Cameroon	13.03	12.28	10.10	10.49	2.97	2.70	1.37	0.33	18.46	19.65	19.48	17.28
ODE	Cape Verde	8.39	9.30	7.90	8.78	1.40	0.54	0.36	1.07	14.24	17.10	17.32	17.72
ODE	Congo	15.45	15.69	13.64	12.36	3.77	2.83	2.27	1.20	18.36	19.18	12.59	19.61
ODE	Côte d'Ivoire	11.65	11.37	10.86	11.23	3.41	2.26	1.26	1.08	12.95	13.73	12.75	7.58
ODE	Cuba	10.98	11.96	9.62	8.28	2.38	3.23	3.50	0.71	11.64	11.44	12.54	13.67
ODE	Dominican Republic	12.47	12.99	11.99	15.26	0.79	0.74	0.29	-0.79	8.73	9.88	9.53	12.76
ODE	Ecuador	13.16	13.38	13.36	22.88	4.35	3.24	2.82	2.60	10.44	9.11	11.29	18.40
ODE	Egypt	12.85	13.19	11.84	16.93	1.83	1.04	0.73	0.93	10.31	10.48	7.93	13.37
ODE	El Salvador	13.76	13.59	12.28	24.66	4.02	2.62	2.28	-0.52	5.03	5.44	5.18	11.77
ODE	Fiji	12.17	12.64	8.91	9.53	0.62	0.66	-0.30	-0.42	13.19	13.34	16.19	13.76
ODE	Georgia	13.58	13.78	14.12	15.63	2.64	2.27	0.89	-2.74	2.49	2.08	2.40	1.97
ODE	Ghana	11.99	12.72	10.13	11.29	3.52	3.36	1.22	1.58	12.85	13.22	12.50	10.82
ODE	Grenada	9.49	8.71	8.59	6.09	0.08	-1.22	-1.40	-3.85	12.24	13.83	8.31	12.63
ODE	Guatemala	13.71	14.25	13.31	12.92	3.67	3.02	2.73	-1.10	5.28	5.13	4.69	10.02
ODE	Guyana	12.89	12.18	12.16	9.24	1.35	0.68	0.89	1.27	11.18	11.77	9.57	13.77
ODE	Honduras	13.34	13.42	14.73	14.48	2.59	1.93	1.95	-0.39	5.57	6.27	7.00	10.82
ODE	Jamaica	12.92	13.76	12.04	10.93	2.90	2.51	1.58	-1.31	9.09	10.29	10.97	13.82
ODE	Jordan	11.91	13.45	12.08	17.29	3.05	2.31	1.91	1.07	10.87	11.87	10.48	14.01
ODE	Kenya	11.27	12.39	10.01	10.50	3.12	2.14	2.42	2.83	13.71	13.96	13.95	8.58
ODE	Kyrgyz Republic	12.61	14.17	11.33	18.64	2.94	1.76	-0.14	0.22	3.76	4.29	3.77	3.97
ODE	Moldova	12.53	13.30	12.75	18.53	2.17	1.56	0.17	7.47	5.16	5.26	7.39	9.95
ODE	Mongolia	12.20	13.18	13.54	33.51	0.47	0.62	0.17	-1.22	4.93	5.02	5.10	5.06
ODE	Montenegro	8.09	9.22	10.47	15.58	0.86	0.77	0.40	-0.81	1.83	3.56	3.68	5.70
ODE	Morocco	14.44	14.84	13.18	15.99	4.71	4.37	2.48	3.25	10.51	14.64	14.77	20.69
ODE	Namibia	12.87	15.65	13.29	14.09	2.92	2.41	0.57	0.61	8.42	4.87	5.24	4.09
ODE	Nicaragua	12.83	12.82	12.93	16.11	2.49	1.53	1.20	-0.39	4.61	4.72	3.87	11.63
ODE	Nigeria	12.42	12.19	11.09	11.86	3.20	1.93	2.47	1.67	15.03	14.45	13.00	13.97
ODE	Pakistan	10.98	11.70	9.93	11.89	2.84	3.17	2.02	5.48	14.57	14.15	14.54	13.36
ODE	Panama	14.68	14.67	15.62	26.76	3.88	4.22	1.55	5.54	7.56	7.65	7.97	10.22
ODE	Papua New Guinea	12.38	11.71	10.90	10.66	0.88	1.39	0.44	1.64	6.15	7.90	7.54	6.12
ODE	Paraguay	12.08	14.05	14.48	15.82	3.22	2.68	3.09	2.12	11.04	6.61	11.63	18.44
ODE	Peru	11.77	12.23	13.14	17.43	3.38	3.22	1.61	2.33	6.23	5.78	7.39	10.65

contd.

Table A5 / Contd.

Group	Importer's Name	Simple average AVE of TBTs imposed against exporting group:				Simple average AVE of SPS measures imposed against exporting group:				Simple average levied tariffs against exporting group:			
		AIE	EIE	ODE	LDC	AIE	EIE	ODE	LDC	AIE	EIE	ODE	LDC
ODE	Philippines	12.46	14.23	10.38	11.65	4.73	4.40	3.48	1.16	4.92	3.90	4.68	6.11
ODE	Saint Lucia	12.58	11.36	11.87	8.86	1.44	-0.27	0.60	-2.87	11.48	13.72	7.89	12.96
ODE	Saint Vincent and the Grenadines	11.93	11.34	10.78	8.35	1.19	0.77	0.16	-1.08	11.53	12.80	8.23	13.11
ODE	Seychelles	3.50	3.86	3.55	2.70	0.34	0.33	0.67	-0.01	8.19	8.25	6.94	10.57
ODE	Sri Lanka	13.10	13.93	12.58	15.24	2.59	1.47	3.17	5.41	10.70	9.67	9.95	10.47
ODE	Swaziland	12.92	15.60	15.24	21.45	1.14	2.40	1.17	1.02	11.25	5.31	13.56	13.11
ODE	Trinidad and Tobago	12.95	13.37	10.86	16.25	3.36	3.18	0.42	7.81	9.89	11.54	12.79	15.29
ODE	Vietnam	8.93	9.73	9.37	9.03	1.15	1.25	1.53	2.78	9.97	8.02	9.20	8.26
ODE	Zimbabwe	12.96	14.83	12.68	13.47	3.23	2.95	1.47	1.75	17.84	14.40	15.72	10.94
LDC	Afghanistan	3.84	4.09	4.25	5.24	-0.49	-0.32	-0.16	-0.09	7.58	7.34	7.78	8.44
LDC	Benin	12.33	12.40	10.60	11.41	2.29	1.79	1.00	1.29	13.49	14.89	11.50	8.24
LDC	Burkina Faso	13.27	14.28	12.45	11.46	2.84	3.18	1.63	1.84	12.47	13.48	10.95	9.07
LDC	Burundi	12.99	14.17	12.73	13.72	1.27	1.89	0.88	3.20	15.57	15.42	6.50	5.15
LDC	Cambodia	10.89	11.80	12.05	8.69	2.01	1.52	2.46	-0.33	13.57	11.46	10.72	12.49
LDC	Central African Republic	11.95	11.79	11.89	14.98	3.01	0.90	1.82	-0.17	17.70	19.67	12.41	20.57
LDC	Gambia	11.48	11.48	9.93	11.31	0.99	0.26	0.29	2.62	16.14	16.07	15.48	12.51
LDC	Guinea	12.27	12.46	11.18	13.39	2.87	1.40	1.99	0.57	10.77	12.00	11.53	10.83
LDC	Laos	10.75	10.50	9.12	10.41	0.08	0.67	-0.17	2.48	7.69	1.43	1.03	4.34
LDC	Madagascar	13.20	12.74	10.52	10.01	2.64	1.95	1.27	0.52	9.15	9.28	10.40	8.81
LDC	Malawi	13.09	15.35	11.48	13.17	2.81	2.52	2.47	0.78	14.36	11.39	9.08	6.24
LDC	Mali	12.57	12.67	9.92	12.16	2.33	2.02	3.04	-0.07	12.67	13.48	12.56	10.79
LDC	Mozambique	13.34	13.56	11.09	11.50	1.86	1.49	0.47	-0.13	10.70	9.47	10.38	8.38
LDC	Nepal	13.48	15.51	15.57	17.68	0.54	0.73	1.65	0.70	14.11	12.37	15.27	15.65
LDC	Rwanda	13.40	14.86	13.07	13.77	1.67	1.89	1.66	0.96	16.79	16.25	4.89	6.14
LDC	Samoa	5.97	8.24	6.09		-0.22	-0.30	-0.22		12.86	11.87	12.66	
LDC	Senegal	13.91	15.56	10.13	9.11	3.40	3.16	0.68	1.26	13.14	14.15	13.04	10.50
LDC	Tanzania	12.88	13.08	12.22	11.08	3.95	3.21	2.47	1.93	14.81	14.29	10.44	10.49
LDC	Togo	12.17	12.25	10.75	10.91	1.90	1.35	0.68	2.97	13.44	14.85	12.87	8.86
LDC	Uganda	13.03	13.41	12.74	12.19	3.13	2.70	2.03	1.56	12.29	12.92	5.69	6.72
LDC	Yemen	1.68	2.61	1.71	1.72	0.19	0.18	0.13	0.42	5.75	6.00	4.15	7.07
LDC	Zambia	13.26	14.62	12.85	11.79	3.63	2.70	4.55	0.72	15.38	11.97	11.14	10.40

Note: AVEs of TBTs and SPS measures are estimated by authors. Exporting country groups are defined in terms of their development levels and GDP per capita following the UNIDO classification (Upadhyaya, 2013). These four distinct groups of countries are Advanced Industrial Economies (AIE) , Emerging Industrialised Economies (EIE), Other Developing Economies (ODE) and Least Developed Economies (LDE).

APPENDIX B. TECHNICAL DETAILS ON THE EXOGENOUS INSTRUMENTS USED IN THE AVE ESTIMATIONS

The two exogenous instruments for the price index in import demand elasticities are defined as follows:

The simple average world price index is calculated as follows:

$$\bar{z}_{tijh} = \ln \frac{\sum_j^J \sum_{k\neq i}^{I-1} p_{tkjh}}{(I \times J) - 1} - \left(\frac{\left(\ln \frac{\sum_{k\neq i}^{I-1} p_{tk}}{I-1}\right) - \left(\frac{\sum_j^J \sum_{k\neq i}^{I-1} \bar{s}_{tkjh}}{(I \times J) - 1}\right) \ln \frac{\sum_j^J \sum_{k\neq i}^{I-1} p_{tkjh}}{(I \times J) - 1}}{1 - \left(\frac{\sum_j^J \sum_{k\neq i}^{I-1} \bar{s}_{tkjh}}{(I \times J) - 1}\right)} \right) \quad \text{(A1)}$$

$$\forall h = 1, \ldots H, \forall i = 1, \ldots, I, \forall j = 1, \ldots, J, i \neq j$$

For the distance-weighted average price index, we use the following calculation:

$$\bar{\bar{z}}_{tijh} = \ln \sum_j^J \sum_{k\neq i}^{I-1} \frac{d_{kj}}{\sum_j^J \sum_{k\neq i}^{I-1} d_{kj}} p_{tkjh} - \left(\frac{\left(\ln \sum_{k\neq i}^{I-1} \frac{d_{kj}}{\sum_j^J \sum_{k\neq i}^{I-1} d_{kj}} p_{tk}\right) - \left(\sum_j^J \sum_{k\neq i}^{I-1} \frac{d_{kj}}{\sum_j^J \sum_{k\neq i}^{I-1} d_{kj}} \bar{s}_{tkjh}\right) \ln \sum_j^J \sum_{k\neq i}^{I-1} \frac{d_{kj}}{\sum_j^J \sum_{k\neq i}^{I-1} d_{kj}} p_{tkjh}}{1 - \left(\sum_j^J \sum_{k\neq i}^{I-1} \frac{d_{kj}}{\sum_j^J \sum_{k\neq i}^{I-1} d_{kj}} \bar{s}_{tkjh}\right)} \right) \quad \text{(A2)}$$

$$\forall h = 1, \ldots H, \forall i = 1, \ldots, I, \forall j = 1, \ldots, J, i \neq j$$

where d_{kj} is the geographical distance in kilometres between importing country k and exporting country j.

The world average price $\bar{p}_{tijh_4}$ of imports of all six-digit goods h within the four-digit sector H_4 other than the imported price under question is calculated as follows:

$$\bar{p}_{tijh_4} = \sum_{h \in H_4} \sum_j^J \sum_{k\neq i}^{I-1} \frac{\sum_j^J \sum_{k\neq i}^{I-1} x_{tkjh}}{\sum_j^J \sum_{k\neq i}^{I-1} q_{tkjh}} \quad \text{(A3)}$$

$$\forall h = 1, \ldots H, \forall i = 1, \ldots, I, \forall j = 1, \ldots, J, i \neq j$$

The world average price $\bar{p}_{tijh_4}$ of imports is averaged by importer-product-year, exporter-product-year, and bilateral product, which are used in the estimation of first-stage Heckman in equation (2). These averages are calculated as follows:

$$\bar{\bar{p}}_{tjh} = \frac{\sum_i^I \bar{p}_{tijh_4}}{I}$$

$$\bar{\bar{p}}_{tih} = \frac{\sum_j^J \bar{p}_{tijh_4}}{J} \quad \text{(A4)}$$

$$\bar{\bar{p}}_{ijh} = \frac{\sum_t^T \bar{p}_{tijh_4}}{T}$$

Therefore, the exogenous instrument $\overline{NTM}^{p}_{iwht}$ for each NTM of type n imposed by country i against the import of product h from country j is constructed as the price-weighted average of NTMs of all countries in the world other than the importing country i under question as follows:

$$\overline{NTM}^{p}_{iwht} = \sum_{j} \sum_{k} \frac{p_{kjht}}{\sum_{k} p_{kjht}} NTM_{n,kjht}\,, \quad k \neq j \ \wedge \ i \neq j \ \wedge \ i \neq k, \qquad \text{(A5)}$$
$$\forall h \in HS, \forall t \in \{1, \dots, T\}, \forall i, j, k \in \{1, \dots i, \dots j, \dots k, \dots, I\}, n \in \{TBT, SPS\}$$

where p_{kjht} is the unit value of product h in year t imported from country j to country k, which is different from country i that is the importing country in equation (6).

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